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INCENTIVES BEYOND THE MONEY AND MOTIVATIONAL CAPITAL IN HEALTH CARE ORGANIZATIONS

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Abstract

This paper explores the conditions that characterize the optimality for a principal (health manager) to undertake investments to motivate agents (doctors). In the model, doctors are intrinsically motivated and can have different identities. We develop a principal agent dynamical model with moral hazard, which captures the possibility of affecting doctors' intrinsic motivation and identity through contracts offered by the health manager. Identity and intrinsic motivation of the doctor can be undermined (crowding-out) or enhanced (crowding-in) by incentive policies and monetary rewards. When motivations beyond the money play a role in the agents behaviour, the optimality of the equilibrium outcomes may be altered.

Intrinsic motivation is defined as doctor's experienced enjoyment from doing her work and commit toward a mission. By "full" identity we mean a situation in which the doctor shares the organizational objectives and views herself as a part of the organization. We assume that "full" identity can be achieved when health managers include mission supportive investments in contracts. This also crowds in intrinsic motivation. However, crowding out occurs when the health manager uses only pure monetary rewards to incentivize doctors with the goal of drive their actions in his own interest.

Solving the model, we are allowed to make comparative statics and discuss the conditions under which spending resources to invest in motivational capital, is optimal for the health organization's manager. Our results may help to inform policy-makers about optimal policy design and optimal management of health organizations. For instance, we conclude that investing in motivational capital is more likely to be profitable in the long run whereas mere monetary incentives are more likely to be optimal in the short run.

Keywords: contracts, moral hazard, intrinsic motivation, crowding effects, motivational capital.

JEL Codes: D03, D86.

1 Introduction

The present work aims to throw light to give answer to some questions about doctors' intrinsic motivation, identity, and the economic effects we can expect from these. Is the motivation of the doctors other kind of capital in which the health care organizations should invest? Is doctors' identity and motivation another productive asset of the health care organizations? How should organizations' managers design the mechanisms and incentives in order to benefit from this "Motivational Capital"? Could identity be the key to avoid the opportunistical behaviour of the doctors who sometimes game the system for their self-interest?

Other questions are also of much significance facing the above listed ones. Say for example, which determinants are on the basis of doctors' intrinsic motivation? Are doctors intrinsically motivated or they are just self interested income maximizers as assumed by the standard economics? How the actions of the managers and government officers of the health affect this intrinsic motivation? Can health care organizations' principals reduce costs by mean of crowd in doctors' intrinsic motivation? Answering properly these questions involve a deep discussion and a deep thought on concepts such as *Intrinsic Motivation*, *Crowding-in* and *Crowding-out* effects, *Identity*, *Mission*,...

The motivation of workers at the public sector has been an issue in the recent economic literature. James Q. Wilson's work (1989) entitled *"Bureaucracy: what government agencies do and why they do it"* is a common startpoint for this body of the literature. The topic under discussion is that privately owned competitive firms do not performance optimally when the good that have to be supplied is a collective good such as education, health, civil and social safety, a common pool resource or a public good. In the provision of these collective goods the role played by competition and the optimal incentives may differ from the private competitive provision of them.

One emergent explanation of the above question focuses on the fact that organizations that provide collective goods pursue goals and objectives, which are not necessarily monetary profitable, and the motivation of the employees who work within these organizations goes beyond the expected monetary gain. People who work in the provision of collective goods sector are generally intrinsically motivated agents who pursue goals because they perceive satisfaction from the very act of doing so. That is to say that these workers benefit in some degree just from exerting effort in the provision of the collective goods. Teachers, doctors, firefighters, policemen or social workers are good examples of such intrinsically motivated workers. Julian LeGrand's book *Motivation, agency, and public policy: of knights and knaves, pawns and queens* LeGrand [32] is an excellent, bright and original work showing the role played by intrinsic motivation in public sector positions and professionals.

A related body of work has centered the atention in the role played by the intrinsic motivation and the notion that non pecuniary aspects of motivation matter (Bowles [12], Bowles and Polania [14], Benabou and Tirole [7], Frey [29], Frey and Jegen [30], Paul Seabright [44], Kevin Murdock [35]). This branch of the literature also points out the importance of the crowding out effect of the monetary rewards and other material payments on the intrinsic motivation. In these works, therefore, there is an interplay between the principal's action and the agent's intrinsic motivation and thus there is a chance to affect agent‘s intrinsic motivation through the choice behavior of the principal.

Another substantial body of work on economics has approached that topic from a perspective based on the individual identity. More precisely, in these works intrinsic motivation is examined as a matter which depends on how workers see themselves in relation to the firm. Workers' identification with their positions, jobs, tasks, etc. creates identities which make organizations perform better, due to the higher productivity of those motivated and identificated workers. Akerlof and Kranton [2], grant to this definition of the identity the value of being *"a way to motivate employees, different than incentives from monetary compensation"*, and they follow saying that *"[. . .] a change in identity is the ideal motivator if, [. . .] the effort of a worker is either hard to observe or hard to reward"*.

Besley and Ghatak [10] propose another approach to the intrinsically motivated behaviours, also related with the concept of identity in the [2] sense of identification as a shared goal. They state that there are two types of firms in the production of goods: non-for-profit or mission oriented firms, and for-profit or maximun profit seeking firms. The former, are firms usually engaged in the provision of collective goods, and workers whithin them are *motivated* in the sense that they pursue goals just because they perceive benefits for doing so. They define these goals as missions and they show that the principal will offer weaker incentives to elicit effort when he shares the employees' missions. In the same line Prendergast [42] proposes a concept of intrinsic motivation similar to [2]. They put the attention in the intrinsic motivation generated when alignment of preferences between firm and worker happens, not only in the case in which these preferences are money centered but also when other non monetary reasons matter. To sum up, in Akerlof and Kranton [2]; Besley and Ghatak [10]; Prendergast [42], the intrinsic motivation is shown as a firm-specific identity or motivation, in the same sense of the firm-specific human capital.

The scope of the present work is centered in the role played by the intrinsic motivation and the identity of the doctors working at the public health system. Our analysis also incorporates the crowding effects, which can undermine or enhance this inner motivations and identities. In the same line of Bowles [12], Bowles and Hwang [13] and Bowles and Polanía [14] we avoid the standard economics approach of the separability between intrinsic and extrinsic motivations of the economic agents. We capture in a principal agent model, the fact that the incentives policy is a way to influence the identity and also intrinsic motivation, either positively (crowding in) or negatively (crowding out). Crowding in means that incentives and intrinsic motivation are complements, and crowding out means that incentives and intrinsic motivation, are substitutes. We assume that usually in designing "motivating" contracts, there is additional cost and there is a trade-off relation between this cost and the productivity improvement for the organization by having motivated or “good” identity workers.

Characterizing the conditions under which the contracts enforce and incentivize intrinsically motivated behaviours and identities, we can state how health organizations can benefit from motivated doctors in terms of cost efficiency and health effectiveness. If lower incentives are enough to elicit “good” behaviors in motivated doctors, health organizations will save a non-negligible amount of financial resources. Depending on the lenght of the contract proposed by the health organization, there will be a profitable chance to invest in motivation. This chance arises when the present value of the time stream of the expected saved cost overcomes the initial amount invested in eliciting “good” identity and crowding in intrinsic motivation. In such a case we state that investing in *Motivational Capital* is a source of monetary profits which leads health organizations to higher efficiency level in the provision of health.

2 Motivation and Basic Concepts

First it is necesary to clarify the meaning of some words and concepts involved in the work.

Intrinsic Motivation−. Porter and Lawler [43] were the first in proposing a model of *extrinsic* and *intrinsic* work motivation. They stated that intrinsic motivation involves people doing an activity because they find it interesting and derive spontaneous satisfaction from the activity itself. Starting from this view intrinsically motivated activities were defined as those from which individuals benefit just from the very act of doing them. Individuals engage in these activities even in absence of operationally separable consequences such as rewards or punishments. A first definition of the intrinsic motivation can be found in Deci [19][1]

> One is said to be intrinsically motivated to perform an activity when one receives no apparent reward except the activity itself. (p.105)

Thus we consider intrinsic motivation as the willingness to perform in a given activity without any external reinforcement because the doing of an interesting activity is itself intrinsically rewarded. In a more general way Deci and Ryan [21] defined intrinsic motivation as,

> Intrinsically motivated behaviors are those that are freely engaged out of interest without necessity of separable consequences, and, to be mantained, they require satisfaction of the needs for autonomy and competence. (p.233)

[1]There are an extense literature in psychology and economics that analyze the importance of the role played by intrinsic motivation in individual and social behaviour: Benabou and Tirole [7] [8]; Besley and Ghatak [10]; Bowles and Polanía [14]; Deci and Ryan [23]; DeCharms [18]; Frey [29]; Frey and Jegen [30]; Murdock [35]).

In the context of doctors, health managers, and health organizations, intrinsic motivation can be seen as the willingness showed by doctors to exert effort and spend energy to perform in those dimensions of the medical activity which are of their interest. Collaborating and participating in teaching, research, offering extra time to study and work on interesting and specific cases, cooperation, and so forth.

As we will see, intrinsic motivation, is closely related with the concept of *mission* which we will discuss and explain below.

Mission$-$.The necessity of developing a sense of mission[2] was discussed first time in Wilson [46]. He pointed out the importance for an organization to avoid *"vague objectives"* and to define a set of *"critical tasks"* or *"operational goals"*. In his own words,

> The "culture" of an organization is a way to see what these critical tasks are and how to deal with them. (p.93)

> A "mission" is a single culture that is widely and enthusiastically shared by the members of the organization. (p.99)

In our model "mission" has to do also with the Wilson's view. But is different in some sense, because "mission" is the single culture that is shared by doctors. This culture is a matter of non-material rewards and has to do with the sense of duty and purpose, individual recognition and personal power, and the associative benefits that come from being part of an organization.

> Bureaucrats have preferences. Among them is the desire to do the job. That desire may spring entirely out of a sense of duty, or it may arise out of a willingness to conform to the expectations of fellow workers and superiors even when there is no inmediate financial advantage in doing so. (p. 156).

Wilson stated that many of most productive firms have tried to substitute monetary incentives with the culture of mission.

> In business where one might suppose that money incentives are the whole story, great efforts have been made by the most productive firms to supplement those incentives with a sense of mission based on a shared organizational culture. (p.157)

Thus a mission is understood as the way in which doctors would like to perform and do in their profession. They have preferences to be empathetic with patients, to do extra work when this is required for the wellness of patients. Also they have preferences toward

[2]A deep discussion of the concept of *mission* in the public agencies and organizations has been shown in many works. James Q. Wilson's 1989 book *Bureaucracy* can be considered as the pioneer work, and following the line drawn by this work, the concept of *mission* has been incorporated to the economic analysis by Dewatripont, Jewitt and Tirole [24] [25]; Besley and Ghatak [10]; Prendergast [40] [41] [42].

research and scientific knowledge, or they enjoy from teaching, learning and getting further education. The addition of all of these "critical tasks" or "operational goals" resulting in a "culture" shared by doctors, in a group, service, team is what we mean as "mission".

This sense of mission is related with doctors' *Intrinsic Motivation.* The mission preferences defined this way are on the basis of how doctors benefit from the very fact of doing their work or activity. That is, how they can perform in their profession in the way they would like and enjoy.

Crowding effects−. External intervention, e.g. monetary incentives, punishments, awards, command and control policies, and so forth, may undermine, and under some identifiable conditions strengthen, the intrinsic motivation[3]. This is what we know as crowding effect, that is the effect produced by the external intervention on individual's intrinsic motivation.

Crowding out happens when external intervention undermines individual's *intrinsic motivation.* Analogously, *crowding in* will happen when external intervention strengthens individual's *intrinsic motivation*[4]. Over the last few years, the theories of intrinsic motivation emanating from social psychology have been integrated into economics yielding explanatory and succesful results. Arguably, the *crowding out* effect is one of the most important anomalies in economics, which acts in opposite to the most fundamental economic 'law', that raising monetary incentives increases supply. What is well established, is that all interventions originating from outside the person under consideration may crowd out or crowd in intrinsic motivation.

There are two basic approaches in the literature explaining the channels through which, these crowding effects may happen.

1. *A change in preferences.* Agent's behaviour changes in reponse to an external intervention and reveals an altered amount of intrinsic motivation. The observed change in behaviour is attributed to a change in preferences[5].

2. *A change in the perceived nature of the performed task, in the task-environment or in the actor's self-perception.* This approach explains the changes in the individual behaviour mantaining the standard economic assumption of fixed preferences[6].

Sam Bowles and Sandra Polanía [14], in a recent review of the literature on crowding effects in public goods experiments, summarize the channels through which the crowding out effect acts in four:

[3]There is an extense literature which shows the existence of crowding effects. Camerer and Hogarth [17]; Frey and Jegen [30]; Bowles and Polanía [14] are depth reviews.

[4]Benabou and Tirole [7] [8]; Bowles [12]; Bowles and Polanía [14]; Frey [29]; Frey and Jegen [30]; Deci and Ryan [23]; Deci, Koestner and Ryan [22]; Gagné and Deci [31]; LeGrand [32].

