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Incentives in Agency Relationships: To Be Monetary or Non-Monetary?

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INCENTIVES IN AGENCY RELATIONSHIPS: TO BE MONETARY OR NON-MONETARY?

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Abstract. In this paper, we develop a Principal-Agent model with both monetary and non-monetary incentives. We show that the latter are always more efficient, that is Pareto-dominate, monetary incentives. Indeed, we not only show that all what monetary incentives can do, non-monetary incentives can do it as well, we go further and show the possibility for non-monetary incentives to increase intrinsic motivation, thereby compensating the fact that higher rewards, rather than being encouraging can reduce the motivation to provide effort. However, from a practical point of view, implementing such a scheme within firms requires that the Principal knows the intrinsic value system of the Agent which, as a by-product, gives rise to specific and interesting issues.

1. Introduction

A growing literature has developed the past decade to study work motivation, in particular building on the distinction between intrinsic and extrinsic motivation and incentives. Departing from the assumption of purely self-interested agents, this literature has explored the psychological effects of monetary rewards on motivation and effort (see e.g. Frey, 1997, Kreps, 1997, Frey and Oberholzer-Gee, 1997). The Motivation Crowding Effect Theory relies on the idea that there is a psychological process which underlies intrinsic motivation and extrinsic incentives. Monetary rewards may thus reduce intrinsic motivation: where individuals perceive an external intervention to be controlling, their intrinsic motivation to perform the task diminish (Deci and Ryan, 1985).

However, as pointed out by Akerlof and Kranton (2003), " *A source of motivation is missing from current models of organizations. [We] characterize this missing source as identity. By identity, we mean a person's self image - as an individual and as part of a group. (...) In the Army as well as in civilian organizations, such identification - or lack of it - plays a critical role in determination of work effort, incentive schemes, and organizational design.* " By incorporating the psychology of identity into economic analysis of work incentives, Akerlof and Kranton hence build another bridge between social psychology and economics within recent developments of agency theory.

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Such approaches provide an excellent analysis of psychological motives and their effect on work motivation and effort within agency relationships. Our ambition is different: without departing from the assumption of purely self-interested agents, our goal is to examine whether whatever monetary incentives can do, non-monetary ones can do it as well or not. In other words, we wish to compare the relative performance of monetary versus non-monetary incentives within the standard Principal-Agent framework in terms of Pareto-optimality, showing - from a theoretical perspective and with simple examples - which type of incentives dominates, that is whether monetary and non-monetary incentives could be considered as relative substitutes or complements.

By non-monetary incentives, we mean an incentives device composed of a fixed monetary wage (which may be null) and a non-monetary reward that depends on the state of nature. As we will develop it further in the next section, our definition of non-monetary incentives is rather large. On the one hand, it may indeed be considered as close to the notion of identity developed by Akerlof and Kranton (2003), identity meaning a person's self image. But on the other hand, by explicitly including the state of nature, we embed many different notions of non-monetary rewards (such as a medal, a promotion without a wage increase, a prize etc.) which do not require the notion of self-image or self-esteem to be defined narrowly. Only the system of values ("what matters for the agent") needs to be given. This latter element may be seen as a limit of our model since th Agent's value system must be known by the Principal, but it makes very general the notion of non-monetary incentives.

Our paper relates to the debate on crowding theories of motivation in several retrospects. First, our definition of non-monetary incentives takes into account both motivation crowding-in (positive non-monetary incentives like private benefits illiquid by nature) and crowding-out (negative non-monetary incentives, that is sanctions or punishments).

Second, our model also explicitly takes into account the notion of adhesion to a norm, defined by social psychologists and sociologists as a "general rule of voluntary behavior" (see for instance the discussion by Kreps, 1997). Indeed, given that we model non-monetary incentives with respect to the state of nature and the value system of the Agent, a particular social norm can be considered as a particular system of value to which the Agent adheres. We hence provide a theoretical tool for analysing the importance of such elements within the context of any agency relationship.

