Relative Absence Concerns, Positional Consumption Preferences and Working Hours

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1 Introduction

Individuals care about their own consumption in comparison to that of others. One possible consequence of relative consumption concerns is that the incentives to supply labour are excessive. This is the case since additional income not only enhances consumption possibilities but also improves the own relative position and, thereby, worsens that of others. While the former effect is taken into account by individual decision-makers, the latter impact is ignored. Therefore, relative consumption concerns can justify taxation as a means of internalising this externality.

There also is substantial evidence that higher sickness-related absence by a reference group induces individuals to be absent more. Therefore, absence is associated with what we may call a moral hazard externality, which can be expected to reduce

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Manfred Holler's list of publications (in Google Scholar) contains more than 400 entries. Few of them explicitly deal with labour issues—although he has written two textbooks in German on labour economics (Goerke & Holler, 1997; Holler, 1986). My academic interests, which developed during the work as Manfred's chair in Hamburg, attest to the climate of intellectual openness and curiosity, which he created. Braham and Steffen (2008, p. vi) write in their introduction to the *Festschrift* for Manfred's 60th birthday: '(H)e has always made every effort to free his staff from unnecessary administrative burdens and he never burdened anyone with his own work'. This implied that staff members were free to pursue their own research projects, also if only modestly linked to or even without any relationship to Manfred's work. While, to the best of my knowledge, Manfred has not worked on positional concerns, the present analysis was certainly inspired by his attitude of openness and tolerance.

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welfare further. However, upon closer scrutiny, it may also be conjectured that relative absence concerns mitigate or offset a consumption externality. The latter induces individuals to work too much; the former causes them to exert too little effort. Hence, policy prescriptions may be affected by the co-existence of relative absence concerns and positional consumption preferences.

In this chapter we investigate whether relative absence concerns weaken, neutralise or perhaps over-compensate the distortion resulting from relative consumption considerations. If such countervailing effects occur, fostering absenteeism instead of combatting it may be advisable, because absence constitutes a kind of second best instrument. Moreover, if relative absence concerns reduce the distortion resulting from relative consumption considerations, the case for taxation will be weakened or could even become obsolete. Therefore, we furthermore enquire what features characterise optimal income tax rates and optimal sick pay.

In order to analyse these issues, we set up a simple model with an exogenously given number of homogeneous individuals who can determine labour supply and absence. Relative consumption concerns induce individuals to work too much, compared to the Pareto-efficient amount of working hours, assuming the absence level to be given. Endogenising the choice of absence in the next step, while still neglecting absence externalities, to isolate the effects of absence, we can show that individuals still work excessive hours, while there is too little absence from work. The net effect will be positive such that the consumption level remains too high. As a result, allowing for absence in a world with relative consumption concerns does not invalidate the basic prediction resulting from a consumption externality; people work too much. Finally, we extend the model further and assume preferences which are characterised by relative concerns with respect to consumption *and* absence. This additional positional effect gives rise to the moral hazard externality alluded to above. If such absence externalities induce individuals to expand absence, as the available empirical evidence suggests they do, working hours will remain excessive, while absence and consumption can be too low. Therefore, the theoretical analysis predicts that an absence externality will never internalise the impact of relative consumption concerns, in contrast to the conjecture formulated above. The reason is that the utility from absence differs from the utility from leisure such that enhanced incentives to work are never compensated by an augmented inducement to be absent. In consequence, the income tax rate which guarantees a Pareto-efficient outcome is positive, while sick pay is used to internalise the absence externality.

The remainder of the chapter is structured as follows. In Sect. 2, we review related contributions. Section 3 sets out the theoretical model and, in Sect. 4, we compare the market outcome to the Pareto-efficient allocation for alternative specifications of preferences. The main findings are summarised in three Propositions. Section 5 contains some concluding remarks. Most proofs are collected in the Appendix.

2 Related Contributions

The present analysis is primarily related to theoretical and empirical investigations of relative income or consumption effects and empirical contributions considering absence externalities. The subsequent survey focuses on publications in economics.

The first set of relevant studies is motivated by substantial evidence that subjective well-being is influenced by relative income (see Clark et al., 2008; Dolan et al., 2008 for surveys). If utility levels vary with the income or consumption of reference groups, it is but a short way to assume that such externalities also exist with regard to changes in utility. This, in turn, implies that consumption decisions are affected (see, for example, Alpizar et al., 2005; Heffetz, 2011; Kuhn et al., 2011 for evidence). Since expanding consumption generally requires higher income, relative consumption and income concerns tend to distort labour supply (Duesenberry, 1949; Frank, 1985; Schor, 1991). If, in particular, utility declines with the reference level of consumption, labour supply will exceed the Pareto-efficient level (see, inter alia, Persson, 1995; Corneo, 2002; Dupor & Liu, 2003). Additionally allowing for absence, the strength of positional consumption preferences will affect labour supply and absence equally if the latter has the same utility impact as a reduction in working time (cf. Goerke, 2019). This finding is related to the prediction that individuals will no longer necessarily supply excessive amounts of labour in the presence of relative consumption concerns if they also exhibit relative leisure concerns. Because an increase in working time directly affects the relative leisure position, a Pareto-efficient allocation may result, but is unlikely to occur in the presence of both externalities.[1] In many of the contributions which have established the inefficiency of individual choices tax policy has been looked at.[2]

The theoretical prediction that labour supply is excessive in the presence of relative consumption concerns, though not necessarily wealth considerations (Fisher & Hof, 2008), has also found empirical support. Neumark and Postlewaite (1998), for example, employ data from the National Longitudinal Survey of Youth (NLSY) and show that the employment rate of women is higher if either the sister-in-law is employed or the sister's husband has a higher income than the woman's own spouse. Park's (2010) bases his study on the Current Population Survey (CPS) and documents that female labour force participation rises with relative income. Moreover, Pérez-Asenjo (2011) utilises data from the General Social Survey (GSS) and shows that hours of work, the probability of working full-time and labour force participation

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[1] See, for example, Seidman (1988), Choudhary and Levine (2006) and Arrow and Dasgupta (2009). Gómez (2008) presents a growth model in which the market equilibrium is efficient if the consumption and leisure externality have the same intensity. In the set-up by Aronsson and Johansson-Stenman (2013), there is asymmetric information with respect to ability, such that the two externalities would not balance out, even if they were equally strong. Alpizar et al. (2005) and Carlsson et al. (2007) present evidence based on hypothetical choice experiments that positional leisure preferences are less pronounced than relative income considerations.

[2] See, inter alia, Duesenberry (1949), Boskin and Sheshinski (1978), Persson (1995), Ireland (1998), Corneo (2002), Gómez (2008), Dodds (2012), Aronsson and Johansson-Stenman (2013), Eckerstorfer (2014), Wendner (2014) and Goerke and Neugart (2021).

decline with relative income. Bracha et al. (2015) conducted a laboratory experiment and informed a subset of the participants that they earn half of the amount paid to other participants performing the same tasks. They present evidence that information about relative pay tends to reduce the labour supply of those male subjects paid a lower wage unless a strong justification for unequal pay was provided. Breza et al. (2018) used a field experiment to, inter alia, analyse the effects of relative wages on attendance. Workers who receive a relatively low wage are more likely not to turn up for work, whereas there are no such effects observable for workers who earn high relative wages. In sum, the theoretical notion that relative consumption or income concerns can cause excessive labour supply is well established and there is empirical evidence corroborating this prediction.[3]

The second relevant strand of literature relates to empirical studies of relative absence effects.[4] Ichino and Maggi (2000) employ firm-level data from a large Italian bank. Using changes between branches and different parts of the country to identify social interactions, they find a significant positive impact of the average number of absence periods on individual absence behaviour. De Paola (2010) also utilises firm-level data for a much smaller sample of Italian public sector employees. Relying on an instrumental variable approach, she identifies positive spill-over effects of the absence rates of co-workers.

In a further important paper, Lindbeck et al. (2016) analyse all absence periods lasting longer than 14 days in Sweden for the period 1996–2002. For a variety of identification strategies, they show that the average absence duration in a narrowly defined neighbourhood significantly increases the absence of the individual under consideration. Also employing data from Sweden, Hesselius et al., (2009, 2013) and Johansson et al. (2019) base their studies on a social experiment that took place in Göteborg at the end of the 1980s. At that time, employees could claim sick pay for a week without presenting a medical certificate. This requirement was relaxed for a randomly chosen subgroup of employees. Hesselius et al. (2009) find, inter alia, that the proportion of individuals affected in an employee's workplace had a positive and significant impact on the duration of absence. Johansson et al. (2019) additionally

[3] There are further contributions which point into the same direction. Aronsson et al. (1999) analyse the implications of interdependent labour supply behaviour for estimated labour supply elasticities, using repeated cross-sectional data from Sweden. They find that average working hours in a reference group raise individual labour supply. Pingle and Mitchell (2002) set up a hypothetical choice experiment. They present individuals with combinations of working time and income and report that the average level of hours worked affect individuals' choices.

