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Mikel Berdud
Juan M. Cabasés
Jorge Nieto

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Departamento de Economía

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Identity, Incentives and Motivational Capital in Public Organizations*

Mikel Berdud[1], Juan M. Cabasés[2], Jorge Nieto[3]

[1,2,3]Public University of Navarra, UPNa

Department of Economics

Campus Arrosadia 31006, Pamplona, Spain.

{[1]mikel.berdud, [2]jmcabases, [3]jnieto}@unavarra.es

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Abstract

This paper explores optimality of contracts and incentives when the principal (public organization) can undertake investments to change agents' (public workers) identity. In the model, workers within the organization can have different identities. We develop a principal-agent dynamical model with moral hazard, which captures the possibility of affecting this workers' identity through contracts offered by the firm. In the model, identity is a motivation source which reduces agents' disutility from effort.

We use the term *identity* to refer to a situation in which the worker shares the organizational objectives and views herself as a part of the organization. Contrary, we use the term *conflict* to refer to a situation in which workers behave self-interested and frequently in the opposite way of the organisation. We assume that the principal can include investments to foster identity in contracts. Think for instance in developing a single culture that is shared by all the members of an organization.

We discuss the conditions under which spending resources in changing workers' identity and invest in this kind of *motivational capital* is optimal for organizations. Our results may help to inform public firms' managers about the optimal design of incentive schemes and policies. For instance, we conclude that investing in motivational capital is the best option in the long run whereas pure monetary incentives works better in the short run.

Keywords: contracts, moral hazard, identity, socialization, mission, motivational capital.

JEL Codes: D03, D86.

1 Introduction

The present work deals with incentives and workers' motivations in public organizations. Organizations that provide collective goods pursue goals and objectives, which are not necessarily monetary profitable. Usually the motivation of the employees who work within these organizations goes beyond the expected monetary gain. In general terms people who work in the provision of collective goods sector have a self-view as a pro-social agents. They share organizational goals and objectives and thus they cohere with managers and policy makers in what Wilson [31] called *mission*.

> A "mission" is a single culture that is widely and enthusiastically shared by the members of the organization. Wilson (1989, p. 99)

> 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 immediate financial advantage in doing so. Wilson (1989, p. 156).

If motivations beyond the monetary contribute in drawing the way of public workers' behavior, then non-monetary incentives should be incorporated to motivate them. In many of the most productive firms there have been attempts to substitute monetary incentives with the culture of mission [31].

> 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. Wilson (1989, 157).

Then, mission preferences and other non-monetary or non-economic workers' motivations might lead them to high quality work, high degree of implication, effort culture, and identification with the organization's objectives.

In line with Wilson's [31] approach, Kreps [19] in the 90's leaded a new branch of the literature on organizational theory named *Corporate Culture*. In his seminal work, Kreps [19], treats the corporate culture as a principle that helps to identify the firm's rule of behavior. The rule helps in setting a good reputation that may be used to generate confidence to potential future trading partners. In Kreps's [19] words, culture *"[...] gives hierarchical inferiors an idea ex-ante how the organization will react to circumstances as they arise; in strong sense, it gives identity to the organization."*.

Other relevant works from Corporate Culture literature[1] also have approached the question of how a good culture, shared by all the members of an organization, may be a powerful motivator different from the monetary rewards.

In his highly influential work, Akerlof and Kranton [1] consider this sharing-goals behavior of agents as *Identity*. In their words, identity, is *"a way to motivate employees, different than incentives from monetary compensation"* and also believe that *"[...] a change in identity is the ideal motivator if, [...] the effort of a worker is either hard to observe or hard to reward"*.

Identity in economics and organizations and public workers' motivation have is an issue in the recent economic literature [2]. Identity may alter the economic behavior of workers' because it acts as a workers' internal non-material motivator. Thus, in the provision of collective goods where workers' self-view as pro-social agents plays an important role, the design of optimal incentives may differ from the private sector where the weight of economic motives is higher.

Identity is related with person's self-image. How people think about they and the others should behave [29], [1, 2]. In a organization, identity, is the degree in which agents share organizational goals and objectives. At public organizational level, identity is a measure of

[1] Barney [4], Schein [28], Crémer [11], Lazear [20], Tirole [30], Carrillo and Gromb [9, 10], Hermalin [18] and, Rob and Zemsky [27]

[2] The effects of identity on economic decisions have been analyzed also by Sen [29], Wilson [31], Akerlof and Kranton [1, 2], Besley and Ghatak [8], Ghatak and Mueller [17] and Prendergast [24, 25].

how accurately workers identify themselves with the organization mission or goal of providing social valuable goods. Identity is the internalization of a culture by all the members of an organization and culture can be seen as the organizational goal or mission.

Our work integrates the concept of culture within identity. Identity means that workers' share organizational goals. Culture, in the present work, reflects to a situation in which identity becomes into a stable rule of behavior for all the members of the organization: to behave pro-socially exerting high effort at workplace. Thus identity can lead all the members of an organization to a high effort in oder to produce and provide society with socially valuable goods and services.

The economic literature have analyzed the role of workers' identity and its consequences within firms. But economics has not explain how this identity affects to organizational outcomes and decisions when the organization (principal) may alter workers' (agents) identity. There is a lack of research that incorporates the process of changing identity principal-agent games. In Akerlof and Kranton [1] for instance, they point out the possibility of changing agents identity as a way that allows organizations to get economic benefits. But authors, neither formalize this process nor incorporate it into their model.

Trying to move a step forward from the literature we propose a model in which workers' identity may be altered as a result of *socialization*. Socialization is the process through which organizations can change workers' identity. As a result of socialization workers' and organization's goals and objectives get aligned. By contrast, conflict will be the process that lead workers to be completely disagree from organizational goals. Socialization can be launched by organization's managers carrying out certain investments and actions which promote a sense of mission, shared culture, or common objectives through and among workers. This approach allow us to measure what Akerlof and Kranton [1] call as *motivational capital.* That is, the current value of the stream of the expected costs saved by the organization when principal invests a given amount of resources to improve workers' identity. Once we measure this value of the motivational capital we can establish the conditions under which Firms and organizations might benefit from investing in motivational capital.

The present work analyzes the effects of workers' identity in the economics of organizations. We are particularly interested in public organizations whose principal activity is the provision of collective goods such as education, health, civil safety, social work, etc. Can workers' identity be considered another productive asset of public organizations? If so, how should public organizations' managers design incentive schemes in order to benefit from this *Motivational Capital*? Then, could identity be the key to avoid shirking in public organizations? In order to answer these questions we incorporate into a principal-agent model, the possibility to influence public workers' (agents) identity with the use of incentives. We assume that including some motivational investments in contracts, public organizations may affect positively their employees' identity.

2 The Model

We want to analyze the optimality of contracts in a principal agent model in which the principal may provoke changes in agents' identity through incentives and *identity investments*. We want to capture in the model whether the possibility of changing agents' identity may influence optimal incentive contracts. In the present section of the paper we define the game and we solve it. Then we make comparative statics to draw some interesting results.

2.1 Players' Preferences and Utilities.

There are two players in the game: the agent $\mathcal{A}$ and the principal $\mathcal{P}$[3]. We assume that $\mathcal{A}$ can develop identity. We also restrict the analysis to linear contracts.

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

We model a finite period $t = 0, 1, ..., T, ...$ principal-agent dynamical game where the agents' effort is private information. Agents' behaviour is affected by identity. We incorporate identity into $\mathcal{A}$'s utility function. Identity is a non-monetary source of motivation that affects agents' preferences. Identity also can be altered or changed by principal's choices.

2.1.1 Principal

In our model there is a performance measure q_t that $\mathcal{P}$ wants to optimize in each $t = 0, 1, 2, \ldots, T, \ldots$. Performance q_t is a function of $\mathcal{A}$s' effort $e_t \in \{\underline{e}, \overline{e}\}$. Assume that $q_t \in \{\overline{q}, \underline{q}\}$ where $\overline{q} > \underline{q}$; interpret $\overline{q}$ as $\mathcal{P}$'s target on performance level and $\underline{q}$ as a fail in this target. Let $p(q_t = \overline{q}|e_t) = \theta_i$ be the probability of high performance conditional to $\mathcal{A}$'s effort choice. We use $i = 0, 1$ to label low and high effort: 0 means low effort $\underline{e}$ and 1 means high effort $\overline{e}$. Then $p(q_t = \overline{q}|e_t = \overline{e}) = \theta_1$ will be the probability of high performance when the agent decides to exert high effort, and $p(q_t = \overline{q}|e_t = \underline{e}) = \theta_0$ the probability of high performance when the agent decides to exert low 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 high and low respectively. We assume that performance q_t is an informative but noisy signal of e_t which means that $\theta_1 > \theta_0$.

The principal may use monetary incentives –"carrots and sticks"– or non-monetary incentives –"identity investments"– to maximize q_t or performance. We assume that, regardless agents shirk or not, $\mathcal{P}$ always expects higher profit from high performance level. Formally,

$$\theta_i\big(R_t(\overline{q}_t) - \overline{w}_t^{s_0}\big) > (1 - \theta_i)\big(R_t(\underline{q}_t) - \underline{w}_t^{s_0}\big) \text{ where } s_0 = \{0, S\} \text{ and } i = \{0, 1\}.$$

Despite q_t is a target outcome for $\mathcal{P}$ it is not necessarily the only one for $\mathcal{A}$. This condition of disconnection may be the reason for using incentives in order to achieve high performance.

Let $R_t(q_t)$ be a function which assigns a monetary value to the performance level[4]. $R_t(q_t)$ is positively correlated with the achieved social welfare, the total amount of the collective good or service delivered, and the sort of measures which are salient and observable by the electorate, tax payers and political advisors to evaluate the public supply of collective goods.

Let $E[R_t(q_t)|\theta_i]$ be the expected material rewards for $\mathcal{P}$. Rewards depend on performance q_t. Performance is conditional to θ_i. Let $w_t(q_t)$ be the monetary payments offered by $\mathcal{P}$ to $\mathcal{A}$. Payments are contingent to performance. Let $E[w_t(q_t)|\theta_i]$ be the expected monetary payment that $\mathcal{P}$ offers to $\mathcal{A}$ which is also an expected monetary cost for $\mathcal{P}$. Let s_0 be the total amount of resources invested to promote and change $\mathcal{A}$'s identity. Like any other investment, we assume that $\mathcal{P}$ faces an initial investment cost of $C_0 = \{0, S\}$ at $t = 0$. If $\mathcal{P}$ decides to make *identity investments* $s_0 = S$, he will face the future depreciation cost of such investments in the following periods. We capture this depreciation cost stream with the cost function $C_t(s_0)$.

All the above describes $\mathcal{P}$'s expected profit function Π_t for each period t that can be written as,

$$\Pi_t = E[R_t(q_t)|\theta_i, \upsilon_t] - E[w_t(q_t)|\theta_i, \upsilon_t] - C_t(s_0) \tag{2.1}$$

In equation 2.1 the cost function $C_t(s_0)$ 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 depreciation rate γ.