And thirdly, our paper contributes to the debate on the role of extrinsic incentives versus intrinsic motivation. In the past decade, following social psychologists, economists have shown how intrinsic motivation can be destroyed (at least partially) when price incentives are introduced (see Frey and Oberholzer-Gee, 1997). In this retrospect, our model shows that non-monetary incentives can compensate for such crowding-out effects by increasing intrinsic motivation. Hence, we not only show that all what monetary incentives can do, non-monetary incentives can do it as well, we go further and show the possibility for non-monetary incentives to increase intrinsic motivation, thereby compensating for the fact that higher rewards, rather than being encouraging can reduce the motivation to provide effort. Non-monetary incentives thus Pareto-dominate monetary ones. Yet, for this Pareto-dominance to be robust, our model implies, as we shall see this later, that the Principal knows the value system of the Agent, which is a strong assumption.

To discuss the role of non-monteray incentives compared to monetary ones, our article is composed of five sections. Section 2 presents the model and section 3 the results. The main result is close to a revelation principle whereby all what a monetary scheme can do, a non-monetary scheme can also do it. In section 4, we discuss the other advantages of a non-monetary incentives scheme. In particular, we believe that such a system would increase the intrinsic motivation of agents. Finally, we conclude the article in section 5.

2. The Model

2.1. **Basic set-up and definitions.**

We consider a Principal-Agent relationship with moral hazard[1] in which the Principal uses non-monetary incentives to determine the optimal contract. We group these non-monetary incentives under the term of *symbol*. To give some examples of symbols that can be perceived as non-monetary incentives in different contexts, in particular because they affect a person's image, either her self-image (as this is the case in Akerlof and Kranton, 2003), or her social image, we give the following (non-exhaustive) list.

Example 1.

- *A medal (military or civil like an olympic medal).*
- *A promotion without a significant wage increase.*
- *An academic prize (e.g. Nobel Prize [2], Social and Welfare Prize [3], gold medal of the French CNRS, etc.)*
- *A business Prize (e.g. being elected the "Manager of the year") or recognition (like a business car, a business flat, a trip offered, flowers, a big office etc.).*
- *Being member of a selective club (like the Rotary Club), of a national sport team (soccer, rugby,etc.), of a professional society (e.g. Fellow of the Econometric Society).*

Such kind of symbols or "objects" that serve as non-monetary incentives may be divisible as well as undivisible. We shall define now more precisely these "objects".

[1] The analysis can be extended to any other type of agency relationship (adverse selection, signalling,...).

[2] It seems that most researchers would prefer to obtain the Nobel prize even without the monetary reward associated rather than the pure monetar reward, without the title "Nobel".

[3] No monetary reward is associated to this prize.

Let Ω be the overall set of all symbols and let c and vf respectively denote the *cost function* and *the facial value function* defined by :

$$\begin{aligned} c &: \Omega \longrightarrow \mathbb{R}_+ \\ vf &: \Omega \longrightarrow \mathbb{R}_+ \end{aligned}$$

$c(\omega)$ is the production cost [4] by the Principal of the symbol ω and $vf(\omega)$ is the facial value of this symbol ω. To give an illustration, let assume that ω is a honor medal, then $c(\omega)$ is the production cost of the medal (e.g. $c(\omega) = 5\ USD$) and $vf(\omega)$ denotes the value of the medal (e.g. $vf(\omega) = 7\,USD$). If instead we assume that ω is a trip to Hawai, then $c(\omega)$ is the cost (for the Principal) of this trip (e.g. $c(\omega) = 2000\ USD$) and $vf(\omega)$ denotes the value of this trip (e.g. $vf(\omega) = 3000\,USD$). Finally, another illustration would be to consider that ω represents a (monetary) wage, $c(\omega)$ then equals ω and $vf(\omega)$ also equals ω. In other words, a wage is a particular symbol such that $c(\omega) = vf(\omega) = \omega$. We naturally focus on symbols

i) which are such that the firm or the institution which orders them benefits from price advantages, so that $c(\omega) < vf(\omega)$
ii) and which are not (monetary) wages :

$$\bar{\Omega} = \{\omega \in \Omega : c(\omega) < vf(\omega) \; and \; \omega \notin W\}$$

Remark 1. *Symbols $\omega \in \bar{\Omega}$ are not immediately liquid for the Agent who receives them. Their role therefore does not consist in yielding a monetary revenue to the Agent.*

We assume that the Agent's preference relation is complete and transitive $\succsim$ over the set $\bar{\Omega}$ and that the set $(\bar{\Omega}, \succsim)$ satisfies the usual condition of perfect separability. Thus, there exists an order isomorphism h defined from $(\bar{\Omega}, \succsim)$ over $(\mathbb{R}, \geq)$.

