THE COMPOSITION OF COMPENSATION POLICY:
FROM CASH TO FRINGE BENEFITS

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ABSTRACT. We develop a Principal-Agent model to analyze the optimal
composition of the compensation policy with both monetary and non-
monetary incentives. We characterize nonmonetary benefits as symbols
to capture a large set of non-wage compensations such as fringe bene-
fits, status, identity (or self-image) or even sanctions. We characterize
the optimal composition of the compensation policy when the Principal
fully or imperfectly knows the Agent’s preferences.

JEL Codes: M52.
Keywords: Fringe benefits, Non-Monetary Incentives, Perquisites.
1. Introduction

A firm’s compensation policy has three independent dimensions: the level, the functional form and the composition of rewards (Baker et al. [3]). The level of compensation determines the quality and quantity of employees - that is who the firm can attract, the functional form determines the links between pay and performance - that is how employees perform once they’re hired, and the composition defines the relative amounts of the components of the pay package such as cash, fringe benefits, working conditions, relationships with co-workers, leisure etc. Most of the research on incentives has privileged the first two dimensions. During the last 10 years, researchers’ interest in studying non-monetary benefits as part of worker compensation schemes has increased (see for instance, Dale-Olsen [9], Goldman et al. [10], Hart [11], Hashimoto and Zhao [12], Rajan and Wulf [14], Royalty [15], Wood [16], Yermack [18], etc.). However, the literature is still rather thin. The focus of the researchers the last 10 years has primarily been on empirics (important exceptions are, for instance, Oyer [13], Becker et al. [4], Auriol and Renault [2]), about for example the prevalence of fringe benefits, gender differences in fringe benefits, tax preferences for fringe benefits, how fringe benefits affect firm performance and worker turnover, and job-lock issues caused by health and pension plans.

Our paper provides a welcome change to the recent literature. It tackles the difficult task of providing an understanding of the optimal composition of firms’ compensation package. To the best of our knowledge it is the first paper to embed successfully non-monetary benefits into an agency framework in which the Agent may be compensated for her effort by a wage and a nonmonetary reward, and the non-monetary compensation is treated as a symbol. This concept of symbol allows us to express a wide range of non-monetary benefits, like fringe benefits, perks, status, identify (Akerlof and Kranton [1]) and sanctions.

The symbolic nature of non-wage benefits is a crucial assumption in our analysis and relies on the idea that most nonpecuniary benefits have, as a common denominator, a symbolic dimension at least implicitly. Overall non-monetary benefits represent a significant share of compensation, around one third of total labour costs in OECD countries (Dale-Olsen [7], Watters [17]) and are multi-faceted. They embed employer-provided benefits (pension scheme, health and life insurance, stock options), non-wage amenities (e.g. office space or working condition), fringe benefits, perquisites or payments-in-kind (free car, free housing, travel or lower valued fringes such as merchandises, free coffee etc. But despite their multiple components, most non-monetary benefits have a symbolic dimension. Like true symbols (medals or public prizes awarded during lavish ceremonies) any form of privilege (merchandise, company car, travel etc.) commands recognition by others. In fact, basically all types non-monetary benefits are inherently symbolic because even when they are offered to attract and retain employees (like health insurance, pension scheme or stock options) and/or have a direct monetary equivalent, they improve material well-being or signal employer’s interest and recognition to workers. By treating non-monetary benefits as
symbols, we therefore consider that symbols are not a cheap substitute for money. More precisely, the notion of symbol will refer to nonpecuniary rewards with a symbolic, trophy-like, value and not immediately liquid for the Agent, whereas benefits which are “almost-liquid” will be embedded into the variable describing monetary wage.

This paper analyzes the optimal combination of wage and non-wage benefits in a Principal-Agent framework with moral hazard.

However this problem is not trivial. For instance the program in which the compensation package is composed of a nonmonetary reward only, does not necessarily admit a solution.

We show (in theorem 1) that when the Agent’s preference relation over non-monetary benefits is common knowledge to both parties (Principal and Agent), mixed incentives Pareto-dominate purely monetary incentives for both Principal and Agent. Given imperfect knowledge (proposition 3) about the Agent’s preference relation, a compensation policy comprising a fixed fringe benefit combined with variable wage also Pareto-dominates purely monetary incentives for both Principal and Agent. This result is interesting because the literature did not have a good story why some firms provided non-discriminatory non-performance related benefits (i.e., to all employees) while other provided performance-related benefits to selected groups of employees. In our model, of course, if the Principal does not know (and has no prior) about the Agent’s preference over non-monetary benefits, then the Principal will only resort to pure monetary incentives.

Our article is composed of six sections. Section 2 describes the model. Section 3 characterizes the optimal mix of rewards when the Agent’s preferences are common knowledge. Sections 4 and 5 analyze the choice of the optimal contract with and without common knowledge regarding the Agent’s preferences, and section 6 concludes the article.