[4]Usually for the firm this monetary value is determined by the market price and the quantity sold. But in the case of the public provision of collective goods the absence of markets and market prices makes hard to measure the monetary value of q_t. We can interpret this function as one which calculate the opportunity cost of public supplying rather than market supplying

2.1.2 Agent

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

$$\mathcal{U}_t = \underbrace{E[u_t(w_t(q_t))|\theta_i]}_{\text{Expected utility from income}} - \underbrace{\psi_t(e_t, \overbrace{\upsilon_t(s_0)}^{\text{Identity}})}_{\text{Disutility from effort}} \tag{2.2}$$

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

The second term on the right hand side of the expected utility function represents the disutility from effort $\psi_t(e_t, \upsilon_t(s_0))$. The disutility from effort depends positively on effort and negatively on $\upsilon_t(s_0)$ which is a function representing $\mathcal{A}$'s identity. 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 in its second argument when $e_t = \overline{e}$. 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 $\psi_t(\overline{e}, \underline{\upsilon}) = \Psi$, with $\Psi \in \mathbb{R}_+$.*

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 develops identity. Contrary, when she has no identity, $\mathcal{A}$ experiences the maximum disutility from effort and she only can diminish this disutility making low effort.

2.1.3 Agent's Identity: Information

At the first period of the game, $\mathcal{P}$ learns $\mathcal{A}$s' identity probability distribution $F_0(\upsilon_0)$[5]. $\mathcal{P}$'s action over s_0 affects the $\mathcal{A}$'s identity. Then, conditional to his identity investment choice $s_0 = \{0, S\}$, $\mathcal{P}$ have to update the $\mathcal{A}$s' identity distribution $F_t(\upsilon_t|s_0)$ in the subsequent periods of the game $t = 1, ..., T, ...$ where $t \in \mathbb{N}$.

2.2 The Game

The game is a repeated game with two players: the agent $\mathcal{A}$, and the principal $\mathcal{P}$. We consider a recontracting game in which every period both players have to play again: $\mathcal{P}$ must offer a new contract and $\mathcal{A}$'s has to accept or reject the contract and choose effort level. We analyze this repeated principal agent game with moral hazard, where the choices made by the $\mathcal{P}$ affects $\mathcal{A}$'s identity. Reciprocally these changes in identity and motivation affect the contracts offered by $\mathcal{P}$ in the next period.

2.2.1 Timing

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

The sequence of stages within each period $t = 0, 1, 2, ...$ is as described below:

(0): The principal $\mathcal{P}$ learns the distribution of $\mathcal{A}$s' identity $F_0(\upsilon_0)$ in $t = 0$ or updates $\mathcal{A}$s' identity distribution $F_t(\upsilon_t|s_0)$ in $t = 1, 2, ...$ taking into account his choice of $s_0 \in \{0, S\}$ in $t = 0$. Then, $\mathcal{P}$ offers a contract conditional to the expected value of $\mathcal{A}$'s identity. The contract consists in a dupla of stochastic contingent payments $w_0(q_0) = \{\underline{w}, \overline{w}\}$ and the decision to invest or not in socialization $s_0 \in \{0, S\}$ in $t = 0$: $\{w_0(q_0), s_0\}$. In $t = 1, 2, \ldots$

[5] 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.

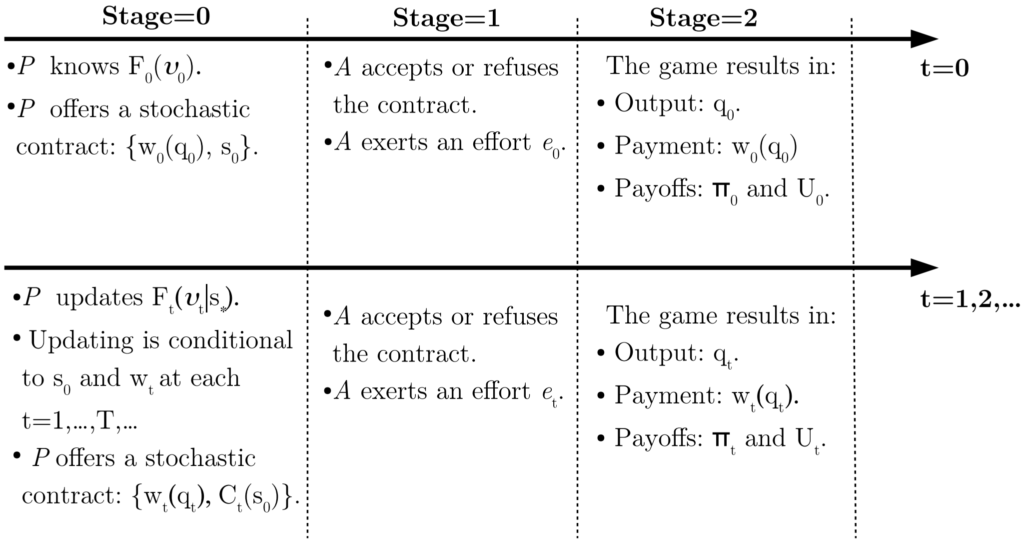

Figure 1: The timing of the game in two separate sequences, $t = 0$ and $t = 1, 2, ...$

a contract consists in a dupla of stochastic contingent payments $w_t(q_t) = \{\underline{w}, \overline{w}\}$ and the commitment of bearing the cost of depreciation of the $s_0 \in \{0, S\}$ investment, $C_t(s_0) = \gamma s_0$. We refer to this contract with $\{w_t(q_t), C_t(s_0)\}$.[6]

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

2.2.2 Identity and Socialization

Agents only differ in their identity. For all of them, their skills and qualification for work is the same. They are equally productive in the production of q_t. Therefore, $\mathcal{P}$ only deals with *moral hazard* because the differences in identity does not involve any difference in agents'

[6]The inclusion of the depreciation cost in every period into the contract, can be interpreted as an instrument used by $\mathcal{P}$ to signal the nature of the incentives offered by him to exert effort from agents: socialization incentives or pure economic transaction incentives.

ability for the production of q. $\mathcal{A}$'s identity distribution is assumed to be known by $\mathcal{P}$.

Contracts and incentives offered by the principal may influence agent's identity. Agent's identity can take a value within some closed interval $\upsilon \in [\underline{\upsilon}, \overline{\upsilon}]$, with $\underline{\upsilon} < \overline{\upsilon}$ and $\upsilon \in \mathbb{R}^+$. In the model higher identity means lower disutility from effort. Thus, we can anticipate that an agent with higher identity needs less monetary incentives to exert high effort. However, the only use of monetary incentives by the principal will involve a higher amount of money offered to $\mathcal{A}$ period after period. This is so because the agent will experience more disutility from effort as mean as she looses his identity.

What we want to capture with the socialization process[7] is $\mathcal{P}$'s ability to influence and change agents' identity carrying out investments in the organization which signal support and awareness toward agents or workers. Activities, meetings and events organized by the organization to set its employees organizational minded, participation of workers in organization's decisions, to agree organizational objectives jointly with workers, setting organization's internal rules of behavior through democratic processes, the design of workteams of employees to represent organization in exhibitons, congresses or conferences, training programs and further education to employees, housing facilities, employees' children schooling facilities, high school or university scholarships to employees' children or the priority to hire the sons and relatives of organization's employees might be some good examples of such investments. Thus, influencing $\mathcal{A}$s' identity with such investments, $\mathcal{P}$ lead them to share the organization's goals and also to be involved with organization. Then, if $\mathcal{P}$ chooses to invest $s_0 = S$ he will switch $\mathcal{A}$s' identity to a higher level and agents will experience less disutility from effort. But if he decides not to invest, $s_0 = 0$, then agents will switch to lower identity, they will be lead to conflict and in such situation they will experience high disutility from exerting effort at workplace.

[7]See Adler and Bryan [3]

To make the last more understandable think in the following opposed situations: in the firm X workers are treated kind by management, supported in their needs not only at work but also at home and in general. Also they are supported in their personal, professional, intellectual, or human development, and encouraged to be participative, responsible, collaborative and proactive in leading organization to achieve their goals. In the firm Y workers are monitored, controlled at their workplace, left out of every decision process whithin the firm, uninformed of organization's goals and pushed to achieve the desired performance only with the use of monetary bonuses or punishments. Then itwill be normal to expect that in the firm X, all its members work harder, more efficiently, more motivated to achieve high standards of quality in production, and more implicated with customers, dealers and suppliers than in the firm Y, independently of they are remunerated with the same, even less, amount of money.

2.2.3 Solving Principal's Problem

In the game $\mathcal{A}$ and $\mathcal{P}$ have to renegotiate contracts period after period. This assumption turns the game into a dynamic *re-contracting* game. Then the game is able to be solved implementing the spot contract in each period. In order to make the vector of the spot contracts as the long term optimal solution we have to assume that 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,

$$Max_{\{w_t(q_t),s_0\}} \quad \alpha_t \cdot \big[E[R_t(q_t)|\theta_0] - E[w_t(q_t)|\theta_0]\big]\Big]$$

$$+ \Big[(1-\alpha_t) \cdot \big[E[R_t(q_t)|\theta_1] - E[w_t(q_t)|\theta_1]\big]\Big] - C_t(s_0) \tag{2.3}$$

Subject to:

$$E[u_t(w_t(q_t)|\theta_1)] - \psi_t(\overline{e}, \upsilon_t) \geqslant E[u_t(w_t(q_t)|\theta_0)] - \psi_t(\underline{e}, \upsilon_t) \text{ (ICC)} \tag{2.4}$$

$$E[u_t(w_t(q_t)|\theta_1)] - \psi_t(\overline{e}, \upsilon_t) \geqslant \overline{U} \quad \text{(PC)} \tag{2.5}$$

$$u_t(\underline{w}) \geqslant 0 \iff w_t(\underline{q}) \geqslant 0 \iff h(u_t(\underline{w})) \geqslant 0 \quad \text{(LLC)} \tag{2.6}$$

(2.3) is the objective function for the principal. $\mathcal{P}$ does not know each agent identity. He only knows agents' identity distribution. Using this information, he offer a contract that satisfies the incentive compatibility of agents with average level of identity $E_t[\upsilon_t|s_0] = \upsilon_t^{avg}$. Then, only agents with identity above the average level will exert high effort and the rest shirk. (2.3) is weighted by $P_t(\upsilon_t < \upsilon^{avg}|s_0) = \alpha_t$ and $P_t(\upsilon_t \geqslant \upsilon^{avg}|s_0) = (1 - \alpha_t)$ to capture this feature of the game. The first, is the probability that the identity of the $\mathcal{A}$ is lower than the average level and the second, is the probability that the agent identity is higher or equal to the average level, both conditional to $\mathcal{P}$'s decision $s_0 = \{0, S\}$.

