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Optimal sickness benefits and workers' absenteeism

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Abstract: In this paper, we analyze the optimal design for sickness benefits using a dynamic principal-agent model. We begin with a simple fact: The probability of contamination depends on the number of sick workers inside the firm. Consequently, firms have incentives to provide sickness benefits to reduce the absenteeism rate. However, sickness benefits are source of hazard moral. Thus, the optimal contract is characterized by increasing sickness benefits. We propose simulations in order to estimate the effects on the productivity of the optimal contract.

Keywords: Health insurance, moral hazard, absenteeism, optimal contract.

Contrat optimal d'indemnités journalières et absentéisme au travail

Abstract : Dans cet article, nous nous intéressons au profil optimal des indemnités journalières pour maladie dans le cadre d'un modèle principal-agent. Nous supposons que la maladie est un risque collectif en raison des risques de contamination au sein des entreprises. Dès lors, il est dans l'intérêt des entreprises de proposer une protection contre la maladie. Cependant, le risque de fraude ne permet pas une assurance complète. Par conséquent, nous montrons que le contrat optimal est caractérisé par un montant progressif des indemnités journalières.

Mots-clefs : Assurance santé, aléa moral, absentéisme, contrat optimal.

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Introduction

In this paper, the design of the optimal sickness benefits is analyzed using a dynamic principal-agent model. This optimal contract is one that maximizes firms' productivity by taking into account two causes of worker absenteeism: epidemics and abuse of sick leave.

Absenteeism is an important issue for firms because it involves inefficiency in the work organization and a loss of work hours. We begin with a fact: Be sick is not an individual risk since the probability to be infected depends on the number of sick workers inside firms. Thus, the existence of externalities between workers encourages firms to have a health policy in order to reduce absenteeism. We focus on a particular tool: sickness benefits. Indeed, in many OCDE countries, firms choose to provide a sick pay to their employees. Beyond the social aspect, generous sickness benefits can prevent epidemic spread by encouraging sick workers to leave temporarily their firm. However, there is considerable evidence that sickness benefits can increase absence rates. Thus, a part of absenteeism is not explained by epidemics, but by impossibility to observe and to sanction abuses of sick leave. It is the reason why firms have to trade off to prevent the spread of epidemics and reduce moral hazard.

To our knowledge, there is no analysis of work absenteeism with a principal-agent model. Economic literature gives several explanations for the work absenteeism issue. Ehrenberg (1970) is a seminal theoretical work on sickness absence. This paper focuses on the effects of absenteeism on the demand for labour and in particular the amount of overtime worked per man. According to Ose (2005), sickness absences are the consequence of health degradation. Thus, bad working conditions in firms increase work absenteeism. It follows that the cost of absenteeism must be transferred from the government and workers to firms in order to give incentives to improve work conditions. Allen (1981) suggests another explanation based on the traditional income/leisure trade off. In fact, labour supply and labour demand are not constant over time while job contracts have fixed working hours. In this framework, sickness benefits allow to adapt labour supply to change in labour demand or leisure marginal utility. Shapiro and Stiglitz (1984) and Barmby and al. (1994) present models with moral hazard and efficiency wages. In these papers, the wage level influences absenteeism and productivity. Coles and Treble (1996) and Chatterji and Tilley (2002) are also interested in productivity - absenteeism links.

These theoretical works highlight the significant role of the gap between wages and sickness benefits in work absenteeism. A large part of the literature on this issue is empirical and focused on determinants of absenteeism (Barmby, Orme and Treble (1995); Brown and Sessions (1996)). Many individual characteristics have effects on the duration of sick leave: gender (Bridges S. and Mumford K (2001)), age (Barmby and Stephan (2000)), and seniority, number of children or income (Chaupain-Guillot and Guillot (2007)). Firms' characteristics and in particular working conditions also affect the employees' health (Valssenko and Willard (1984), Strauss and Thomas (1998); Kuhn, Lalive and Zweimüller (2009); Browning, Dano and Heinesen (2006)). Afsa and Givord (2009), with data from France, show that irregular working hours increase absenteeism. There is also a correlation between economic activity and absenteeism rate. According to Arai and Skogman Thourise (2005) and, Askildsen, Bratberg and Nilsen (2005) absenteeism is pro-cyclical in Norway and Sweden.