[4] Palme and Persson (2020, Sect. 4) concisely review pertinent empirical studies. Miraglia and Johns (2021) provide a much broader survey of the literature on social determinants of absence behaviour, also including contributions from economics. To the best of our knowledge, the implications of relative absence concerns have not yet been analysed in a theoretical model. Somewhat related to our analysis, Skåtun and Skåtun (2004) analyse an efficiency wage model in which individuals can choose hours of work. The authors interpret this choice as a decision about absence behaviour. They assume that fewer hours worked by colleagues raise the workload of individuals and, hence, reduce the individual's working hours as well. The main prediction of the model is that, in contrast to traditional shirking frameworks, employment may be higher in the presence of efficiency wages than in their absence.

demonstrate that these externalities vary with the type of job. Hesselius et al. (2013), furthermore, look at employees living in bordering municipalities. They also find substantial evidence of positive absence spill-overs.

Moving from Sweden to Norway, Dale-Olsen et al. (2015) use a variation in marginal income tax rates and, hence, in net wages in 2006 to identify a change in the incentives to attend work. In a sample of male employees, they observe substantial positive effects of the colleagues' average absence on an individual's own duration of absence. Further evidence of peer effects in Norway is provided by Godøy and Dale-Olsen (2018). They show that an arguably exogenous change in the leniency of certifying sick leave alters an employee's absence behaviour and also that of colleagues who are unaffected by the variation in attesting an illness in the same direction. A final piece of evidence is provided by Bradley et al. (2007) who investigate the behaviour of school teachers in Queensland, Australia. They identify positive interaction effects of illness-related absence by focusing on individuals who move between schools.[5]

In sum, there is consistent evidence originating from various countries and approaches that the absence level of people who are employed in the same workplace has a positive impact on the absence of the individuals under consideration. Such externalities are sometimes interpreted as shirking (e.g. Bradley et al., 2007; Ichino & Maggi, 2000) or as resulting from fairness or reciprocal concerns (i.e. by Dale-Olsen et al., 2015; Hesselius et al., 2013), while there is no evidence that they arise due to the spread of contagious diseases.

Based on the above contributions, we subsequently assume preferences, which ensure that (1) an individual's labour supply rises with reference consumption, and (2) the absence level of an individual increases with the absence of their reference group.

3 Model

In this section, we initially outline the foundations of our analysis, subsequently delineate the details of the model, then derive the market outcome and, finally, describe the Pareto-efficient allocation.

Foundations

We consider a single-period setting, with a given number of identical individuals who decide about working time. Therefore, adjustments in labour supply only take place at the intensive margin. Moreover, intertemporal repercussions of positional consumption preferences and relative absence concerns are ruled out. There is full

[5] Bradley et al. (2014) investigate the impact of a move from temporary to permanent employment on absenteeism for public sector employees in Australia. In some of their specifications they include an indicator of the average absence level at the employee's workplace. The estimated coefficients are consistently positive and significant.

employment and the only actors are workers and firms. The latter cannot influence the output price and are profitable at the wage prevailing in the absence of positional or relative preferences. This assumption ensures that firms can pay wages above the wage resulting in a world without comparison effects. To close the model and retain the homogeneity assumption, profits are redistributed equally to all workers. Since this profit component of income is exogenous from each individual's perspective, the profit income does not affect the impact of relative concerns.

The above assumptions, and further ones outlined below, ensure that labour supply will be excessive in the presence of positional consumption preferences if there are no relative absence concerns (see Sect. 4.1). Therefore, the set-up allows us to isolate the impact of relative absence concerns and their interaction with positional consumption preferences.

Relaxing one or more of the assumptions could, for example, imply that labour supply in the absence of relative absence concerns is no longer excessive. To illustrate, suppose that the labour market is not perfectly competitive, but that market power either by employees or firms reduces the employment to below the level prevailing in a setting without such distortion. In such cases, positional consumption preferences can bring the economy closer to efficiency or even guarantee an efficient outcome (Goerke & Hillesheim, 2013; Goerke & Neugart, 2021). Relaxing the assumption of homogeneous individuals would imply that there may be many Pareto-efficient allocations. Therefore, the effect of relative absence concerns could crucially depend on the benchmark, which is selected to evaluate the market outcome. Finally, relaxing, for example, the assumption of a given number of individuals could result in excessive labour supply not only at the intensive but also, or instead, at the extensive margin, depending on, inter alia, the firms' production technology.

In consequence, all of the simplifying assumptions laid out above may determine the findings presented in Sect. 4, and the policy conclusions derived from them. However, the simplifications greatly help to isolate and understand the basic mechanisms governing the interaction between positional consumption preferences and relative absence concerns.

Set-up

The large number of identical individuals can divide up their time endowment, which we set to unity, into actual working time, $h - a$, absence, a, and leisure, $1 - h$. Actual working time, also referred to as *effort*, is the difference between labour supply or contractual working hours, h, and absence, a. Individuals derive utility from consumption of the single commodity, c, leisure, $1 - h$, and absence, a. Moreover, utility depends on the choices of a reference group, namely the average levels of consumption and absence, $\overline{c}$ and $\overline{a}$. Overall utility, Z, is then specified as

$$Z(h, a) = u(c, \overline{c}) - H(h) + v(a, \gamma\overline{a}) \qquad (1)$$

The separability between the (sub-) utility from consumption, u, the disutility, H, from contractual working hours, h, and the (sub-) utility, v, from absence, a, substantially simplifies subsequent computations, without imposing too much structure on preferences.

Utility, u, is increasing in personal consumption, c, at a decreasing rate ($u_1 > 0 > u_{11}$), where subscripts denote partial derivatives. In line with our motivation, individuals are characterised by envy with regard to income (Dupor & Liu, 2003). Accordingly, utility decreases with the consumption level of the reference group, $\overline{c}$ ($u_2 < 0$). This ensures that working hours chosen individually are excessive, as demonstrated by Cahuc and Postel-Vinay (2005), Persson (1995), Alvarez-Cuadrado (2007), Pérez-Asenjo (2011), Dodds (2012) and Goerke (2019), inter alia. Moreover, utility declines with (contractual) working hours at an increasing rate (H', $H'' > 0$), reflecting the positive but decreasing marginal utility from leisure. Finally, absence raises utility, albeit at a decreasing rate ($v_1 > 0 > v_{11}$). Such positive absence effects can arise, for example, because people who are ill gain extra utility from not having to work. Alternatively, absence can be viewed as being unrelated to health and to be due to shirking. In the present setting, there is no need to precisely determine the cause of absence, because our findings rely on the assumption that the utility from absence, a, differs from the utility due to leisure, $1 - h$. This will certainly be true in the two polar cases outlined above, particularly if shirking involves, for example, feelings of guilt or restricts the range of activities which can be undertaken while being officially ill.[6]

In Eq. (1), utility from absence, v, also depends on the reference group's absence level, $\overline{a}$. The non-negative parameter γ measures the strength of this absence externality. The empirical evidence summarised above suggests that higher absence by a reference group increases an individual's absence level, implying that $\partial v_1/\partial \overline{a} > 0$ holds. This effect may arise because the reference level defines a social norm or focal point. Alternatively, our specification may capture the impact of additional workload arising if colleagues are absent. This extra effort will raise the disutility from work, such that the gain due to own absence rises. Irrespective of the mechanism underlying the absence externality, the empirical evidence does not provide consistent information concerning the direction of the direct utility effect of $\overline{a}$, that is, the sign of $\partial v/\partial \overline{a} = \gamma \partial v/\partial(\gamma \overline{a}) = \gamma v_2$.[7]

[6] Absence can also have detrimental effects on future wages and employment (see, e.g., Hansen, 2000; Hesselius, 2007; Markussen, 2012; Scoppa & Vuri, 2014). While we do not model such consequences explicitly, one feasible short-cut in order to incorporate them into the model is the above assumption that utility from absence is distinct from that due to leisure.

[7] Carrieri (2012) found that a higher sickness level of a reference group reduces well-being. If (1) higher sickness induces people to be absent more and (2) utility from absence can be approximated by subjective well-being, Carrieri's (2012) result suggests $v_2 < 0$. However, this line of argument may be problematic, given survey results that positional concerns with regard to health are relatively weak (cf. Solnick & Hemenway, 2005; Grolleau & Saïd, 2008; Wouters et al., 2015). These findings from surveys contrast with evidence from panel data for Australia (cf. Mujcic & Frijters, 2015) according to which the self-assessed health status of a peer group is consistently and strongly associated with a reduction in life satisfaction.