(2.4) is $\mathcal{A}$'s *incentive compatibility constraint* (ICC), and ensures that the agent will prefer to exert high effort. (2.5) is the $\mathcal{A}$'s *participation constraint* (PC), and ensures that the agent will prefer to participate and accept the contract. Finally, (2.6) is a *limited liability constraint* (LLC), and ensures that the low payment never falls below zero level.

$\mathcal{P}$'s problem is solved for each t. The solution for each period t consist in a payment function $w(q) : q \longrightarrow w$

$$w(q) = \begin{cases} \overline{w} & \text{if} \quad q = \overline{q} \\ \underline{w} & \text{if} \quad q = \underline{q} \end{cases}$$

where $\overline{w} > \underline{w}$.[8] In the next section we will analyze the conditions under which to offer socialization incentives and invest in changing $\mathcal{A}$s' identity is optimal for $\mathcal{P}$. From now in

[8]The calculation of these contingent payments is formally shown in the mathematical appendix, section A.2

advance we just show the pair of payments which solves the spot contracting problem. Let $h : u \longrightarrow w$ be the inverse function of the utility function,

$$h(u) = \begin{cases} \overline{w} & \text{if} \quad u = \overline{u} \\ \underline{w} & \text{if} \quad u = \underline{u} \end{cases}$$

Applying the variable change $w = h(u(w(q))) = (u(w(q)))^{-1}$ we have the following payments,

$$\overline{w}_t = h(u_t(\overline{w})) = \left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0))\right)^{-1} \tag{2.7}$$

$$\underline{w}_t = h(u_t(\underline{w})) = \left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0))\right)^{-1}. \tag{2.8}$$

As it can be seen, identity lowers $\overline{w}$ and raises $\underline{w}$. To establish a more precise a relation between identity and incentive payments it is necessary to analyze how identity and the disutility from effort interacts each with the other. Also it is necessary to analyze how socialization affects workers' identity and how these changes affects future stochastic contingent payments. Once these interactions are established we can calculate principal's expected costs and profits and then analyze the possible outcomes of the game.

$\mathcal{P}$ can not perfectly discriminate agents attending their identity. $\mathcal{P}$ only knows the distribution of identity. Then, he updates such distribution at every period taking into account his own past behavior and knowing how the socialization process works. After updating $\mathcal{A}$s' identity distribution, $\mathcal{P}$ is able to offer a new contract based on the expected identity of agents[9]. Thus, at every period of the game, $\mathcal{P}$ must offer a new pair of expected

[9]This solution is suboptimal compared with the first best solution where effort level and identity are perfectly observable. Also is more far away from the first best solution than the second best solution in which only the effort is unobservable but identity doesn't play any role.

payments adjusted to agents' expected identity,

$$\overline{w}_t(E[\upsilon_t|s_0]) = \left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1} \tag{2.9}$$

$$\underline{w}_t(E[\upsilon_t|s_0]) = \left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E[\upsilon_t|s_0])\right)^{-1}. \tag{2.10}$$

We write the Expected Cost Function for $\mathcal{P}$ at each t,

$$EC_t = \alpha_t \cdot \left[\theta_0\overline{w}_t(E[\upsilon_t|s_0]) + (1-\theta_0)\underline{w}_t(E[\upsilon_t|s_0])\right]$$

$$+ (1-\alpha_t) \cdot \left[\theta_1\overline{w}_t(E[\upsilon_t|s_0]) + (1-\theta_1)\underline{w}_t(E[\upsilon_t|s_0])\right] + C_t(s_0) \tag{2.11}$$

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

$$EC_t^0 = \alpha_t \cdot \left[\theta_0\overline{w}_t(E[\upsilon_t|0]) + (1-\theta_0)\underline{w}_t(E[\upsilon_t|0])\right]$$

$$+ (1-\alpha_t) \cdot \left[\theta_1\overline{w}_t(E[\upsilon_t|0]) + (1-\theta_1)\underline{w}_t(E[\upsilon_t|0])\right] \tag{2.12}$$

$$EC_t^S = \alpha_t \cdot \left[\theta_0\overline{w}_t(E[\upsilon_t|S]) + (1-\theta_0)\underline{w}_t(E[\upsilon_t|S])\right]$$

$$+ (1-\alpha_t) \cdot \left[\theta_1\overline{w}_t(E[\upsilon_t|S]) + (1-\theta_1)\underline{w}_t(E[\upsilon_t|S])\right] + C_t(S) \tag{2.13}$$

Now we introduce into the analysis the earnings of $\mathcal{P}$ expressed by the function $R_t(q_t)$. We take the earnings in expected terms due $\mathcal{A}$'s identity hetereogeneity captured by the conditional distribution function $F_t(\upsilon_t|s_0)$, and also due to the stochastic effort-peformance relation captured with $\theta_i \in [0, 1]$ probabilities. We can express the expected earnings of $\mathcal{P}$ as follows,

$$E[R_t(q_t)|\theta_i, \upsilon_t] = \alpha_t \cdot E[R_t(q_t)|\theta_0] + (1-\alpha_t) \cdot E[R_t(q_t)|\theta_1] =$$

$$\Big[\alpha_t \cdot \big[\theta_0 R_t(\bar{q}) + (1-\theta_0) R_t(\underline{q})\big]\Big] + \Big[(1-\alpha_t) \cdot \big[\theta_1 R_t(\bar{q}) + (1-\theta_1) R_t(\underline{q})\big]\Big]$$

We also write the *Expected Revenue Function* conditional to $\mathcal{P}$'s action,

$$ER_t^0 = \Big[\alpha_t \cdot \big[\theta_0 R_t(\bar{q}) + (1-\theta_0) R_t(\underline{q})\big]\Big] + \Big[(1-\alpha_t) \cdot \big[\theta_1 R_t(\bar{q}) + (1-\theta_1) R_t(\underline{q})\big]\Big]$$

$$ER_t^S = \Big[\alpha_t \cdot \big[\theta_0 R_t(\bar{q}) + (1-\theta_0) R_t(\underline{q})\big]\Big] + \Big[(1-\alpha_t) \cdot \big[\theta_1 R_t(\bar{q}) + (1-\theta_1) R_t(\underline{q})\big]\Big]$$

Finally we write the *Expected Profits Function*, also conditional to $\mathcal{P}$'s choice over s_0,

$$E\Pi_t^0 = ER_t^0 - EC_t^0 = \alpha_t \cdot \Big[\theta_0 \big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|0])\big) + (1-\theta_0)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|0])\big)\Big]$$

$$+ (1-\alpha_t) \cdot \Big[\theta_1 \big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|0])\big) + (1-\theta_1)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|0])\big)\Big] \tag{2.14}$$

$$E\Pi_t^S = ER_t^S - EC_t^S = \alpha_t \cdot \Big[\theta_0 \big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|S])\big) + (1-\theta_0)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|S])\big)\Big] - C_t(s_0)$$

$$+ (1-\alpha_t) \cdot \Big[\theta_1 \big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|S])\big) + (1-\theta_1)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|S])\big)\Big] + C_t(S) \tag{2.15}$$

Identity can be considered another productive asset of the organization that we call *Motivational Capital.* Confronting $\mathcal{P}$'s expected profits from using socialization incentives Π_t^S, with his expected profits from using monetary incentives Π_t^0, in every period $t = 0, 1, 2, \dots,$ we can measure the return of investing in motivational capital. This return is calculated as the present value of the stream of the differences in expected profits obtained by the principal. Formally,

$$CNV^{mk} = \sum_{t=0}^{T} \delta^t \left[E\Pi_t^S - E\Pi_t^0\right] \tag{2.16}$$

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 $CNV^{mk} \geqslant 0$ and we say that, there is no incentive to invest in motivational capital when $CNV^{mk} < 0$.

3 Results

To obtain results first we calculate the spot contract's cost, the organization profits and agents utilities for every $t = 0, 1, ..., T, ...$ Then we confront the case in which $\mathcal{P}$ chooses to use socialization incentives to change $\mathcal{A}$s' identity $s_0 = S$ with the case in which $\mathcal{P}$ chooses to use only monetary incentives $s_0 = 0$. Finally we present some results drawn from comparative statics in the last subsection. We also discuss on some conclusions.

3.1 Identity Incentives and Socialization: Investment in Motivational Capital

Consider the case in which the principal chooses to use identity incentives $s_0 = S$. In this case the principal tries to benefit from investing in motivational capital. The spot payments at every t are,

$$\overline{w}_t^S(E_t[\upsilon_t|S]) = h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right) \tag{3.1}$$

$$\underline{w}_t^S(E_t[\upsilon_t|S]) = h\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|S])\right) \tag{3.2}$$

At $t = 0$ payments will be,

$$\overline{w}_t(E_0[\upsilon_0]) = h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_0(\overline{e}, E_0[\upsilon_0])\right) \tag{3.3}$$

$$\underline{w}_t(E_0[\upsilon_0]) = h\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_0(\overline{e}, E_0[\upsilon_0])\right) \tag{3.4}$$

Payments at $t = 0$ are equal independently of using socialization incentives $s_0 = S$ or pure monetary incentives $s_0 = 0$. This is so because at the starting period of the game the socialization effect can not have occurred yet. For the case of $s_0 = S$ we will write the spot expected profit function for the principal as follows,

$$E\Pi_t^S = ER_t^S - EC_t^S = \alpha_t \cdot \Big[\theta_0\big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|S])\big) + (1-\theta_0)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|S])\big)\Big]$$

$$+ (1-\alpha_t) \cdot \Big[\theta_1\big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|S])\big) + (1-\theta_1)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|S])\big)\Big] - C_t(S) \qquad (3.5)$$

Now we calculate either, the spot expected utility $\mathcal{U}_t^S$ for an $\mathcal{A}^h$ who have an identity $\upsilon_t^h > \upsilon_t^{avg}$ and chooses $e_t = \overline{e}$ and also the spot expected utility for an $\mathcal{A}^l$ who have an identity $\upsilon_t^l \leqslant \upsilon_t^{avg}$ and chooses $e_t = \underline{e}$.