Rather than using $\bar{\Omega}$, we can therefore use the set $S = h(\bar{\Omega})$. Indeed, $(S, \geq)$ exactly fits the composition of $(\bar{\Omega}, \succsim)$. $s = h(\omega)$ hence is the symbolic equivalent of ω in $\mathbb{R}$.

It is interesting to use S because any element $s \in S$ is real.

h may be interpreted as a *self-satisfaction or "ego" function.* The Agent prefers the symbol ω to the symbol ω' because ω provides more self-esteem than does ω'. Hence, $h(\omega)$ may also be interpreted as the non-monetary wage provided by the symbol ω to the Agent. For the rest of the article, S will denote and be interpreted as the set of all non-monetary rewards. To give a simple intuition and illustration of our modelling of non-monetary schemes, let consider the following example.

Example 2. $\bar{\Omega} = \{\omega_1,\ \omega_2,\ \omega_3\}$ *where ω_1= honor medal (for instance, the French "Legion d'honneur"), ω_2= a week in Hawai, ω_3= a week in Firenze.*

$$c(\omega_1) = 5\,USD;\ c(\omega_2) = 2000\,USD;\ c(\omega_3) = 1000\,USD$$
$$vf(\omega_1) = 7\,USD;\ vf(\omega_2) = 3000\,USD;\ vf(\omega_3) = 1500\,USD$$

We can have : $\omega_1 \succ \omega_3 \succ \omega_2$ where $\succ$ is the Agent's strict preference relation. In turn we get :

$$h(\omega_1) = s_1 > h(\omega_3) = s_3 > h(\omega_2) = s_2$$

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[4] Another cost is not taken into account here: the cost of organizing a public ceremony during which the symbol is granted.

Besides, the cost function $\widetilde{c}$ is defined as follows :

$$\begin{aligned} \widetilde{c} \;:\; & S \longrightarrow \mathbb{R}_+ \\ & s \longmapsto \widetilde{c}(s) = c(h^{-1}(\omega)) \end{aligned}$$

And when no confusion arises, we will (abusively) replace the notation $\widetilde{c}$ by c.

Finally, we assume that the cost of a symbol ω is lower than the gain (in terms of non-monetary reward) for the Agent :

$$\begin{aligned} c(s) &= \alpha(s).s \\ 0 &\leq \alpha(s) < 1 \end{aligned}$$

We also assume that [5]:

$$\alpha'(s) < 0$$

This assumption simply means that the higher the self-satisfaction generated by a symbol ω, the lower the relative associated cost for the Principal. However, function c is non monotonically either increasing or decreasing. Indeed, if we consider the previous example 2 , we have :

$$s_1 > s_3 \quad \textit{but} \quad c(s_1) < c(s_3)$$

Let define the (risk-neutral) Principal's profit function as follows :

$$B(x - w - c(s)) = x - w - c(s)$$

where w denotes the Agent's monetary payment and $c(s)$ is the monetary cost (for the Principal) of the Agent's non-monetary reward. x is a random variable with respect to the results (for the sake of simplicity the random variable and its realization are considered as identical), $x \in X$ the set of results. w and s are in fact two functions such that :

$$\begin{aligned} w &: X \longrightarrow W \\ s &: X \longrightarrow S \end{aligned}$$

where W is the set of (monetary) wages, $W \subseteq \mathbb{R}_+^*$.

The Agent's utility function is given by:

$$\tilde{U}(w, s, e).$$

It is assumed to be additively separable :

$$\tilde{U}(w, s, e) = u(w) + g(s) - v(e),$$

where e is an effort variable, $e \in \mathbb{R}_+$; with :

$$\begin{aligned} u'(w) &> 0, u''(w) \leq 0, \\ v'(e) &> 0, v''(e) \geq 0, \\ g'(s) &> 0, g''(s) \leq 0 \end{aligned}$$

Remark 2. *In the standard Principal-Agent framework, the traditional utility function with monetary incentives corresponds to the projection of* $\widetilde{U}$ *over* $W \times \mathbb{R}_+$ *:*

$$U(w, e) = \Pr_{W \times \mathbb{R}_+} oj\, \tilde{U}(w, s, e)$$

[5]Note that such an assumption is not needed in the proofs of our results.