[5]Frey [29]; Frey and Jegen [30].

[6]Benabou and Tirole [6] [7] [8] [9].

1. Incentives provide information affecting the behaviour of the target in ways additional to the effects on the material costs and benefits of the target's actions.

2. Incentives provide cues of appropiate behaviour.

3. Incentives may compromise *Self-determination* and crowd out intrinsic motives[7].

4. The effects of the incentives in preferences may persist over long periods even in the subsequent absence of the incentives (endogenous preferences).

Identity−. Identity has to do with person's self-image, how people feel about themselves, how people think of themselves in terms of social categories, and how people think that they and others should behave[8].

Identity plays a crucial role in our model. In the model dentity is the degree to which, the goals of both players are aligned. A measure of how precisely doctors and health organizations share goals and objectives. In other words the degree to which, the doctor internalize and assume the organizational goals and also the degree to which, health managers support and share doctors' mission preferences.

Identity in our model weakens the *moral hazard* incentive constraint because makes effort subjectively less costly for the doctor. A doctor with *'good'* identity, exerting high effort is the ideal way to behave, because she views herself as being part of the organization.

Socialization−. Socialization, in the model, is the process through which the doctor and Health organization goals match. This will occur when brought out by the principal investment actions supporting doctors' mission preferences, the identity of doctors switch towards the good one. Thus, socialization occurs when finally doctors internalize organizational goals and both players' objectives results aligned. On the contrary, we mean as conflict the process which brings the doctor to completely disagree with the organizational goals at the end.

Motivational Capital− In general, less incentives are needed to elicit effort when organization have "full" identity motivated workers[9]. Thus we can consider the motivation as another productive asset of the organization over which the principal may decide to invest. Then, the motivational capital could be identified with the measure of the present value of the stream of the expected costs saved by the health organization, when health manager invests S to improve doctors' identity through supporting her mission preferences.

We introduce the possibility that contracts may affect this intrinsic motivation, either possitively (crowding in) and also negatively (crowding out). We mean as crowding-in

[7]Deci and Ryan [23]; Deci and Ryan [21].
[8]Sen [45]; Akerlof and Kranton [1] [2]
[9]Motivational capital was formulated first time in Akerlof and Kranton [2].

incentive scheme one that gives support to the mission oriented preferences of doctors. Examples of such mission supportive behaviour of the principal in health organizations might be: public award of research in health results, financial aid for researching activities, further education and teaching at university level, investing in new technologies, funding for research groups, financing of publication services, aid for organize advanced courses and seminars, include discussion and self-evaluative group activities within the worktime, etc. This way, the identity may be encouraged and the intrinsic motivation of the doctor may be enhanced. In such a case, the moral hazard in the game is weakened making the doctors' and health manager's objetives more aligned.

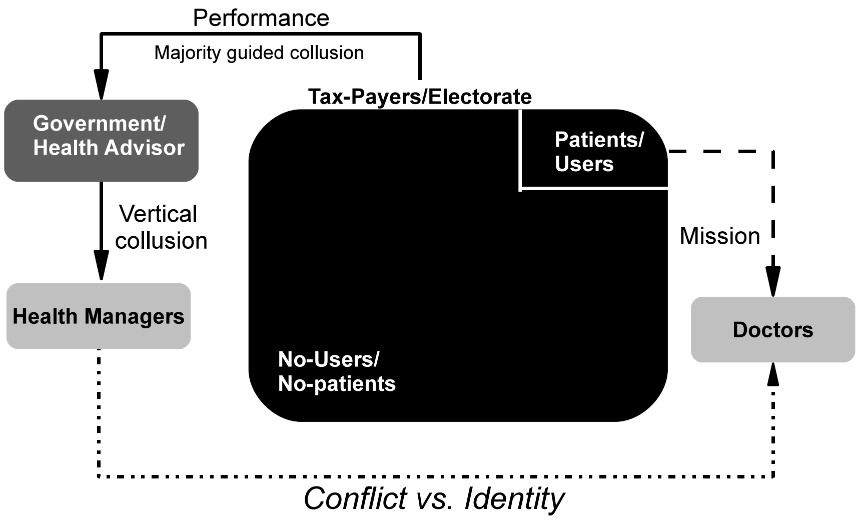

Figure 1: Principal Agent relations in health organizations I.

However, as we can see often in the real world, principals in health are significatively focused on their private benefits. They put a lot of weight maximizing the expected number of votes in elections or improving political popularity indexes at the same time as they have a picture of doctors as self interested profit maximizing agents. Thus they are biased to maximize performance measures that are easily obsevables by the electorate and therefore have a great impact on the public opinion.

Figure 1, depicts all the principal agent relations in health and summarize the goals of the players involved in health: managers and doctors. Arrows reflect principal agent relations. Thus, the electorate or tax payers are the principal and govenment is the agent in the higher level principal agent relation. Government's task consist in organizing in an efficient way the public resources trying to maximize some publicly observable measures of performance which, are of great impact in public opinion: reduce the waiting time in waiting lists, increase the number of surgeries made in common patologies, increase the infraestructures, buy new technology assets, reduce the cost an save resources, or enlarge the range of the services supplied for instance. In general all of them quantitative performance measures. Governments hire managers to manage hospitals in the second level principal agent relation in health. These managers can be more aligned with doctors or with government advisors. We assume that managers and government collude in the government goals.

On the right side, figure 1 shows the principal agent relation between doctors and patients. This relation is captured in the figure with the dashed line labelled with the word mission. Doctors' goals are focused toward patients who are a subset belonging to all the tax payers or electorate. We assume that doctors' mission is to do the work with the goal of maximize patients welfare. Say for instance, more personalized medical assistence or the inmediate incorporation of advanced treatments. Also whithin doctors' mission, we can find other activities like research, further education or teaching, which all of these have to do with becoming better professional and become more skilled doing her work and trying to maximize patients welfare. Mission, thus, can be different from health managers' goals and objectives. This divergence in objectives is a source of conflict in health and generates confrontation between doctors and health managers. This conflic is what the figure 1 shows with principal agent relation which is represented with the dashed line in the bottom.

The central issue in this work is that, there is a possibility for the health manager to make investments to alleviate the conflict degree. If we assume that any doctor is intrinsically motivated for doing her work in line with her mission and also that health manager can use some amount of resources to facilitate this mission oriented behaviour, then is possible to change the identity of the doctor. Thus doctors will view herself as a part of the whole health organization. This way objectives turn aligned and shared, and both parties will look after about the other goals. This idea is what we have wanted to capture with the concept of identity.

Health principals neglect doctors' mission preferences and intrinsic motivation. This neglecting behaviour becomes explicit in the contracts and incentive schemes offered and, as a consequence, the intrinsic motivation of doctors is hurted. Doctors observe that their mission is not being supported, take outsider identity, and conflict arise because objectives of both are not aligned. In this context the incentives necessary to overcome moral hazard in the tasks related to the objectives of the principal raise, making the costs of elicit effort higher.

There will exist a maximun total amount of resources that the health manager can spend in supporting the mission of doctors in a private profitable way. This amount will be therefore characterized by the difference between the saved costs coming from loosen the moral hazard in the case of crowding in, and the higher incentives that the principal has to offer to elicit effort in the case of crowding out. Which of these two overweight the other will put the principal in one way or another. When the conditions make crowding in policies more profitable, then the health organization's manager has interest to invest in *motivational capital*. The conditions for this latter case occurs depends on, the distribution of types, the socialization speed rate and the range of the incentive payments, which at the same time depends on the informative value of the performance measure about doctor's action.

3 The Model

We want to analyze the optimality of contracts in a principal agent model in which the agent (she) is intrinsically motivated at some level, and the principal's (he) action choice, may affect the agent's intrinsic motivation. Such influence can be both, positive or negative. Put in other words, may respectively *crowd in* or *crowd out* the agent's intrinsic motivation.

We want to capture in the model if such possibility to affect the agent's inner motivations through principal's actions may influence the optimality properties of the incentive contracts. Specifically, if taking into account the crowding effects, the principal might have chances to move toward more profitable outcomes. This question has been neglected by standard *Contract Theory*, which traditionally has assumed that economic agents are purely motivated by material self-interest.

In the present section of the paper, first we are going to describe in a precise way the channel through which the crowding effects happen and, second, we will go to deal with the task of formalize and incorporate them into the model. Then, we will define the game and finally we will solve it computing all the posible equilibria to make the comparative statics.

3.1 *Players' Preferences and Utilities.*

There are two players in the game: the agent $\mathcal{A}$ (doctor) and the principal $\mathcal{P}$[10]. The population of doctors whithin the organization, however, is a number $n \geqslant 2$. Therefore, despite the optimal payments can be calculated *one-by-one*, in order to compute the total cost that $\mathcal{P}$ must face we have to multiply by n the single expected cost of payments. We assume that $\mathcal{A}$ is intrinsically motivated. We also restrict the analysis to linear contracts.

We model a finite period $t = 0, 1, ..., T, ...$ principal-agent dynamical game where the doctor's effort is of private information. Doctors' behaviour is also driven by identity and intrinsic motivation. Identity and intrinsic motivation, both, affect doctor's preferences and, at the same time can be affected by the health manager action choice.

[10]Often we use she and he to refer to the agent and the principal respectively, as conventionally the principal agent literature does.

3.1.1 The Principal: Health Manager

First, assume that for the health manager $\mathcal{P}$, there is a performance measure q that he wants to maximize. We focus on the problem of how to maximize this performance efficiently using incentives which could be material or of the nature of "carrots and sticks" or also of non-monetary nature. Then the starting point of this work is the incentivization of an extra or a marginal health outcome summed up in the performance measure q. Another assumption is that this q is a target outcome for $\mathcal{P}$ but is not an objective for $\mathcal{A}$, and therefore is necessary to use incentives to maximize it.

Let $R_t(q_t)$ be a function which transforms the performance level into health manager's material rewards. These material rewards could be the expected number of votes, popularity indexes, and the kind of measures that are salient and used to evaluate the government action by the electorate or tax payers.

Let q_t be the performance measure observed by the electorate and also by the health manager. This performance is a function of the doctor's effort $e_t \in \{\underline{e}, \overline{e}\}$. Assume that $q_t \in \{\overline{q}, \underline{q}\}$ where $\overline{q} > \underline{q}$[11]. Let $p(q_t = \overline{q}|e_t) = \theta_i$ be the probability of high performance conditional to $\mathcal{A}$'s effort choice $i = 0, 1$ where 0 means low effort $\underline{e}$ and 1 means high effort $\overline{e}$. Then $p(q_t = \overline{q}|e_t = 1) = \theta_1$ will be the probability of high performance when the doctor exerts effort, and $p(q_t = \overline{q}|e_t = \underline{e}) = \theta_0$ the probability of high performance when the doctor does not exert effort. Alternatively $p(q_t = \underline{q}|e_t = 1) = 1 - \theta_1$ and $p(q_t = \underline{q}|e_t = \underline{e}) = 1 - \theta_0$ will be the probabilities of low performance when effort is exerted and effort is not exerted, respectively. We assume that $\theta_1 > \theta_0$, that is performance $\tilde{q}_t$ is an informative signal of $\tilde{e}_t$

Now we can define $E[R_t(q_t)|\theta_i]$ as the expected material rewards achieved by the health manager[12] conditional to q_t, the achieved performance level.

Let $w_t(q_t)$ be the performance contingent monetary payment offered to $\mathcal{A}$ by $\mathcal{P}$. Then, $E[w_t(q_t)|\theta_i]$ will be the expected monetary payment for the doctor or $\mathcal{A}$, and the expected monetary cost for the health organization or $\mathcal{P}$ at the same time. Let s_0 be the total amount of invested resources to change $\mathcal{A}$'s identity. That is to say that $\mathcal{P}$ only can make an investment to change the $\mathcal{A}$s' identity at the starting period of the game $t = 0$ as an initial investment. This investment generates a cost stream that we capture with the cost function $C_t(s_0)$. Thus we will be able to write $\mathcal{P}$'s problem in a single equation. Then the health manager's $\mathcal{P}$ problem will be to maximize the profit function described below.

Then $\mathcal{P}$'s profit function π_t for each period t can be written as,

[11] Take $\overline{q}$ as $\mathcal{P}$'s target on performance level and $\underline{q}$ as a fail in target performance level

[12] Here the material profits are defined as if these would be the same for the health manager and the government. We assume perfect collusion between the health manager and the health advisor of the government. Thus when we refer to $\mathcal{P}$ we don't distinguish between both of them, health manager and government advisor.

$$\pi_t = E[R_t(q_t)|\theta_i] - E[w_t(q_t)|\theta_i] - C_t(s_0) \tag{1}$$

Where the investment cost function $C_t(s_0)$ is such that, takes the value $C_0(S) = S$ in $t = 0$ and an depreciation cost $C_t(S) = \gamma S$ for every $t \geqslant 1$ at constant depreciaton rate γ.