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

$$+ (1-\theta_1)\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t\big(\overline{e}, E_t[\upsilon_t|S]\big)\right) - \psi_t\big(\overline{e}, \upsilon_t^h(S)\big) \quad \text{and,} \qquad (3.6)$$

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

$$+ (1-\theta_0)\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t\big(\overline{e}, E_t[\upsilon_t|S]\big)\right) - \psi_t\big(\underline{e}, \upsilon_t^l(S)\big) \qquad (3.7)$$

Finally, we compute the present value of the sum of spot profits and the sum of the spot utilities, and also the expression which measures the present value of the total surplus TS^S when $\mathcal{P}$ action is $s_0 = S$.

$$\Gamma^S = \sum_{t=0}^{T} \delta^t \Pi_t^S = \sum_{t=0}^{T} \delta^t \Big[ER_t^S - EC_t^S\Big] \qquad (3.8)$$

$$\Lambda^S = \sum_{t=0}^{T} \delta^t \Big[\alpha_t \cdot \mathcal{U}_t^{S,l} + (1-\alpha_t)\cdot \mathcal{U}_t^{S,h}\Big] \qquad (3.9)$$

$$TS^S = [\Lambda_t^S + \Gamma^S] \qquad (3.10)$$

3.2 *Agents in Conflict: No-investment in Motivational Capital*

In this section we analyze the no investment case or $s_0 = 0$. In this case $\mathcal{P}$ does not invest any amount of resources to promote $\mathcal{A}$'s identity. The mere use of monetary incentives to control $\mathcal{A}$s' behavior will put agents into conflict toward organization. For this case spot payments are,

$$\overline{w}_t^0(E_t[\upsilon_t|0]) = h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right) \tag{3.11}$$

$$\underline{w}_t^0(E_t[\upsilon_t|0]) = h\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right) \tag{3.12}$$

Payments in $t = 0$ are exactly the same as those described in the previous subsection. taking the expected costs, EC_t^0 into account we can calculate the spot expected profit Π_t^0 for $\mathcal{P}$.

$$E\Pi_t^0 = ER_t^0 - EC_t^0 = \alpha_t \cdot \Big[\theta_0\big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|0])\big) + (1-\theta_0)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|0])\big)\Big]$$

$$+ (1-\alpha_t) \cdot \Big[\theta_1\big(R_t(\bar{q}) - \overline{w}_t(E[\upsilon_t|0])\big) + (1-\theta_1)\big(R_t(\underline{q}) - \underline{w}_t(E[\upsilon_t|0])\big)\Big] \tag{3.13}$$

Then we also can calculate the spot expected utility $\mathcal{U}_t^0$ for an $\mathcal{A}^h$ agent who have an identity $\upsilon_t^h > \upsilon_t^{avg}$ and chooses $e_t = \overline{e}$, and for an agent $\mathcal{A}^l$ who have an identity $\upsilon_t^l \leqslant \upsilon_t^{avg}$ and chooses $e_t = \underline{e}$.

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

$$+ (1-\theta_1)\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, E_t[\upsilon_t|0])\right) - \psi_t(\overline{e}, \upsilon_t(0)) \quad \text{and,} \tag{3.14}$$

$$\mathcal{U}_t^{0,l} = \theta_0\left(\overline{U} + \tfrac{(1-\theta_0)}{\Delta\theta}\psi_t\big(\overline{e}, E_t[\upsilon_t|0]\big)\right)$$

$$+ (1-\theta_0)\left(\overline{U} - \frac{\theta_0}{\Delta\theta}\psi_t\big(\overline{e}, E_t[\upsilon_t|0]\big)\right) - \psi_t\big(\underline{e}, \upsilon_t^l(0)\big) \tag{3.15}$$

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 $s_0 = 0$.

$$\Gamma^0 = \sum_{t=0}^{T} \delta^t E_t \Pi_t^0 = \sum_{t=0}^{T} \delta^t \left(ER_t^0 - EC_t^0\right) \tag{3.16}$$

$$\Lambda^0 = \sum_{t=0}^{T} \delta^t \Big[\alpha_t \cdot \mathcal{U}_t^{0,l} + (1-\alpha_t)\big) \cdot \mathcal{U}_t^{0,h}\Big] \tag{3.17}$$

$$TS^0 = \left[\Lambda_t^0 + \Gamma_t^0\right] \tag{3.18}$$

3.3 Comparative statics

Our model shows that an agent with identity whithin the firm or public organization is willing to work hard at a high effort for a lower overall pay. This lower incentive requirement to foster high effort from agents represents a cost advantage of achieving high performance to the organization. When this cost advantage is high enough, it can be worthwhile for $\mathcal{P}$ to undertake a costly program to promote agents' identity.

Comparative statics of our model establish under which conditions agents' identity lead the organization to find profitable to invest in promoting identity among workers. If inculcating identity is low-cost, if output and agents' effort are weakly correlated (effort is hard to observe an hard to reward), if agents are especially risk averse or if high effort is critical to the organization's output, then the use of an identity incentive scheme will be more profitable and more likely to be used.

3.3.1 Identity and Motivational Capital

One very first result that it is straightforward to set, comes from the comparison between the current 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 *Current Net Value* of the $\mathcal{A}$'s motivational capital (CNV^{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 of the game. Let $K < T$ be number of periods large enough to allow socialization or conflict entirely happen. For a δ large enough and if $\theta_1 \overline{w}_K^0 + (1-\theta_1)\underline{w}_K^0 > \gamma S + h(\overline{U})$ there exists a threshold t^* such that,*

$$CNV^{mk} = \Gamma^S - \Gamma^0 = 0 \tag{3.19}$$

from which the following is concluded:

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

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

Figure 2 illustrate results of proposition 1. Figure 2 shows jointly as a function of time t, $\mathcal{P}$'s $E\Pi_t^{s_0}$, $ER_t^{s_0}$ and $EC_t^{s_0}$ in either case, when $\mathcal{P}$ choose $s_0 = 0$ or$s_0 = S$. A comparison between $E\Pi_t^S$ and $E\Pi_t^0$ and the discounted sum of the difference between these two functions CNV_t^{mk} are shown.

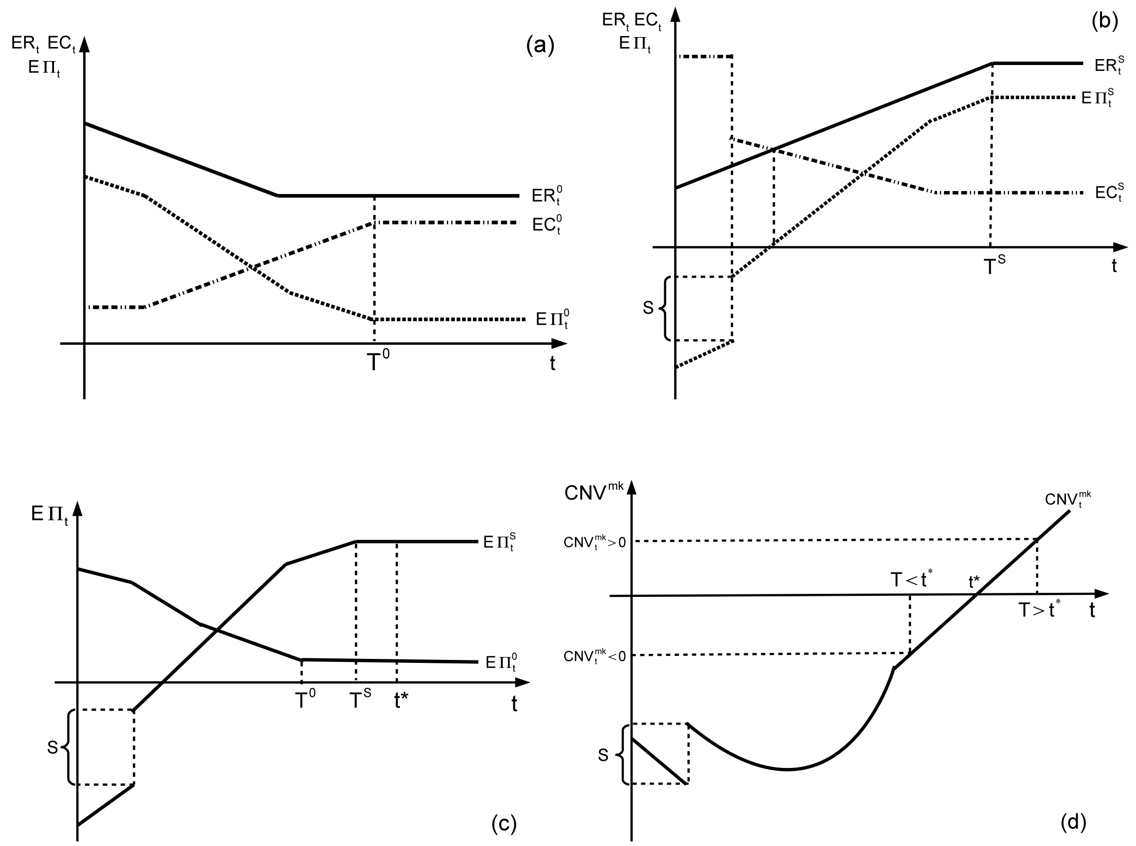

Figure 2: In the figure, first graph (a) shows the time evolution of ER^0_t, EC^0_t and $E\Pi^0_t$ in the case of pure monetary incentives $s_0 = 0$. T^0 represents the period in which the socialization process is completed and all the agents present an identity $\upsilon_{T^S} = \overline{\upsilon}$. Second graph (b) shows the time evolution of ER^S_t, EC^S_t and $E\Pi^S_t$ in the case of identity incentives $s_0 = S$. T^S represents the period in which the conflict process is completed and all the agents present an identity $\upsilon_{T^0} = \underline{\upsilon}$. Third graph (c) confront the time evolution of $\mathcal{P}$'s expected profits in each case, $s_0 = 0$, and $s_0 = S$. Finally, d) shows the time evolution of the current net value of the motivational capital CNV^{mk}_t, where the profitability threshold labelled with t^*, is the cutoff between CNV^{mk}_t function and x-axis.

The graph (d) down, on the right side of the figure 2 shows the value of the CNV^{mk} as a function of time t. Two cases are shown in the graph: socialization incentives $s_0 = S$ and pure monetary incentives $s_0 = 0$. The t^* threshold determines the critical point that states the optimal strategy for $\mathcal{P}$.

The motivational capital profitability threshold t^* is key for $\mathcal{P}$ in order to choose the optimal action. This threshold depends 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.

Now let us compare the total surplus of each strategy $s_0 \in \{0, S\}$ of $\mathcal{P}$, to analyze the cases in which all the members whithin an organisation are better off. The following proposition shows that the social optimum coincides with the optimal choice of $\mathcal{P}$. This is so, because incentive compatibility constraint (2.4) and participation constraint (2.5) ensure that for every choice $s_0 \in \{0, S\}$ of $\mathcal{P}$, and every $t = 0, 1, \ldots, T$ the expected utility required by $\mathcal{A}$ to exert high effort is the same. The only difference consists in the source from which $\mathcal{A}$ gets the utility. Depending on the $\mathcal{P}$'s choice over $s_0 \in 0, S$, $\mathcal{A}$ get utility from the economic incentive and identity with different weights although the total expected utility remains constant. Proposition 2 establishes, when a given strategy profile is socially optimun.