That is :

$$U(w, e) = u(w) - v(e)$$

Function g is a utility function with the same meaning of function u. $g(h(\omega))$ is the utility derived by the Agent from her non-monetary reward generated by symbol ω. Nevertheless, u and g may have different shape. We indeed pose that [6] :

$$u(w) = g(h(\omega)) \Rightarrow w > h(\omega)$$

The intuition and interpretation behind this is the following. Offering flowers to one's mother for the mothers' day is less costly than sending her money, at identical utility.

2.2. **Illustrations.**

To go further into the understanding of non-monetary incentives schemes, we give the three following examples. The first one shows that two symbols may have the same facial value while yielding a self-satisfaction (h) and a utility (u) different to the Agent. The second and the third examples respectively show that when the Principal implements a non-monetary incentives scheme, she must know the value system of the Agent and this system must produce a public signal regarding the Agent.

Example 3. $\bar{\Omega} = \{\omega_1, \ \omega_2\}$ *where* ω_1= *non reimbursable gift of* $1000\, USD$ *in the shop of an expensive brand,* ω_2= *non reimbursable gift of* $1000\, USD$ *in the shop of a cheap brand. We then have:*

$$vf(\omega_1) = 1000\, USD$$
$$vf(\omega_2) = 1000\, USD$$

However, it seems reasonable to have : $\omega_1 \succ \omega_2$ *where* $\succ$ *is the Agent's strict preference relation. Therefore :*

$$h(\omega_1) = s_1 > h(\omega_2) = s_2$$

and :

$$g(h(\omega_1)) > u(1000) > g(h(\omega_2))$$

Example 4. *Let assume that the Agent may choose among the two following symbols :*

ω_1 = *lowest honor medal in the home country, for instance France*

ω_2 = *highest honor medal in a very far away and small Island, for instance New Guinea*

If the Agent is French, it is very likely that we will then have :

$$h(\omega_1) > h(\omega_2)$$

Whereas if the Agent's citizenship is from New Guinea we will have:

$$h(\omega_1) < h(\omega_2)$$

In other word, the value that the Agent attributes to a symbol depends on the way this Agent internalizes and interprets this symbol, that is on her value system (a notion that could be linked to social or personal norms).

[6]but this is not necessary for the proofs of our results.

Example 5. *Let assume now that the Agent has the choice between the following two symbols :*

ω_1 = *Nobel Prize in Economics but nobody knows it except the Nobel Committee and the Agent (in particular there is no public ceremony)*
ω_2 = *Social Choice and Welfare Prize (with public ceremony)*

It will probably be the case that :

$$h(\omega_1) < h(\omega_2)$$

In other words, for a symbol to have a meaning and to influence the Agent's behavior, it must send a public signal over the Agent's "quality".

2.3. **A simplified version of the model.**

To simplify our model, let assume that:

- The Agent has the choice between two effort levels: $e \in \left\{e^L, e^H\right\}$, with $e^L < e^H$
- The result x is a random variable over the support:

$$\begin{aligned} X &= \{x_1, ..., x_n\} \\ x_1 &< x_2 < x_3 < ... < x_n \end{aligned}$$

- $p_i^H = \Pr(x = x_i | e = e^H) > 0$, $p_i^L = \Pr(x = x_i | e = e^L) > 0$ and $p_i^H > p_i^L$.

In the traditional Principal-Agent analysis with monetary incentives, the problem solved by the Principal is the following :

$$\text{(PMON)} \quad \begin{array}{c} \underset{\{w(x_i)\}_{i=1}^n}{Max} \sum_{i=1}^n p_i^H \left(x_i - w\left(x_i\right)\right) \\ s.t. \\ \sum_{i=1}^n p_i^H u(w(x_i)) - v(e^H) \geq \underline{U} \\ \sum_{i=1}^n \left(p_i^H - p_i^L\right) u(w(x_i)) \geq v(e^H) - v(e^L) \end{array}$$

where the first constraint is the participation constraint, the second one is the incentive compatibility constraint, and $\underline{U}$ is the Agent's reservation utility.

If now we consider a non-monetary incentives scheme, then the Principal solves the following program :

$$\text{(PNMO)} \quad \begin{array}{c} \underset{\{w, s(x_i)\}_{i=1}^n}{Max} \sum_{i=1}^n p_i^H \left[x_i - w - c\left(s(x_i)\right)\right] \\ s.t. \\ \sum_{i=1}^n p_i^H \left[u(w) + g(s(x_i))\right] - v(e^H) \geq \underline{U} \\ \sum_{i=1}^n \left(p_i^H - p_i^L\right) \left[u(w) + g(s(x_i))\right] \geq v(e^H) - v(e^L) \end{array}$$

3. Main results

Our model lead to the following results.