3.1.2 Agent's preferences: the doctor

We represent the $\mathcal{A}$'s preferences with the following expected utility function.

$$E[U_t^{\mathcal{A}}|\theta_i] = \underbrace{E[u_t(\tilde{w}_t)|\theta_i]}_{\text{Expected utility from income}} - \underbrace{\psi_t(e_t, \overbrace{\upsilon_t(s_0)}^{\text{Identity}})}_{\text{Disutility from effort}} + \overbrace{\phi_t\Big(\underbrace{\Omega_t}_{\text{Incentives}}, m_t(s_0)\Big)}^{\text{Intrinsic motivation}} \tag{2}$$

The first term on the right hand side of the above utility function, $E[u_t(\tilde{w}_t)|\theta_i]$, is the expected utility from monetary transfer. The agent is risk averse, $u' > 0$ and $u'' < 0$, and the parameter θ_i is the probability of high or low performance.

The middle term on the right hand side of the utility function $\psi_t(e_t, \upsilon_t(s_0))$ disutility from effort. The disutility from effort depends negatively on $\upsilon_t(s_0)$ which is a function representing $\mathcal{A}$'s identity and depends positively from effort. The properties of the disutility from effort are summed up in the following set of assumptions.

A1: *The function* $\psi_t(e_t, \upsilon_t(s_0))$ *is continuous in the interval* $[\underline{\upsilon}, \overline{\upsilon}]$.

A2: *The function* $\psi_t(e_t, \upsilon_t(s_0))$ *is strictly decreasing inits second argument*

*w*hen $e_t = \overline{e}$. That is, $\frac{\partial \psi_t(\overline{e}, \upsilon_t)}{\partial \upsilon_t}|_{e_t = \overline{e}} < 0$.

A3: *When* $e_t = \underline{e}$, *then* $\psi_t(\underline{e}, \upsilon_t) = 0$; $\forall \upsilon_t \in [\underline{\upsilon}, \overline{\upsilon}]$.

A4: *The function* $\psi_t(e_t, \upsilon_t(s_0))$ *is bounded below and above. Is bounded below when* $\psi_t(\underline{e}, \upsilon_t) = 0 \ \forall \upsilon_t$, *and* $\psi_t(\overline{e}, \overline{\upsilon}) = 0$. *The function is bounded above when* $\psi_t(\overline{e}, \underline{\upsilon}) = \Psi$.

The above assumptions ensure that, when identity converge to its upper *(lower)* bound, then $\mathcal{A}$'s disutility from doing high effort converges to zero *(Ψ)*. That is, the agent does not suffer disutility from exerting high effort when she has high identity. Contrary, when she has low identity, $\mathcal{A}$ experiences the maximun disutiliy from effort when she exerts effort. The only way to avoid this disutility when identity is low is to choose the low effort action.

The last term $\phi_t(\Omega_t, m_t(s_0))$ on the right hand side of the utility function captures $\mathcal{A}$'s intrinsic motivation. This term is a function of her experienced level of enjoyment doing the activity, work, task, or the job. This term has to do with her own effectiveness achieving her mission oriented goals $m_t(s_0)$. This effectiveness degree $m_t(s_0)$ also depends on the $\mathcal{P}$ investment in motivational capital s_t. We have defined s_0 as the resources spent by $\mathcal{P}$ in supporting those activities toward which $\mathcal{A}$ is intrinsically motivated. Thus the $m_t(s_0)$ can be read as the measure of the $\mathcal{A}$'s performance level in her mission [46]. Intrinsic motivation also depends on incentives $\Omega_t = \Delta w_t$[13]. What is a key feature of the model is that these two terms are interdependent and thus material rewards may affect the intrinsic motivation through crowding effects. The properties of this intrinsic motivation function are summed up in the following set of assumptions.

B1: *The function $m_t(s_0)$ takes two possible values, $m_t(s_0) \in \{m, M\}$, where $m < M$, $m_t(S) = M$, and $m_t(0) = m$.*

B2: *Let $\Omega_t = \Delta w_t = w_t(\overline{q}) - w_t(\underline{q})$ be the measure of the intensity of incentives. Then, for any fixed value of Ω_t, $\Omega^* \in [0, \infty)$ we have $\Delta^{(m_t)}\phi_t = \phi_t((\Omega)^*, M) - \phi_t((\Omega)^*, m) > 0$.*

B3: *The function $\phi_t(\Omega_t, m_t(s_0))$ is continuous and upper and lower bounded in the interval* $[0, \Phi]$ where,

$$\lim_{\Omega_t \to \infty} \phi_t(\Omega_t, m) = 0 \qquad \lim_{\Omega_t \to 0} \phi_t(\Omega_t, M) = \Phi.$$

$$\lim_{\Omega_t \to 0} \phi_t(\Omega_t, m) < \lim_{\Omega_t \to 0} \phi_t(\Omega_t, M) = \Phi = Sup\ \phi_t.$$

$$Inf\ \phi_t = 0 = \lim_{\Omega_t \to \infty} \phi_t(\Omega_t, m) < \lim_{\Omega_t \to \infty} \phi_t(\Omega_t, M).$$

B4: *The function $\phi_t(\Omega_t, m_t(s_0))$ is strictly decreasing in its first argument.*

$$\frac{\partial \phi_t(\Omega_t, m_t)}{\partial \Omega_t} < 0.$$

B5: For simplicity, we assume that the negatively sloped relation between Ω_t and $\phi_t(\cdot)$ is linear,

$$\frac{\partial^2 \phi_t(\Omega_t, m)}{\partial \Omega_t^2} = 0.$$

[13]What the literature of crowding effects exactly says, is that intrinsic motivation depends negatively from monetary incentives. This is what they call crowding out effect: see for example Bowles [12]; Bowles and Hwang [13]; Bowles and Polanía [14]; Deci [19]; Deci and Ryan [23] [21]; Frey [29]; Frey and Jegen [30] and LeGrand [32]. Other works, from psychology, show the possibility of crowding in or improve intrinsic motivation using incentives focused in supplying more autonomy, recognition, or effectance doing work. See Deci [19]; Deci and Ryan [23];[21]; Gágne and Deci [31]; LeGrand [32].

Assumption B2 captures in some sense what Bowles and Polanía [14] call *Categorical Crowding out Effect*[14]. Analogously, this categorical crowding out effect might be seen as *Categorical Crowding in Effect* from the point of view of $\mathcal{P}$, when he invests $m(s_t) = M$ in motivational capital. Assumption B4 also involves that intrinsic motivation is negatively correlated with incentives as stated in the crowding effects literature. Assumption B5 involves that both, the marginal crowding in and the marginal crowding out effects are constant.

3.2 The Game

The game is a repeated game with two players, the agent or the doctor $\mathcal{A}$ and the principal or the health manager $\mathcal{P}$. We consider the game as a repeated dynamic recontracting game in which every period both players have to make new choices: $\mathcal{P}$ must offer a new contract after updating his beliefs about $\mathcal{A}$'s type. Then, $\mathcal{A}$ has to choose a new effort level. Thus, we analyze a repeated principal agent game with moral hazard, where the choices made by the $\mathcal{P}$ affects $\mathcal{A}$'s identity and intrinsic motivation. Reciprocally these changes in identity and motivation affect the contracts and equilibrium payments offered by $\mathcal{P}$ in the next period.

3.2.1 Timing

Each period the game consists iof three stages: stage 0, stage 1, and stage 2. The sequence of these stages at period $t = 0$ is graphically shown in figure 2. The timing of the within-period in $t = 0$ is:

(0) The principal $\mathcal{P}$ learns the distribution of doctors' identities $F_0(\upsilon_0)$ and the distribution of doctor's intrinsic motivation $G_0(\phi_0)$. Then, he offers a contract to $\mathcal{A}$. This contract consists of a pair of stochastic contingent payments $w_0^{\upsilon,\phi}(q_0) = \{\underline{w}, \overline{w}\}$ conditioned to the expected value of identity $E[\upsilon_0]$, the expected value of intrinsic motivation $E[\phi_0]$[15], and the choice to invest or not in motivational capital s_0: $\{w_0^{\upsilon,\phi}(q_0), s_0\}$.

(1) $\mathcal{A}$ accepts or refuses the contract. If she accepts, then choose an action over effort $e_0 \in \{\underline{e}, \overline{e}\}$. Contrary, if she refuses then she gets her reservation utility $\overline{U}$.

(2) Finally, output is realized $q_0 \in \{\underline{q}, \overline{q}\}$. Stochastic contingent payment is realized $w_0^{\upsilon,\phi}(q_0) = \{\underline{w}, \overline{w}\}$ and payoffs π_0 and U_0 are realized.

Figure 3 shows the timing of the within-period game in $t = 1, 2, ..., T, ...$. Such timing of the within-period is as follows:

(0) The principal $\mathcal{P}$ updates the distribution of doctors' identities $F_t(\upsilon_t|s_0)$ conditioned to his choice behaviour over investing or not in motivational capital s_0. The principal $\mathcal{P}$

[14] Bowles and Polanía [14], separate the crowding effects into two: categorical and marginal.

[15] In the game $\mathcal{P}$ has to contract at least n agents

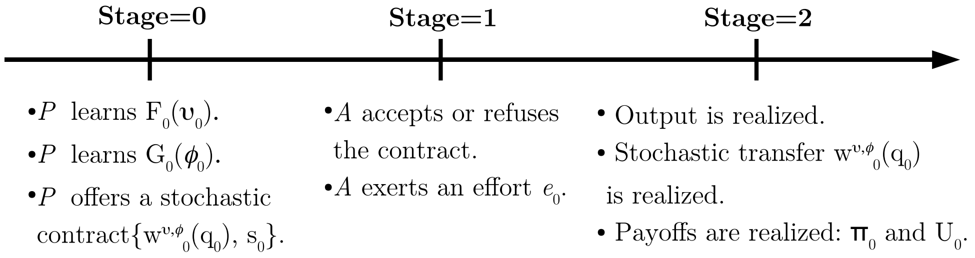

Figure 2: The timing of the game in the starting period $t = 0$.

also updates the distribution of doctors' intrinsic motivation $G_t(\phi_t|s_0, \Omega_t)$ conditioned also to s_0 and to incentives intensity Ω_t. Then, he offers a contract to $\mathcal{A}$: $\{w_t^{\upsilon,\phi}(q_t), s_t\}$.

(1) $\mathcal{A}$ accepts or refuses the contract. If she accepts, then choose an action over effort $e_t \in \{\underline{e}, \overline{e}\}$. Contrary, if she refuses then she gets her reservation utility $\overline{U}$.

(2) Finally, output is realized $q_t \in \{\underline{q}, \overline{q}\}$. Stochastic contingent payment is realized $w_t^{\upsilon,\phi}(q_t) = \{\underline{w}, \overline{w}\}$ and payoffs π_t and U_t are realized.

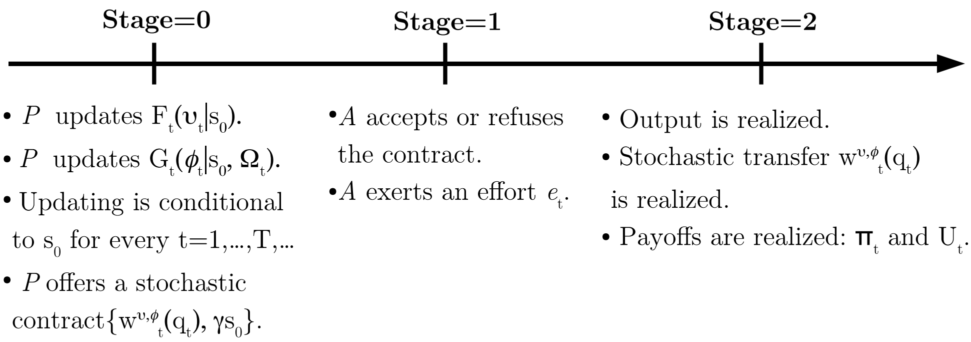

Figure 3: The timing of the game in the t=1,... periods.

3.2.2 Information

At the first period of the game, $\mathcal{P}$ learns $\mathcal{A}$'s type or identity[16]probability distribution $F_0(\upsilon_0)$. Taking into account that his action s_0 will affect the $\mathcal{A}$'s type in a known way, $\mathcal{P}$ will learn the $\mathcal{A}$'s type distributions $F_t(\upsilon_t|s_0)$ for the subsequent periods $t = 1, ..., T, ...$ where $t \in \mathbb{N}$.

$\mathcal{P}$ also has to learn $\mathcal{A}$'s intrinsic motivation. Then he also learns the probability distribution of intrinsically motivated doctors $G_0(\phi_0)$ in $t = 0$. Knowing that intrinsic motivation depends negatively on monetary incentives and positively on his motivational capital investment behaviour[17], then, he can learn $G_t(\phi_t|s_0, \Omega_t)$ for the subsequent periods $t = 1, 2, ..., T, ...$ where $t \in \mathbb{N}$.

3.2.3 Identity, Crowding effects, and Socialization

Doctors only differ in their identity and their intrinsic motivation degree. For all of them, their skills and qualification for work at health is the same. They are equally efficient in the production of q_t. All doctors have the same probability distribution over performance outcomes $q = \{\underline{q}, \overline{q}\}$. Therefore, $\mathcal{P}$ only deals with *moral hazard* because the differences in motivation degree does not involve any difference in doctors' efficiency producing q and the distributionas are assumed to be known by $\mathcal{P}$.