Nevertheless, the major determinant in the duration of work absence is sickness benefits. Johanson and Palm (1996) and, Henrekson and Persson (2004) provide evidence that an increase in the differential between wages and benefits sickness increases work absenteeism. A worker decides to stop working when the increase in welfare associated with leisure offsets the reduction in income. Therefore, the higher the sickness benefits are, the lower the drop in leisure utility have to be high. This result, in accordance with neoclassical theory, also implies that a sick worker leaves his job more easily than a healthy worker. Indeed, sick workers give more importance to leisure value because work becomes more difficult. The distinction between sick workers and individuals abusing the system is difficult. Firms do not have the skills to assess the workers health. Moreover, international standards of individual rights protect the doctor - patient relationship. In most OECD countries, medical confidentiality protects doctors and patients from interference by firms and government: health is a private information. Thus, the health monitoring is necessarily very imperfect and costly.

To limit sickness benefits expenditures, firms and governments use other tools than monitoring to provide good incentives to workers: sickness benefits are lower than wages and vary over time. Generally, the amount of benefits increase with the sick leave duration. Sometimes, workers do not receive income during the first days of their illness. This system creates an entry cost reducing the moral hazard risk. In France, public insurance pays benefit from the 4th day off of work. It amounted to 50% of wage. More than two-thirds of firms (usually medium and large firms) choose to complete these benefits. The goal is to reduce costs by fighting against the spread of epidemic taking into account abuses of sick leave.

In France, the sickness benefits expenditures increased by 7.6% by year between 1997 and 2003. These expenditures were 5.3 billion euros in 2005 for a total of 200 million days of absence (Chaupain-Guillot and Guillot (2007)). To these direct costs, we can add the cost associated to the labor disorganization in firms (temporary employment, overtime, loss of production, ...). The work absenteeism in the European Union implies a loss equivalent to 1% of GDP. With U.S. data, Szucs (1999) estimates the cost of the influenza between 10 and 15 billion dollars. According to Levy (1996), this cost is 2.5 billion dollars for France. In any case, sickness benefits represent only about 15% of the estimated total cost.

Table 1: Sickness benefit: An international comparison

Country	Day of Waiting period	Montant of sickeness benefit	Share of employees absent at least on day in the last month	Average duration of sick leave
Belgium	0	60% of wage	15.1%	9
France	3	50% of wage	9.7%	12
Ireland	6	188 euros by week	12.6%	4
Italy	3	50% of wage	8.3%	9
Netherlands	2	70% of wage	18.8%	7
Spain	0	60% of wage during the first 3 weeks, then 75%	11.5%	-
UK	7	89 euros during the first 13 weeks, then 110 euros	-	5

Data: MISSOC (January 2016), Chaupain-Guillot and Guillot (2009)

Table **??** presents the European legislations on compensation for sick leave. The first column corresponds to the duration of the waiting period and the second to the sickness benefits. The benefits are from 50% (France and Italy) to 70% (Netherlands) of the wage. In general, the amount of benefits is indexed to wages. Only Ireland and England offer a lump sum. In Spain and Belgium, employees are compensated from the first day of illness. In the other countries, there is a waiting period. In France and Italy, workers are only compensated after 3 days absence. The waiting period is equal to one week in England. Thus, in most countries, the compensation profile is increasing. In the case of Spain and England, benefits also increase after several weeks of sickness.

Compensation schemes for English and Irish illness appear to be the least generous. On the other hand, Spanish and Belgian workers benefit from the most favorable systems. The third column shows the share of employees absent for at least one day in the last month and the fourth column shows the average length of absence per worker. Italy and France are the countries with the lowest rates of absenteeism. They are respectively 9.7 % and 8.3 %. Belgium and the Netherlands have the highest rates. However, French workers have the longest absence (12 days) while the Irish are absent for an average of 4 days.