Empirically, a substantial fraction of employees is observed never to be absent from work (Frick & Malo, 2008). In order to ensure interior choices of working hours and absence, we postulate that $u_1(c \to 0) \to \infty$, $H'(h \to 0) \to 0$, $H'(h \to 1) \to \infty$ and $v_1(a \to 0) \to \infty$ hold. Further, marginal utility from consumption, u_1, and absence, v_1, decline with a general rise in consumption, respectively, absence. This requires $u_{11} + u_{12} < 0$ and $v_{11} + \gamma v_{12} < 0$ and guarantees stability of the equilibrium, together with the restrictions on H and the production function (see below). Following, for example, Dupor and Liu (2003), we additionally assume that a general rise in consumption makes the individual under consideration better off ($u_1 + u_2 > 0$ for $\mathrm{d}c = \mathrm{d}\overline{c}$) and decreases the marginal utility from consumption ($\mathrm{d}(u_1 + u_2)/\mathrm{d}c = u_{11} + 2u_{12} + u_{22} < 0$). Similar restrictions with respect to utility from absence are imposed, implying that $v_1 + \gamma v_2 > 0$ and $\mathrm{d}(v_1 + \gamma v_2)/\mathrm{d}a = v_{11} + 2\gamma v_{12} + \gamma^2 v_{22} < 0$ hold for $\mathrm{d}a = \mathrm{d}\overline{a}$. Since the number of individuals is fixed, we can finally, and without loss of generality, normalise their number to unity.

Production takes place in a representative firm which produces the single consumption good with labour as the sole factor. Output and consumption are given by $c = f(h - a)$, where f constitutes the production function which is increasing in effort, $h - a$, at a decreasing rate ($f' > 0 > f''$). If effort is zero, $h - a = 0$, so will be output ($f(0) = 0$), while the first unit of effort will be infinitely productive ($f'((h - a) \to 0) \to \infty$). Because the output price is constant we also normalise it and set it equal to unity to save on notation.

Market Equilibrium

In market equilibrium, all individuals are employed and earn a wage, w, per unit of working time. Moreover, they may receive sick pay, s, per time unit of absence, as is the case in most OECD countries (OECD, 2010, pp. 128 f). While wage income is generally taxed, the picture relating to sick pay is more mixed (see MISSOC (2021) for European Union and EFTA countries). Therefore, we assume that a linear income tax is levied on wages at the rate t, $0 \le t < 1$, while sick pay remains untaxed and does not exceed the net wage, $0 \le s \le w[1 - t]$.[8] Tax receipts are returned to individuals in a lump-sum manner. The respective payment T equals $w[h - a]t$ in equilibrium. Furthermore, to close the model, individuals obtain profit income, π.

Since individuals cannot save, consumption, c, and total net income coincide and are given by[9]

$$c = w[1-t][h-a] + sa + T + \pi \tag{2}$$

[8] The subsequent findings are unaffected by the assumption that sick pay is untaxed, unless noted below (cf. Proposition 3). To focus on relative absence and consumption concerns, the model developed below is static. As mentioned above, there is substantial evidence that sickness-related absence has detrimental long-term labour market effects (Hansen, 2000; Hesselius, 2007; Markussen, 2012; Scoppa & Vuri, 2014). An alternative or additional way of including this empirical observation in the present static setting is the assumption that sick pay is less than the net wage, i.e. $s < w[1 - t]$.

[9] Note that terms in square brackets describe multiplicative components, while parentheses indicate a functional dependence.

Maximisation of utility $Z(h, a)$ with respect to h and a, subject to the individual budget constraint (2), taking as given average consumption, $\overline{c}$, average absence, $\overline{a}$, the wage, w, lump-sum returns from tax authorities, T, and profits, π, yields two first-order conditions (for the second-order conditions, see Appendix 1).

$$Z_{\mathrm{h}} = u_1(c, \overline{c})w[1-t] - H'(h) = 0 \tag{3a}$$

$$Z_{\mathrm{a}} = u_1(c, \overline{c})[s - w[1-t]] + v_1(a, \gamma\overline{a}) = 0 \tag{3b}$$

The individual choice of working hours, denoted by h^{m} in market equilibrium, results from the trade-off between the additional utility due to higher net income and the loss in utility from less leisure. The duration of absence a^{m} in equilibrium balances the utility change resulting from the loss in income with the utility gain from not having to work.

The representative firm covers the costs of sick pay, as it is the case for shorter absence spells in many OECD countries (cf. OECD, 2010, pp. 128 f; MISSOC, 2021). Hence, profits are given by

$$\pi(h) = f(h-a) - w[h-a] - sa \tag{4}$$

Maximisation of profits, $\pi(h)$, with respect to contractual working hours, h, yields

$$\pi_{\mathrm{h}} = f'(h-a) - w = 0 \tag{5}$$

The second-order condition for a maximum is guaranteed by the strict concavity of the production function ($\pi_{\mathrm{hh}} = f'' = -\pi_{\mathrm{ha}} < 0$).

In equilibrium, wage adjustments ensure that labour demand and labour supply coincide. Accordingly, working hours, h, absence, a, the reference values of consumption, $\overline{c}$, and of absence, $\overline{a}$, as well as the wage, w, are endogenous variables. Moreover, tax payments equal the lump-sum transfer, T, in equilibrium and consumption is affected by changes in endogenous variables via the resulting variation in profits. In Appendix 2, we show that given the restrictions on the utility function imposed above, the Jacobian determinant, $|J|$, of the system of Eqs. (3a), (3b) and (5), taking into account the above repercussions, is negative.

Given a balanced-budget requirement and taking into account profit income (cf. Eq. (17) in the Appendix), the derivatives of the first-order conditions (3a) and (3b) with respect to the tax rate, t, and sick pay, s, are given by $Z_{\mathrm{hs}} = 0$, $Z_{\mathrm{at}} = -Z_{\mathrm{ht}} = u_1(c, \overline{c})w$ and $Z_{\mathrm{as}} = u_1(c, \overline{c})$. This implies that working hours and absence rise with sick pay ($\mathrm{d}h^{\mathrm{m}}/\mathrm{d}s$, $\mathrm{d}a^{\mathrm{m}}/\mathrm{d}s > 0$; see also Appendix 6), absence increases with the tax rate ($\mathrm{d}a^{\mathrm{m}}/\mathrm{d}t > 0$), while the effect of a tax rate change on working hours is determined by the sign of $v_{11}(a, \gamma\overline{a}) - u_{11}(c, \overline{c})sf'(h-a)$ and, hence, ambiguous for $s > 0$.

Pareto-Efficiency

In a Pareto-efficient allocation, all individuals are treated identically and there will not be sick pay because consumption can be determined directly. Therefore, Pareto-efficiency is characterised by a maximum of utility Z, subject to the output constraint, $c = f(h - a)$, and the restriction that personal consumption and absence levels, c and a, as well as working hours, h, coincide with their respective averages, $\overline{c}$, $\overline{a}$, and $\overline{h}$. This implies that $\mathrm{d}c = \mathrm{d}\overline{c}$, $\mathrm{d}a = \mathrm{d}\overline{a}$ and $\mathrm{d}h = \mathrm{d}\overline{h}$ hold. From the output constraint, the relationship between consumption and working hours can be derived.

$$\frac{\mathrm{d}c}{\mathrm{d}h} = -\frac{\mathrm{d}c}{\mathrm{d}a} = f'(h-a) > 0 \tag{6}$$

Differentiation of

$$\Gamma(h,a) = u\big(c(h,a), \overline{c}\big(\overline{h},\overline{a}\big)\big) - H(h) + v(a, \gamma\overline{a}) \tag{7}$$

with regard to hours, h, and absence, a, yields (see Appendix 3 for the second-order conditions):

$$\Gamma_{\mathrm{h}} = [u_1(c,\overline{c}) + u_2(c,\overline{c})]f'(h-a) - H'(h) = 0 \tag{8a}$$

$$\Gamma_{\mathrm{a}} = -[u_1(c,\overline{c}) + u_2(c,\overline{c})]f'(h-a) + v_1(a,\gamma\overline{a}) + \gamma v_2(a,\gamma\overline{a}) = 0 \tag{8b}$$

The Pareto-efficient number of working hours, h*, results from the trade-off between the additional utility from the higher output and, hence, consumption on the one hand, and the utility reduction due to less leisure on the other (cf. Eq. (8a)). The utility gain from greater consumption, in turn, consists of a direct, positive effect and an indirect, negative one, because higher consumption by other individuals reduces utility due to relative consumption concerns ($u_2 < 0$), ceteris paribus. The Pareto-efficient absence level, a*, arises from a similar trade-off as it applies to working hours (cf. Eq. (8b)). Since all individuals are treated identically, the Pareto-efficient allocation is uniquely defined.[10]

The Pareto-efficient allocation can be attained in a market economy in which working hours and absence cannot be determined directly by setting the tax rate, t, and sick pay, s, in such a manner that the objective $\Gamma(h,a)$ (cf. Eq. (7)) is maximised. This is feasible because taxes and sick pay affect individual choices (in accordance with Eqs. (3a) and (3b)).