As we mean previously, incentives and contracts offered by the principal may change agent's intrinsic motivation and identity. Assume that there is a continuum of types of doctors sorted by their identity, $\upsilon \in [\underline{\upsilon}, \overline{\upsilon}]$, with $\underline{\upsilon} < \overline{\upsilon}$.

We can see in the $\mathcal{A}$'s utility function presented above that higher identity means lower disutility from effort and higher intrinsic motivation[18]. Thus, Intuitively we can anticipate that more identity needs less monetary incentives in order to overcome *moral hazard* and elicit high effort level.

However, if the principal does not make any investment in *motivational capital* and only use monetary incentives to elicit high effort, he will need to put more money than before by two reasons: first, because the agent now will experience more disutility from effort, and

[16]We consider a continuum of types of $\mathcal{A}$, $\upsilon_t \in [\underline{\upsilon}, \overline{\upsilon}]$ There is a possibility of switching $\mathcal{A}$s' type or identity making an investment in the starting period of the game. For a precise description of the time evolution of the conditional distribution of types see the mathematical appendix.

[17]Taking into account Ω_t and s_0, $\mathcal{P}$ is able to know what direction will take the crowding effect. This is because making $s_0 = S$ or $s_0 = 0$, he knows that $\frac{d\upsilon_t(S)}{dt} > 0$ and $\frac{d\upsilon_t(0)}{dt} < 0$. As we will show later this affects negatively Ω_t. The intuition behind this correlation is that higher (lower) identity υ_t, means lower (higher) disutility from effort, and therefore lower (higher) incentives Ω_t. The relation $\frac{\partial \phi_t(\cdot)}{\partial \Omega_t} < 0$ makes the rest.

[18]Just as intrinsic motivation and identity have been defined, these two variables are positively a monotonically correlated in the model thus higher identity means higher intrinsic motivation.

second, because the mere monetary incentivation will decrease the intrinsic motivation by crowding out effect[19].

What we want to capture with the socialization process[20] is $\mathcal{P}$'s ability to make changes in the identity of the agents by doing investments and organizative changes within the organization. Thus if $\mathcal{P}$ chooses to invest $s_0 = S$ then he will switch $\mathcal{A}$s' identity to a higher level, bringing all of them to good identity. But if he decides not to invest, $s_0 = 0$ then agents will switch to lower identity level bringing all of them to the lowest identity. Mixing monetary incentives and identity investments improves the $\mathcal{A}$'s intrinsic motivation through crowding in effect and contrary, the only use of monetary incentives will hurt $\mathcal{A}$'s intrinsic motivation through crowding out effect.[21]

3.2.4 Equilibrium

In order to solve the game and calculate the equilibrium outcome, first we set some assumptions and second we define $\mathcal{P}$'s problem. The first assumption is that the principal and the agent can not commit themselves at $t = 0$, to any contract in the future periods. Then, they have to renegotiate contracts at every period t. This assumption turns the game into a *dynamic re-contracting game*. Then we solve the game implementing the spot contract in each period of the game. In order to make the vector of the spot contracts as the long term optimal solution we have to assumme no availability to renegotiate in the short term. In this game the only way to agree upon a contract is playing the repeated game at every period $t = 0, 1, ..., T, ...$ as a new game.

Then we can write the $\mathcal{P}$'s problem as follows,

$$Max_{\{w_t(q_t),s_0\}} E[R_t(q_t)|\theta_i] - n \cdot E[w_t(q_t)|\theta_i] - C_t(s_0) \tag{3}$$

Subject to

$$E[u_t(\tilde{w}_t|\theta_i)] - \psi_t(\overline{e}, \upsilon_t) + \phi_t\Big(\Omega_t, m_t\Big) \geqslant$$

$$E[u_t(\tilde{w}_t|\theta_i)] - \psi_t(\underline{e}, \upsilon_t) + \phi_t\Big(\Omega_t, m_t\Big) \text{ (ICC)} \tag{4}$$

[19]See for instance Bowles [12]; Bowles and Polanía [14]; Deci and Ryan [23]; Frey [29]; and Frey and Jegen [30].

[20]Adler and Bryan [4]

[21]For a formal description of crowding effects see the B.2 appendix.

$$E[u_t(\tilde{w}_t|\theta_i)] - \psi_t(\overline{e}, \upsilon_t) + \phi_t\Big(\Omega_t, m_t\Big) \geqslant \underline{U} \quad \text{(PC)} \tag{5}$$

$$u_t(\underline{w}) \geqslant 0 \iff w_t(\underline{q}) \geqslant 0 \iff h(u_t(\underline{w})) \geqslant 0 \quad \text{(LLC)} \tag{6}$$

(4) is $\mathcal{A}$'s *incentive compatibility constraint* (ICC), and ensures the agent will prefer to exert high effort.(5) is the $\mathcal{A}$'s *participation constraint* (PC), and ensures the agent will prefer to participate and accept the contract. Finally, (6) is a *limited liability constraint* (LLC), and ensures the low payment never falls below zero level.

The solution to the above problem and for each t is a pair of contingent payments $\{\overline{w}, \underline{w}\}$ associated with $\overline{q}$ and $\underline{q}$, respectively[22]. We analyze in the next section, under what conditions is optimal for $\mathcal{P}$ to spend resources in changing the identity of $\mathcal{A}$. Here, however, we just show the pair of contingent payments which solves the spot contracting problem. Let $h : u(w) \longrightarrow w$ be the inverse function of the utility function $h(u(\tilde{w})) = (u(\tilde{w}))^{-1} = \tilde{w}$. Applying the variable change $\tilde{w}_t(\tilde{q}) = h(u_t(\tilde{w})) = (u_t(\tilde{w}))^{-1}$, we have the following payments,

$$\overline{w} = h(u_t(\overline{w})) = \left(\underline{U} - \phi_t\left(\Omega_t, m(s_0)\right) + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0))\right)^{-1} \tag{7}$$

$$\underline{w} = h(u_t(\underline{w})) = \left(\underline{U} - \phi_t\left(\Omega_t, m(s_0)\right) - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0))\right)^{-1}. \tag{8}$$

It is straightforward to see that identity lowers $\overline{w}$ and raises $\underline{w}$. But, to be more precise, with the relation between identity and the money that the health manager will need to incentivize the good action of the doctor, we have to analyze how identity interacts with either, the disutility from effort and intrinsic motivation. Then, we will analyze how these two affect stochastic contingent payments. Finally, we will analyze how the socialization process affects the temporal evolution of doctors' identity distribution and how this evolution affects stochastic contingent payments.

However, the principal cannot perfectly discriminate doctors attending their identity. He only knows the distribution of identities. Then, the only thing he can do is to update the distribution every period taking into account his own actions and the socialization process. Once this updating process is completed, $\mathcal{P}$ is able to offer payments based on the expected identity and expected intrinsic motivation of doctors[23]. Thus, at every period of the game, he faces the following expected payments,

[22] How these contingent payments have been calculated is formally shown in the mathematical appendix, section B.3

[23] This solution is suboptimal compared with the first best solution where effort level, identity and intrinsic motivation are perfectly observable. Also is more far away from the first best compared with in a stronger sense of the second best solution where only the effort is unobservable but identity and intrinsic motivation are observable.

$$\overline{w}(E[\upsilon_t|s_0], E[\phi_t|s_0,\Omega_t]) = \left(\underline{U} - E[\phi_t|s_0,\Omega_t] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1} \tag{9}$$

$$\underline{w}(E[\upsilon_t|s_0], E[\phi_t|s_0,\Omega_t]) = \left(\underline{U} - E[\phi_t|s_0,\Omega_t] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1}. \tag{10}$$

Then we write the Expected Cost Function for the health manager at each t as follows,

$$\begin{aligned} ECF_t = n \cdot & \left(\theta_1 \left(\underline{U} - E[\phi_t|s_0,\Omega_t] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1}\right) + \\ n \cdot & \left((1-\theta_1)\left(\underline{U} - E[\phi_t|s_0,\Omega_t] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1}\right) + C_t(s_0). \end{aligned}$$

Or, in a more reduced form,

$$ECF_t = n \cdot (\theta_1 \overline{w}(E[\upsilon_t|s_0], E[\phi_t|s_0,\Omega_t]) + (1-\theta_1)\underline{w}(E[\upsilon_t|s_0], E[\phi_t|s_0,\Omega_t])) + C_t(s_0) \tag{11}$$

Let us use the superscript $s_0 \in \{0, S\}$ in $ECF_t^{s_0}$, in order to differenciate the expected cost function when $\mathcal{P}$ invests in motivational capital $s_0 = S$, from the no investment case $s_0 = 0$. Then we have ECF_t^S and ECF_t^0.

$$\begin{aligned} ECF_t^0 &= n \cdot (\theta_1 \overline{w}(E[\upsilon_t|0], E[\phi_t|0,\Omega_t]) + (1-\theta_1)\underline{w}(E[\upsilon_t|0], E[\phi_t|0,\Omega_t])) \\ ECF_t^S &= n \cdot (\theta_1 \overline{w}(E[\upsilon_t|S], E[\phi_t|S,\Omega_t]) + (1-\theta_1)\underline{w}(E[\upsilon_t|S], E[\phi_t|S,\Omega_t])) + c_t(S) \end{aligned}$$

As already said in Section 2, motivation can be considered another productive asset of the organization. Another kind of capital of the organization. Then we can measure the return of such investment in *Motivational Capital* computing the present value of the stream of the expected costs saved by the health organization. This return can be measured with the following mathematical expression,

$$NPV^{mk} = \sum_{t=0}^{T} \delta^t \left[ECF_t^0 - ECF_t^S\right] \tag{12}$$

Where, $\delta^t = \left(\frac{1}{1+r}\right)^t$ is the discount factor, and r is the discount rate. We say that the principal has incentives to invest in motivational capital when $NPV^{mk} \geqslant 0$ and we say that, there is no incentive to invest in motivational capital when $NPV^{mk} < 0$.

4 Results

Now we will show how we compute the equilibrium payments to the spot contract for every $t = 0, 1, ..., T, ...$. We solve the principal's problem under three alternative scenarios. In the first the model is solved under the standard model assumptions, that is, in absence of identity and intrinsic motivation. Then, we solve the model when identity and intrinsic motivation play a role. When incentives beyond the money are present, two alternative strategies are available for $\mathcal{P}$: to invest in motivational capital $s_0 = S$ or not to invest at all $s_0 = 0$. We calculate the solution for each case. In the last subsection we make comparative statics and derive necessary and sufficient conditions for investing in motivational capital. We also discuss on some conclusions.

4.1 *Benchmark: Second Best in the Standard Model*

First, let us to solve the model in absence of identity and intrinsic motivation. This is the standard economics result to the problem. Here pure monetary rewards are the only way for $\mathcal{P}$ to incentivize $\mathcal{A}$'s effort. In absence of motivations beyond the money, the stochastic contingent payments which solve the spot contract for every t are the following,

$$\overline{w} = h\left(\underline{U} + \frac{(1-\theta_0)}{\Delta\theta}\Psi\right) \tag{13}$$

$$\underline{w} = h\left(\underline{U} - \frac{\theta_0}{\Delta\theta}\Psi\right) \tag{14}$$

Therefore, we can write the expected cost function[24] ECF_t^{sm} for each period t,

$$ECF_t^{sm} = n \cdot \left[\theta_1 h\left(\underline{U} + \frac{(1-\theta_0)}{\Delta\theta}\Psi\right) + (1-\theta_1 h)\left(\underline{U} - \frac{\theta_0}{\Delta\theta}\Psi\right)\right] \tag{15}$$

Now we can calculate the spot expected profits $E_t[\pi_t^{sm}|\theta_1]$, for $\mathcal{P}$ and the spot expected utility for $\mathcal{A}$. These two are shown with the following,

$$E_t[\pi_t^{sm}|\theta_1] = E_t[R_t(q_t)|\theta_1] - [ECF_t^{sm}] \tag{16}$$

$$E_t[\mathcal{U}_t^S|\theta_1] = \theta_1\left(\underline{U} + \frac{(1-\theta_0)}{\Delta\theta}\Psi\right) + (1-\theta_1)\left(\underline{U} - \frac{\theta_0}{\Delta\theta}\Psi\right) \tag{17}$$

For this benchmark case, characterized by the solution of the standard model in economics, the total value of the contract for the principal and agents, measured respectively,

[24] We use the superscript sm to label the expected cost function as the corresponding with the standar economic model case.

by the present value of the stream of profits and the present value of the stream of the expected utilities are,

$$\Pi^{sm} = \sum_{t=0}^{T} \delta^t E_t[\pi_t^{sm}|\theta_1] = \sum_{t=0}^{T} \delta^t \left(E_t[R_t(q_t)|\theta_1] - [ECF_t^{sm}]\right) \tag{18}$$

$\mathbf{T}E[\mathcal{U}^{\mathcal{A}}|\theta] = \sum_{t=0}^{T} \delta^t E_t[\mathcal{U}_t^{\mathcal{A}}|\theta_1]^{sm} =$

$$\sum_{t=0}^{T} \delta^t \left[\theta_1 \left(\underline{U} + \frac{(1-\theta_0)}{\Delta\theta}\Psi\right) + (1-\theta_1)\left(\underline{U} - \frac{\theta_0}{\Delta\theta}\Psi\right)\right] \tag{19}$$

Finally, we take the present value of the sum of $E_t[\mathcal{U}_t^{\mathcal{A}}|\theta_1]^{sm}$ and $E_t[\pi_t^{sm}|\theta_1]$ as the present value of the total surplus,

$$TS^{sm} = \sum_{t=0}^{T} \delta^t \left(E_t[\mathcal{U}_t^{\mathcal{A}}|\theta_1]^{sm} + E_t[\pi_t^{sm}|\theta_1]\right) \tag{20}$$

It is straightforward to see that the expected utility got by $\mathcal{A}$ and the profit level achieved by $\mathcal{P}$, both remain constant in every t. Therefore, the total surplus also remains constant in every t and grows in a linear way over time. We will compare this result with the cases in which incentives beyond the money play a role.