Paradoxically, countries with low absenteeism rate have longer absenteeism duration. This phenomenon can be explained in the following way: for France and Italy, the 3 days of waiting period dissuade workers who are little ill from taking a sick leave. They can also have a deterrent effect on fraudsters. This implies that workers taking a sick leave are on average more sick than in countries without waiting period. Therefore, the average duration of a sick leave is longer.

This article is enrolled in the line of the classical tradition of arbitration work-leisure (Allen (1981)). We develop a dynamic principal-agent model in which leisure utility is affected to each period by idiosyncratic shocks. A temporary increase in leisure utility encourages workers, sick or healthy, to leave work. Obviously, sick workers give more importance to leisure value because work becomes more difficult. Thus, absent workers may be sick or healthy. We also assume that the contamination probability depends on the number of sick workers inside firm. Therefore, it is possible to reduce the sick rate by encouraging workers to stay home when they are sick. However, a rise in sickness benefits increases the risk of moral hazard. Thus, we determine the optimal benefits in function of the sick leave duration using a dynamic principal-agent model (Spear and Srivastava (1987) and Phelan and Townsend (1991)).

Our model allows to answer several issues. Thus, we can characterize the optimal contract that maximizes profit for a firm that has to provide a minimum level of welfare. We can also determine the contract that maximizes the workers' welfare and provides a positive profit to the firms. Finally, by taking into account wages, we can study how firms can provide health insurance to workers in exchange for lower wages.

In the section 2, the model is presented. Section 3 presents the results and section 4 concludes.

The model

Health insurance does not only protect against individuals risks through mutualisation mechanisms. Health is also a public good since contagious nature of sick is a source of externality. In other words, health expenditure of an individual can reduce the contamination risks for others.

The purpose of this paper is to study characteristics of the optimal sickness benefits (sick pay) when health expenditures can prevent epidemics spread inside firms. We propose to extend the analysis of Allen [1981] where the decision to work is the result of a trade-off between labor income and the value of leisure. In our model, the leisure value in each period depends on idiosyncratic shock and firms can not observe the real cause of absenteeism. Thus, workers can use sickness benefits to adjust their labor supply according to the changing value of leisure. Generous sickness benefits improve the productivity by reducing contamination risks, but increase moral hazard.

Contamination process and workers' behavior

We consider an economy where workers can know 2 health states: healthy and sick. Let j indicate the health state, $j = h, s$. Individuals also have to choose between 2 labor states: occupying his job or taking a sick leave. Let i indicates the labor state, $i = e, n$. The cure probability s for a sick individual is exogeneous and identical for all the population. The contamination probability for healthy worker at time t is $\pi_e(t)$. This probability depend on the number of sick workers, $Q_{e,s}(t)$, inside the firm:

$$\pi_e(t) = \lambda_q + \lambda_p . \sqrt{Q_{e,s}(t)} \tag{1}$$

Where λ_q corresponds to the external contamination sources (family, other firms,...) and $\lambda_p . \sqrt{Q_{e,s}(t)}$ is the internal contamination source. For workers on sick leave, the contamination probability is:

$$\pi_n(t) = \lambda_q \tag{2}$$

Thus, sick leave reduces the contamination risk. The number of workers in the economy is normalized to 1 and individuals are identical ex ante. Agents maximize their intertemporal utility:

$$E_o \sum_{t=1}^{+\infty} \beta^{t-1} [u_{i,j}(t) - \alpha_j . \varepsilon_t] \tag{3}$$

Where $0 < \beta < 1$ is the intertemporal discount factor, $c_{i,j}(t)$ consumption at time t, ε_t the value of leisure and α_j a exogeneous and positif parameter. The leisure opportunity cost is given by $\alpha_j . \varepsilon_t$ and $u(.)$ is a CRRA instantaneous utility function, increasing, twice differentiable and strictly concave with $u'(0) = +\infty$:

$$u(c_{i,j}(t)) = \frac{c_{i,j}(t)^{1-\sigma}}{1-\sigma} \tag{4}$$

Where σ is the risk aversion. The value of leisure is drawn a each time t from a know distribution $F(\varepsilon)$ with support $(0, +\infty)$ and density $f(\varepsilon)$. This assumption implies that the leisure value is not constant through time and is independent from worker' behavior. For instance, spouse's work, children' health, colleagues' productivity or weather influence the decision to work or not (Connolly (2008), Bradley, Green and Leeves (2007)). Obviously, the value of leisure increases in sickness since work becomes more difficult.Thus, we assume that $\alpha_j = 0$ for absent workers $\forall j$ and $\alpha_s > \alpha_h > 0$ for present workers. We normalize α_h to 1.