Proposition 1. *The optimal mechanism which solves program (PNMO) is given by*

$$\left\{w^0, s^*(x_i)\right\}_{i=1}^n$$

where :

$$w^0 = u^{-1}\left[v(e^H) + \underline{U} - \sum_{i=1}^n p_i^H g(s^*(x_i))\right]$$

and $s^*(x_i)$ *is such that :*

$$\frac{g'(s^*(x_i))}{c'(s^*(x_i))} = \frac{1}{\lambda_2 + \mu_2\left(1 - \frac{p_i^L}{p_i^H}\right)}$$

where λ_2, μ_2*, the Lagrange multipliers of the problem (PNMO) are strictly positive.*

Let Π^*_{MON} the Principal's optimal profit in the program (PMON) and Π^*_{NMON} the Principal's optimal profit in the program (PNMO). The main issue raised in this paper is to determine **the conditions under which** $\Pi^*_{MON} \leq \Pi^*_{NMON}$ **.**

Theorem 1 (Main Result)**.** *If there exists an optimal monetary scheme* $\{w^*(x_i)\}_{i=1}^n$ *which solves the program (PMON) then there exists an optimal non-monetary scheme* $\left\{w^0, s^*(x_i)\right\}_{i=1}^n$ *which solves the program (PNMO) which guarantees to the Principal an expected profit strictly higher, that is such that:*

$$\Pi^*_{NMON} > \Pi^*_{MON}$$

and which guarantees the same expected utility to the Agent, that is such that :

$$u(w^0) + \sum_{i=1}^n p_i^H g(s^*(x_i)) - v(e^H) = \sum_{i=1}^n p_i^H u(w^*(x_i)) - v(e^H)$$

This result is a kind of revelation principle. It indicates that all what a monetary scheme can provide, a non-monetary scheme can do it as well. But it goes further since it shows that a non-monetary incentives scheme Pareto-dominates a monetary incentives scheme.

Remark 3. *The Principal can implement negative non-monetary incentives s (sanctions), that is such that* $g(s) < 0$*. For instance if* $x = x_1$ *then the Principal can sanction the Agent by suppressing all the apparent signs of her authority (transfer into a smaller office, exclusion from meetings, etc.). But*

$$w^0 = u^{-1}\left[v(e^L) + \underline{U} - \sum_{i=1}^n p_i^L g(s(x_i))\right]$$

Hence, implementing negative non-monetary incentives requires that the Principal raises w^0*, the fixed part of the Agent's monetary wage within the non-monetary scheme* $\left\{w^0, s(x_i)\right\}_{i=1}^n$ *for the participation and the incentives compatibility constraints to be satisfied.*

Remark 4. *In the proof of theorem 1, we have not used the assumption:*

$$u(w) = g(h(\omega)) \Rightarrow w > h(\omega)$$

However, such an assumption has an obvious consequence on the attractiveness of non-monetary incentives schemes: it reinforces them.

Corollary 1. *If there exists an optimal monetary scheme* $\{w^*(x_i)\}_{i=1}^n$ *which solves the program (PMON) then there exists a (non optimal) non-monetary scheme* $\{w, s(x_i)\}_{i=1}^n$ *which solves the program (PNMO) and which provides an expected profit to the Principal* Π_{NMON} *at least equal to the same amount, that is such that:*

$$\Pi^*_{NMON} > \Pi_{NMON} \geq \Pi^*_{MON}$$

and which guarantees to the Agent a higher expected utility, that is such that:

$$u(w) + \sum_{i=1}^{n} p_i^H g(s(x_i)) - v(e^H) > \sum_{i=1}^{n} p_i^H u(w^*(x_i)) - v(e^H)$$

This Corollary states that if the Principal is ready to acccept a profit Π_{NMON} strictly lower than Π^*_{NMON} , then there exists a non-monetary incentives scheme which Pareto-dominates *strictly* the solution given by a monetary incentives scheme.

This article shows that a non-monetary incentives scheme may be more efficient (Pareto-dominating) than a standard monetary scheme. It is obvious that taking into account the tax policy[7], a non-monetary incentives scheme is more interesting both for the Principal and for the Agent under a progressive tax system for the lower part of any income subset subject to a traditional threshold level. Indeed, for such categories of workers, a monetary bonus may sometimes be completely suboptimal if it implies that the Agent switches up to the higher income category, making her pay taxes and losing social transfers. For the Principal as well, if labor taxes are progressive, a non-monetary incentives scheme represents a non-neglictible fiscal advantage.