4.2 *Investment in Motivational Capital*

Now we assume that, both, identity and intrinsic motivation are present and play a role in the doctors behaviour. First, we solve the model for the case in which health manager chooses to invest in motivational capital or in the case that he takes $s_0 = S$ action. This case is what we interpret as the crowding in case. In this case, and for every t, spot payments are such that,

$$\overline{w}^S(E_t[\upsilon_t|S], E_t[\phi_t|\Omega_t, S]) = h\left(\underline{U} - E_t[\phi_t|\Omega_t, S] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right) \tag{21}$$

$$\underline{w}^S(E_t[\upsilon_t|S], E_t[\phi_t|\Omega_t, S]) = h\left(\underline{U} - E_t[\phi_t|\Omega_t, S] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right) \tag{22}$$

With a pair of payments in $t = 0$ such that,

$$\overline{w}(E_0[\upsilon_0], E[\phi_0]) = h\left(\underline{U} - E[\phi_0] + \frac{(1-\theta_0)}{\Delta\theta}\psi_0(\overline{e}, E_0[\upsilon_0])\right) \tag{23}$$

$$\underline{w}(E_0[\upsilon_0], E_0[\phi_0]) = h\left(\underline{U} - E_0[\phi_0] - \frac{\theta_0}{\Delta\theta}\psi_0(\overline{e}, E_0[\upsilon_0])\right) \tag{24}$$

These two payments of $t = 0$ will be exactly the same for the case in which $\mathcal{P}$ does not invest any amount in motivational capital, say when $s_0 = 0$. Then, for the case we are analyzing now, $s_0 = S$ we write the following expected cost function for health manager,

$$ECF_t^S = n \cdot \big(\theta_1 \overline{w}^S(E_t[\upsilon_t|S], E_t[\phi_t|\Omega_t, S])\big)$$

$$+n \cdot \big((1-\theta_1)\underline{w}^S(E_t[\upsilon_t|S], E_t[\phi_t|\Omega_t, S])\big) + C_t(S). \tag{25}$$

Now we can calculate the spot expected profit $E_t[\pi_t^S|\theta_1]$ for $\mathcal{P}$ and the spot expected utility $E_t[\mathcal{U}_t^S|\theta_1]$ for $\mathcal{A}$.

$$E_t[\pi_t^S|\theta_1] = E_t[R_t(q_t)|\theta_1] - [ECF_t^S] \tag{26}$$

$$E_t[\mathcal{U}_t^S|\theta_1] = \theta_1 \left(\underline{U} - E[\phi_t|\Omega_t, S] + \tfrac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right)$$

$$+(1-\theta_1)\left(\underline{U} - E_t[\phi_t|\Omega_t, S] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right) - \psi_t^i(e_t, \upsilon_t(s_0) + \phi_t^i\Big(\Omega_t, m_t(s_0)\Big) \tag{27}$$

Where the superscript $i = 1, ..., n$ is to distinguish the particular doctor who is contracting and experiencing the utility of this contract. Finally, as we made in the previous case, we compute the present value of the sum of spot profits and the sum of the spot utilities, and also the expresion which measures the present value of the total surplus TS^S when $\mathcal{P}$ action is $s_0 = S$.

$$\Pi^S = \sum_{t=0}^{T} \delta^t E_t[\pi_t^S|\theta_1] = \sum_{t=0}^{T} \delta^t \left(E_t[R_t(q_t)|\theta_1] - [ECF_t^S]\right) \tag{28}$$

$$\mathbf{T}E[\mathcal{U}^S|\theta_1] = \sum_{t=0}^{T} \delta^t E_t[\pi_t^S|\theta_1] =$$

$$\sum_{t=0}^{T} \delta^t \left[\theta_1 \left(\underline{U} - E[\phi_t|\Omega_t, S] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right)\right]$$

$$+\sum_{t=0}^{T} \delta^t \left[(1-\theta_1)\left(\underline{U} - E_t[\phi_t|\Omega_t, S] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right)\right]$$

$$+\sum_{t=0}^{T}\delta^t\left[\phi_t^i\Big(\Omega_t, M)\Big) - \psi_t^i(e_t, \upsilon_t(S)\right] \tag{29}$$

$$TS^S = \sum_{t=0}^{T}\delta^t\left(E_t[\mathcal{U}_t^S|\theta_1] + E_t[\pi_t^S|\theta_1]\right) \tag{30}$$

4.3 *No-investment in Motivational Capital*

The third case we analyze is the no investment case or $s_0 = 0$. In such a case the health manager does not face any cost from investing behaviour in changing identities by supporting doctors' mission. Then despite incentives beyond the money play a determinant role in $\mathcal{A}$'s behaviour the mere use of monetary rewards to incentivize doctors' effort causes crowding out of intrinsic motivation and a loss in identity. In this case, the spot payments are,

$$\overline{w}^0(E_t[\upsilon_t|0], E_t[\phi_t|\Omega_t, 0]) = h\left(\underline{U} - E_t[\phi_t|\Omega_t, 0] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right) \tag{31}$$

$$\underline{w}^0(E_t[\upsilon_t|0], E_t[\phi_t|\Omega_t, 0]) = h\left(\underline{U} - E_t[\phi_t|\Omega_t, 0] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right) \tag{32}$$

Payments in $t = 0$ are exactly the same as those described in the previous subsection. With all these payments we can state the expected cost function for this incentive policy in every $t = 0, 1, ..., T, ...,$ that we call ECF_t^0.

$$ECF_t^0 = n\cdot(\theta_1\overline{w}^0(E_t[\upsilon_t|0], E_t[\phi_t|\Omega_t, 0]))$$

$$+n\cdot\left((1-\theta_1)\underline{w}^0(E_t[\upsilon_t|0], E_t[\phi_t|\Omega_t, 0])\right) \tag{33}$$

Now we can calculate the spot expected profit $E_t[\pi_t^S|\theta_1]$ for $\mathcal{P}$ and the spot expected utility $E_t[\mathcal{U}_t^S|\theta_1]$ for $\mathcal{A}$.

$$E_t[\pi_t^0|\theta_1] = E_t[R_t(q_t)|\theta_1] - ECF_t^0 \tag{34}$$

$$E_t[\mathcal{U}_t^0|\theta_1] = \theta_1\left(\underline{U} - E_t[\phi_t|\Omega_t, 0] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right)$$

$$+(1-\theta_1)\left(\underline{U} - E_t[\phi_t|\Omega_t, 0] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right)$$

$$-\psi_t^i(\overline{e}, \upsilon_t^i(0)) + \phi_t^i\Big(\Omega_t, m\Big) \tag{35}$$

Also for this case we complete the results showing the present value of the sum of spot profits and the sum of the spot utilities, and also the expresion which measures the present value of the social welfare TS^0 under the incentive policy $s_0 = 0$.

$$\Pi^0 = \sum_{t=0}^{T} \delta^t E_t[\pi_t^0|\theta_1] = \sum_{t=0}^{T} \delta^t \left(E_t[R_t(q_t)|\theta_1] - [ECF_t^0]\right) \tag{36}$$

$$\mathbf{T}E[\mathcal{U}^0|\theta_1] =$$

$$\sum_{t=0}^{T} \delta^t \left[\theta_1 \left(\underline{U} - E[\phi_t|\Omega_t, 0] + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right)\right]$$

$$+\sum_{t=0}^{T} \delta^t \left[(1-\theta_1) \left(\underline{U} - E_t[\phi_t|\Omega_t, 0] - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right)\right]$$

$$+\sum_{t=0}^{T} \delta^t \left[\phi_t^i\Big(\Omega_t, m\Big) - \psi_t^i(e_t, \upsilon_t(0))\right] \tag{37}$$

$$TS^0 = \sum_{t=0}^{T} \delta^t \left(E_t[\mathcal{U}_t^0|\theta_1] + E_t[\pi_t^0|\theta_1]\right) \tag{38}$$

4.4 Comparative statics

Our model shows that a doctor who develops identity from her organization or job whithin the health organization, is willing to work for lower overall pay. This way, less variation in payment schedule is needed in order to induce her to exert high level of effort. Thus, this less variation in payments results in additional cost savings for $\mathcal{P}$, or the health organization. In addition, when doctors are risk averse, less variation in payments means that they must be compensated with a lower risk premiun, and this constitutes another cost saving source for the health organization. When these cost advantages are high enough, it can be worthwhile for $\mathcal{P}$ to undertake a costly program to promote doctors' "good" identity.

Comparative statics of our model show when identity and intrinsic motivation could play a bigger role in motivating doctors and hence when a health organization could find profitable to invest in developing doctors' identity and crowding in their intrinsic motivation. Changes in each parameter of the model will affect the profitability of such an investment on *Motivational Capital* and will be a key question to analyze the $\mathcal{P}$ behaviour. If inculcating identity is cheap, if there is much uncertainty, if doctors' effort is hard to observe, if doctors are especially risk averse, if high effort is critical to the organization's output, then the use of an identity-oriented motivational incentive scheme, would be more profitable and more likely to be used.

4.4.1 Motivational Capital

One very first result that it is straightforward to set, comes from the comparison between the present value of the sum of spot profits for $\mathcal{P}$ when he takes S action and when he takes 0 action. That is, firstly calculating the *Net Present Value* of the $\mathcal{A}$'s motivational capital (NPV^{mk}), and then checking if it is positive or negative.This first result is formally shown in proposition 1.

Proposition 1. *Let T the number of periods the game will be played. For n and δ large enough, and γ small enough, there exists a threshold t^* such that,*

$$n \cdot \sum_{t=0}^{t^*} \delta^t \left[\theta_1 \underline{(\overline{\mathbf{w}}_\mathbf{t}^\mathbf{0} - \overline{\mathbf{w}}_\mathbf{t}^\mathbf{S})} + (1-\theta_1)\underline{(\underline{\mathbf{w}}_\mathbf{t}^\mathbf{0} - \underline{\mathbf{w}}_\mathbf{t}^\mathbf{S})}\right] = \sum_{t=0}^{t^*} \delta^t C_t(S)$$

and for which

i. If $t^* \leqslant T$ then $NPV^{mk} \geqslant 0$ and $\mathcal{P}$ finds profitable to invest in motivational capital and choose the $s_0 = S$ strategy.

ii. If $t^* > T$ then $NPV^{mk} < 0$ and $\mathcal{P}$ finds profitable not to invest in motivational capital and choose the $s_0 = 0$ strategy.

Figure 4 shows graphically this first result. The graph on the left side of the figure 4 shows jointly, and as a function of time t, both, $\mathcal{P}$'s expected cost function in the case of $s_0 = 0$, and $\mathcal{P}$'s expected cost function in the case of $s_0 = S$. The discounted sum of the difference between these two functions will be the measure of the net present value of an investment in motivational capital for $\mathcal{P}$. In the graph three different cases are shown with the goal of being illustrative of the proposition 1 results.

The graph on the right side of the figure 4 shows the value of the NPV^{mk} as a function of time t. In this graph also the three cases shown in the other graph are shown. The t^* threshold determines the critical point below which the best strategy for $\mathcal{P}$ will be not to invest.

The motivational capital profitability threshold t^* is the key variable for $\mathcal{P}$'s optimal action choice. This threshold depens on several variables. The relations given between these variables and the motivational capital profitability threshold is what determines $\mathcal{P}$'s optimal decision in this contracting game. We will focus on the analysis of these relations in order to draw conditions under which one or another strategy, $s_0 \in \{0, S\}$ is optimal.

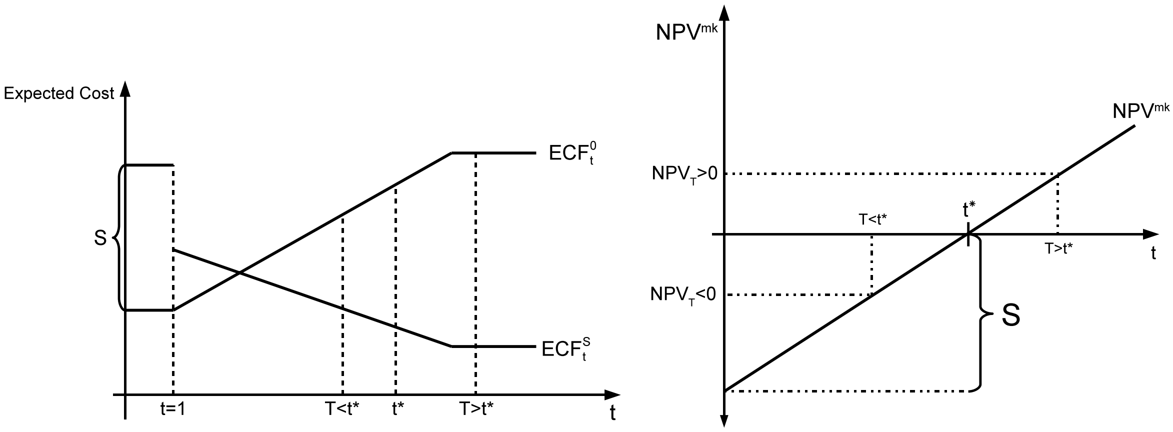

Figure 4: Net Present Value of the Motivational Capital.