To adjust labor supply to changes in the value of leisure, workers can use sick leave. This is possible since firms can not observe causes of sickness. Indeed, firms do not have the skills to assess the workers' health. In addition, the medical confidentiality between doctor and patient makes health a private information. This is why sickness benefits are lower than wages to limit abuse of sick leave. We assume that it is impossible to smooth consumption over time using precautionary savings. Thus, consumption for a worker is equal to the wage, $c_{ej} = w$. We assume that the wage is the same for all workers. However, sickness benefits are not necessarily constant over time. Absent workers receive sickness benefits equal to $c_{nj} = b(T)$ where T is the sick leave duration.

Let $V_{e,j}(\varepsilon_t)$ denote the expected value for workers at time t with a health state j and $V_{n,j}(\varepsilon_t, T)$ denote the expected value for absent workers with a health state j, after T period of sick leave. We can write Bellman equations for healthy workers:

$$
\begin{aligned}
V_{e,h}(\varepsilon_t) = u(w) - \alpha_h \varepsilon_t \quad &+ \quad \beta \pi_e(t) \int_0^{+\infty} \max\left(V_{e,s}(\varepsilon'_{t+1}), V_{n,s}(\varepsilon'_{t+1}, 1)\right) d\varepsilon'_{t+1} \\
&+ \quad \beta(1-\pi_e(t)) \int_0^{+\infty} \max\left(V_{e,h}(\varepsilon'_{t+1}), V_{n,h}(\varepsilon'_{t+1}, 1)\right) d\varepsilon'_{t+1} \\
V_{n,h}(\varepsilon_t, T) = u(b_T) \quad &+ \quad \beta \pi_n(t) \int_0^{+\infty} \max\left(V_{e,s}(\varepsilon'_{t+1}), V_{n,s}(\varepsilon'_{t+1}, T+1)\right) d\varepsilon'_{t+1} \\
&+ \quad \beta(1-\pi_n(t)) \int_0^{+\infty} \max\left(V_{e,h}(\varepsilon'_{t+1}), V_{n,h}(\varepsilon'_{t+1}, T+1)\right) d\varepsilon'_{t+1}
\end{aligned}
$$

For sick workers, these values can be written:

$$
\begin{aligned}
V_{e,s}(\varepsilon_t) = u(w) - \alpha_s \varepsilon_t \quad &+ \quad \beta s \int_0^{+\infty} \max\left(V_{e,h}(\varepsilon'_{t+1}), V_{n,h}(\varepsilon'_{t+1}, 1)\right) d\varepsilon'_{t+1} \\
&+ \quad \beta(1-s) \int_0^{+\infty} \max\left(V_{e,s}(\varepsilon'_{t+1}), V_{n,s}(\varepsilon'_{t+1}, 1)\right) d\varepsilon'_{t+1} \\
V_{n,s}(\varepsilon_t, T) = u(b_T) \quad &+ \quad \beta s \int_0^{+\infty} \max\left(V_{e,h}(\varepsilon'_{t+1}), V_{n,h}(\varepsilon'_{t+1}, T+1)\right) d\varepsilon'_{t+1} \\
&+ \quad \beta(1-s) \int_0^{+\infty} \max\left(V_{e,s}(\varepsilon'_{t+1}), V_{n,s}(\varepsilon'_{t+1}, T+1)\right) d\varepsilon'_{t+1}
\end{aligned}
$$