[10] It could be argued that absence has a distinct, positive utility effect. If, therefore, preferences were given by $u(c,\overline{c}) - H(h,a) + v(a,\gamma\overline{a})$, where the partial derivatives are $\tilde{H}_1 < 0 < \tilde{H}_2$, the nature of the first-order conditions for individual choices and for the characterisation of Pareto-efficiency would not be altered under mild additional restrictions (see Appendix 4). Hence, the findings derived below are unlikely to be affected.

4 Comparisons of Outcomes

4.1 Working Hours as Sole Choice Variable

In the first step, we assume that individuals can decide only about working hours, so that there is no absence ($a = v_1 = v_2 = 0$). The market equilibrium is then defined by the combination of Eqs. (5) and (3a) for $a = s = 0$ and Pareto-efficiency by Eq. (8a), which we rewrite as (9b) for ease of comparison, while imposing $v_1 = v_2 = 0$.

$$f'(h^{\mathrm{m}}) = \frac{H'(h^{\mathrm{m}})}{u_1(c^{\mathrm{m}}, \overline{c})[1 - t]} \tag{9a}$$

$$f'\left(h^*\right) = \frac{H'(h^*)}{u_1(c^*, c^*) + u_2(c^*, c^*)} \tag{9b}$$

Inspection of (9a) and (9b) shows that:

Proposition 1

Assume that individuals only decide about working hours in market equilibrium.

(a) If income is untaxed, working hours will be excessive.
(b) The tax rate, $t(a = 0)$, which ensures that individuals choose the optimal number of working hours, is given by

$$0 < t(a = 0) = -\frac{u_2(c^*, c^*)}{u_1(c^*, c^*)} < 1. \tag{10}$$

Proof Part (a) follows from the comparison of (9a) and (9b) for $u_2 < 0$, from the strict concavity of f in h, the assumption that u_1 and $u_1 + u_2$ decrease in consumption c, and the production constraint (cf. Eq. (17) in Appendix 2). Substituting $t(a = 0)$ into (9a) shows that this equality will then hold for working hours h^* which are implicitly defined by (9b). As, moreover, tax payments $w[h - a]t$ equal the lump-sum transfer, T, and profits are returned to individuals, their income and, hence, consumption levels will be the same as in the Pareto-efficient allocation, given $h^{\mathrm{m}} = h^*$ and $c^{\mathrm{m}} = c^*$. Since $u_1 + u_2 > 0 > u_2$ for any given combination of h and a, the tax rate $t(a = 0)$ is less than unity. ■

Proposition 1 indicates that individuals work too many hours, h, because they do not take into account that an increase in h decreases other individuals' relative consumption position. This prediction of excessive labour supply is well established and variants of it have been derived, for example, by Seidman (1988), Persson (1995), Ljungqvist and Uhlig (2000), Corneo (2002), Dupor and Liu (2003), Cahuc and Postel-Vinay (2005), Alvarez-Cuadrado (2007), Pérez-Asenjo (2011) and Goerke and Hillesheim (2013). Since labour demand is unaffected by relative consumption concerns, excessive supply of working hours translates into too much equilibrium effort. Because consumption rises with effort, the same is true for the consumption level. Turning to the optimal tax rate, it can be noted that the gain to society from a general rise in consumption is given by $u_1 + u_2$, because consumption of the reference group also rises. If an individual decides about consumption, the marginal gain is only u_1 because the variation in the consumption of other individuals' reference groups is ignored. Therefore, individual consumption—or hours—decisions neglect a fraction u_2/u_1 of the utility change. As established in a variety of analyses (e.g. Alvarez-Cuadrado, 2007; Aronsson & Johansson-Stenman, 2010, 2013, 2018; Dupor & Liu, 2003; Liu & Turnovsky, 2005; Ljungqvist & Uhlig, 2000; Persson, 1995), the tax rate on income which mimics this fraction, induces an individual to choose the optimal number of working hours.

4.2 *Absence of Absence Externality*

In this sub-section, we assume that individuals decide about working hours and the duration of absence, but we continue to disregard absence externalities ($\gamma = 0$). To isolate the impact of envy, we initially set sick pay equal to zero ($s = 0$) and consider its effects at the end of this sub-section. Imposing $\gamma = 0$ in the conditions characterising the market equilibrium (3a), (3b) and the Pareto-efficient outcome (8a), (8b), and combining (3a) and (3b) with (5) yields

$$u_1(c^{\mathrm{m}}, \bar{c}) f'(h^{\mathrm{m}} - a^{\mathrm{m}})[1 - t] - H'(h^{\mathrm{m}}) = 0 \tag{11a}$$

$$-u_1(c^{\mathrm{m}}, \bar{c}) f'(h^{\mathrm{m}} - a^{\mathrm{m}})[1 - t] + v_1(a^{\mathrm{m}}) = 0 \tag{11b}$$

$$\left[u_1\left(c^*, c^*\right) + u_2\left(c^*, c^*\right)\right] f'\left(h^* - a^*\right) - H'\left(h^*\right) = 0 \tag{12a}$$

$$-\left[u_1\left(c^*, c^*\right) + u_2\left(c^*, c^*\right)\right] f'\left(h^* - a^*\right) + v_1\left(a^*\right) = 0 \tag{12b}$$

From the comparison of these equations, we obtain

Proposition 2

Assume that individuals decide about working hours and absence in market equilibrium, sick pay is zero ($s = 0$), and there is no absence externality ($\gamma = 0$).

(a) If income is untaxed, working hours, effort and consumption will be excessive, while there will be too little absence from work.
(b) The tax rate $\hat{t} := t(s = \gamma = 0)$, which ensures that individuals choose the optimal number of working hours and the optimal duration of absence, is given by

$$0 < \hat{t} = -\frac{u_2(c^*, c^*)}{u_1(c^*, c^*)} < 1. \tag{13}$$

Proof: See Appendix 5.

In order to provide intuition for Proposition 2, note that individuals will be absent from work even if they do not obtain income while being away ($s = 0$) because absence increases utility directly. Relative to the Pareto-efficient outcome, however, absence is too low. This is the case since absence reduces income and, thus, consumption possibilities. When trading off the gain from being absent, i.e. the increase in 'absence utility', v, with the costs in the form of lower consumption, an individual will not take into account that lower consumption makes all other individuals better off because of the existence of envy, as captured by the term u_2 (< 0) in (12b), which is not contained in (11b), describing individual behaviour.

The combination of Eqs. (11a), (11b) and (12a), (12b) shows that the relationship between working hours and absence both in market equilibrium and in the Pareto-efficient allocation is governed by the equality of the marginal disutility of work, $-H'(h)$, and the marginal utility from absence, $v_1(a)$. As argued above, absence is too low in market equilibrium. Hence, the marginal utility from absence is higher than in a Pareto-efficient allocation. Consequently, also the marginal disutility from extra hours must be higher, that is, less leisure must be consumed in market equilibrium relative to the efficient allocation. Therefore, working hours in market equilibrium are excessive, whereas absence is too low, and effort and consumption must surely be too high. Proposition 2, furthermore, states that a single tax instrument suffices to ensure the efficiency of two endogenous variables, namely working hours and absence. This is the case because the choice of absence is not distorted, for a given number of working hours.

Moving beyond the narrow confines of our theoretical set-up, the above prediction of insufficient absence could also be interpreted in light of the debate about presenteeism. In order to do so, the model would have to be extended to allow for truly sickness-related absence. Assume, therefore, that each individual is sick for some time and then has to decide whether to attend work or to be absent. If the gain from absence is highest when sick, too little absence implies that individuals will sometimes be present at work although they are ill. Hence, the existence of relative consumption concerns would imply that people not only supply too many hours but also go to work too often when ill. Consequently, relative consumption concerns in the form of envy can be argued to cause presenteeism.