2. The Model

2.1. Basic set-up and definitions.

We consider a moral hazard model\(^1\) between a Principal and an Agent. The output of the relationship is a random observable variable and the Agent’s effort is unobservable by the Principal. The Principal designs the optimal contract by proposing a compensation package composed of a monetary wage and/or a nonmonetary reward. The nonmonetary reward is characterized by two essential dimensions: its symbolic nature and its value for the Agent who receives them.

We label nonmonetary rewards under the term of symbol. The notion of symbol encompasses non-wage amenities like fringe benefits (e.g. health

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\(^1\)The analysis can be extended to any other type of agency relationship (adverse selection, signalling,...).
and life insurance, vacation trips, use of automobile, childcare services etc) and all types of nonmonetary incentives with a trophy value. Examples of various symbols are receiving a medal (military or civil like an olympic medal), a promotion (without a substantial wage increase), an academic prize, a business award or recognition (e.g. being elected the “Manager of the year”). The main characteristics of symbols is that they are not immediately liquid for the Agent, their role therefore does not consist in yielding a monetary, tradable, revenue. Symbols also have a trophy value and affect one’s image (either self-image and identity or social image and hierarchical status in the organization).

The **value of symbols** depends on the Agent’s preferences between monetary and nonmonetary benefits. These preferences are representative of the Agent’s value system\(^2\). To define the value and costs of symbols, we denote by \(\Omega\) the infinite overall set of symbols. The **Agent’s preferences** are characterized by a standard\(^3\) preference relation \(\succsim\) defined over \(\Omega\) and by a **real symbolic equivalent** (of \(\omega\)) \(s \in S\) such that\(^4\):

\[
s = h(\omega), \quad \omega \in \Omega
\]

where \(h\) represents a *self-satisfaction or ego function*\(^5\) and where \(S\) is the set of real numbers “equivalent” to the set of symbols \(\Omega\).

The **cost of symbols** for the Principal is defined by the cost of a symbol \(\omega\), \(c(\omega) \in \mathbb{R}_+\), and its equivalent for \(s\):

\[
c(h^{-1}(s)) \in \mathbb{R}_+, \quad s \in S
\]

To simplify notations, and when no confusion arises, we will replace the notation \(c(h^{-1}(s))\) by \(c(s)\). Note that function \(c\) is not necessarily either monotonically increasing or decreasing. For now, \(c\) is simply assumed to be twice continuously differentiable.

### 2.2. Technology and preferences.

Given the costs and rewards defined previously, we characterize in this section the Principal’s profit, the Agent’s utility and effort and the output of the relationship.

The stochastic **production level** can take \(n\) possible values: \(x \in X = \{x_1, ..., x_n\}\) where \(x_1 < x_2 < x_3 < ... < x_n\).

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\(^2\)For instance, these preferences indicate whether it is worth proposing to salespersons nonmonetary benefits in the form of travel, merchandise or cash if they already travel too much.

\(^3\)In the sense that \(\succsim\) is complete and transitive and that \((\succsim, \Omega)\) satisfies the usual condition of perfect separability.

\(^4\)From a mathematical standpoint, \(h\) is an *order isomorphism* defined from \((\succsim, \Omega)\) into \((\mathbb{R}, \geq)\). Hence rather than using \(\Omega\), we can use the set \(S = h(\Omega)\). It is worth working with this set \(S\) because any element \(s \in S\) is a real number while the \(\omega\) are pure symbols. Since \(h(\omega)\) captures the nonmonetary reward provided by the symbol \(\omega\), the set \(S\) is interpreted throughout our paper as the set of nonmonetary rewards.

\(^5\)The Agent prefers \(\omega\) to \(\omega'\) because \(\omega\) provides more self-esteem than does \(\omega'\).
The Agent’s effort level can take two possible values: \( e \in \{ e_L, e_H \} \) with \( e_L < e_H \), and the stochastic influence of effort in production is defined by the probabilities \( p_H^i = \Pr(x = x_i|e = e_H) > 0 \), \( p_L^i = \Pr(x = x_i|e = e_L) > 0 \). Of course we assume that the probabilities of success satisfy the monotone likelihood ratio property.

The Agent’s compensation is composed of a monetary wage \( w(x) \) and a nonmonetary component \( s(x) \). The Agent is risk-averse and her utility function is defined by:

\[
\tilde{U}(w, s, e) = \tilde{u}(w(x), s(x)) - v(e)
\]

where \( \tilde{u} \) is a strictly increasing (in both arguments) concave utility function and \( v(e) \) is the Agent’s cost of effort: \( v'(e) > 0 \), \( v''(e) \geq 0 \), \( v(0) = 0 \).

The risk-neutral Principal profit function is defined by:

\[
B(x - w - c(s)) = x - w(x) - c(s(x))
\]

where \( w \) denotes the Agent’s monetary reward, \( c(s) \) is the \( C^2 \) cost of the nonmonetary reward and \( x \in X \) is the observable random output.

2.3. Available contracts for the Principal.

Given the nature of rewards available, the Principal may offer several types of contracts to the Agent:

- **A mixed contract (PMIX)**, corresponding to the general case where the compensation package is composed of both monetary and nonmonetary rewards.