The equilibrium of flows

Individuals maximize their expected present values by choosing reservation values of leisure below which they work. Let $X_{j,T}$ denote the reservation value of leisure for an individual with a health state j. Thus, $X_{h,T}$ is given by the equality between the value of a healthy worker and the value of a sick worker, $V_{e,h}(X_{h,T}) = V_{n,h}(X_{h,T}, T)$. Similarly, the reservation value for sick workers, $X_{s,T}$, is characterized by $V_{e,s}(X_{s,T}) = V_{n,s}(X_{s,T}, T)$.Therefore, the probability to work is $F(X_{h,T})$ for healthy workers and $F(X_{s,T})$ for sick workers. The dynamic of the number of individuals in each state is given by the following equations:

$$
\begin{aligned}
Q_{e,h}(t+1) &= Q_{e,h}(t).(1-\pi_e(t)).F(X_{h,1}) + \sum_{T=1}^{+\infty} Q_{n,h}(t,T).(1-\pi_n(t)).F(X_{h,T+1}) \\
&+ Q_{e,s}(t).\phi.F(X_{h,1}) + \sum_{T=1}^{+\infty} Q_{n,s}(t,T).\phi.F(X_{h,T+1}) \\
Q_{e,s}(t+1) &= Q_{e,h}(t).\pi_e(t).F(X_{s,1}) + \sum_{T=1}^{+\infty} Q_{n,h}(t,T).\pi_n(t).F(X_{s,T+1}) \\
&+ Q_{e,s}(t).(1-\phi).F(X_{s,1}) + \sum_{T=1}^{+\infty} Q_{n,s}(t,T).(1-\phi).F(X_{s,T+1}) \\
Q_{n,h}(t+1,1) &= Q_{e,h}(t).(1-\pi_e(t)).(1-F(X_{h,1})) + Q_{e,s}(t).\phi.(1-F(X_{h,1})) \\
Q_{n,s}(t+1,1) &= Q_{e,h}(t).\pi_e(t).(1-F(X_{s,1})) + Q_{e,s}(t).(1-\phi).(1-F(X_{s,1})) \\
Q_{n,h}(t+1,T+1) &= Q_{n,h}(t,T).(1-\pi_n(t)).F(X_{h,T+1}) + Q_{n,s}(t,T).\phi.F(X_{h,T+1}) \\
Q_{n,s}(t+1,T+1) &= Q_{n,h}(t,T).\pi_n(t).F(X_{s,T+1}) + Q_{n,s}(t,T).(1-\phi).F(X_{s,T+1})
\end{aligned}
$$

A contract is characterized by a wage w and a vector $B = [b_1, b_2, b_3, ..., b_t]$. Given this contract, agents maximize their intertemporal utility by choosing reservation values $X_{h,T}$ and $X_{s,T}$. Then, we can compute a vector for the stationary distribution of population $D = [Q_{e,h}, Q_{e,s}, Q_{n,h}(T), Q_{n,s}(T)]$ consistent with the decision rules of the agents and firms'profit.

The principal: Firms' behavior

The objectif of a firm (the principal) is to maximize its profits under a promise keeping constraint for a sick worker present in this firm, $E(V_{e,h}(\varepsilon)) = \bar{V}$. Firms cannot observe reservation values of leisure, but they know the previous behaviors. Therefore, firms know their economic environment and in particular contamination probabilities, π_i, and workers'behavior. Firms choose the optimal job contract, which is characterized by a wage,w, and a sequence of sickness benefits, $B = [b_1, b_2, b_3, ..., b_t]$. We assume that workers cannot smooth consumption through time using precautionary savings. Thus, the firm perfectly observes and controls agents' consumption.

For each contract, w, B, there is a vector for the distribution of the population $D = [Q_{e,h}, Q_{e,s}, Q_{n,h}(T), Q_{n,s}(T)]$. At equilibrium, this distribution is stationary. Consequently, the optimal contract is the one maximizing the profit for all t under the promise keeping constraint. Then, profit Π must satisfy the following Bellman equation:

$$\Pi = \max_{w,B} Y - (Q_{e,h} + Q_{e,s}).w - \sum_{T=1}^{+\infty} (Q_{n,h}(T) + Q_{n,s}(T)).b(T)$$

subject to

$$E(V(e,h)) = \bar{V}$$

Where Y is the function of production that depends on the number of healthy workers in the firm. We assume that $Y = \sqrt{Q_{e,h}}$. There are several contracts providing the promise-keeping constraint $V_{e,h} = \bar{V}$, but with different costs for the firm. The optimal contract is one that maximizes the profit for the firm.