4.4.2 Effort Effectiveness and Motivational Capital

The model captures $\mathcal{A}$'s effort effectiveness with the $\theta_i \in [0,1]$ parameter, where $i = 0, 1$ are the subscripts meaning $\mathcal{A}$'s low effort and high effort action, respectively. A natural way to read this parameter is as a probability of high performance conditional to effort action. For θ_i to be informative, it has to be $\theta_1 > \theta_0$. Comparative statics on θ_0 allows us to stablish that greater values of θ_0, closer to θ_1, make higher incentives necessary in order to elicit doctors to do high effort. In addition to this, crowding out effect push incentives to raise when these monetary rewards are high.

In the light of previous findings, we can establish that pure monetary rewards as incentivization strategy is very expensive when the effort is hard to observe due to the low quality of the signal used to do this. In such cases, for $\mathcal{P}$ to implement a crowding in strategy as incentive policy (in our model $s_0 = S$) results more likely to be optimal when effort is hard to observe and hard to reward. This is because, despite the cost of investing in motivational capital $C_t(S)$, identity allows $\mathcal{P}$ to save costs because he will not need to incentivize effort. Taking into account the fact that with high θ_0 monetary incentives have to be very high, savings due to $s_0 = S$ strategy will be very high and therefore investing in motivational capital will be optimal because the net present value of such an investment turns to be positive earlier.

Proposition 2 summarizes the above result:

Proposition 2. *Let $NPV^{mk}_{\hat{\theta}_0}$ and $NPV^{mk}_{\bar{\theta}_0}$ be the net present value of making investments in motivational capital for the cases of $\hat{\theta}_0$ and $\bar{\theta}_0$ respectively. Let $t^{\hat{\theta}_0}$ and $t^{\bar{\theta}_0}$ be the number of periods necessary so that the net present value of investing in motivational capital turns positive in each case $\hat{\theta}_0$ and $\bar{\theta}_0$, respectively. Then, holding everything else constant and assuming limited liability constraint, for every $\hat{\theta}_0$, $\bar{\theta}_0 \in [0,1]$ such that $\hat{\theta}_0 > \bar{\theta}_0$, $NPV^{mk}_{\hat{\theta}_0}$*

will be higher than $NPV^{mk}_{\bar{\theta}_0}$ *and therefore* $t^{\hat{\theta}_0} < t^{\bar{\theta}_0}$. *Then, always will be more profitable to invest in motivational capital when the value of* θ_0 *is higher.*

Thus another consistent relation is drawn from the model. For lower values of the probability of high performance conditioned to low effort $p(q = \overline{q}|e = \underline{e}) = \theta_0$, for $\mathcal{P}$ to take the $s_0 = S$ action to invest in motivational capital always will be more profitable and therefore more likely. This result is consistent with what Akerlof and Kranton (2005) state about identity as an incentive for work motivation.

> [...] a way to motivate employees, different than incentives from monetary compensation.
>
> [...] a change in identity is the ideal motivator if, [...] the effort of a worker is either hard to observe or hard to reward.

4.4.3 Organizational Size and Agents Population

Other key fact which can make the investment in motivational capital more likely to be optimal strategy in the short term is the size of agents population involved in the game. In other words, the size of the health organization in which the problem of incentives must be resolved.

$\mathcal{P}$ must decide $s_0 \in \{0, S\}$ and faces $C_t(s_0)$ cost. This cost, as it has been defined in previous section, will be $C_t(0) = 0$ in the case of no-investment behaviour and $C_t(S) = S + \sum_{t=1}^{T} \delta^t [\gamma S]$

Which choice will result optimal for $\mathcal{P}$ will come determined by the sign of the *Net Present Value* of the motivational capital:

$$NPV^{mk} = \sum_{t=0}^{T} \delta^t \left[ECF_t^0 - ECF_t^S\right]$$

When the NPV^{mk} is positive then investment in motivational capital is the best choice for $\mathcal{P}$. As it has been shown in *proposition 1*, there is a threshold t^* which determines the border between the optimality of investing or not in motivational capital. The posterior analysis lies in characterizing which values of the other parameters in the model affect this threshold, raising or lowering it.

Focusing our attention over the number of contracts n that $\mathcal{P}$ must perform, and taking into account that the organizational change and the initial investment that $\mathcal{P}$ has to do in $t = 0$ is a fixed cost, we can state the following result shown in the proposition 3.

Proposition 3. *Let* $\Delta EC = \left[ECF_t^0 - ECF_t^S\right]$ *be the saved expected cost for* $\mathcal{P}$ *in every* $t \geqslant 1$ *when he chooses to invest in motivational capital. By proposition 1 (*$P1$*) we know that there exists a given* $t \geqslant 1$ *for which the sign of the* ΔEC *will turn positive. The total value of* ΔEC *will be higher when the number of contracts performed by* $\mathcal{P}$*,* n*, would be higher. Then for every pair* n_1, n_2 *such that* $n_1 > n_2$ *the initial investment in motivational capital* S *will be compensated earlier with* n_1*, and* $t^*_{n_1} < t^*_{n_2}$ *(*$P1$*). Therefore, for* $\mathcal{P}$ *to choose* S *action will be more likely to be optimal for higher values of* n*.*

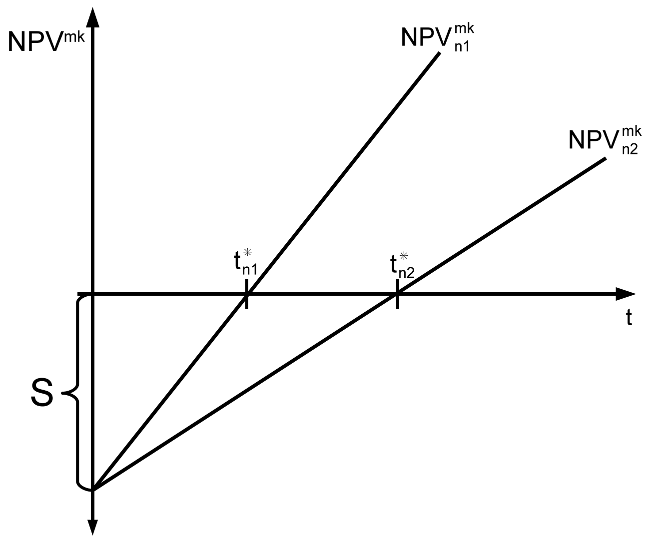

Figure 5: A comparison between the net present value of two different agents population n_1 and n_2.

The result of the proposition 3 is summarized in figure 5. The figure shows the *Net Present Value* corresponding to the cases n_1 and n_2. Shown jointly, these two functions illustrate how, when the number of contracts that $\mathcal{P}$ must perform is higher, then earlier the NPV^{mk} turns positive.

5 Conclusion

We introduce the notions of identity and intrinsic motivation in a model of principal agent with moral hazard to capture the idea of how incentives beyond the money can be effective in order to elicit agents, doctors in our case, to exert high effort. The incorporation of such inner motivators of the individual behaviour has been done on the basis of an extense literature on intrinsic motivation and identity[25]. The aim of the paper then, can be summed

[25] See for instance Frey [29]; Frey and Jegen [30]; and Benabou and Tirole [7] [8]; for the case of intrinsic motivation and Akerlof and Kranton [1] [2] [3] and Benabou and Tirole [8]; for the case of identity.

up with the following quote of Fehr et al. [28]:

> [...] concerns for fairness have an important impact on the actual and the optimal design of contracts. Traditional contract theory has neglected these effects, but they have to be taken into account if we want to fully understand the functioning of real world contracts and the associated incentive schemes. [...] This approach is a first step to developing richer models that may become part of "behavioral contract theory."

Introducing these notions of identity in a principal agent model, assuming that doctors are intrinsically motivated and also that they can change identity and align their particular goals with the organizational goals, the present work has shown the conditions under which to spend resources crowding in doctors' intrinsic motivation and changing their identity is profitable for health organizations.

These conditions are, for instance, the lenght of the contracts offered, the informative value of the signal used to observe and incentivize effort, the total number of contracts that a principal must sign, the initial distribution of identity and intrinsic motivation between the agents and also the properties of such distributions.

Taking all into account, what we conclude from this work is: an initial investment in long-term incentives beyond the money and crowding in policies, though costly at inception, will result more effective to control public health expenditure and achieve better outcomes than usual monetary and regulatory incentives. In other terms, there is an incentive for governments to invest in motivational capital in the public health. Then, Governments, Health Care Authorities and Health Care Advisors, should take into account and incorporate these findings to the policy design. For instance, from the *proposition 1* a planner could conclude that monetary incentives are the best way to achieve a specifical goal in the short term. Something like, a sudden increase in waiting lists, stationary flu, or other sudden epidemic episodes. However for the long term goals: quality, efficiency, effectivenes, research and develop results, then *proposition 1* establishes, that a change in identity and making investments in *motivational capital* is the most profitable action for the health care manager.

Another conclusion taht is straightforward to derive from the above established ones is that, wherever the health care managers will be politically designed, their time horizon will be the legislative time period and then it is more likely that they are focused in the short term goals. Thus, they will have a willingness to chosse pure monetary rewards as incentive schemes for health, despite in the long term the best choice is the investmetn in *motivational capiatl*. Anyway these conclusions are interesting future research questions which, should be testedand studied in depth in the future.

A Additional Notation

B Mathematical Appendix

B.1 Socialization: the Evolution of the Identities Distribution.

Let $F(\upsilon_t|s_0)$ be the probability distribution function of the $\mathcal{A}$s' identity υ_t, where $\upsilon_t \in [\underline{\upsilon}, \overline{\upsilon}]$, $\underline{\upsilon} < \overline{\upsilon}$ and $\underline{\upsilon}, \overline{\upsilon} \in \mathbb{R}_+$.

Assume that for any decision choice of s_0, $F_0(\upsilon_0|S) = F_0(\upsilon_0|0) = F_0(\upsilon_0)$. Socialization will reflect evolution of identity distribution through time, conditional to the choice of s_0.

We separate the socialization into two cases: socialization and conflict. The distribution of identity will evolve oppositely depending on the $\mathcal{P}$'s s_0 investement strategy.

Thus for every value of $\upsilon_t = \upsilon^*$ when $s_0 = 0$ the distribution function at any period t is stochastically dominated by the distribution function of the previous period $t-1$. Alternatively for every value of υ_t when $s_0 = S$ the distribution function at any period t dominates stochastically the distribution function of the previous period $t-1$. This property is formally written as follows,

$$
\begin{aligned}
F_t(\upsilon_t = \upsilon^*|0) \geqslant F_{t-1}(\upsilon_{t-1} = \upsilon^*|0) \geqslant \cdots \geqslant F_0(\upsilon_0) \\
\geqslant \cdots \geqslant F_{t-1}(\upsilon_{t-1} = \upsilon^*|S) \geqslant F_t(\upsilon_t = \upsilon^*|S)
\end{aligned}
$$

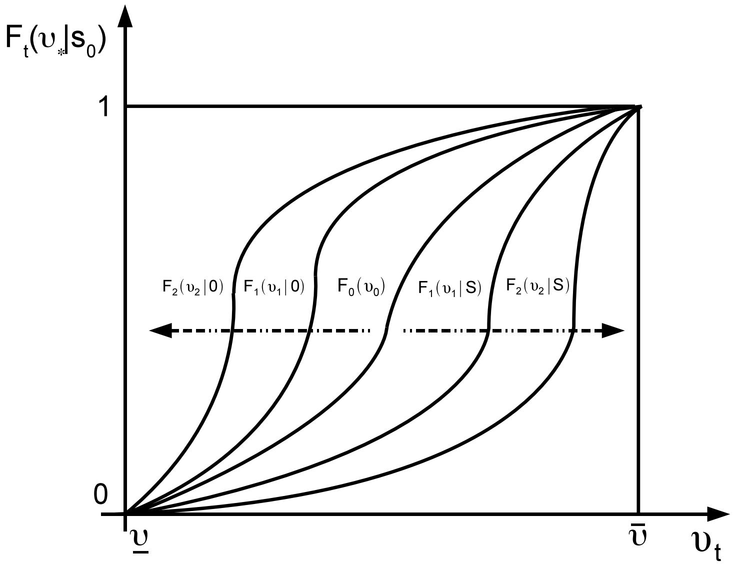

Figure 6: Identity. Stochastic Dominance.