In this case, the Principal solves the following program:

\[
\begin{align*}
\text{Max} & \quad \sum_{i=1}^n p_H^i [x_i - w(x_i) - c(s(x_i))] \\
\text{s.t.} & \quad \sum_{i=1}^n p_H^i \tilde{u}(w(x_i), s(x_i)) - v(e^H) \geq U \\
& \quad \sum_{i=1}^n (p_H^i - p_L^i) \tilde{u}(w(x_i), s(x_i)) \geq v(e^H) - v(e^L)
\end{align*}
\]

where the first constraint is the participation constraint, the second one is the incentive compatibility constraint, and \( U \) is the Agent’s reservation utility.

- **A purely monetary contract (PMON)**, corresponding to the standard Principal-Agent framework with moral hazard, in which the compensation package is composed of a monetary wage only.

In this case, the Agent’s utility depends on monetary rewards only: \( U(w, e) = u(w) - v(e) \), with \( u'(w) > 0 \), \( u''(w) \leq 0 \), \( u(0) = 0 \). This utility function
$U(w,e)$ is the projection of $\hat{U}(w,s,e)$ on the wage-effort space. The Principal solves the following program:

\[
\begin{align*}
\text{(PMON)} & \quad \max \sum_{i=1}^{n} p_{t}^{H} (x_{i} - w(x_{i})) \\
\text{s.t.} & \quad \sum_{i=1}^{n} p_{t}^{H} u(w(x_{i})) - v(e^{H}) \geq U \\
& \quad \sum_{i=1}^{n} (p_{t}^{H} - p_{t}^{L}) u(w(x_{i})) \geq v(e^{H}) - v(e^{L})
\end{align*}
\]

This program will serve as a benchmark of comparison for all other types of contracts.

- **A purely nonmonetary contract (PNOW)**, corresponding to a particular case where the compensation package is composed of a nonmonetary reward only.

In this case, the Agent’s utility would depend on nonmonetary rewards only: $G(s,e) = g(s) - v(e)$, with $g'(s) > 0$, $g''(s) \leq 0$. This function $G(s,e)$ is the projection of $\hat{U}(w,s,e)$ on the symbol-effort space. The main difference between $u$ in (PMON) and $g$ in (PNOW) is that $g(s)$ can be negative. Such $s$ with $g(s) \leq 0$ are called negative non-monetary incentives or sanctions (Recall that while $w \in \mathbb{R}_{+}$, $s \in \mathbb{R}$). When there is no monetary wage, the Principal solves the following program:

\[
\begin{align*}
\text{(PNOW)} & \quad \max \sum_{i=1}^{n} p_{t}^{H} [x_{i} - c(s(x_{i}))] \\
\text{s.t.} & \quad \sum_{i=1}^{n} p_{t}^{H} g(s(x_{i})) - v(e^{H}) \geq U \\
& \quad \sum_{i=1}^{n} (p_{t}^{H} - p_{t}^{L}) g(s(x_{i})) \geq v(e^{H}) - v(e^{L})
\end{align*}
\]

In this situation the program (PNOW) does not necessarily admit a solution (see Appendix). In particular, if the cost function is strictly decreasing then the program (PNOW) has no solution. The absence of solution in such a case relies on the fact that there is a contradiction between the profit maximizing objective of the Principal and the participation and incentive constraints. This property is interesting because it shows that using symbols as incentive devices in agency problems is not trivial even when the costs of providing symbols are decreasing. To avoid this problem, we assume for the rest of the paper that:

**Assumption 1.** The cost function $c$ is a strictly increasing convex function.

In practice, in modern firms or organizations, the Agent cannot be paid only with symbols and a monetary reward (at least fixed, that is independent of the output level) has to be included in the contract. The purely nonmonetary contract hence will not be accepted by the Agent. However, among mixed contracts, some may be designed with fixed wages and/or fixed non-wage benefits. Such contracts will be discussed in section 3. For this purpose, we will consider, among mixed contracts, a contract composed of a fixed wage and a variable fringe benefit, and a contract composed of a fixed fringe benefit and a variable wage:
• Mixed contract with fixed wage (PMIX2). In this contract, the compensation package is composed of monetary and nonmonetary rewards but the monetary part is independent of output.

More precisely, we consider a contract in which the wage offered by the Principal guarantees to the Agent at least her certainty equivalent. In this case, the Principal solves the following program:

\[
\max_{\{s(x_i)\}_{i=1}^n} \sum_{i=1}^n p_i^H [x_i - c(s(x_i))] - \bar{w} \\
\text{s.t.} \\
\sum_{i=1}^n p_i^H \tilde{u}(\bar{w}, s(x_i)) - v(eH) \geq U \\
\sum_{i=1}^n (p_i^H - p_i^L) \tilde{u}(\bar{w}, s(x_i)) \geq v(eH) - v(eL)
\]

where \( \bar{w} \geq I_{\Lambda} \), \( I_{\Lambda} \) being the certainty equivalent of lottery

\[\Lambda = (p_1^H, w^*(x_1); \ldots; p_n^H, w^*(x_n))\]

with \( \{w^*(x_i)\}_{i=1}^n \), solution of (PMON).