The optimal contract for sickness benefits

In this section, we study the characteristics of the optimal contract for sickness benefits. After calibration of our model, we analyze the optimal contract when benefits are constant. Then, we compare the imperfect information case to the perfect information case. Finally, we study the optimal contract when sickness benefits vary with the sick leave spell.

Calibration

In France, the public health insurance counts for 200 million sick days by year (Cnamts). This represents an average absenteeism rate of 7.5% (Cnamts (2006)). This rate is similar to that observed in other European countries (Barmby, Ercolani and Treble (2002)). Sickness benefits depend on firms and the sick leave duration. The amount is between 0 euro for a worker only absent one day and 90% of wage when the firm provides a complementary insurance. On average, benefits represent 75% of wage. Finally, 25% of influenza patients declare they do not stop working. The objective of our calibration is to reproduce these three stylized facts when benefits are constant over time and that the firm maximizes its profit.

The model is calibrated on daily data. Following the economic literature on optimal contracts, we set the coefficient of relative risk aversion σ to 2. The discount factor β is equal to 0.9999 which implies an annual discount rate of 4%. We assume the distribution $F(.)$ is log-normal with a mean equal to 0.08 and standard deviation to 1. The parameter α_s is set to 10 in order to reproduce the rate of absence. We calibrate the epidemic dynamics from data on influenza in France. The probability of cure ϕ is equal to 14%. Thus, individuals are sick and contagious for an average duration of one week. Probabilities λ_q and λ_p are respectively 0.005 and 0.05 in

Table 2: Calibration

σ	β	λ_q	λ_p	α_s
2	0.9999	0.005	0.05	10

Table 3: Stylized facts

$\frac{b}{w}$	$Q_{n,h}+Q_{n,b}$	$\frac{Q_{n,s}}{Q_{e,s}+Q_{n,s}}$
75%	7.5%	25%

order to reproduce the disease rate given the value of ϕ. Finally, the constraint $\bar{V}$ is equal to the intertemporal value of employees when the firm maximizes its profit in an economy without insurance $b_t = 0$, $\forall t$. We define a welfare criterion $\bar{c}$ that corresponds to the constant consumption level to reproduce the intertemporal utility for a healthy worker:

$$V_{e,h} = \frac{\bar{c}^{1-\sigma}}{(1-\sigma)(1-\beta)}$$

The optimal contract with constant sickness benefits

Profit maximization with a promise keeping constraint

To begin, we determine the value of the promise keeping $\bar{V}$. We assume that this value corresponds to the case where the firm sets the wage in order to obtain profits equal to zero when there are no sickness benefits $b_t = 0$. The percentage of sick workers is then 14.3% and none of them take sick leave because there is no health insurance. Production is $Y = 0.926$ with a wage equal to $w = 0.925$. Then, we get the value of the promise keeping as $\bar{V} = V_{e,h}$. The criterion of constant consumption, $\bar{c}$, is equal to 0.865 with:

$$\bar{V} = \frac{\bar{c}^{1-\sigma}}{(1-\sigma)(1-\beta)}$$

This case without sickness benefits is our benchmark. Indeed, $V_{e,h} = \bar{V}$ and $\Pi > 0$ are the two constraints used in the following simulations.