Proposition 2. *Let* $CNV^{mk} = TS^S - TS^0 = \sum_{t=0}^{T} \delta^t \left[EC_t^0 - EC_t^S\right]$. *Let* $\left(s_0, e_t\left(\upsilon_t^{l,h}\right)\right)$ *be the strategy profile that solves the game.*

i. If $CNV^{mk} \geqslant 0$, *then* $(S, \overline{e}^h, \underline{e}^l)$ *is a Pareto-Efficient strategy profile and Pareto-Dominates any other possible strategy profile:* $(S, \underline{e}^h, \underline{e}^l)$, $(0, \overline{e}^h, \underline{e}^l)$ *or* $(0, \underline{e}^h, \underline{e}^l)$.

ii. If $CNV^{mk} < 0$, then $(0, \overline{e}^h, \underline{e}^l)$ is a Pareto Efficient strategy profile and Pareto Dominates any other possible strategy profile: $(S, \overline{e}^h, \underline{e}^l)$, $(S, \underline{e}^h, \underline{e}^l)$ or $(0, \underline{e}^h, \underline{e}^l)$.

Proposition 2 then shows that in case of $CNV^{mk} \geqslant 0$ investing in motivational capital results optimal for the principal. High effort will be optimal for the agent whose identity is higher than average $\overline{e}^h$. The agent whose identity is low will shirk $\underline{e}^l$.Then, $(S, \overline{e}^h, \underline{e}^l)$ is the equilibrium strategy profile for the game and there is no chances to improve any of the players without necessarily worsening at least one of the others. Analogously, if $CNV^{mk} < 0$, then using pure monetary rewards is optimal for the principal. High effort choice will be optimal for the agent whose identity is high $\overline{e}^h$. The agent whose identity is low will shirk $\underline{e}^l$. Then, $(0, \overline{e})$ is the equilibrium strategy profile for the game, there is no chances to improve any player of the game without necessarily worsening at least one of the others.

3.3.2 The Role of the Depreciation Rate of Motivational Investment.

Profitability threshold t^* and time depreciation of the motivational investment that the principal must face to run a socialization incentives program γ, provide another interesting insight. Once the entire socialization effect or conflict effect has happened, principal finds crucial to balance two opposite effects: the higher profits from having agents with high identity in contrast with the additional costs he must face to run a socialization incentive policy. The first effect establish that $\theta_1(\overline{R} - \overline{w}_t^0) + (1 - \theta_1)(\underline{R} - \underline{w}_t^0) < \theta_1(\overline{R} - \overline{w}_t^S) + (1 - \theta_1)(\underline{R} - \underline{w}_t^S)$.

But, to lead agents' identity towards $\upsilon_t = \overline{\upsilon}$, $\mathcal{P}$ must face the consequent depreciation cost of using socialization incentives $C_t(S) = \gamma S$, in $t = 1, 2, \ldots$. Then depreciation cost rate γ becomes a key parameter to study the profitability of investing in motivational capital. As γ takes values closer to one, t^* becomes larger and is less likely for the principal to find profitable to invest in motivational capital.

In other words, in a context in which a principal $\mathcal{P}$, who have to reinvest a sufficiently high amount of resources $C_t(S) = \gamma S$ in $t = 1, 2, \ldots$, would not find that investment profitable because it would never be compensated by the savings generated from lower incentive requirements. To illustrate this case, assume that there is a maximum depreciation rate γ^+ above of which the *Current Net Value* of motivational capital never will reach a positive value. Then, investing in motivational capital will not be profitable at all. Proposition 3 summarize this result.

Proposition 3. *Let $K < T$ be number of periods large enough to allow socialization or conflict entirely happens. Where $\upsilon_K = \overline{\upsilon}$ if $s_0 = S$ and $\upsilon_K = \underline{\upsilon}$ if $s_0 = 0$. Taking S as constant, if $\gamma \geqslant \frac{\theta_1 \overline{w}^0_K + (1-\theta_1)\underline{w}^0_K - h(\overline{U})}{S}$, then $CNV^{mk} < 0$ for all $t = 1, 2, \ldots$ and $\mathcal{P}$ never will find profitable to invest in motivational capital.*

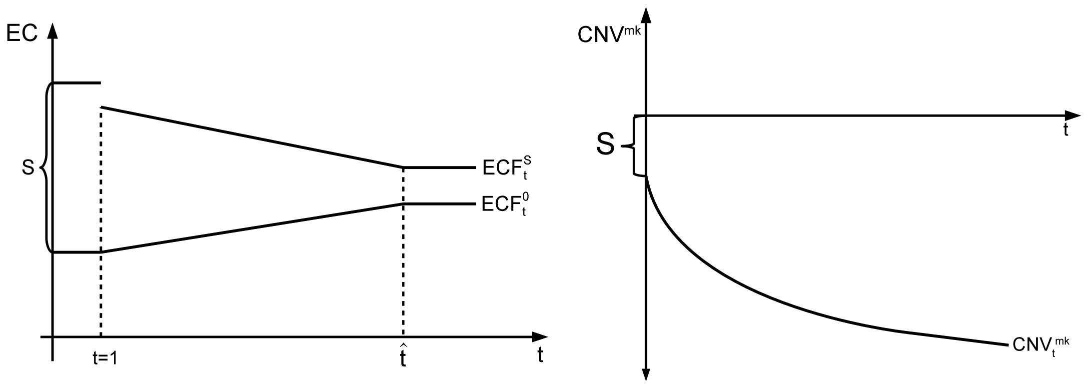

Figure 3: Negative Current Net Value of the Motivational Capital, $CNV^{mk} < 0$ due to high cost of depreciation γS.

Intuitively proposition 3 states that, there is no reason to spend resources to change workers' identity, neither in the short run nor in the long run, whenever $\mathcal{A}$s' identity is not large enough to cause an advantage in payments which offset the cost of promoting identity $\left(E[w^0_t - w^S_t|\theta_i, \alpha_t] < C_t(S)\right)$. This case have sense for organizations and jobs in which workers have to perform in bad work environment, doing nasty, exhausting and/or boring tasks, the work implicitly involves conflict of interests between the members of organization and is costly to change their identity.

However, we are more interested in the case in which identity is large enough to overcome the cost of generating it $E[w_t^0 - w_t^S|\theta_i, \alpha_t] > \gamma S$ at some time period $t' \in \{0, 1, \dots\}$. In this case $\mathcal{P}$'s expected savings from identity when is strictly increasing and bounded. Taken together with the assumption of a constant depreciation cost, γS we have that the optimality of investing in motivational capital becomes a matter of time. The time that the organization has to wait in order to get profits from identity changes, $CNV^{mk} > 0$, will be a function of the depreciation rate value γ. Proposition 4 shows such a relation.

Proposition 4. *Let $j = \{A, B\}$ be two alternative actuations to foster agents' identity with γ_A and γ_B associated depreciation costs such that $\gamma_A < \gamma_B$. Let $t = t'_j$, $t'_j \in \{0, 1, \dots\}$ be the time periods in which the change in agents' identity reach a value such that $E\left[w^0_{t'_j} - w^S_{t'_j}|\theta_i, \alpha_t\right] \geqslant \gamma_j S$. Let $t = t^*_j$, $t^*_j \in \{0, 1, \dots\}$ be the number of time periods in which $CNV^{mk}_j = 0$. Then $t'_A < t'_B$ and $t^*_A < t^*_B$.*

Figure 4 illustrates the result of the proposition 4. In situations in which investing in motivational capital is profitable. Then, those actuations or investments with higher depreciation costs will require a higher number of periods in order to generate positive returns. In other words, when changing agents' identity requires more resources (obstinate agents, distrustful agents,...), investing in motivational capital will be less likely to be optimal. Organizations with high rotation rate of employees is a particular case of this result.

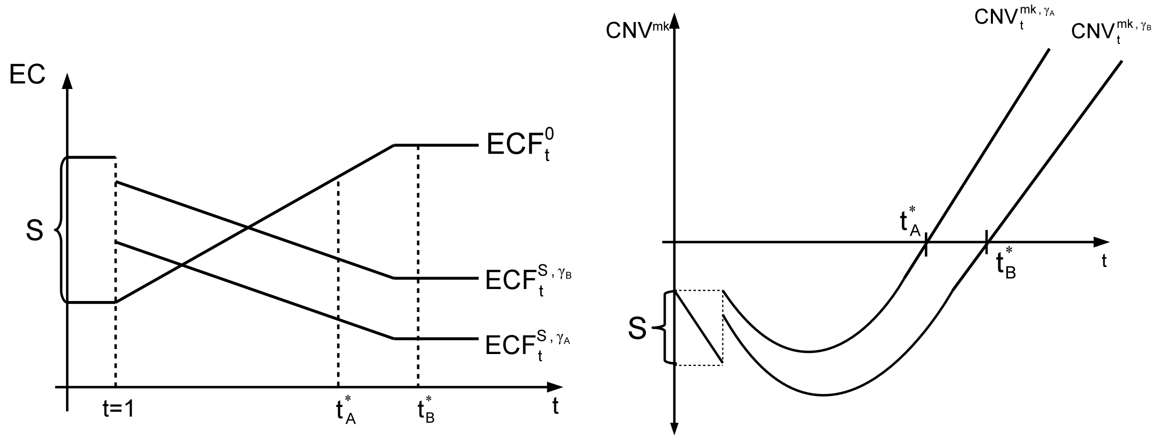

Figure 4: Current Net Value of Motivational Capital with two different depreciation rates γ_A and γ_B such that $\gamma_A < \gamma_B$.

3.3.3 Effort Effectiveness and Motivational Capital

The parameter $\theta_i \in [0, 1]$ measures $\mathcal{A}$'s effort effectiveness, where $i = 0, 1$ serve to distinguish low effort action and high effort action respectively. θ_i measures the probability of achieving high performance conditional on $\mathcal{A}$'s effort choice. We say that θ_i is informative if $\theta_1 > \theta_0$. As mean as the value of θ_0 approaches to θ_1, $\mathcal{P}$ must offer higher incentives to force $\mathcal{A}$ to exert high effort. This is what literature in economics of information calls *agent's rent extraction power*. In words, to make shirking costly enough in order to incentivize $\mathcal{A}$ to high effort will result more expensive as mean as performance is more noisy signal of effort.

Then pure monetary incentives results too expensive when the signal used to link payments to effort is hard to observe and hard to reward. In such cases, $\mathcal{P}$ will find optimal to invest in motivational capital $s_0 = S$ more likely. Although investing in motivational capital is costly $C_t(S)$, $\mathcal{P}$ will reduce payment costs because workers with identity do not need monetary incentives to exert high effort (at least not as high as those of the workers without identity). If θ_0 implies higher monetary incentives, then potential savings from implementing $s_0 = S$ strategy will be very high and the current net value, CNV^{mk} becomes positive earlier.

Proposition 5. *Higher values of θ_0 implies higher values of CNV_t^{mk} for every $t = 0, 1, \ldots, T, \ldots$. Then, investing in motivational capital is more profitable for $\mathcal{P}$, when performance is a more random signal about $\mathcal{A}$'s effort level.*

Proposition 5 shows that as higher is the probability of achieving high performance when the effort is low, $p(q = \overline{q}|e = \underline{e}) = \theta_0$, then more profitable will be for $\mathcal{P}$ to invest in motivational capital $s_0 = S$[10].