• Mixed contract with fixed nonmonetary reward (PMIX3). In this contract, the compensation package is composed of monetary and non-monetary rewards but the nonmonetary part is fixed and independent of output.

More precisely, we consider a contract in which the Principal offers a variable wage and a fixed symbol\(^6\) \( \omega' \) (with real symbolic equivalent \( s' \)). In this case, the Principal solves the following program:

\[
\max_{\{w(x_i)\}_{i=1}^n} \sum_{i=1}^n p_i^H [x_i - w(x_i)] - c(s') \\
\text{s.t.} \\
\sum_{i=1}^n p_i^H \tilde{u}(w(x_i), s') - v(eH) \geq U \\
\sum_{i=1}^n (p_i^H - p_i^L) \tilde{u}(w(x_i), s') \geq v(eH) - v(eL)
\]

2.4. The Agent’s value system.

Given the types of contracts that may be offered by the Principal, the Agent’s value system plays a crucial role in the optimal compensation policy. The reward package will indeed depend on the Agent’s preferences over wage and non-wage benefits. In practice, knowing the Agent’s value system is crucial to determine the best compensation policy.

The Agent’s value system is represented by his preference relation \( \succeq \) (or equivalently by the real symbolic equivalent \( h \) of this preference relation).

Two situations can then arise.

(1) Full information: In this case, \( h \) is common knowledge to both parties (Principal and Agent). This will be our benchmark case (see sections 3 and 4).

\(^6\)Considering more than one symbol would not change the program.
(2) **Private information:** In this case, \( h \) is not perfectly known by the Principal and is *conditional* to the observation of a random variable \( \theta \in \Theta \) (see section 5).

### 3. Characteristics of the mixed contract when Agent’s preferences are common knowledge

In this section we characterize the optimal compensation scheme when the Agent’s value system is common knowledge to both parties. In particular, we will exhibit two main properties of such contracts: the links between wage and non-wage benefits and the risk exposure of the Agent.

#### 3.1. Are wage and non-wage benefits substitutable?

To analyze whether wage and symbols are relative substitute or complement, it is necessary to examine the property of the optimal compensation policy solution of (PMIX). The following proposition characterizes the solution and the links between wage and symbols.

**Proposition 1.** When the Agent’s value system is common knowledge, the optimal solution of (PMIX), \( \left\{ w^*_{mix}(x_i) \right\}_{i=1}^{n}, \left\{ s^*_{mix}(x_i) \right\}_{i=1}^{n} \), is such that

\[
\frac{\overline{u}'_s\left( w^*_{mix}(x_i), s^*_{mix}(x_i) \right)}{\overline{u}'_w\left( w^*_{mix}(x_i), s^*_{mix}(x_i) \right)} = c'(s^*_{mix}(x_i)), \quad \forall \ x_i \in X.
\]

and therefore exhibits stronger wage/symbol complementarity (or congruence) at high wage levels.

The fact that the optimal compensation policy depends on the degree of substitutability between monetary and nonmonetary rewards relies on the concavity (in the two arguments) of the utility function: in the plane \( (w(x_i), s(x_i)) \), a convex indifference curve exhibits increasing marginal rate of substitution between \( s(x_i) \) and \( w(x_i) \), \( MRS_{sw} = \frac{\overline{u}'(\cdot)}{\overline{u}'_w(\cdot)} \). \( MRS_{sw} \) measures the amount of wage that the Agent is willing to give up to obtain one additional unit of symbol. Since this rate is increasing, the amount of wage that the Agent is willing to give up to obtain one additional unit of symbol varies with the level of wage.

In other words, the value that the agent places on one extra unit of a symbol is higher and the opportunity cost of wage is lower at high wage.

\( ^7 \)The random variable \( \theta \) can be interpreted as a signal over the Agent’s preferences and can thus allow introducing heterogeneous types of Agent. In this situation, the design of the compensation package may become a screening and auto-selection device leading to an endogenous sorting of workers according to their type (Besley and Ghatak [5] developed a similar argument).
levels, and lower at low wage levels\textsuperscript{8}. Hence, the complementarity between wage and symbol is higher at high wage levels. This property holds for standard utility functions. Let us consider a CES utility function:

\[
\hat{u}(w(x_i), s(x_i)) = \left[\alpha w(x_i)^{-\varepsilon} + \beta s(x_i)^{-\varepsilon}\right]^{-\frac{1}{\varepsilon}}
\]

with \(\varepsilon \geq -1\), and \(\alpha, \beta, v, \nu\) are positive constants. Then the optimality condition derived from proposition 1 writes:

\[
\left(\frac{\alpha}{\beta}\right) \frac{w_{\text{mix}}^*(x_i)}{s_{\text{mix}}^*(x_i)} \varepsilon + 1 = c'(s_{\text{mix}}^*(x_i))
\]

That is:

\[
\frac{w_{\text{mix}}^*(x_i)}{s_{\text{mix}}^*(x_i)} = \left[\frac{\beta}{\alpha} \times c'(s_{\text{mix}}^*(x_i))\right]^{-\frac{1}{\varepsilon+1}}
\]

We see that \(\frac{w_{\text{mix}}^*(x_i)}{s_{\text{mix}}^*(x_i)}\) is a decreasing function of \(\varepsilon\), where the elasticity of substitution between wage \((w)\) and non-monetary rewards \((s)\) is \(\sigma = \frac{1}{1+\varepsilon}\).