Allowing for an Exogenously Given Level of Sick Pay

Subsequently, we relax the restriction that there is no sick pay. If one instrument, the income tax rate $\hat{t}$, suffices to induce individuals to make efficient choices in market equilibrium (cf. Proposition 2, Part (b)), a second market intervention can only cause inefficiencies. Therefore, any exogenously given, non-zero sick pay, s, will cause a distortion. The reason is that sick pay only affects the absence decision, but does not alter the choice of working hours (cf. Eqs. (3a) and (3b)). In consequence, irrespective of the tax rate, the market equilibrium cannot be efficient in the presence of sick pay if there is no absence externality.

If sick pay is positive, contractual working hours and absence will be higher in market equilibrium than for $s = 0$, for a given tax rate, while effort will be lower (see Appendix 6).[11] Sick pay has no income effect in equilibrium because it is paid for by firms. Hence, the rise in labour income is compensated by the fall in profits, such that the overall impact on an individual's income and consumption is zero. However, higher sick pay raises the marginal gain from absence. Thus, the substitution effect implies that absence rises, such that production and consumption will decline. To mitigate this detrimental impact on utility, contractual hours are increased. Their rise will be less pronounced than the increase in absence because of the disutility of contractual hours, $H(h)$. Consequently, work effort declines.

Absence in market equilibrium without sick pay is too low because individuals ignore the impact of absence on the reference income. The absence level in a market equilibrium in which sick pay is positive will be higher ($a^{\mathrm{m}}(s > 0) > a^{\mathrm{m}}(s = 0)$). The Pareto-efficient allocation, however, is characterised by the absence of sick pay. Therefore, absence resulting in market equilibrium with sick pay may be higher or lower than the Pareto-efficient amount. Furthermore, working hours will be excessive in market equilibrium without sick pay, s, and will rise with s. Since their Pareto-efficient number is independent of sick pay, working hours will surely be excessive in the presence of sick pay. Finally, the effort level resulting in market equilibrium with sick pay may be higher or lower than the Pareto-efficient amount since (1) effort is excessive if sick pay is zero and (2) effort declines with sick pay.

4.3 Simultaneous Existence of Consumption and Absence Externalities

Propositions 1 and 2 show that contractual working hours and effort are excessive in a world with envy. We next scrutinise whether the prediction continues to apply if there also is an absence externality. To do so, we initially consider the impact of a greater reference level of absence, $\overline{a}$, on individual choices, holding constant the wage, that is, for a given market outcome. The impact of $\bar{a}$ on individual choices is determined by $Z_{\mathrm{h}\bar{\mathrm{a}}} = 0$ and $Z_{\mathrm{a}\bar{\mathrm{a}}} = \gamma v_{12}$. Using $Z_{\mathrm{ha}} > 0$ and $Z_{\mathrm{hh}} Z_{\mathrm{aa}} - (Z_{\mathrm{ha}})^2 > 0$ (cf. Appendix 1), we obtain

$$\frac{\mathrm{d}a^{\mathrm{m}}}{\mathrm{d}\overline{a}}_{|\mathrm{d}w=0} = -\gamma v_{12} \frac{Z_{\mathrm{hh}}}{Z_{\mathrm{hh}} Z_{\mathrm{hh}} - (Z_{\mathrm{ha}})^2} \tag{14a}$$

$$\frac{\mathrm{d}h^{\mathrm{m}}}{\mathrm{d}\overline{a}}_{|\mathrm{d}w=0} = \gamma v_{12} \frac{Z_{\mathrm{ha}}}{Z_{\mathrm{hh}} Z_{\mathrm{hh}} - (Z_{\mathrm{ha}})^2} \tag{14b}$$

[11] Since effort is too low in market equilibrium and declines with sick pay, such payments can be argued to reduce presenteeism (see Pichler and Ziebarth (2017) for according empirical evidence).

$$\frac{\mathrm{d}(h^{\mathrm{m}} - a^{\mathrm{m}})}{\mathrm{d}\bar{a}}_{|\mathrm{d}w=0} = \gamma v_{12} \frac{Z_{\mathrm{ha}} + Z_{\mathrm{hh}}}{Z_{\mathrm{hh}} Z_{\mathrm{hh}} - (Z_{\mathrm{ha}})^2} = \gamma v_{12} \frac{u_{11} w[1-t]s - H''}{Z_{\mathrm{hh}} Z_{\mathrm{hh}} - (Z_{\mathrm{ha}})^2} \tag{14c}$$

If we take as our starting point the overwhelming empirical evidence that a higher absence level of a reference group raises absence by an individual (see Sect. 2), the derivative in (14a) and, consequently v_{12}, are positive. Therefore, working hours in market equilibrium also increase with the absence of the reference group, while effort declines.

Assuming $v_{12} > 0$, we can next compare the market outcome and the Pareto-efficient allocation and analyse the importance of relative absence concerns. Additionally, Proposition 3 characterises the tax rate and level of sick pay that induce Pareto-efficient choices.

Proposition 3

Assume that individuals decide about working hours and absence and there is an absence externality ($\gamma > 0$).

(a) If the tax rate is zero ($t = 0$), sick pay is non-negative ($s \geq 0$), and higher absence by the reference group does not raise utility from absence ($v_2 \leq 0$), working hours in market equilibrium will be excessive, while the differences between Pareto-efficient and market outcomes with respect to absence and consumption are indeterminate.
(b) If a higher absence level by the reference group increases the level of absence chosen individually ($v_{12} > 0$), greater strength of relative absence concerns, as captured by an increase in the parameter γ, raises the number of working hours and the duration of absence in market equilibrium, while effort declines.
(c) A greater strength of relative absence concerns has ambiguous consequences for the Pareto-efficient allocation.
(d) The tax rate and level of sick pay which induce a Pareto-efficient allocation as the market outcome are given by

$$0 < t^*\big(c^*, \gamma\big) = -\frac{u_2(c^*, c^*, \gamma)}{u_1(c^*, c^*, \gamma)} < 1 \text{ and } s^*\big(c^*, a^*, \gamma\big) = \frac{\gamma v_2(a^*, \gamma)}{u_1(c^*, c^*, \gamma)}$$

Proof: See Appendix 7.

If there is no absence externality, working hours will be excessive and absence insufficient (cf. Proposition 2). If higher absence by the reference group reduces utility from absence ($v_2 < 0$), there are additional incentives to raise absence. Consequently, it needs no longer to be too low. Therefore, absence externalities indeed mitigate or even compensate for the effect of relative consumption concerns on absence, as surmised in the Introduction. Moreover, the prediction concerning working hours is unaffected by the incorporation of absence externalities. Part (a) of Proposition 3 also clarifies that relative consumption and absence concerns will never balance out, in that their co-existence induces a Pareto-efficient market equilibrium. This is the case because absence affects utility differently than leisure. In consequence, the composition of effort will never be efficient. Therefore, if relative consumption concerns are complemented by relative absence effects, the efficiency consequences will be fundamentally different than in a setting in which relative consumption and relative leisure effects co-exist. In the latter case, a higher relative consumption level is tantamount to more work and, hence, an inferior relative leisure situation. Such a direct linkage does not exist if preferences exhibit relative absence concerns.

Part (b) of Proposition 3 additionally indicates that the existence of absence externalities (for $v_{12} > 0$) induces individuals to work more and to be absent for a longer duration than in a market outcome without such relative absence effects. However, effort declines. Parts (b) and (c) of Proposition 3 further reveal that there is no straightforward relationship between the strength of relative absence concerns, as measured by the parameter γ, and the efficiency properties of the market outcome. This is the case because both the market equilibrium and the Pareto-efficient allocation change with the strength of relative absence concerns. A rise in the parameter γ increases the marginal utility from absence if $v_{12} > 0$, so that there is more absenteeism. A greater duration of absence raises labour demand and, hence, working hours in equilibrium. As hours are excessive in market equilibrium, a further increase would enlarge the difference between the efficient amount of contractual working time and the market outcome only if the Pareto-efficient allocation were invariant to the strength of the absence externality. With regard to the duration of absence and effort, no such statements are feasible because the absence and effort levels in the market equilibrium may exceed or fall short of their efficient levels.

Finally, Part (d) of Proposition 3 states that the tax rate which induces an efficient choice of working hours is determined by the same ratio of marginal utilities as it is the case in a setting either without absence externality or without the possibility to determine the absence level individually.[12] This structural equality comes about because the tax rate only corrects the distortion in working hours resulting from relative consumption concerns. Part (d) additionally shows that the distortion due to relative absence considerations requires the level of sick pay to be negative if utility decreases with the reference level of absence ($v_2 < 0$), and to be positive otherwise.[13] This is the case because such preferences will induce individuals to choose an excessive level of absence, for a given amount of working hours. Clearly, if sick pay also insured individuals against income variations, an argument in favour of a positive level would arise. Nevertheless, the above analysis indicates that the optimal level of sick pay is reduced by the presence of relative absence concerns.