Another important element in recent developments in the Principal-Agent theory lies in the differentiation between extrinsic and intrisic motivation. We analyze in the following section the contribution of our paper to the debate regarding such issues.

[7]A formal analysis of the incidence of non-monetary incentives within a macroeconomic framework with a third party - the government - and a specific tax policy is outside the scope of this paper. Hence, we leave it for further research.

4. Non-monetary incentives and intrinsic motivation

Frey and Oberholzer-Gee (1997) define intrinsic motivation as "*activities one simply undertakes because one likes to do them or because the individual derives some satisfaction from doing his or her duty*". Our analysis of non-monetary incentives schemes contributes to this debate on extrinsic (activated from the outside) versus intrinsic motivation by showing that all what a monetary scheme can do, a non-monetary incentives scheme can do it as well.

There is a relative consensus in the literature nowadays regarding the fact that if a non-monetary incentives scheme proves to increase extrinsic motivation, it may also have a negative impact on intrinsic motivation, thereby inducing hidden costs for the Principal. These costs have been labelled by social psychologists as "*hidden costs of rewards*" (Lepper and Green, 1978), and they have been analyzed formally later on by economists within agency contexts (see Lane, 1991, Benabou and Tirole, 2003).

What we show in this section is that non-monetary incentives increase intrinsic motivation within agency contexts, thereby counterbalancing the negative impact of price incentives. Before going deeper into the analysis of the impact of non-monetary incentives on intrinsic motivation, let recall the factors that contribute to increase intrinsic motivation (see Deci, 1975, Benabou and Tirole, 2003, Akerlof and Kranton, 2003).

(1) If the incentives scheme is not perceived by the Agent as designed to monitor her behavior, then there is no negative incidence on her intrinsic motivation.

(2) If the incentives scheme is perceived by the Agent as being discretionnary (that is as designed to reward ex post her effort level), then the Agent will interpret such an incentives system as a positive message from the Principal and will increase her intrinsic motivation.

(3) If the incentives scheme sends a positive signal to the Agent regarding her "self-determination", then her intrisinc motivation will be raised up.

A non-monetary incentives scheme $\left\{w^0, s\left(x_i\right)\right\}_{i=1}^n$ will not be perceived by the Agent as designed to monitor her behavior because the monetary component w^0 is the same whatever the result x_i. The non-monetary symbol associated $\omega\left(x_i\right)$ varies with the results but it is not a monetary wage. The Agent will perceive it as an ex-post reward for the effort provided. If for instance $X = \{x_1, x_2\}$ with $\omega\left(x_1\right) =$ "*scooter*" , $\omega\left(x_2\right) =$ "*car*" , $w^0 = 3000USD/month$ and if $x = x_2$ occurs; the Agent will consider the car given by the Principal as a discretionnary reward aimed at rewarding her effort. It is both a prize (since it rewards an effort) and a gift from the Principal (since it shows that her work is publicly recognized). And this is the case all the more as, according to corollary 1, the Principal can build the monetary system in such a way that the Agent obtains an expected utility strictly higher than under a monetary incentive scheme. Besides, since a symbol is perceived by the Agent as a discretionnary reward, then the Agent will behave more in favor of the organization. Indeed, according to Fehr and Gächter (1998), and Akerlof and Kranton (2003), a gift (from the Principal) induces reciprocity (from the Agent), and hence increases the Agent's intrinsic motivation.

Finally, regarding the third case, let remind that the Agent's utility is given by :

$$\tilde{U}(w, s, e) = u(w) + g(s) - v(e)$$

where $s = h(\omega)$ is the non-monetary wage obtained by the Agent from symbol ω. But s is also an index of "ego" or self-satisfaction. Besides, example 5 shows that if a symbol ω is used by the Principal (and accepted by the Agent) as a non-monetary incentive, then it necessarily sends back a signal over the quality of the Agent. In other words, a non-monetary incentives scheme sends a positive signal over the Agent's competence and "self-determination".

Regarding the debate on crowding effects, non-monetary incentives reveal to be compensating for crowding-out effects by increasing intrinsic motivation. IN other words, they reveal to be a compensation for the fact that higher rewards, rather than being encouraging can reduce the motivation to provide effort.