As \(\varepsilon\) increases, \(s\) and \(w\) become less and less substitutable. In the limit case when \(\varepsilon = +\infty\) (i.e. \(\hat{u}\) is a Leontief utility function), \(s\) and \(w\) are complementary, and given the optimality condition, we have \(w_{\text{mix}}^*(x_i) = s_{\text{mix}}^*(x_i)\).

When \(\varepsilon\) decreases, \(s\) and \(w\) become more substitutable and \(w_{\text{mix}}^*/s_{\text{mix}}^*\) increases.

When \(\varepsilon = 0\) (Cobb-Douglas function) then \(w_{\text{mix}}^*(x_i) = s_{\text{mix}}^*(x_i) \times \frac{\alpha}{\beta} c'(s_{\text{mix}}^*(x_i))\).

When \(\varepsilon = -1\) (Linear function) then \(w_{\text{mix}}^*(x_i)\) must be very high compared to \(s_{\text{mix}}^*(x_i)\).

In sum, the optimal composition of the compensation package and the degree of substitutability between monetary and nonmonetary benefits varies with the workers’ wage level. There is some empirical evidence in line with this issue. Dale-Olsen \cite{8} shows that in Norwegian non-public sector establishments in 2002, there seems to exist a positive correlation between wages and fringe benefits. However, when accounting for the size of the establishments then Norwegian manufacturing is actually characterized by a convex relationship between fringe benefits and workforce size to the position in the conditional wage distribution. This convex relationship means that high wage establishments offer more fringes to their employees and have a higher size, but very low wage establishments also offer more fringes and are large\textsuperscript{9}.

\textsuperscript{8}Of course the attitude towards risk (w.r.t the monetary and non-monetary dimensions) will play a role. Let us take for example a CARA utility function : \(\hat{u}(w(x_i), s(x_i)) = 1 - \exp(-Aw(x_i) - Bs(x_i))\) where \(w(x_i), s(x_i) \geq 0\) and \(A, B > 0\) are respectively the absolute aversion coefficients w.r.t. the monetary and the non-monetary dimensions. The optimality condition derived from proposition 1 writes: \(\frac{\alpha}{\beta} = c'(s_{\text{mix}}^*(x_i))\). Since \(c\) is a strictly increasing convex function, then \(\frac{\alpha}{\beta} = c'(s_{\text{mix}}^*(x_i))\) implies \(s^*(x_i) = s_0\), whatever \(x_i\); with \(s_0 = c'^{-1}\left(\frac{\alpha}{\beta}\right) > 0\). To conclude, if the utility function belongs to the class of CARA utility functions, then the optimal compensation scheme is such that the non-monetary reward \((s_0)\) is fixed. This non-monetary reward \(s_0\) is indirectly connected to the optimal wage through \(\frac{\alpha}{\beta}\): the higher \(\frac{\alpha}{\beta}\), the higher \(s_0\).

\textsuperscript{9}US data from the Bureau of Labor Statistics show that very low wage employees receiving only health benefits and sick leave sometimes have a very high percentage of total compensation in fringe benefits. This is due to the fact that the cost of health
These facts are not inconsistent with our assessment that complementarity is higher for high wage levels.

3.2. Risk-exposure w.r.t. the monetary dimension and compensation mix.

In order to characterize agent risk exposure, we compare the mixed contract with a constant - riskless - wage to a contract where only a monetary -risky- wage is received. We therefore consider a particular type of mixed contracts (contract PMIX2) composed of a fixed wage at least equal to the certainty equivalent of the lottery $\Lambda$ corresponding to the purely monetary program (PMON) where $\Lambda = (p^H_1, w^*(x_1); \ldots; p^H_n, w^*(x_n))$ and

$$w^*(x_i) = u^{-1}\left(\frac{1}{\lambda + \mu \left(1 - \frac{p^L_i}{p^H_i}\right)}\right)$$

with $\lambda$ and $\mu$ are strictly positive Lagrange multipliers. The comparison of (PMON) and (PMIX2) yields the following proposition.