[12] Since the Pareto-efficient consumption level may be higher or lower if there are absence externalities than in a setting without such externalities, the magnitude of $t^*(c^*, \gamma)$, relative to $\hat{t}$, cannot be determined. An exception arises if consumption levels are the same, as it will be true for an iso-elastic utility function u. Since the Pareto-efficient consumption level does not vary with γ in such a setting, tax rates are also the same, i.e. $t^*(c^*, \gamma) = \hat{t}$.

[13] If sick pay were taxed, the level inducing efficient behaviour would have to be higher in absolute terms in order to counteract the mitigating impact of taxes and given by $s^*(c^*, a^*, \gamma) = \gamma v_2(a^*, \gamma)/(u_1(c^*, c^*, \gamma) + u_2(c^*, c^*, \gamma))$.

Going beyond Proposition 3, a setting may be considered in which, for example, the level of sick pay cannot be chosen optimally. Suppose for illustrative purposes that sick pay is too high, $s > s^*(c^*, a^*, \gamma)$. Accordingly, working hours and absence exceed their optimal levels, h^* and a^* (see also Appendix 6). If higher taxes (weakly) raise working hours, the second best optimal tax rate will surely be less than $t^*(c^*, \gamma)$. This will be the case because a reduction in t will mitigate the increases in working hours and in absence that are due to sick pay exceeding its optimal level.

5 Conclusions

In this chapter, we complement a model featuring positional consumption preferences with relative absence concerns. The former externality induces individuals to work too much, the latter has the opposite impact. We show that the net impact on actual working hours, i.e. effort, may coincidentally be zero. However, irrespective of the overall impact on effort, its composition will never be efficient and working hours will always be too high. The main modelling assumption determining this prediction, for which there is also substantial evidence, is that leisure and absence have different utility effects. As a consequence, relative absence concerns do not invalidate but only modify the case for taxation due to positional income considerations. In particular, the tax rate inducing the efficient number of working hours is positive but generally depends on the strength of relative absence concerns. Moreover, relative absence concerns imply that the level of sick pay-inducing efficiency must be less than the amount which is optimal in the absence of such externality. Since the empirical evidence suggests that relative absence concerns focus on colleagues, the optimal level of sick pay may consequently be firm- or even workplace-specific.

The present analysis constitutes a first attempt to model the co-existence of relative absence concerns and positional income preferences. To do so, the investigation relies on several simplifying assumptions, discussed in more detail at the beginning of Sect. 3. Therefore, it may be worthwhile to investigate if the findings derived above will also hold if individuals differ, for example, (a) in the strength of positional preferences, (b) with respect to the other individuals they compare to or (c) the scope for alterations in working hours and absence. Furthermore, we have assumed competitive markets, the absence of unemployment and of adjustments at the extensive margin both for individuals and firms.

Appendix

1. Utility Maximum

From an individual's perspective, the reference levels of consumption and absence, profits, the tax rate and the lump-sum transfer are constant. Therefore, the second-order conditions for a maximum are given by $Z_{hh}, Z_{aa} < 0 < Z_{hh}Z_{aa} - (Z_{ah})^2$, where Z_h and Z_a are defined in Eqs. (3a) and (3b) and the net wage equals $w^N = w[1 - t]$.

$$Z_{hh} = u_{11}\left[w^N\right]^2 - H'' < 0 \tag{15a}$$

$$Z_{aa} = u_{11}\left[s - w^N\right]^2 + v_{11} < 0 \tag{15b}$$

$$Z_{ha} = Z_{ah} = u_{11}w^N\left[s - w^N\right] \geq 0 \tag{15c}$$

Hence, we have

$$Z_{hh}Z_{aa} - {Z_{ah}}^2 = u_{11}\left[v_{11}\left[w^N\right]^2 - H''\left[s - w^N\right]^2\right] - H''v_{11} > 0 \tag{16}$$

2. Stability of Market Equilibrium

In equilibrium, lump-sum payments, T, are determined endogenously in order to balance the budget. Thus, $T = wt[h - a]$. Moreover, profits as defined in (4) are paid out to individuals and affect their consumption. Hence, the equilibrium level of consumption equals production:

$$\begin{aligned} c^m &= w[1-t]\left[h^m - a^m\right] + sa^m + wt\left[h^m - a^m\right] + f(h^m - a^m) - w\left[h^m - a^m\right] - sa^m \\ &= f(h^m - a^m) \end{aligned} \tag{17}$$

To ascertain whether the market equilibrium is stable, we calculate the Jacobian determinant $|J|$ of the system defined by Eqs. (3a), (3b) and (5), taking into account (17). Moreover, all individuals behave identically. Hence, changes in consumption, c, and the reference level, $\overline{c}$, are the same. Similarly, the variations in a and $\overline{a}$ coincide. Thus, the derivatives of (3a), (3b) and (5) with respect to contractual hours, h, absence, a, and wages, w, incorporating (17), are given by $\pi_{hh} = f'' = -\pi_{ha} < 0$, $\pi_{hw} = -1$ and:

$$Z^e_{hh} = [u_{11} + u_{12}]f'w^N - H'' < 0 \tag{18a}$$

$$Z^{e}_{aa} = -[u_{11} + u_{12}]f'\left[s - w^{N}\right] + v_{11} + \gamma v_{12} < 0 \tag{18b}$$

$$Z^{e}_{ha} = -[u_{11} + u_{12}]w^{N} f' > 0 \tag{18c}$$

$$Z^{e}_{ah} = [u_{11} + u_{12}]\left[s - w^{N}\right]f' > 0 \tag{18d}$$

$$Z^{e}_{hw} = u_{1}[1 - t] = -Z^{e}_{aw} > 0 \tag{18e}$$

In (18a) to (18e), we use the superscript e to indicate that equilibrium repercussions via lump-sum payments T and profits are incorporated. The Jacobian determinant $|J|$ of the system defined by the modified Eqs. (3a), (3b) and (5) is negative.

$$\begin{aligned} |J| &= -\left[Z^{e}_{hh}Z^{e}_{aa} - Z^{e}_{ha}Z^{e}_{ah}\right] - f''Z^{e}_{hw}\left[Z^{e}_{ha} + Z^{e}_{aa} + Z^{e}_{hh} + Z^{e}_{ah}\right] \\ &= -\,H''\left[[u_{11} + u_{12}]\left[s - w^{N}\right]f' - \left[v_{11} + \gamma v_{12}\right]\right] \\ &\quad +\, f''u_{1}[1 - t]\left[H'' - \left[v_{11} + \gamma v_{12}\right]\right] < 0 \end{aligned} \tag{19}$$

3. Pareto-Efficient Allocation

The second-order conditions for a maximum of Γ are

$$\Gamma_{hh} = [u_{11} + 2u_{12} + u_{22}]\left[f'\right]^{2} + [u_{1} + u_{2}]f'' - H'' < 0 \tag{20a}$$

$$\Gamma_{aa} = [u_{11} + 2u_{12} + u_{22}]\left[f'\right]^{2} + [u_{1} + u_{2}]f'' + v_{11} + 2\gamma v_{12} + \gamma^{2}v_{22} < 0 \tag{20b}$$

and $\text{Det} = \Gamma_{hh}\Gamma_{aa} - {\Gamma_{ha}}^{2} > 0$. Using

$$\Gamma_{ha} = -\underbrace{[u_{11} + 2u_{12} + u_{22}]}_{(-)}\left[f'\right]^{2} - \underbrace{[u_{1} + u_{2}]f''}_{(-)} = -\Gamma_{hh} - H'' > 0, \tag{21}$$

the determinant of the system of Eqs. (8a) and (8b) is found to be positive.

$$\begin{aligned} \text{Det} = &\underbrace{\left[[u_{11} + 2u_{12} + u_{22}]\left[f'\right]^{2} + [u_{1} + u_{2}]f''\right]}_{(-)}\underbrace{\left[v_{11} + 2\gamma v_{12} + \gamma^{2}v_{22} - H''\right]}_{(-)} \\ &- H''\underbrace{\left[v_{11} + 2\gamma v_{12} + \gamma^{2}v_{22}\right]}_{(-)} > 0 \end{aligned} \tag{22}$$