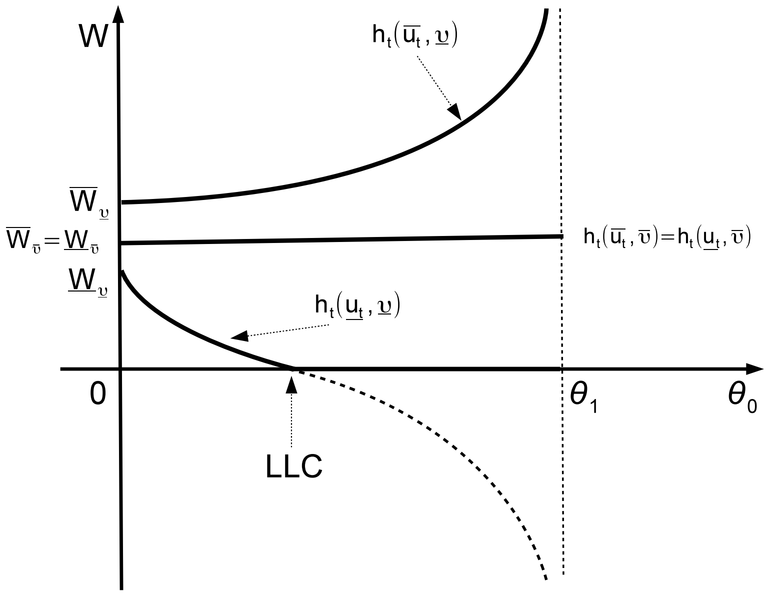

Figure 5: Information and motivational capital. As figure shows, values of θ_0 closer to θ_1 makes motivational investments more profitable for $\mathcal{P}$. A worse signal of effort increases $\mathcal{A}$'s rent extraction power so much that the expected savings from having workers with identity exceed the costs of investing in otivatonal capital. With $\upsilon_t = \underline{\upsilon}$ the low payment $h(\underline{u}_t, \underline{\upsilon})$ goes to 0 (LLC) when θ_0 approaches θ_1 and the high payment $h(\overline{u}_t, \underline{\upsilon})$ goes to infinity. However, if $\upsilon_t = \overline{\upsilon}$ the payment remains constat independently of the value of θ_0.

Figure 5 shows how the high payment grow towards infinity and the low payment falls up to 0 (LLC) as θ_0 approaches to θ_1. However, having agents with identity implies that no incentive payments are needed to elicit them to exert high effort and then, the savings

[10]This result is consistent with what Akerlof and Kranton (2005) state about identity as motivating for work. *[...] a change in identity is the ideal motivator if, [...] the effort of a worker is either hard to observe or hard to reward.*(p. 10)

from having workers with identity will be so large that compensate the cost of socialization investments.

3.3.4 Agents' Risk Aversion and Motivational Capital

In the model, agents are risk-averse with respect to their monetary earnings. They perceive utility from incentives which consists in contingent payments $w_t(q_t)$. But agents also experience utility from identity. As mean as agent's identity increases, fewer incentives are required in order to encourage him to exert high effort. Less variation in payments indicates that $\mathcal{A}$ must be compensated with a lower risk premium. Then, as $\mathcal{A}$s' identity increases, incentives fall and this constitutes another cost-saving source for the organization.

Proposition 6 formally states that investing in motivational capital is more profitable in the presence of risk-averse $\mathcal{A}$.

Proposition 6. *Let $\mathcal{A}_1$ and $\mathcal{A}_2$ be a pair of agents with υ_1 and υ_2 identity respectively. If agents are risk-averse and $\upsilon_1 < \upsilon_2$, then incentives will be lower in the case of $\mathcal{A}_2$ than in the case of $\mathcal{A}_1$. Therefore $t_1^* > t_2^*$ and $\mathcal{P}$ will find more profitable to invest in motivational capital when agents are more risk averse.*

The intuition behind this result is that incentives must be greater in order to encourage high effort from agents without identity. Lower identity enlarge the different between low $\underline{w}$ and high $\overline{w}$ incentive payments. Given that $\mathcal{A}$ is risk averse, the risk premium that $\mathcal{P}$ should offer to reach the certainty equivalent will result higher. Analogously, agents with identity will require fewer incentives to exert high effort. Consequently, an agent with high identity has to bear a lower variance over payments and has to be compensated with a lower risk premium. Thus identity generates savings for $\mathcal{P}$.

4 Conclusion

We introduce the notion of identity in a model of principal agent with moral hazard. Incentives beyond the money can be an alternative option to money incentivization in order to encourage agents towards exerting high effort. The incorporation of identity has been done on the basis of an extense literature on identity[11]. Our approach has to do with what Fehr et al. [16] summed up with the following quote:

> [...] This approach is a first step to developing richer models that may become part of "behavioral contract theory."

Incorporating the notion of identity in a principal agent model and also incorporating the ability for the principal to manage agents' identity, the present work has shown under which conditions spending resources in changing agents' identity is profitable for organizations.

These conditions are, for instance, the lenght of the contracts offered, the total cost of investing in changing agents' identity for the principal, the informative value of the signal used to observe and incentivize effort or the degree of agents' risk aversion.

Taking all into account, what we conclude from this work is: an initial investment in motivational capital using incentives beyond the money though costly at inception, will result more effective to control public organizations expenditure and fostering their efficiency and productivity. Then, Governments, political advisors and public organisations 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. However for the long term goals: quality, efficiency, effectivenes, research and develop results, then *proposition 1* establishes, that a

[11] See for instance Akerlof and Kranton [1, 2] and Benabou and Tirole [6].

change in identity and investments in *motivational capital* is the most profitable action for the organisation.

Finally, wherever the principal in the public organization is politically designated, 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, despite in the long term the best choice is the investment in *motivational capital* given that workers' contracts are much longer that legislative piece of time. Anyway these conclusions are interesting future research questions which, should be tested and studied in depth in the future.

A Mathematical Appendix

A.1 Socialization: the Evolution of Identity 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,

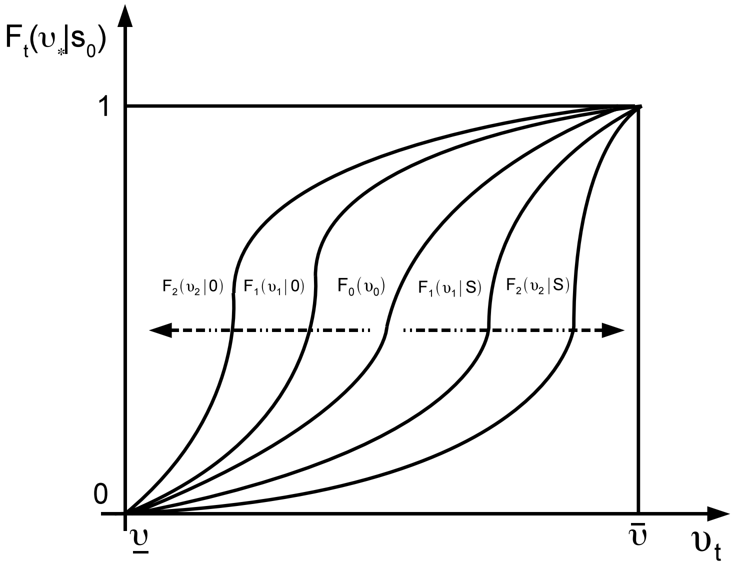

Figure 6: Identity. Stochastic Dominance.

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

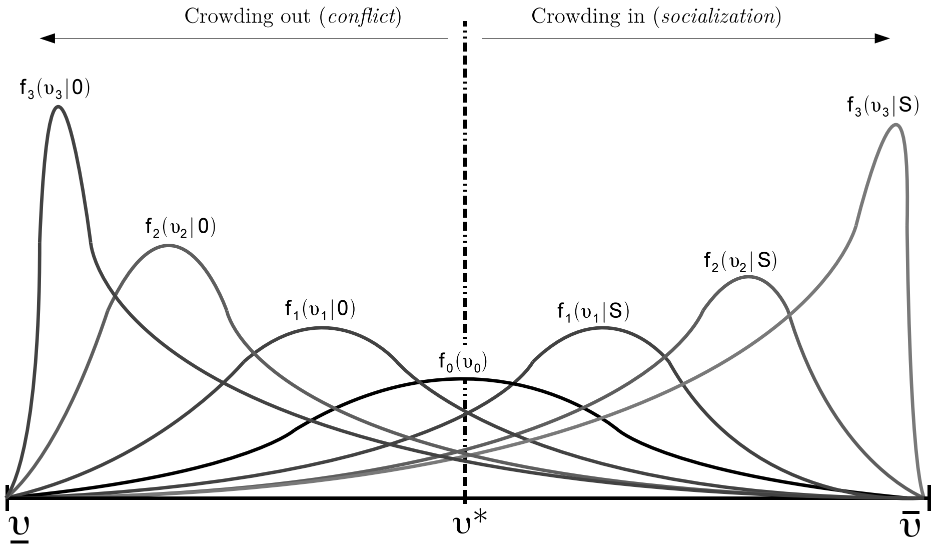

Figure 7: Identity. Time Evolution of Densities.