**Proposition 2.** If the Principal knows the Agent’s value system, then the optimal mechanism which solves program (PMIX2), $(\bar{w}, \{s_{mix2}^*(x_i)\}_{i=1}^n)$, where $s_{mix2}^*(x_i)$ is defined by:

$$\bar{u}'(\bar{w}, s_{mix2}^*(x_i)) = \frac{1}{\lambda_3 + \mu_3 \left(1 - \frac{p^L_i}{p^H_i}\right)}$$

with $\lambda_3, \mu_3$, the strictly positive Lagrange multipliers of (PMIX2), is such that, compared to the contract with purely monetary incentives (PMON), the Agent is indifferent while facing faces a lower risk exposure in terms of monetary wage.

In other words, the principal can rely on nonmonetary incentives to reduce monetary risk exposure. Since the agent is indifferent between both types of contract, choosing the riskier contract in terms of monetary reward reveals a preference for risk. Becker et al. [4] develop a model in which a higher status raises the marginal utility of income to explain the demand for risky activities. Higher status is acquired by the winners of lotteries and other risky activities and the willingness to participate in risky activities is the result of the importance of status in the agents’ preferences. This assumption implies a complementarity between status, income and “risk-loving”. In our framework, risk-averse agents will prefer the variable part of rewards to bear on symbols and not wage. However, potentially higher symbols (conditional on output) are associated with less risk in terms of monetary wage in contract PMIX2, which is preferred by risk-averse agents. Our assumption of a general utility function implies that the links between benefits is very large relative to the wages of a minimum wage employee and comparisons should be made very carefully in such particular cases (see Campbell [6]).
symbol, wage and risk are more complex and depend on the agent’s wage level.

Given that several types of contracts may be offered by the principal, we have to compare them to determine whether one (or more) of them would be preferred by the principal and/or the agent. This comparison will depend on the agent’s preferences over wage and non-wage benefits. Hence, we will examine what is the optimal compensation package when the agent’s system value is common knowledge (section 4) and when it is not common knowledge (section 5).

4. Choice of the optimal contract when Agent’s preferences are common knowledge

One might think that it is always more profitable for the principal to offer a mixed contract to the agent because when there are more rewarding tools, incentives are more powerful and this automatically increases the principal’s profit. However, when offering a mix of rewards, the principal relies on more incentives instruments but also bears more costs. Let consider for example a particular type of non-monetary benefits such that $c(s(x_i)) = w(x_i)$ $\forall x_i \in X$. In this case, a mixed contract will reduce the principal’s profit compared to a purely monetary contract. Hence, the issue of the optimal composition of the compensation policy is not trivial.

Let us add the following assumption to the previous one.

Assumption 2. Let $S_n$ be the set (strictly included in $S$) of non-monetary rewards effectively used by the Principal, then:

$$E(s) = \sum_{i=1}^{n} s(x_i)p_i^H > E(c(s)) = \sum_{i=1}^{n} c(s(x_i))p_i^H$$

Assumption 2 means that in expected terms, the value (for the Agent) attached to symbols should exceed its costs for the Principal. In other words, the employer should have a relative comparative advantage in offering non-monetary benefits to the employee. When the principal knows the agent preferences, assumption 2 is not too much constraining because the set of non-monetary incentives is sufficiently large for the Principal to find out a set (subset of $S$) of non-monetary benefits whose conditional (to $e^H$) expected cost is lower than their conditional expected value. Of course, assumption 2 does not obviously imply the results obtained in theorem 1.

Let $\Pi_{MON}^*$ be the principal’s optimal profit in the program (PMON) and $\Pi_{MIX}^*$ be the principal’s optimal profit in the program (PMIX).

The trade-off between monetary and mixed incentives packages is then characterized as follows.
Theorem 1. When the Principal knows the Agent’s value system, if there exists a purely monetary contract \( \{w^*(x_i)\}_{i=1}^n \) which solves (PMON), then there exists a mixed contract \( \{(w_{mix}^*(x_i))_{i=1}^n, (s_{mix}^*(x_i))_{i=1}^n\} \) solution of (PMIX) which increases the Principal’s expected profit:

\[
\Pi^*_{MIX} > \Pi^*_{MON}
\]

and leaves the Agent indifferent:

\[
\sum_{i=1}^n p_i^H \tilde{u}(w_{mix}^*(x_i), s_{mix}^*(x_i)) - v(e^H) = \sum_{i=1}^n p_i^H u(w^*(x_i)) - v(e^H)
\]

This result indicates that when the principal knows the agent’s preferences, a mixed contract Pareto-dominates a purely monetary contract. A consequence of this result is that the Principal may use nonmonetary compensations to offset the hidden costs of rewards.