The second line of table **??** shows the equilibrium for the optimal contract when information is imperfect. Profit is maximized under the promise keeping constraint $\bar{V}$ using constant sickness benefits and the wage. The firm can not observe causes of sickness. Therefore, sickness benefits are identical for sick workers and individuals abusing sick leave system. The optimal contract is then characterized by a wage of

Table 4: Profit maximization with a promise keeping constraint - $V_{e,s} = \bar{V}$

	Y	Π	w	b_h	b_s	$Q_{e,h}$	$Q_{n,h}$	$Q_{e,s}$	$Q_{n,s}$
Without sickness benefits	0.926	0	0.925	0	0	0.857	0	0.143	0
Imperfect information	0.952	0.115	0.853	0.639	0.639	0.906	0.019	0.018	0.057
Perfect information	0.983	0.142	0.845	0	0.723	0.966	0	0	0.034

0.853 and sickness benefits of 0.639. The optimal replacement ratio $\frac{b}{w}$ is 75%. With this contract, 7.5% of workers are sick against 14.3% in the benchmark equilibrium. Thus, a more generous insurance system can reduce absenteeism in the firm. The improvements of workers' health implies an increase in production of 2.8% from 0.926 to 0.952.

Meanwhile, the insurance system encourages workers to cheat: 1.9% of the population are healthy individuals who abuse the sick leave system. This represents 25% of all sick people. However, the existence of fraud is not an argument in favour of reducing sickness benefits. Indeed, productivity gains obtained with improvement of workers' health offset the presence of cheaters in the economy. Finally, the sickness benefits system increases firms' profits.

However, the imperfect observation of workers has a cost. On the one hand, firms pay sickness benefits to some healthy workers. On the other hand, in order to limit the number of cheaters, the replacement ratio is lower with imperfect information than when the information is perfect. This implies that some sick workers decide to work. Thus, sickness benefits are too low for 24% of sick workers who decide to stay in the firm. This behavior reduces the workers' welfare and prevents the contamination risk in the firms from being completly eliminated.

To evaluate the cost of imperfect information, we compute the equilibrium assuming that firms can provide different sickness benefits to sick workers and healthy workers. The results are shown in the third line of table **??**. Wage is equal to 0.845 and sickness benefits to 0.723. Thus, we have a replacement ratio of 85.5%. For healthy workers, the replacement ratio is equal to 0%. This optimal contract completely eliminates cheaters and allows for all sick individuals to leave work. Thus, the number of sick is at its lowest level and only depends on the exogenous parameter λ_q. In other words, the rate of sick is only explained by contamination factors outside the firm. Production is 0.983 and the profit is 0.142. Thus, if information is perfect, the production increases by 3.2% and profit by 23.5%.

Welfare maximization with a positive profit constraint

Sickness benefits improve the productivity. Until now, we assumed that the intertemporal utility of healthy workers was equal to the promise keeping constraint. Thus,

Table 5: Welfare maximization with a positive profit constraint - $\Pi = 0$

	Y	$\tilde{c}$	w	b_h	b_s	$Q_{e,h}$	$Q_{n,h}$	$Q_{e,s}$	$Q_{n,s}$
Without sickness benefits	0.925	0.865	0.925	0	0	0.857	0	0.143	0
Imperfect information	0.950	0.977	0.97	0.715	0.715	0.902	0.023	0.018	0.057
Perfect information	0.983	1.004	0.986	0	0.896	0.966	0	0	0.034

productivity gains do not improve the welfare's workers, but only the firm's profit. Therefore, we propose the opposite exercise: firms maximize the workers' welfare under the constraint of having a positive profit, $\Pi = 0$. This is the case when the labor market is tight and competition is high between firms to hire workers.

Line 2 of table **??** shows the contract with imperfect information when firms use the wage and sickness benefits to maximize the intertemporal utility for healthy workers $V_{e,h}$ under the constraint of a positive profit $\Pi > 0$. Then, the wage is 0.97 and sickness benefits 0.715. The welfare's workers $\bar{c}$ increases by 13% with a constant profit equal to 0. Thus, the increasing productivity achieved with the improvement of health totally finances sickness benefits and wage growth. However, cheaters capture a part of the productivity gains. Line 3 shows the optimal contract assuming that the firm can choose different sickness benefits between sick workers and cheaters. The wage and sickness benefits increase respectively by 1.6% and 25.3% while the replacement ratio for the cheaters drops to 0%. Thus, perfect information provides new productivity gains (The absenteeism rate is only 3.4%) redistributed to workers. Welfare $\bar{c}$ increases from 0.977 to 1.004.