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 $\upsilon_t = \underline{\upsilon}$.

$$\lim_{t \to T^S} F_t(\upsilon_t|S) = \lambda \qquad \text{where} \quad \lambda = \begin{cases} 1 & \text{if } \upsilon = \overline{\upsilon} \\ 0 & \text{otherwise} \end{cases} \qquad \text{for some } T^S \in [0, \infty) \text{ and,}$$

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

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,

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

A.2 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:	$\psi_t(\overline{e}, \upsilon_t(s_0)) = \psi_t$
$\mathcal{P}$'s revenue function:	$R_t(\overline{q}) = \overline{R}$; $R_t(\underline{q}) = \underline{R}$
$\mathcal{P}$'s revenue variation:	$\Delta R_t \equiv \overline{R} - \underline{R}$
Payments variability:	$\Delta w_t^S = \overline{w}_t^S - \underline{w}_t^S$
	$\Delta w_t^0 = \overline{w}_t^0 - \underline{w}_t^0$
Change of variables:	$\overline{w} = h(\overline{u})$; $\underline{w} = h(\underline{u})$
Probability variation:	$\Delta\theta = (\theta_1 - \theta_0)$
Reservation utility:	$\overline{U}$

Table 1: Notational simplification

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

$$Max_{\{w_t(q_t), s_0\}} \quad \alpha_t \cdot \Big(\theta_0 \left(\overline{R} - h(\overline{u})\right) - (1-\theta_0)\left(\underline{R} - h(\underline{u})\right)\Big)$$
$$+ (1-\alpha_t) \cdot \Big(\theta_1 \left(\overline{R} - h(\overline{u})\right) - (1-\theta_1)\left(\underline{R} - h(\underline{u})\right)\Big) - C_t(s_0) \qquad \text{(A.1)}$$

Subject to

$$\theta_1 \overline{u} + (1-\theta_1)\underline{u} - \psi_t \geqslant \theta_0 \overline{u} + (1-\theta_0)\underline{u} \text{ (ICC)} \qquad \text{(A.2)}$$

$$\theta_1 \overline{u} + (1-\theta_1)\underline{u} - \psi_t \geqslant \overline{U} \quad \text{(PC)} \qquad \text{(A.3)}$$

$$\underline{u} \geqslant 0 \quad \text{(LLC)} \tag{A.4}$$

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:

$$\frac{1}{u'(\overline{w})} = \mu + \lambda \frac{\Delta\theta}{\theta_1} \tag{A.5}$$

$$\frac{1}{u'(\underline{w})} = \mu - \lambda \frac{\Delta\theta}{1-\theta_1} \tag{A.6}$$

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,

$$\mu = \frac{\theta_1}{u'(\overline{w})} + \frac{1-\theta_1}{u'(\underline{w})} > 0 \tag{A.7}$$

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

$$\lambda = \frac{(1-\theta_1)\theta_1}{\Delta\theta}\left(\frac{1}{u'(\overline{w})} - \frac{1}{u'(\underline{w})}\right) > 0 \tag{A.8}$$

And the incentive compatibility constraint (6) is also binding. Thus we can obtain immediately 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,

$$u_t(\overline{w}) = \underline{U} + \frac{(1-\theta_0)}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0)) \tag{A.9}$$

$$u_t(\underline{w}) = \underline{U} - \frac{\theta_0}{\Delta\theta}\psi_t(\overline{e}, \upsilon_t(s_0)). \tag{A.10}$$

A.3 Proof of Proposition 1

We want to establish that, in case in which $\overline{w}_T^0 > \gamma \cdot S + h(\overline{U})$ always there exists a threshold $t^* \in \{0, \ldots, T, \ldots\}$ for which the following equality holds.

$$CNV^{mk} = \Gamma^S - \Gamma^0 = 0 \tag{A.11}$$

We can rewrite the above expression in the following way,

$$CNV^{mk} = \sum_{t=0}^{T} \delta^t \Big[E\Pi_t^S - E\Pi_t^0 \Big] = 0$$

As we know, in the first period of the game $t = 0$ the elicit high effort using incentive payments that $\mathcal{P}$ must offer to elicit $\mathcal{A}$ to exert high effort is exactly equal independently of using socialization incentives ($s_0 = S$) or pure monetary rewards ($s_0 = 0$). This is so because in the first period neither socialization nor conflict cause any effect. Therefore, in

$t = 0$ we have that $(\overline{w}_0^0, \underline{w}_0^0) = (\overline{w}_0^S, \underline{w}_0^S)$ and then we know that,

$$CNV^{mk} = \sum_{t=0}^{0} \delta^0 \Big[E\Pi_0^S - E\Pi_0^0 \Big] = -S < 0$$

In words, using socialization incentive scheme has negative returns $t = 0$. But in subsequent periods $t = 1, 2, \ldots$ socialization and conflict processes start to work,

$$\text{Socialization:} \quad \frac{d\big[\theta_i \overline{w}_t^S + (1-\theta_i)\underline{w}_t^S\big]}{dt} < 0$$
$$\text{Conflict:} \quad \frac{d\big[\theta_i \overline{w}_t^0 + (1-\theta_i)\underline{w}_t^0\big]}{dt} > 0 \text{ for } i = 0, 1.$$

And this means that at $t = 1, 2, \ldots$

$$\frac{dE\Pi_t^S}{dt} > 0 \qquad \text{and} \qquad \frac{dE\Pi_t^0}{dt} < 0,$$

therefore,

$$\frac{d\big[E\Pi_t^S - E\Pi_t^0\big]}{dt} > 0$$

Without loss of generality assume that the game reaches the period $t = K$ for which the processes of socialization (in case that $\mathcal{P}$ chooses $s_0 = S$) and conflict (in case that $\mathcal{P}$ chooses $s_0 = 0$) are completed. Let T^S the number of periods necessary for agents to reach the maximun level of identity due to socialization: $\upsilon_{T^S} = \overline{\upsilon}$. Analogously, let T^0 the number of periods necessary for agents to reach the minimum level of identity due to conflict: $\upsilon_{T^0} = \underline{\upsilon}$. Then $K \geqslant T^S$ and $K \geqslant T^0$.

Then at period $t = K$ disutility from effort for an agent with identity $\upsilon_K = \overline{\upsilon}$ will be zero $\psi_K(e_K, \overline{\upsilon}) = 0$. This involves that in order to elicit from her high effort the principal should offer to him a dupla of incentive payments such that $\overline{w}_K^S = \underline{w}_K^S = w_K^S$. Formally,

$$\overline{w}_K^S = h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta} \cdot \overbrace{\psi_K(\overline{e},\overline{\upsilon})}^{=0}\right) = h\left(\overline{U}\right) = h\left(\overline{U} - \frac{\theta_0}{\Delta\theta} \cdot \overbrace{\psi_K(\overline{e},\overline{\upsilon})}^{=0}\right) = \underline{w}_K^S$$

Analogously, to incentivize an agent with identity $\upsilon_K = \underline{\upsilon}$, the principal should offer to him a dupla of incentive payments like the following,

$$\begin{aligned}
\overline{w}_K^0 &= h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta} \cdot \overbrace{\psi_K(\overline{e},\overline{\upsilon})}^{=\Psi}\right) = h\left(\overline{U} + \frac{(1-\theta_0)}{\Delta\theta} \cdot \Psi\right) \\
\underline{w}_K^0 &= h\left(\overline{U} - \frac{\theta_0}{\Delta\theta} \cdot \overbrace{\psi_K(\overline{e},\overline{\upsilon})}^{=\Psi}\right) = h\left(\overline{U} - \frac{\theta_0}{\Delta\theta} \cdot \Psi\right)
\end{aligned}$$

We also know that, the probabilities in $t = K$ of having full identity $\upsilon_K = \overline{\upsilon}$ or be in conflict $\upsilon_K = \underline{\upsilon}$, conditional to $s_0 = S$ and $s_0 = 0$ are respectively the following,

$$P_K(\upsilon_K = \overline{\upsilon}|S) = 1 \qquad \text{and} \qquad P_K(\upsilon_K = \underline{\upsilon}|0) = 1,$$

At this point there is no agent who shirk because the average level of identity, in each case, matches exactly $\upsilon_K = \overline{\upsilon}$ or $\upsilon_K = \underline{\upsilon}$. Then all the agents within the organization will have and expected identity level of $E_K[\upsilon_K|S] = \overline{\upsilon}$ or $E_K[\upsilon_K|0] = \underline{\upsilon}$ respectively.

All the above lead us to write the $\mathcal{P}$'s expected profits conditional to chosen incentives $s_0 \in \{0, S\}$:

$$\begin{aligned}
E\Pi_K^S &= \theta_1\overline{R} + (1-\theta_1)\underline{R} - w_K^S - \gamma S \\
E\Pi_K^0 &= \theta_1\big(\overline{R} - \overline{w}_K^0\big) + (1-\theta_1)(\underline{R} - \underline{w}_K^0)
\end{aligned}$$

In the following we calculate the difference in expected profits due to selected incentive policies at the point of socialization and conflict effects are completed.

$$E\Pi_K^S - E\Pi_K^0 = \big(\theta_1 \overline{w}_K^0 + (1-\theta_1)\underline{w}_K^0\big) - \big(w_K^S + \gamma S\big)$$

For proposition 1 we focus our attention in the case of $\theta_1 \overline{w}_K^0 + (1-\theta_1)\underline{w}_K^0 > \gamma S + h(\overline{U})$. Also we know that $w_K^S = h(\overline{U})$ and therefore we have,

$$E\Pi_K^S - E\Pi_K^0 = \big(\overbrace{\theta_1 \overline{w}_K^0 + (1-\theta_1)\underline{w}_K^0}^{>\gamma S + h(\overline{U})}\big) - \big(\underbrace{w_K^S}_{=h(\overline{U})} + \gamma S\big) > 0$$

As we have seen up to this point, CNV^{mk} starts being negative at $t = 0$. Also we know that once $\mathcal{P}$'s selected incentive policy has completed his associated effect, socialization or conflict, the subsequent added values to the CNV^{mk} will remain positive period after period up to the game ends. We know also, that socialization and conflict processes imply that added values to the CNV^{mk} will be increasing in time. Then at some period $t = \hat{t} < K$ $E\Pi_{\hat{t}}^S = E\Pi_{\hat{t}}^0$.

$$CNV^{mk} = \underbrace{\sum_{t=0}^{\hat{t}} \delta^t \Big[E\Pi_0^S - E\Pi_0^0\Big]}_{<0} + \overbrace{\sum_{t=\hat{t}+1}^{T} \delta^t \Big[E\Pi_0^S - E\Pi_0^0\Big]}^{>0}$$

Up to $t = \hat{t}$, CNV^{mk} will be decreasing and negative but limited. After the game overcomes $t = \hat{t}$ and up to $t = T$, CNV^{mk} will be increasing and limited only by the length of the game. That is, the positive value of CNV^{mk} will find its limit determined by the total number of periods $t = T$ of the game.

Let us to assume the following limited negative value of the current net value of motivational capital in $t = \hat{t}$,

$$CNV^{mk} = \sum_{t=0}^{\hat{t}} \delta^t \left[E\Pi_0^S - E\Pi_0^0 \right] = -M \text{ where } M \in \mathbb{R}_{++}$$

Assume for simplicity that $\hat{t} + 1 = K$. Then we have that,

$$E\Pi_K^S - E\Pi_K^0 = \left(\theta_1 \overline{w}_K^0 + (1 - \theta_1)\underline{w}_K^0\right) - \left(w_K^S + \gamma S\right) = m \text{ where } m \in \mathbb{R}_{++}$$

Then for a discount factor large enough $\delta > \frac{M-m}{M}$ we have that,

$$\sum_{t=K+1}^{\infty} \delta^t m - M > 0$$

then at some period $t^* \in (K, \infty)$,

$$\sum_{t=K+1}^{t^*} \delta^t m - M = 0$$

and therefore $CNV_{t^*}^{mk} = 0$.

A.4 Proof of Proposition 2

Immediate by comparison of (3.10) and (3.18), joint with the application of *Proposition 1*. Proof available from the authors upon request.

A.5 Proof of Proposition 3

Inmediate. If, at the limit, there is no positive return from changing agents identity at any period $t \in \{0, 1, 2 \ldots, T, \ldots\}$, then the initial investmet never becomes profitable and the best choice is to not invest any amount to change agents identity. Proof available from the authors upon request.

A.6 Proof of Proposition 4

Proof available from the authors upon request.