Corollary 1. When the Principal knows the Agent’s value system, if there exists a purely monetary contract \( \{w^*(x_i)\}_{i=1}^n \) which solves (PMON), then there exists a (non optimal) mixed contract \( \{(w_{mix}^*(x_i))_{i=1}^n, (s_{mix}^*(x_i))_{i=1}^n\} \) which provides an expected profit to the Principal \( \Pi_{MIX}^* \) such that:

\[
\Pi^*_{MIX} > \Pi_{MIX} \geq \Pi^*_{MON}
\]

and increases the Agent’s expected utility:

\[
\sum_{i=1}^n p_i^H \tilde{u}(w_{mix}^*(x_i), s_{mix}^*(x_i)) - v(e^H) > \sum_{i=1}^n p_i^H u(w^*(x_i)) - v(e^H)
\]

This corollary establishes that if the principal is willing to accept an expected profit level \( \Pi_{MIX}^* \) strictly lower than \( \Pi^*_{MIX} \) (but still greater than \( \Pi^*_{MON} \)), then there exists a mixed contract which strictly Pareto-dominates purely monetary contract. In other words, any compensation mix always improve the employer’s profits compared to a monetary contract.

We are now going to examine the case where the agent’s value system is not common knowledge.

5. Choice of the optimal contract when Agent’s preferences are not common knowledge

When the Agent’s preferences are not known by the Principal, \( h \) is then conditional to the observation of a random variable \( \theta \in \Theta \). The Agent’s preferences over wage and non-wage amenity is denoted by \( \succeq^\theta \) and its corresponding real symbolic equivalent writes \( h(\omega, \theta) \). Three subcases are distinguished:
5.1. Subcase 1: The Principal does not know (and has no prior on) the probability distribution of $\theta$.

In this case, the Principal can only resort to pure monetary incentives.

5.2. Subcase 2: The Principal knows the probability distribution of $\theta$.

In this case, a mixed monetary/nonmonetary incentives mechanism can be designed by working on the expected self-satisfaction of a symbol $\omega$ denoted $\hat{h}(\omega) = \hat{s} = E_\Theta [h(\omega, \theta)]$.

5.3. Subcase 3: The Principal does not know (and has no prior on) the probability distribution of $\theta$ but she knows that there exist (at least) two symbols $\omega', \omega'' \in \Omega$ such that $\omega' \succ \omega''$.

In this case, the Principal can design a mixed contract composed of a variable wage and a fixed nonmonetary reward $s'$ (associated to $\omega'$). Since the compensation package is composed of a monetary wage and a nonmonetary reward fixed and independent of output, the optimal contract solves program (PMIX3). Since the Principal uses only one symbol, then assumption 2 writes: $s' > c(s')$. The optimal compensation package is then characterized by the following proposition.

**Proposition 3.** When the Principal does not know (and has no prior) the probability distribution of $\theta$ but knows that there exist (at least) two symbols $\omega', \omega'' \in \Omega$ such that $\omega' \succ \omega''$, then the optimal incentive mechanism derived from program (PMIX3) \( \{w_{mix3}^*(x_i)\}_{1=1}^n, s' \) such that:

$$\tilde{u}_{w}(w_{mix3}^*(x_i), s') = \frac{1}{\lambda_4 + \mu_4 \left(1 - \frac{p_i}{p_{i'}}\right)}$$

with $\lambda_4$ and $\mu_4$ the strictly positive Lagrange multipliers, always Pareto-dominates purely monetary incentives solution of (PMON).

This proposition shows that even when the Principal imperfectly knows the Agent’s value system, a mixed contract can still be offered and is pareto-improving compared to the purely monetary contract: the Agent obtains the same reservation utility while the Principal’s profit are increased. This proposition is important since in most firms and organizations, many fringe benefits are not conditioned to the firm’s result. This is the case for instance of health insurance, nursery, or free car. Our results suggest that using a fixed fringe benefit and a variable monetary wage as an incentive device improves firms’ profits. In particular, a profitable firm’s strategy would be to target the fringe benefits policy. On the one hand, fixed non-wage amenities would be offered on the basis of weak information (only that employees have a preference for them) and could thus be interpreted as a way to retain employees and reduce turnover (see Dale-Olsen [8]). This could be the case
of health insurance for example. On the other hand, symbols with a high trophy value would be offered on the basis of strong information, employers should know what trade-off determine workers preferences between wage and non-wage rewards, and could thus be profitably linked to the firm’s results. This could be the case of status in the organization.

6. Conclusion

This paper develops a Principal-Agent model to analyze the optimal composition of the compensation policy with both monetary and nonmonetary incentives. Our results are compatible with the empirical literature concerning nonmonetary incentives.

From an economic policy perspective, taking into account the tax system might reinforce our results in the following sense. A mixed monetary/non-monetary incentives scheme would be more interesting both for the Principal and for the Agent under a progressive tax system for the lower part of the income distribution subject to a traditional threshold level. Indeed, for such categories of workers, a monetary bonus may sometimes be completely suboptimal when 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-purely monetary incentives scheme represents a non-negligible fiscal advantage, even though we have seen that the role of cost in the optimal compensation package is not trivial.