4. Alternative Specification of Preferences

Suppose preferences are given by

$$\tilde{Z}(h,a) = u(c,\overline{c}) - \tilde{H}(h,a) + v(a,\gamma\overline{a}), \tag{23}$$

where $\tilde{H}_1 < 0 < \tilde{H}_2$. Pareto-efficiency can then be characterised by maximising:

$$\tilde{\Gamma}(h,a) = u\big(c(h,a), \overline{c}\big(\overline{h},\overline{a}\big)\big) - \tilde{H}(h,a) + v(a,\gamma\overline{a}) \tag{24}$$

The first-order conditions for individually optimal choices and describing Pareto-efficiency are

$$\tilde{Z}_h = u_1 w[1-t] - \tilde{H}_1(h,a) = 0 \tag{25a}$$

$$\tilde{Z}_{\mathrm{a}} = u_1\big[s - w^{\mathrm{N}}\big] - \tilde{H}_2(h,a) + v_1 = 0 \tag{25b}$$

$$\tilde{\Gamma}_{\mathrm{h}} = [u_1 + u_2] f'(h-a) - \tilde{H}_1(h,a) = 0 \tag{26a}$$

$$\tilde{\Gamma}_{\mathrm{a}} = -[u_1 + u_2] f'(h-a) - \tilde{H}_2(h,a) + v_1 + \gamma v_2 = 0 \tag{26b}$$

The properties of the model will be unaffected if (1) $\tilde{H}_2$ is not too large in absolute value such that (25b) and (26b) define interior solutions for absence choices, and (2) $v_1(a,\gamma\overline{a}) - \tilde{H}_2(h,a)$ exhibits the same qualitative features as $v_1(a,\gamma\overline{a})$ with respect to a.

5. Proof of Proposition 2

Part (a): *If income is untaxed, working hours will be excessive, there will be too little absence from work and, hence, effort and consumption will also be excessive.*

The combination of (11a), (11b), and (12a), (12b) shows that

$$H'(h^{\mathrm{m}}) = v_1(a^{\mathrm{m}}) \tag{27a}$$

and

$$H'\big(h^*\big) = v_1\big(a^*\big). \tag{27b}$$

Given the assumptions on the derivatives (H', H'', $v_1 > 0 > v_{11}$), there are three possible combinations of market outcomes relative to the efficient combination:

Case (1): $h^{\mathrm{m}} = h^*$ and $a^{\mathrm{m}} = a^*$,

Case (2): $h^{\mathrm{m}} < h^*$ such that $H'(h^{\mathrm{m}}) < H'(h^*)$ and $v_1(a^{\mathrm{m}}) < v_1(a^*)$, which implies $a^{\mathrm{m}} > a^*$,

Case (3): $h^{\mathrm{m}} > h^*$ and $a^{\mathrm{m}} < a^*$, according to the same line of argument as in Case (2).

In Case (1), Eqs. (27a) and (27b) hold, but (11a) and (12a), respectively (11b) and (12b), cannot be satisfied simultaneously. Therefore, $h^{\mathrm{m}} = h^*$ and $a^{\mathrm{m}} = a^*$ do not guarantee that the conditions which characterise the market equilibrium and the efficient outcome are both fulfilled.

In Case (2), $h^{\mathrm{m}} - a^{\mathrm{m}} < h^* - a^*$ results, which implies that $c^{\mathrm{m}} = f(h^{\mathrm{m}} - a^{\mathrm{m}}) < c^* = f(h^* - a^*)$ holds. This, in turn, indicates that $f'(h^{\mathrm{m}} - a^{\mathrm{m}}) > f'(h^* - a^*)$ and $u_1(c^{\mathrm{m}}) > u_1(c^*)$ due to the strict concavity of f and u. Furthermore, deducting (12a) from (11a) yields

$$\begin{aligned} u_1(c^{\mathrm{m}}, \bar{c}) f'(h^{\mathrm{m}} - a^{\mathrm{m}}) - H'(h^{\mathrm{m}}) - \left[\left[u_1(c^*, c^*) + u_2(c^*, c^*)\right] f'(h^* - a^*) - H'(h^*)\right] \\ = \underbrace{u_1(c^{\mathrm{m}}, \bar{c}) f'(h^{\mathrm{m}} - a^{\mathrm{m}}) - u_1(c^*, c^*) f'(h^* - a^*)}_{=\mathrm{A1}} \\ + \underbrace{H'(h^*) - H'(h^{\mathrm{m}})}_{=\mathrm{A2}} - \underbrace{u_2(c^*, c^*) f'(h^* - a^*)}_{(-)} = 0 \end{aligned} \tag{28}$$

In Case (2), the terms A1 and A2 are positive. Therefore, equality (28) cannot hold and $h^{\mathrm{m}} < h^*$, $a^{\mathrm{m}} > a^*$ do not describe the market outcome relative to the efficient situation.

In consequence, the only constellation of working hours and absence which simultaneously guarantees the conditions which describe the market equilibrium and the Pareto-efficient allocation is described by Case (3). If $h^{\mathrm{m}} > h^*$ and $a^{\mathrm{m}} < a^*$, $c^{\mathrm{m}} > c^*$ must also hold. ■

Part (b): *The tax rate $\hat{t} := t(s = \gamma = 0)$ which ensures that individuals choose the optimal number of working hours and the optimal duration of absence is given by*

$$0 < \hat{t} = -\frac{u_2(c^*, c^*)}{u_1(c^*, c^*)} < 1. \tag{29}$$

This part can be demonstrated by substituting $\hat{t} := t(s = \gamma = 0) = -u_2(c^*, c^*)/u_1(c^*, c^*)$ in Eqs. (11a) and (11b). Given a unique market equilibrium, it can only be characterised by the values of h and a which fulfil Eqs. (12a) and (12b), i.e. the Pareto-efficient combination. As tax receipts are returned to individuals and they obtain all profit income, consumption will be the same as in the Pareto-efficient allocation, given the same levels of working hours and absence. ■

6. Sick Pay

In market equilibrium, consumption equals production, $c^{\mathrm{m}} = f(h^{\mathrm{m}} - a^{\mathrm{m}})$. Therefore, the derivatives of the first-order conditions (3a), (3b) and (5) with regard to sick pay, s, are $Z^{\mathrm{e}}_{\mathrm{hs}} = \pi_{\mathrm{hs}} = 0$ and $Z^{\mathrm{e}}_{\mathrm{as}} = u_1$. Also taking into account (18a) to (18e), the changes in contractual hours, absence and effort due to a rise in sick pay, s, are found to be

$$\frac{\mathrm{d}h^{\mathrm{m}}}{\mathrm{d}s} = \frac{u_1}{|J|}\left[f'' Z^{\mathrm{e}}_{\mathrm{hw}} - Z^{\mathrm{e}}_{\mathrm{ah}}\right] > 0 \tag{30a}$$

$$\frac{\mathrm{d}a^{\mathrm{m}}}{\mathrm{d}s} = \frac{u_1}{|J|}\left[Z^{\mathrm{e}}_{\mathrm{hh}} + f'' Z^{\mathrm{e}}_{\mathrm{hw}}\right] > 0 \tag{30b}$$

$$\frac{\mathrm{d}(h^{\mathrm{m}} - a^{\mathrm{m}})}{\mathrm{d}s} = -\frac{u_1[u_{11} + u_{12}]f's}{|J|} < 0 \tag{30c}$$

7. Proof of Proposition 3

Notation: Market outcomes in a world with absence externalities are denoted by $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma)$, $a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma)$ and $c^{\mathrm{m}}(h^{\mathrm{m}}, a^{\mathrm{m}}) = c^{\mathrm{m}}(h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma), a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma))$, while the Pareto-efficient allocation is characterised by $h^*(a^*, \gamma)$, $a^*(h^*, \gamma)$, and $c^*(\gamma)$.

Part (a): *If the tax rate is zero ($t = 0$), sick pay is non-negative ($s \geq 0$), and higher absence by the reference group does not raise utility from absence ($v_2 \leq 0$), working hours in market equilibrium will be excessive, while the differences between Pareto-efficient and market outcomes with respect to absence and consumption are indeterminate.*

The comparison of the first-order conditions characterising the market equilibrium and the Pareto-efficient outcome or of a combination of them does not provide insights with respect to the relative levels of working hours and absence. However, it can be shown that only a number of combinations of h, a and $h - a$ are feasible. Basically, the differences $[h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma)] - [h^*(a^*, \gamma) - a^*(h^*, \gamma)]$, $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - h^*(a^*, \gamma)$ and $a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - a^*(h^*, \gamma)$ could be positive, zero or negative. Hence, the theoretically maximal number of outcomes is 27. To simplify the subsequent argument, note that imposing a sign on the term Diff 1: $= h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - [h^*(a^*, \gamma) - a^*(h^*, \gamma)] = h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - h^*(a^*, \gamma) - [a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - a^*(h^*, \gamma)]$ implies that the same sign applies to the difference Diff 2: $= c^{\mathrm{m}}(h^{\mathrm{m}}, a^{\mathrm{m}}) - c^*(\gamma)$ because $c = f(h - a)$.