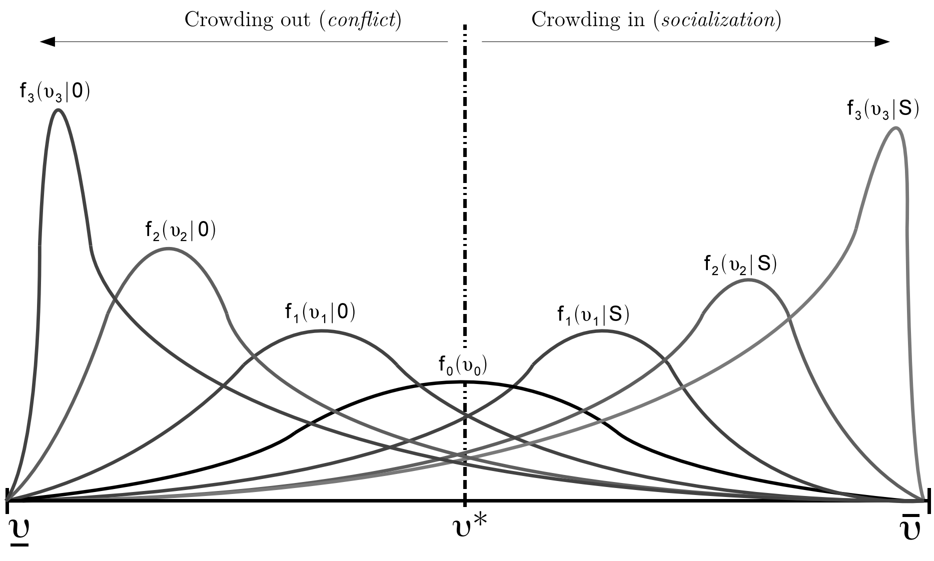

Figure 7: Identity. Time Evolution of Densities.

Finally assume that $F_t(\upsilon_t|S)$ converges to put all the probability on the upper bound of the identity $\upsilon_t = \overline{\upsilon}$, and $F_t(\upsilon_t|0)$ converges to put all the probability on the lower bound of the identity $\upsilon_t = \underline{\upsilon}$.

$$\lim_{t\to\infty} F_t(\upsilon_t|S) = \lambda \qquad \text{where} \quad \lambda = \begin{cases} 1 & \text{if } \upsilon = \overline{\upsilon} \\ 0 & \text{otherwise} \end{cases}$$

and

$$\lim_{t\to\infty} F_t(\upsilon_t|0) = 1, \text{ for every } \upsilon \in [\underline{\upsilon}, \overline{\upsilon}].$$

Let $E_t[\upsilon_t|s_0]$ be the mathematical expectation in t of the value of υ_t conditional to the incentive policy s_0. Implications of the s_0 conditioned stochastic dominance on $E_t[\upsilon_t|s_0]$:

$$\forall t = 0, 1, ..., T, ... \qquad E_t[\upsilon_{t+1}|0] < E_t[\upsilon_t|0]$$
$$\forall t = 0, 1, ..., T, ... \qquad E_{t+1}[\upsilon_{t+1}|S] > E_t[\upsilon_t|S]$$
$$\forall t = 0, 1, ..., T, ... \qquad E_t[\upsilon_t|0] < E_t[\upsilon_t|S]$$

Where,

$$E_t[\upsilon_t|s_0] = \int_{\underline{\upsilon}}^{\overline{\upsilon}} \upsilon_t f(\upsilon_t|s_0) d\upsilon_t$$

B.2 Crowding effects.

Let $\phi_t(\Omega_t, m(s_0)) \in (0, \Phi]$ be a function which measures the intrinsic motivation of the agent, where $(0, \Phi] \in \mathbb{R}_+$. Let $m(s_0) \in \{m, M\}$ be the amount of intrinsic motivation of a doctor with $m, M \in \mathbb{R}_+$ and $M > m$. First, let us to assume, in line with crowding effects literature, that intrinsic motivation depends negatively from incentives intensity Ω_t. Formally,

$$\frac{\partial \phi_t(\Omega_t, m(s_0))}{\partial \Omega_t} < 0; \text{ with } \frac{\partial^2 \phi_t(\Omega_t, m)}{\partial \Omega_t^2} < 0 \text{ and } \frac{\partial^2 \phi_t(\Omega_t, M)}{\partial \Omega_t^2} > 0.$$

What we are assuming here is that, elicit good action by the only use of incentives crowds out $\mathcal{A}$'s intrinsic motivation. However, when $\mathcal{P}$ invest in motivational capital and supports $\mathcal{A}$'s mission preferences to change her identity, then the higher identity the doctor has, less incentives she needs to do good action. Therefore, this crowds in $\mathcal{A}$'s intrinsic motivation over time:

$$\frac{d\phi_t(\Omega_t, M)}{dt} > 0$$

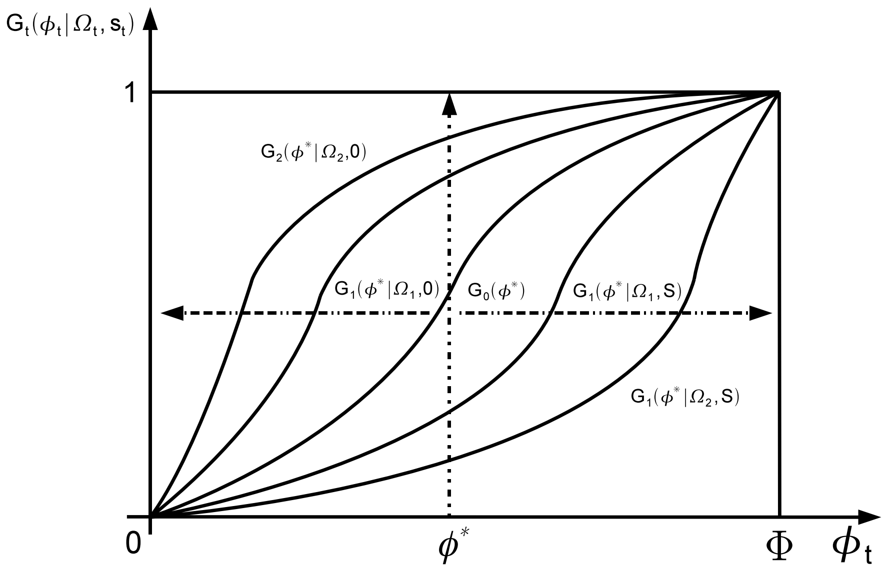

Figure 8: Intrinsic Motivation. Stochastic Dominance

Intrinsic motivation ϕ_t also is affected, in this case possitively, by the principal investment supporting doctor's mission preferences. Formally, as the assumption B2 states, for any fixed $\Omega_t = \Omega^* \in [0, \infty)$, we have $\Delta^{(m_t)}\phi_t = \phi_t((\Omega)^*, M) - \phi_t((\Omega)^*, m) > 0$.

Doctors may have different degrees of intrinsic motivation in $t = 0$. The model captures this heterogeneity with a probability distribution function defined over the value of the intrinsic motivation in $t = 0$, $G_0(\phi_0)$. For any $\phi_0 = \phi^* \in [0, \Phi]$ the distribution function gives back, $G_0(\phi^*) = Prob(\phi_0 \leqslant \phi^*)$. Let $g_0(\phi_0)$ be the density associated to $G_0(\phi_0)$ which, we will read as, for any $\phi_0 = \phi^* \in [0, \Phi]$ $g_0(\phi^*) = Prob(\phi_0 = \phi^*)$.

Once $\mathcal{P}$ has inferred $G_0(\phi_0)$ and taking into account that his offer in $t = 0$ will affect $\mathcal{A}$'s intrinsic motivation through crowding effects, the he can infer the subsequents conditional distributions over ϕ_t, say, $G_t(\phi_1|\Omega_t, s_0)$. In order to make this two conditionals informative about the intertemporal changes in the distribution of the intrinsic motivation, let us formulate some assumptions.

First we assume stochastic dominance.

$$\begin{aligned} G_t(\phi_t = \phi^*|0, \Omega_t) \geqslant G_{t-1}(\phi_{t-1} = \phi^*|0, \Omega_{t-1}) \geqslant \cdots \geqslant G_0(\phi_0) \\ \geqslant \cdots \geqslant G_{t-1}(\phi_{t-1} = \phi^*|S, \Omega_{t-1}) \geqslant G_t(\phi_t = \phi^*|S, \Omega_t) \end{aligned}$$

Assume that $G_t(\phi_1|\Omega_t, S)$ converges to put all the probability on the upper bound of intrinsic motivation $\phi_t = \Phi$ and $G_t(\phi_1|\Omega_t, 0)$ converges to put all the probability on the lower bound of intrinsic motivation $\phi_t = 0$.

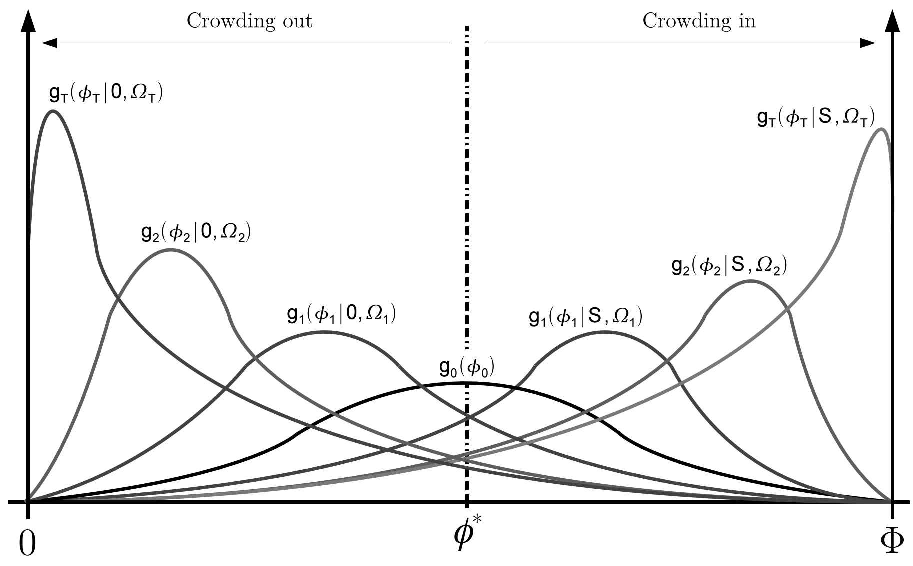

Figure 9: Intrinsic Motivation. Time Evolution of Densities.

$$\lim_{t\to\infty} G_t(\phi_t|S,\Omega_t) = \rho \qquad \text{where} \quad \rho = \begin{cases} 1 & \text{if } \phi_t = \Phi \\ 0 & \text{otherwise} \end{cases}$$

and

$$\lim_{t\to\infty} G_t(\phi_t|0,\Omega_t) = 1, \text{ for every } \phi_t \in [0,\Phi].$$

Let $E_t[\phi_t|s_0,\Omega_t]$ be the mathematical expectation in t of the value of ϕ_t conditional to the incentive policy s_0 and the intensity of incentives[26] Ω_t. Implications of the s_0 conditioned stochastic dominance on $E_t[\phi_t|\cdot]$:

$$\forall t = 0,1,...,T,... \qquad E_{t+1}[\phi_{t+1}|0,\Omega_{t+1}] < E_t[\phi_t|0,\Omega_t]$$
$$\forall t = 0,1,...,T,... \qquad E_{t+1}[\phi_{t+1}|S,\Omega_{t+1}] > E_t[\upsilon_t|S,\Omega_t]$$
$$\forall t = 0,1,...,T,... \qquad E_t[\phi_t|0,\Omega_t] < E_t[\phi_t|S,\Omega_t]$$

Where,

$$E_t[\phi_t|s_0] = \int_0^\Phi \phi_t f(\phi_t|s_0,\Omega_t) d\phi_t$$

[26]Both, incentive policy and the intensity of monetary incentives are positively correlated $\forall s_0 \in \{0,S\}$ and $\forall \Omega_t \in [0,\infty]$. Then, s_0 is sufficient informative statistic and we can simplify the model using only it as informative signal about intrinsic motivation $E[\phi_t|\cdot]$.

B.3 Problem Solving

Let us now to simplify the notation in order to make algebraic operations easier. We relabel some variables of the model in order to do that. All changes are summarized in table 1.