A.7 Proof of proposition 5.

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, $\theta_1 > \theta_0$. Results show that the parameter θ_i affects payments $w_t = \{\overline{w}, \underline{w}\}$.

Let us to analyze the impact of θ_0 on both payments,

$$\overline{w}_t^{s_0}(E_t[\upsilon_t|s_0]) = h\left(\overline{U} + \frac{(1-\theta_0)}{(\theta_1 - \theta_0)}\psi_t(\overline{e}, E_t[\upsilon_t|s_0])\right) \tag{A.12}$$

$$\underline{w}_t^{s_0}(E_t[\upsilon_t|s_0]) = h\left(\overline{U} - \frac{\theta_0}{(\theta_1 - \theta_0)}\psi_t(\overline{e}, E_t[\upsilon_t|s_0])\right). \tag{A.13}$$

By definition $h'(\cdot) > 0$ and $h''(\cdot) > 0$. Let us to recall $\psi_t(\overline{e}, E_t[\upsilon_t|s_0]) = \Psi$ to simplify notation. Then,

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

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

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

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

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

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.

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

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

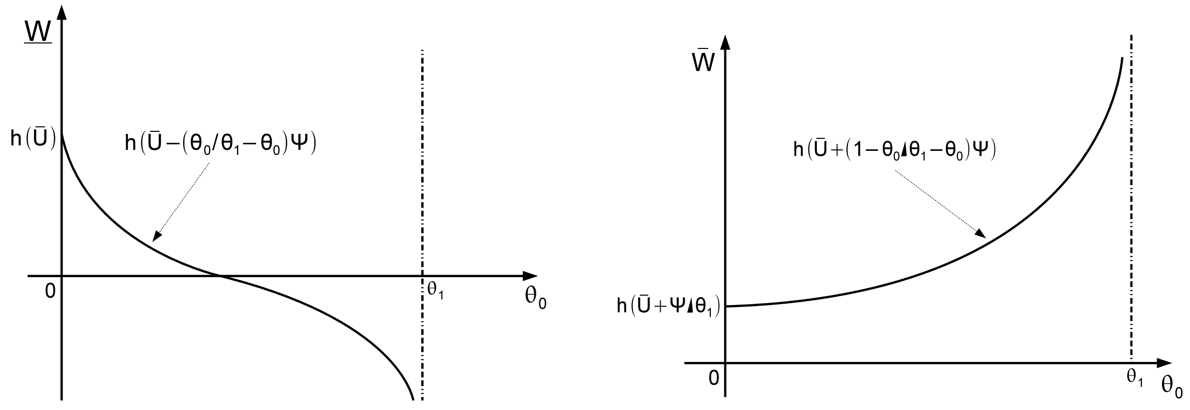

Figure 8: Payments and the informative value of the signal

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 ∞.

$$\lim_{\theta_0 \to \theta_1} h\Big(\overline{U} + \frac{(1-\theta_0)\Psi}{\theta_1 - \theta_0}\Big) = \infty \tag{A.14}$$

We know that for a given value $\theta_0 = \hat{\theta}_0$ enough close to θ_1, $\underline{w}$ will fall below 0. Then, applying LLC (2.6), for all $\theta_0 \in [\hat{\theta}_0, \theta_1)$ we have $\underline{w} = 0$ and, (A.14).

In the model an agent with $\upsilon_t = \overline{\upsilon}$ experiences no-disutility from effort and he will not need incentives to exert high effort.

$$\psi_t(\overline{e}, \overline{\upsilon}) = 0 \tag{A.15}$$

Consequently payments will not depend on the effectiveness of the signal θ_i because the agent will always choose $e = \overline{e}$ action in every t in exchange of a constant payment $w_t^S = h(\overline{U})$. Then,

$$\lim_{\theta_0 \to \theta_1} \left[\alpha_t \cdot \left(\theta_0 \overline{w}_t^0 + (1-\theta_0) \underline{w}_t^0 \right) + (1-\alpha_t) \left(\theta_1 \overline{w}_t^0 + (1-\theta_1) \underline{w}_t^0 \right) - w_t^S \right] = \infty \tag{A.16}$$

and (A.16) proves the proposition 5.

A.8 Proof of Proposition 6

First let us to recall some assumptions of the model and some properties of functions of the model. Let us start with $\psi_t(e_t, \upsilon_t)$. We now that, this function is continuous and differentiable, and depends negatively on $\mathcal{A}$'s identity

$$\psi'_{\upsilon} = \frac{\partial \psi_t(e_t, \upsilon_t)}{\partial \upsilon_t} < 0 \tag{A.17}$$

Then, for every pair of agents $i = A, B$ with $\upsilon_{t,A}$ and $\upsilon_{t,B}$ identities respectively, where $\upsilon_{t,A} > \upsilon_{t,B}$ whe have that,

$$\psi_t(\overline{e}, \upsilon_{t,A}) = \Psi_A < \Psi_B = \psi_t(\overline{e}, \upsilon_{t,B})$$
$$\psi_t(\underline{e}, \upsilon_{t,A}) = \psi_t(\underline{e}, \upsilon_{t,B}) = 0$$

$\mathcal{A}$s' identity affects $\mathcal{P}$'s expected costs,

$$EC_t = \alpha_t \cdot \big[\theta_0 \cdot \overbrace{h\left(\overline{U} + \frac{(1-\theta_0)}{(\theta_1-\theta_0)} \cdot \psi(e_t, \upsilon_t)\right)}^{h(\overline{u}) = \overline{w}} + (1-\theta_0) \cdot \overbrace{h\left(\overline{U} + \frac{-\theta_0}{(\theta_1-\theta_0)} \cdot \psi(e_t, \upsilon_t)\right)}^{h(\underline{u} = \underline{w})} \big]$$

$$+ (1-\alpha_t) \cdot \big[\theta_1 \cdot \underbrace{h\left(\overline{U} + \frac{(1-\theta_0)}{(\theta_1-\theta_0)} \cdot \psi(e_t, \upsilon_t)\right)}_{h(\overline{u}) = \overline{w}} + (1-\theta_1)\, \underbrace{h\left(\overline{U} + \frac{-\theta_0}{(\theta_1-\theta_0)} \cdot \psi(e_t, \upsilon_t)\right)}_{h(\underline{u}) = \underline{w}} \big] + C_t(s_0)$$

Let EC_t^r the $\mathcal{P}$'s expected cost function when $\mathcal{A}$ are risk averse. We differentiate EC_t^r with respect to υ_t,

$$\frac{\partial EC_t^r}{\partial \upsilon_t} = \frac{\alpha_t}{(\theta_1 - \theta_0)} \cdot \left[\theta_0(1-\theta_0) \cdot h'(\overline{u}) \cdot \psi_v' - \theta_0(1-\theta_0) \cdot h'(\underline{u}) \cdot \psi_v'\right]$$
$$+ \frac{(1-\alpha_t)}{(\theta_1 - \theta_0)} \cdot \left[\theta_1 \cdot (1-\theta_0) \cdot h'(\overline{u}) \cdot \psi_v' - \theta_0(1-\theta_1) \cdot h'(\underline{u}) \cdot \psi_v'\right] \tag{A.18}$$

We know that agents are risk averse: $u' > 0$ and $u'' < 0$. The inverse of utility function $h(u(w)) = w$ is defined in order to calculate payments. By risk aversion we have that $h' > 0$ and $h'' > 0$. Then for $\overline{u} > \underline{u}$ we have that,

$$h'(\overline{u}) > h'(\underline{u})$$

Also we know that performance is an informative signal of effort: $\theta_1 > \theta_0$, and then $\theta_1(1-\theta_0) > \theta_0(1-\theta_1)$. Therefore, joint with (A.17), it is straight forward to see that,

$$\frac{\partial EC_t^r}{\partial \upsilon_t} < 0$$

The interpretation of (A.18) is that as agents' identity increases, the cost of incentivize them to exert high effort decreases.

Let us now to use as benchmark the risk neutrality case to confront with the risk aversion case. If agents are risk neutral, then $u(w) = k \cdot w$ with $k > 0$. Then $u' = k > 0$ and $u'' = 0$. Let EC_t^n the $\mathcal{P}$'s expected cost function when $\mathcal{A}$ are risk neutral. We differentiate EC_t^r with respect to υ_t,

$$\frac{\partial EC_t^n}{\partial \upsilon_t} = \frac{(1-\alpha_t)}{(\theta_1 - \theta_0)} \cdot k \cdot \psi_v' \cdot (\theta_0 - \theta_1) \tag{A.19}$$

Which is also negative,

$$\frac{\partial EC_t^n}{\partial \upsilon_t} < 0$$

It is immediate to see that the negative effect of the identity on $\mathcal{P}$'s cost is always of higher magnitude when agents are risk averse.

$$\left|\frac{\partial EC_t^r}{\partial \upsilon_t}\right| > \left|\frac{\partial EC_t^n}{\partial \upsilon_t}\right| \tag{A.20}$$

And then, in presence of risk averse agents, $\mathcal{A}$s' identity diminishes $\mathcal{P}$'s expected costs more than in the case of risk neutral agents.

Next, let us to analyze the consequences of this on CNV_t^{mk}. Conditional to $\mathcal{P}$'s choice on $s_0 \in \{0, S\}$, $\mathcal{A}$s' identity will increase or decrease, and consequently, the expected costs will decrease or increase along time.

$$\begin{gathered}\frac{\mathrm{d}\upsilon_t(S)}{\mathrm{d}t} > 0 \Rightarrow \frac{\mathrm{d}EC_t}{\mathrm{d}t} < 0 \\ \frac{\mathrm{d}\upsilon_t(0)}{\mathrm{d}t} < 0 \Rightarrow \frac{\mathrm{d}EC_t}{\mathrm{d}t} > 0\end{gathered}$$

From (A.20) we know that,

$$\begin{gathered}\left|\frac{\mathrm{d}[EC_t^r]}{\mathrm{d}t}\right| > \left|\frac{\mathrm{d}[EC_t^n]}{\mathrm{d}t}\right| \Rightarrow \frac{\mathrm{d}[E\Pi_t^r]}{\mathrm{d}t} > \frac{\mathrm{d}[E\Pi_t^n]}{\mathrm{d}t} \ \text{ if } \ s_0 = S \\ \frac{\mathrm{d}[EC_t^r]}{\mathrm{d}t} > \frac{\mathrm{d}[EC_t^n]}{\mathrm{d}t} \Rightarrow \left|\frac{\mathrm{d}[E\Pi_t^r]}{\mathrm{d}t}\right| > \left|\frac{\mathrm{d}[E\Pi_t^n]}{\mathrm{d}t}\right| \ \text{ if } \ s_0 = 0\end{gathered}$$

And,

$$CNV_t^{mk,r} > CNV_t^{mk,n}$$

For every $t = 1, 2, \ldots, T, \ldots$ as we want to proof.

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