Some of the 27 feasible combinations are logically impossible. If Diff 2 > (<) 0 holds, $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - h^*(a^*, \gamma) \leq (\geq)\, 0$ and $a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - a^*(h^*, \gamma) \geq (\leq)\, 0$ cannot occur

Table 1 Feasible and impossible combinations of working hours, absence and effort

Sign of Diff 1 & Diff 2	Sign of $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - h^{*}(a^{*}, \gamma)$	Sign of $a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - a^{*}(h^{*}, \gamma)$	Not feasible because
+	+	+	
+	+	0	
+	+	–	
+	0	+	logically impossible
+	0	0	logically impossible
+	0	–	of argument B
+	–	+	logically impossible
+	–	0	logically impossible
+	–	–	of argument B
0	+	+	
0	+	0	logically impossible
0	+	–	logically impossible
0	0	+	logically impossible
0	0	0	of argument A
0	0	–	logically impossible
0	–	+	logically impossible
0	–	0	logically impossible
0	–	–	of argument A
–	+	+	
–	+	0	logically impossible
–	+	–	logically impossible
–	0	+	of argument A
–	0	0	logically impossible
–	0	–	logically impossible
–	–	+	of argument A
–	–	0	of argument A
–	–	–	of argument A

simultaneously. This argument rules out 4 (and another 4) of the 27 combinations. Additionally, if Diff 2 $= 0$ holds, $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) - h^{*}(a^{*}, \gamma)$ and $a^{\mathrm{m}}(h^{\mathrm{m}}, \gamma) - a^{*}(h^{*}, \gamma)$ must have the same signs. Hence, another six combinations cannot describe the market outcome relative to the Pareto-efficient allocation (cf. Table 1).

We next consider the case of Diff 2 ≤ 0 again. This implies that $u_1(c^{\mathrm{m}}) \geq u_1(c^{*})$, given $u_{11} + u_{12} < 0$ and $f'(h^{\mathrm{m}} - a^{\mathrm{m}}) = w \geq f'(h^{*} - a^{*})$. As a result, $u_1(c^{\mathrm{m}})w > [u_1(c^{*}) + u_2(c^{*})]f'(h^{*} - a^{*})$, since $u_2 < 0$. The comparison of (3a) and (8a), assuming $t = 0$, clarifies that $H'(h^{\mathrm{m}}) > H'(h^{*}) < 0$ must hold, because otherwise the equations cannot be fulfilled simultaneously. Given the convexity of H in h, $H'(h^{\mathrm{m}}) > H'(h^{*})$ implies that $h^{m}(a^{m}, \gamma) > h^{*}(a^{*}, \gamma)$ holds. Accordingly, all theoretically feasible cases for which Diff 2 ≤ 0 is assumed are only compatible with $h^{m}(a^{m}, \gamma) > h^{*}(a^{*}, \gamma)$, ruling out a further 6 of the remaining 13 (27 − 4 − 4 − 6) combinations as incompatible with $h^{m}(a^{m}, \gamma)$, $a^{m}(h^{m}, \gamma)$ characterising the market equilibrium and $h^{*}(a^{*}, \gamma)$, $a^{*}(h^{*}, \gamma)$ the Pareto-efficient allocation (argument A).

Note that thus far the proof has required no restrictions with respect to sick pay and the sign of v_2. Suppose, next, that $h^{m}(a^{m}, \gamma) \leq h^{*}(a^{*}, \gamma)$ holds. In accordance with the above line of argument, this implies that $H'(h^{m}) < H'(h^{*})$ is true. Combining (3a), (3b) and (8a), (8b) yields

$$u_1(c^{m})s - H'(h^{m}) + v_1(a^{m}) = 0 \tag{31a}$$

$$\gamma v_2 - H'\left(h^{*}\right) + v_1\left(a^{*}\right) = 0 \tag{31b}$$

For $\gamma v_2 < 0$ and $s \geq 0$ or $\gamma v_2 = 0$ and $s > 0$, Eqs. (31a) and (31b) can only hold at the same time if $v_1(a^{m}) < v_1(a^{*})$, that is for $a^{m}(h^{m}, \gamma) > a^{*}(h^{*}, \gamma)$, and given $v_{11} < 0$ (argument B). Hence, two further combinations have been ruled out. Because no further incompatibilities of the first-order conditions, or combinations thereof, can be discerned, the above considerations leave 5 of the 27 permutations (see Table 1). All of them are characterised by $h^{m}(a^{m}, \gamma) > h^{*}(a^{*}, \gamma)$. ■

The proof that $h^{m}(a^{m}, \gamma) > h^{*}(a^{*}, \gamma)$ is the only feasible outcome, assumes either a positive level of sick pay ($s > 0$) and $\gamma v_2 \geq 0$, or non-negative sick pay ($s \geq 0$) and envy with respect to absence ($\gamma v_2 < 0$); cf. argument B. Therefore, it also covers the case of positive sick pay and no absence externality. Hence, the above argument constitutes an alternative to the proof provided in Appendix 6 establishing that working hours in market equilibrium will be excessive if sick pay is positive.

Part (b): *If a higher absence level by the reference group increases the level of absence chosen individually ($v_{12} > 0$), a greater strength of relative absence concerns, as captured by an increase in the parameter γ, raises the number of working hours and the duration of absence in market equilibrium, while effort declines.*

Since $Z^{e}_{h\gamma} = \pi_{h\gamma} = 0$ and $Z^{e}_{a\gamma} = v_{12}\overline{a}$, the changes in working hours, absence and effort are

$$\frac{dh^{m}}{d\gamma} = -Z^{e}_{a\gamma} \underbrace{\frac{Z^{e}_{ah} + f'' Z^{e}_{aw}}{|J|}}_{(-)} \tag{32a}$$

$$\frac{da^{m}}{d\gamma} = Z^{e}_{a\gamma} \underbrace{\frac{Z^{e}_{hh} + Z^{e}_{hw} f''}{|J|}}_{(+)} \tag{32b}$$

$$\frac{\mathrm{d}(h^{\mathrm{m}} - a^{\mathrm{m}})}{\mathrm{d}\gamma} = -Z^{\mathrm{e}}_{\mathrm{a}\gamma} \frac{Z^{\mathrm{e}}_{\mathrm{hh}} + Z^{\mathrm{e}}_{\mathrm{ha}}}{|J|} = Z^{\mathrm{e}}_{\mathrm{a}\gamma} \underbrace{\frac{H''}{|J|}}_{(-)} \tag{32c}$$

Part (c): *A greater strength of relative absence concerns has ambiguous consequences for the Pareto-efficient allocation.*

The partial derivatives of Eqs. (8a) and (8b) with respect to γ are given by $\Gamma_{\mathrm{h}\gamma} = 0$ and $\Gamma_{\mathrm{a}\gamma} = v_2 + (v_{12} + \gamma v_{22})\overline{a}$. Since $\Gamma_{\mathrm{a}\gamma}$ cannot be signed without specifying the utility function v, the changes in working hours, absence and effort in the Pareto-efficient allocation are ambiguous. ■

Part (d): *The tax rate and level of sick pay which induce a Pareto-efficient allocation as market outcomes are given by* $0 < t^*(c^*, \gamma) = -\frac{u_2(c^*, c^*, \gamma)}{u_1(c^*, c^*, \gamma)} < 1$ and $s^*(c^*, a^*, \gamma) = \frac{\gamma v_2(a^*, \gamma)}{u_1(c^*, c^*, \gamma)}$.

Replacing t and s in Eqs. (3a) and (3b) by $-u_2(c^*, c^*, \gamma)/u_1(c^*, c^*, \gamma)$ and $\gamma v_2(a^*)/u_1(c^*, c^*, \gamma)$ and using $w = f'(h - a)$ from (5) shows that Eqs. (3a) and (3b) will hold for those values of working hours and absence which characterise the Pareto-efficient allocation described by Eqs. (8a) and (8b). All tax payments are returned to individuals via lump-sum payments. Moreover, individuals obtain the entire profit income. Consequently, income and consumption will be the same as in the Pareto-efficient allocation, given $h^{\mathrm{m}}(a^{\mathrm{m}}, \gamma) = h^*(a^*, \gamma)$ and $a^{\mathrm{m}} = a^*$. ■

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