Utility from monetary payments:	$u_t(\overline{w}) = \overline{u}$; $u_t(\underline{w}) = \underline{u}$
Disutility from effort:	$\psi_t(\overline{e}, \upsilon_t(s_0)) = \psi_t$
Intrinsic motivation	$\phi_t(\Delta w_t, m(s_t)) = \phi_t$
$\mathcal{P}$'s revenue function:	$R_t(\overline{q}) = \overline{R}$; $R_t(\underline{q}) = \underline{R}$
Change of variables:	$\overline{w} = h(\overline{u})$; $\underline{w} = h(\underline{u})$
Probability variation:	$\Delta\theta = (\theta_1 - \theta_0)$
Reservation utility:	$\underline{U}$

Table 1: Notational simplification

Then we can rewrite the $\mathcal{P}$'s problem as follows:

$$Max_{\{w_t(q_t),s_0\}}\theta_1\left(\overline{R} - h(\overline{u})\right) - (1-\theta_1)\left(\underline{R} - h(\underline{u})\right) - s_t \tag{39}$$

Subject to

$$\theta_1\overline{u} + (1-\theta_1)\underline{u} - \psi_t + \phi_t \geqslant \theta_0\overline{u} + (1-\theta_0)\underline{u} + \phi_t \text{ (ICC)} \tag{40}$$

$$\theta_1\overline{u} + (1-\theta_1)\underline{u} - \psi_t + \phi_t \geqslant \underline{U} \quad \text{(PC)} \tag{41}$$

Note that the $\mathcal{P}$'s objective function is now strictly concave in $\overline{u}$ and $\underline{u}$, because $h(\cdot)$ is strictly convex. The function $u^{-1} = h(u)$ gives back *ex post* the monetary payments from utility levels. We have now linear constraints and a nonempty interior of the constrained set and therefore the problem is concave and the Kuhn-Tucker conditions are sufficient and necessary for characterizing optimality.

Letting λ and μ be the non-negative multipliers associated respectively with the (ICC) and (PC) constraints. First-order conditions of this problem yield:

$$\frac{1}{u'(\overline{w})} = \mu + \lambda\frac{\Delta\theta}{\theta_1} \tag{42}$$

$$\frac{1}{u'(\underline{w})} = \mu - \lambda\frac{\Delta\theta}{1-\theta_1} \tag{43}$$

The equations (9) and (10) jointly with (6) and (7) form a system of four equations with four variables $(\overline{w}, \underline{w}, \mu, \lambda)$ which allows us to calculate the solution. Multiplying (9) by θ_1 and (10) by $(1-\theta_1)$ and adding those two modified equations, we obtain,

$$\mu = \frac{\theta_1}{u'(\overline{w})} + \frac{1-\theta_1}{u'(\underline{w})} > 0 \tag{44}$$

Hence, $\mu > 0$ and the participation constraint (7) is binding. Using (11) and (9), we also obtain,

$$\lambda = \frac{(1-\theta_1)\theta 1}{\Delta\theta} \left(\frac{1}{u'(\overline{w})} - \frac{1}{u'(\underline{w})} \right) > 0 \tag{45}$$

And the incentive compatibility constraint (6) is also binding. Thus we can obtain inmediately the values of $u(\overline{w})$ and $u(\underline{w})$ by solving a system with two equations and two unknowns. The result is shown below,

$$u_t(\overline{w}) = \underline{U} - \phi_t\left(\Omega_t, m(s_0)\right) + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0)) \tag{46}$$

$$u_t(\underline{w}) = \underline{U} - \phi_t\left(\Omega_t, m(s_0)\right) - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0)). \tag{47}$$

B.4 Effort effectiveness: some analysis on θ_i.

Preliminary assumptions over θ_i:

$$\begin{array}{ll} P(q_t = \overline{q} | e_t = \overline{e}) = \theta_1 & P(q_t = \overline{q} | e_t = \underline{e}) = \theta_0 \\ P(q_t = \underline{q} | e_t = \overline{e}) = 1-\theta_1 & P(q_t = \underline{q} | e_t = \underline{e}) = 1-\theta_0 \end{array}$$

Assume also that performance is an informative signal about effort, $\theta_1 > \theta_0$. Further, results show that in any case, benchmark case or standard economic model, investment in motivational capital, and no-investment in motivational capital, the stochastic parameter θ_i only affects the stochastic payments $\tilde{w}_t(\tilde{q}_t)$.

Let us to take the standard model's stochastic payments $\tilde{w}_t$ as start point. We analyze the impact of θ_0 on both, $\underline{w} = h\big(\underline{U} - \frac{\theta_0}{\theta_1-\theta_0}\Psi\big)$ and $\overline{w} = h\big(\underline{U} + \frac{1-\theta_0}{\theta_1-\theta_0}\Psi\big)$. By definition $h'(\cdot) > 0$ and $h''(\cdot) > 0$

$$\frac{d\underline{w}(\underline{q})}{d\theta_0} = h'(\underline{u})\frac{\partial\left(\underline{U} - \frac{\theta_0}{\theta_1-\theta_0}\Psi\right)}{\partial\theta_0} = -h'(\underline{u})\Big[\frac{\Psi\theta_1}{(\theta_1-\theta_0)^2}\Big] < 0$$

The sign of this first derivative of $h(u(\underline{w}))$ from θ_0 is negative for any value $\theta_0 \in [0, \theta_1]$. Then the low stochastic payment depends negatively from θ_0

Now we calculate the second derivative of $\underline{w}$ from θ_0,

$$\frac{d^2\underline{w}(\underline{q})}{d\theta_0^2} = \Big[-h''(\underline{u})\cdot\Big(\frac{\Psi\theta_1}{(\theta_1-\theta_0)^2}\Big)^2\Big] + [-h'(\underline{u})]\cdot\Big(\frac{2\Psi\theta_1}{(\theta_1-\theta_0)^3}\Big) < 0$$

The second derivative is negative. Then, the value of the utility experienced from the low payment, decreases more quickly on θ_0 as mean as the latter increases. Is straightforward to se that in the limit the low payment $\underline{w}$ converges to $-\infty$ when θ_0 goes to θ_1

$$\lim_{\theta_0\to\theta_1} h\Big(\underline{U} - \frac{\theta_0\Psi}{\theta_1-\theta_0}\Big) = -\infty$$

On the other hand, the first derivative on θ_0 of the high payment is as follows,

$$\frac{d\overline{w}(\overline{q})}{d\theta_0} = h'(\overline{u})\cdot\frac{\partial u(\overline{w}(\overline{q}))}{\partial\theta_0} = h'(\overline{u})\cdot\frac{\partial\Big(\underline{U} + \frac{(1-\theta_0)\Psi}{\theta_1-\theta_0}\Big)}{\partial\theta_0} = h'(\overline{u})\cdot\Psi\frac{(1-\theta_1)}{(\theta_1-\theta_0)^2} > 0$$

The sign of the first derivative in the case of high payment, is possitive. Then, as mean as the value of θ_0 increases, the high payment also increases. The sign of the second derivative show whether the payment increases faster or slower as mean as θ_0 increases.

$$\frac{d^2\overline{w}(\overline{q})}{d\theta_0^2} = \Big[h''(\overline{u})\cdot\frac{\partial\Big(\underline{U}+\frac{(1-\theta_0)\Psi}{\theta_1-\theta_0}\Big)}{\partial\theta_0}\Big]\cdot\Big(\Psi\frac{(1-\theta_1)}{(\theta_1-\theta_0)^2}\Big) + \Big[h'(\overline{u})\cdot\frac{2\Psi}{(\theta_1-\theta_1)^3}\Big] =$$

$$= h''(\overline{u})\cdot\Big(\Psi\frac{(1-\theta_1)}{(\theta_1-\theta_0)^2}\Big)^2 + h'(\overline{u})\cdot\frac{2\Psi}{(\theta_1-\theta_1)^3} > 0$$

Is straightforward to see that the high payment is increasing in θ_0 and this positive relation is also increasing in θ_0. Then, when θ_0 value converges to θ_1, the high stochastic optimal payment converges to ∞.

$$\lim_{\theta_0\to\theta_1} h\Big(\underline{U} + \frac{(1-\theta_0)\Psi}{\theta_1-\theta_0}\Big) = \infty$$

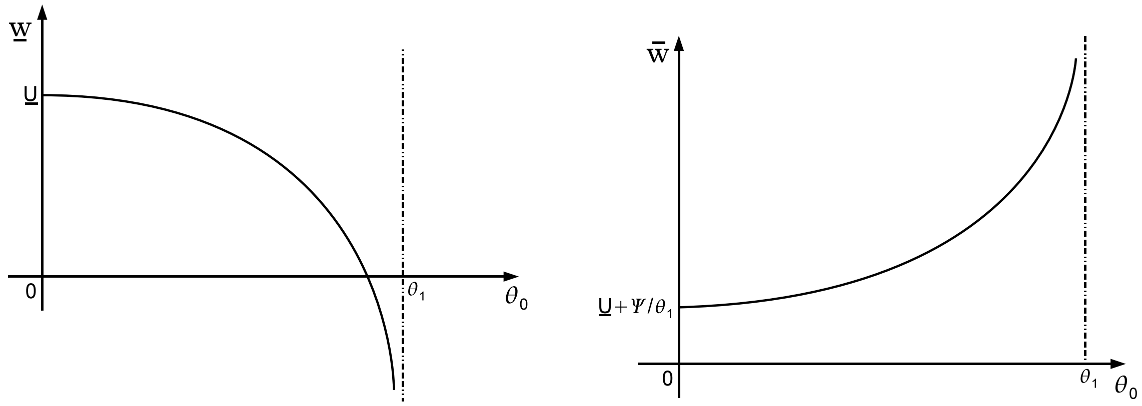

Figure 10: Payments and the informative value of the signal

Figure

Finally we analyze how $\Omega = \overline{w} - \underline{w}$ evolves with the informative value of the signal. That is, how the informative value of the signal, $\Delta\theta = \theta_1 - \theta_0$ affects the range and the amount of the incentives. As it is shown, as more close to θ_1 is θ_0, then lower will be $\underline{w}$ and higher will be $\overline{w}$, and therefore $\Omega = \Delta w$ must be greater. Analogously, as more separate is θ_0 from θ_1, then higher will be $\underline{w}$, lower will be $\overline{w}$, and therefore $\Omega = \Delta w$ must be lower. In conclusion, signal informativeness makes monetary incentives less necessary.

Now, assume that intrinsic motivation and identity plays a role in the agent behaviour. Then, as it is shown in the section 3.2.4. of this paper, the problem solving payments are,

$$\overline{w} = h(u(\overline{w})) = h\left(\underline{U} - \phi\left(\Omega, m(s_0)\right) + \frac{(1-\theta_0)}{\Delta\theta}\psi(\overline{e}, v(s_0))\right)$$
$$\underline{w} = h(u(\underline{w})) = h\left(\underline{U} - \phi\left(\Omega, m(s_0)\right) - \frac{\theta_0}{\Delta\theta}\psi(\overline{e}, v(s_0))\right).$$

Formalized in section 3.2.3. there is a negative interplay between monetary incentives and intrinsic motivation. More monetary incentives hurt intrinsic motivation by crowding out effect and analogously less incentives improves intrinsic motivation.

$$\frac{\partial\phi\left(\Omega, m(s_0)\right)}{\partial\Omega} < 0 \tag{48}$$

Then, this negative relation strenghten the effect that the informative value of the signal has over incentives. More precisaely, in presence of intrinsic motivation, for every given value of θ_0, Ω will be greater. This result is easily drawn from the fact that a greater θ_0 means greater ω and the (48) equation.

Respect to the role played by identity, higher identity means more alignment between organizational or $\mathcal{P}$'s goals and $\mathcal{A}$'s goals. In the model more identity means that $\mathcal{A}$ experience a lower disutility from effort, which will be zero in the limit when agent achieve full identity.

$$\psi_t(\overline{e}, \overline{v}) = 0 \tag{49}$$

Thus, the incentives to elicit $\mathcal{A}$ to exert effort will not depend on the effectiveness of the signal θ_i because for the agent will chosse $e = \overline{e}$ action in every t due to this goals alignment and full identity and to link higher expected payments to the choice of $e = \overline{e}$ action is not necessary.

B.5 Organizational Size and Agents Population

Let $\overline{w}_t^0$ and $\underline{w}_t^0$ be the contingent payments when $s_0 = 0$ and Let $\overline{w}_t^S$ and $\underline{w}_t^S$ be the contingent payments when $s_0 = S$.

Let now $E[w_t^0|\theta_1] = \theta_1\overline{w}_t^0 + (1-\theta_1)\underline{w}_t^0$ and $E[w_t^S|\theta_1] = \theta_1\overline{w}_t^S + (1-\theta_1)\underline{w}_t^S$ be the expected payments when the action choosen by $\mathcal{P}$ is $s_0 = 0$ and $s_0 = S$ respectively. By identity and crowding effects we know that, for eny given population n of agents, $E[w_t^0|\theta_1] - E[w_t^S|\theta_1] > 0$.

Let n_1 and n_2 be two different population of agents such that $n_1 > n_2$. We can write the expected saved costs for each case respectively as follows: $n_1\left[E[w_t^0|\theta_1] - E[w_t^S|\theta_1]\right]$ and $n_2\left[E[w_t^0|\theta_1] - E[w_t^S|\theta_1]\right]$. Given that $n_1 > n_2$ it is straightforward to see that in every $t \geqslant 1$,

$$n_1\left[E[w_t^0|\theta_1] - E[w_t^S|\theta_1]\right] > n_2\left[E[w_t^0|\theta_1] - E[w_t^S|\theta_1]\right]$$

.

Then, following proposition 1, the number of periods necessary to turn the *Net Present Value of motivational capital* possitive $NPV^{mk} > 0$ in each case t_1^* and t_2^* will be such that $t_1^* < t_2^*$ and therefore it is more likely to invest in motivational capital, when the number of contracts or n that $\mathcal{P}$ must perform is higher.

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