The optimal contract with upward sloping sickness benefits

In France, in order to reduce the number of cheaters, there are no sickness benefits during the first 3 days of the sick leave. Thus, the cost of the sickness is payed by the workers during the first days. This entry costs can dissuade cheaters. Figure **??** displays the optimal contract when sickness benefits are not constant through time. Firms maximize the profit under the promise keeping constraint by using wage and benefits sickness. The replacement ratio is 63% the first day, 82.5% the third day and 88.5% after one week. These progressive benefits reduce the number of cheaters at 0.4% (1.9% with constant benefits) and the absenteeism rate to 4.7% (7.61% with constant benefits). This mechanism allows to converge to the system with perfect information. Indeed, the introduction of progressive benefits in the case of imperfect information increases the firms' profit by 18.26%, while perfect information increases the profit by 23.4%.

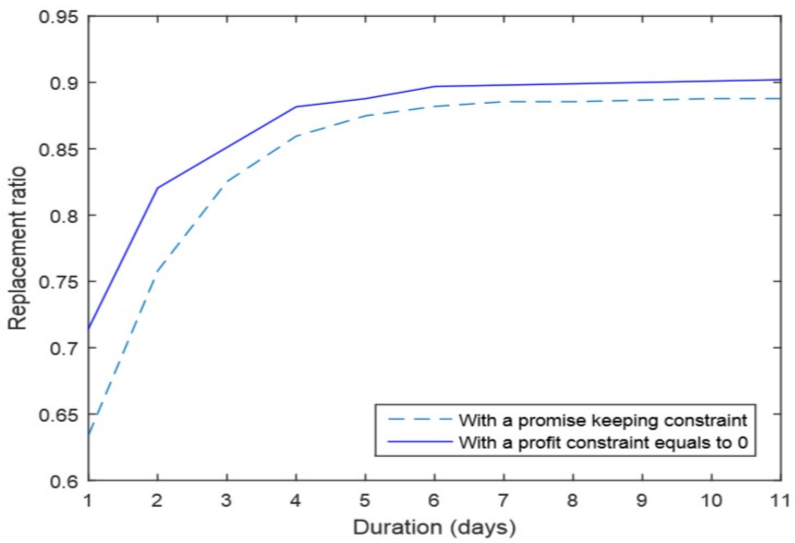
Figure **??** displays the same exercise when firms maximize the intertemporal utility of healthy workers under the constraint of a positive profit $\Pi > 0$. Logically, sickness benefits are progressive and higher than in the case with constant benefits.

Table 6: Optimal contracts with upward sloping sickness benefits

	Y	$\tilde{c}$	Π	w	$Q_{e,h}$	$Q_{n,h}$	$Q_{e,s}$	$Q_{n,s}$
Constraint $V_{e,s} = V$	0.976	0.865	0.136	0.848	0.953	0.004	0	0.043
Constraint $\Pi = 0$	0.973	0.997	0	0.980	0.946	0.020	0	0.034

For a profit equal to zero, welfare is higher. Replacement ratio is 66.3% the first day, and after 90.2%. This system reduces the number of cheaters and allows all sick individuals to take sick leave. Therefore, the number of sick individuals is low and productivity high, $Y = 0.973$. Finally, this system improves the welfare $\bar{c}$ by 2.04% compared to the case with constant benefits. As a comparison, the case with perfect information allows an improvement of welfare by 2.8%. Thus, progressive benefits offset a large part of imperfect information.

Figure 1: Optimal contracts with upward sloping sickness benefits



Concluding remarks

In this paper, we try to characterize the optimal contract for sickness benefits. We show that firms provide sickness benefits to reduce the absenteeism rate. Indeed, sickness benefits can improve the workers' health and the productivity. However, firms can not observe the real causes of the sick leave. Consequently, some healthy workers take sick leave. That is why the optimal contract is characterized by sickness benefits increase with the sick leave duration. We show that the upward sloping sickness benefits reduce significantly the hazard moral. The optimal contract allows to converge to the results of the insurance with constant sickness benefits and perfect information.

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