A strong assumption, and thus a weakness of our model lies in the fact that the Principal must know function h. Such an assumption amounts to assuming that the Principal knows the Agent's intrinsic value system (see example 4). If such an assumption is not satisfied, then it becomes difficult for the Principal to implement a non-monetary incentives scheme.

5. Conclusion

This paper has shown that, within a Principal-Agent model with monetary and non-monetary incentives, the latter Pareto-dominate the former. Non-monetary incentives can then compensate for such crowding-out effects by increasing intrinsic motivation. Hence, we not only show that all what monetary incentives can do, non-monetary incentives can do it as well, we go further and show the possibility for non-monetary incentives to increase intrinsic motivation, thereby compensating the fact that higher rewards, rather than being encouraging can reduce the motivation to provide effort. However, from a practical point of view, implementing such a scheme requires that the Principal knows the intrinsic value system of the Agent which is a strong assumption. Relaxing such an assumption constitutes a fruitful area for further research on the role of monetary versus non-monetary incentives.

APPENDIX: PROOFS

Lemma 1. *Let $L(w, s(x_1), \ldots, s(x_n), \lambda_2, \mu_2)$ the Lagrangean of program (PNMO) with $\lambda_2, \mu_2 \geq 0$. We have*

$$\lambda_2 > 0 \text{ et } \mu_2 > 0.$$

Proof of Lemma 1. Indeed, Kuhn and Tucker's conditions are given as follows:

$$\begin{array}{lc} (a) & -1 + \lambda_2 u'(w) = 0 \\ (b) & -p_i^H c'(s(x_i)) + \lambda_2 p_i^H g'(s(x_i)) + \mu_2 \left(p_i^H - p_i^L\right) g'(s(x_i)) = 0 \\ (c) & \lambda_2 \left[\sum_{i=1}^n p_i^H g(s(x_i)) + u(w) - v(e^H) - \underline{U}\right] = 0 \\ (d) & \mu_2 \left[\sum_{i=1}^n \left(p_i^H - p_i^L\right) g(s(x_i)) - v(e^H) + v(e^L)\right] = 0 \end{array} \tag{5.1}$$

$-1 + \lambda_2 u'(w) = 0 \Rightarrow \lambda_2 = \frac{1}{u'(w)}$. Which implies $\lambda_2 > 0$ because $u'(w) > 0$. Besides, equation (b) also writes :

$$\lambda_2 p_i^H + \mu_2 \left(p_i^H - p_i^L\right) = p_i^H . \frac{c'(s(x_i))}{g'(s(x_i))} \tag{5.2}$$

Let assume that $\mu_2 = 0$, then :

$$\lambda_2 = \frac{c'(s(x_i))}{g'(s(x_i))}$$

Let $\frac{c'(s(x_i))}{g'(s(x_i))}$ be denoted by $\psi(s(x_i))$ then the previous equation becomes :

$$\lambda_2 = \psi(s(x_i))$$

That is :

$$s(x_i) = \psi^{-1}(\lambda_2)$$

In other words, the Agent receives the same symbol whatever the result. In this case, the Agent will choose the lowest effort level e^L. Therefore, such a mechanism is not optimal. □

Proof of proposition 1. λ_2 and $\mu_2 > 0$ are given by lemma 1. w^0 and $s^*(x_i)$ directly stem from subconditions (c) and (b) of Kuhn and Tucker's conditions (5.1). It is a global maximum since $\sum_{i=1}^n p_i^H \left[x_i - w - c\left(s(x_i)\right)\right]$, $\sum_{i=1}^n p_i^H u(w(x_i))$ and $\sum_{i=1}^n \left(p_i^H - p_i^L\right) u(w(x_i))$ are concave functions. □

Lemma 2. *Let denote by q : the following random variable*

$$q = w^*(x) - c(s^*(x)) - w^0$$

q denotes the difference between the optimal wage of the non-monetary incentives scheme $w^*(x)$ and the overall cost of the non-monetary incentives scheme. The following two conditions are equivalent.

1. $\Pi^*_{NMON} \geq \Pi^*_{MON}$
2. $E[q] \geq 0$

Proof of lemma 2.

$$\begin{aligned} \Pi^*_{MON} &= \sum_{i=1}^n p_i^H \left(x_i - w^*(x_i)\right) \\ \Pi^*_{NMON} &= \sum_{i=1}^n p_i^H \left[x_i - \alpha(s^*(x_i)).s^*(x_i) - w^0\right] \end{aligned}$$

Thus :

$$\Pi^*_{NMON} \geq \Pi^*_{MON} \Leftrightarrow \sum_{i=1}^{n} p_i^H \left[w^*(x_i) - \alpha(s^*(x_i)).s^*(x_i) - w^0\right] \geq 0$$

That is :

$$E[q] \geq 0$$

□

Proof of theorem 1. The proof consists in showing that $E[q] > 0$. Using lemma 2, this amounts to show that :

$$\Pi^*_{NMON} > \Pi^*_{MON}.$$

Let :

$$C = \left\{ \begin{array}{c} (w, \{s(x_i)\}_{i=1}^n) : u(w) + \sum_{i=1}^n p_i^H g(s(x_i)) - v(e^H) = \underline{U} \\ and \ \sum_{i=1}^n \left(p_i^H - p_i^L\right) g(s(x_i)) = v(e^H) - v(e^L) \end{array} \right\}$$

Clearly, the optimal solution of program (PNMO) is such that $\left\{w^0, s^*(x_i)\right\}_{i=1}^n \in C$. The set C also writes :

$$C = \left\{ (w, \{s(x_i)\}_{i=1}^n) : w = u^{-1}\left[\underline{U} + v(e^L) - \sum_{i=1}^n p_i^L g(s(x_i))\right] \right\}$$

Now let take $\{w^*(x_i)\}_{i=1}^n$ the optimal solution of program (PMON). Let determine $\{\bar{s}(x_i)\}_{i=1}^n$ such that :

$$w^*(x_i) = u^{-1}\left[\underline{U} + v(e^L) - \sum_{i=1}^n p_i^L g(\bar{s}(x_i))\right] + \bar{s}(x_i) \quad , \ i = 1...n \tag{5.3}$$

(5.3) is a system of n non linear equations with n unknowns which admits an infinite number of solutions. By posing :

$$\bar{w} = u^{-1}\left[\underline{U} + v(e^L) - \sum_{i=1}^n p_i^L g(\bar{s}(x_i))\right]$$

we have: $\{\bar{w}, \bar{s}(x_i)\}_{i=1}^n \in C$ and :

$$w^*(x_i) = \bar{w} + \bar{s}(x_i) \quad , \ i = 1...n \tag{5.4}$$

But, by assumption :

$$\bar{s}(x_i) > c(\bar{s}(x_i)) \quad , \ \forall \ i = 1...n$$

Hence :

$$w^*(x_i) > \bar{w} + c(\bar{s}(x_i)) \quad , \ \forall \ i = 1...n$$

Which implies :

$$x_i - w^*(x_i) < x_i - \bar{w} - c(\bar{s}(x_i)) \quad , \ \forall \ i = 1...n$$

We finally get :

$$\underbrace{\sum_{i=1}^n p_i^H (x_i - w^*(x_i))}_{\Pi^*_{MON}} \quad < \quad \underbrace{\sum_{i=1}^n p_i^H [x_i - \bar{w} - c(\bar{s}(x_i))]}_{\Pi_{NMON}}$$

Let recall that the optimal solution of program (PNMO), $\left\{w^0, s^*\left(x_i\right)\right\}_{i=1}^n \in C$. But by definition we have : $\Pi^*_{NMON} \geq \ \Pi_{NMON}$. Hence :

$$\Pi^*_{NMON} > \ \Pi^*_{MON}.$$

It remains to show that :

$$u(w^0) + \sum_{i=1}^n p_i^H g(s^*(x_i)) - v(e^H) = \sum_{i=1}^n p_i^H u(w^*(x_i)) - v(e^H)$$

This comes directly from the fact that the agent has the same reservation utility under (PMON) and (PNMO). □

Proof of Corollary 1. Trivial. Indeed, we know that

$$\Pi^*_{NMON} > \ \Pi^*_{MON}.$$

If we take for example $0 < \varepsilon < \Pi^*_{NMON} - \ \Pi^*_{MON}$, and if we build another non-monetary incentive scheme with :

$$\begin{aligned} w &= w^0 + \varepsilon \\ s(x_i) &= s^*(x_i) \ , \quad \forall \ i = 1...n \end{aligned}$$

then we get our result. □

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