Our static model could be extended to dynamic one in order to analyze the long term relationship between wage and symbols. For instance, a desire for a status in the future can induce workers to perform efficiently, therefore reducing the need for monetary incentives.
Proof: (PNOW) does not necessarily admit a solution. We can solve the program (PNOW) using Kuhn and Tucker method because on the one part the cost function is twice continuously differentiable and on the other part \( \sum_{i=1}^{n} p_i^H g(s(x_i)) \) and \( \sum_{i=1}^{n} (p_i^H - p_i^L) g(s(x_i)) \) are concave functions. However the solution if it exists is a global maximum. Let \( L(s(x_1), ..., s(x_n), \lambda_1, \mu_1) \) the Lagrangean of program (PNOW) with \( \lambda_1, \mu_1 \geq 0 \). Kuhn and Tucker’s conditions are given as follows:

\[
\begin{align*}
(a) \quad & -p_i^H c'(s(x_i)) + \lambda_1 p_i^H g'(s(x_i)) + \mu_1 (p_i^H - p_i^L) g'(s(x_i)) = 0 \\
(b) \quad & \lambda_1 \left[ \sum_{i=1}^{n} p_i^H g(s(x_i)) - v(e^H) - U \right] = 0 \\
(c) \quad & \mu_1 \left[ \sum_{i=1}^{n} (p_i^H - p_i^L) g(s(x_i)) - v(e^H) + v(e^L) \right] = 0
\end{align*}
\]

Equation (a) also writes:

\[
\lambda_1 p_i^H + \mu_1 (p_i^H - p_i^L) = p_i^H \cdot \frac{c'(s(x_i))}{g'(s(x_i))}
\]

Hence we have:

\[
\lambda_1 = \sum_{i} p_i^H \cdot \frac{c'(s(x_i))}{g'(s(x_i))}
\]

Recall however that while \( g'(s(x_i)) > 0 \), we have made no assumption about the monotonoy of cost function \( c \). If this function is strictly decreasing then \( \sum_{i} p_i^H \cdot \frac{c'(s(x_i))}{g'(s(x_i))} < 0 \) and we have a contradiction with \( \lambda_1 \geq 0 \). Therefore if the cost function is strictly decreasing then program (PNOW) admits no solution. We have the same conclusion if \( c \) is not monotone decreasing but is such that \( \sum_{i} p_i^H \cdot \frac{c'(s(x_i))}{g'(s(x_i))} < 0 \). \( \square \)

Proof of proposition 1. We can solve the program (PMIX) using Kuhn and Tucker method because on the one part the cost function is a convex function and on the other part \( \sum_{i=1}^{n} p_i^H \tilde{u}(w(x_i), s(x_i)) \) and \( \sum_{i=1}^{n} (p_i^H - p_i^L) \tilde{u}(w(x_i), s(x_i)) \) are negative semidefinite functions. Moreover the solution if it exists is a global maximum. Let \( L(w(x_1), ..., w(x_n); s(x_1), ..., s(x_n), \lambda_2, \mu_2) \) the Lagrangean of program (PMIX) with \( \lambda_2, \mu_2 \geq 0 \). Kuhn and Tucker’s conditions are given as follows:

\[
\begin{align*}
(a) \quad & -p_i^H + \lambda_2 p_i^H \tilde{u}'(w(x_i), s(x_i)) + \mu_2 (p_i^H - p_i^L) \tilde{u}'(w(x_i), s(x_i)) = 0 \\
(b) \quad & -p_i^H c'(s(x_i)) + \lambda_2 p_i^H \tilde{u}'(w(x_i), s(x_i)) + \mu_2 (p_i^H - p_i^L) \tilde{u}'(w(x_i), s(x_i)) = 0 \\
(c) \quad & \lambda_2 \left[ \sum_{i=1}^{n} p_i^H \tilde{u}(w(x_i), s(x_i)) - v(e^H) - U \right] = 0 \\
(d) \quad & \mu_2 \left[ \sum_{i=1}^{n} (p_i^H - p_i^L) \tilde{u}(w(x_i), s(x_i)) - v(e^H) + v(e^L) \right] = 0
\end{align*}
\]

(a) writes also:

\[
\lambda_2 p_i^H + \mu_2 (p_i^H - p_i^L) = \frac{p_i^H}{\tilde{u}'(w(x_i), s(x_i))}
\]

Hence:

\[
\lambda_2 = \sum_{i} \frac{p_i^H}{\tilde{u}'(w(x_i), s(x_i))}
\]
Since \( \tilde{u}_w(w(x_i), s(x_i)) > 0 \) then \( \lambda_2 > 0 \) (we reach exactly the same conclusion using Kuhn and Tucker condition \((b)\)). Concerning \( \mu_2 \), if \( \mu_2 = 0 \) then \((a)\) and \((b)\) implies respectively that:

\[
\lambda_2 = \frac{1}{\tilde{u}_w(w(x_i), s(x_i))}
\]

and

\[
\lambda_2 = \frac{c'(s(x_i))}{\tilde{u}'_s(w(x_i), s(x_i))}
\]

\( \lambda_2 = \frac{1}{\tilde{u}_w(w(x_i), s(x_i))} \) implies that (using implicit functions theorem) \( w(x_i) = \phi(\lambda_2, s(x_i)) \). Therefore, \( \lambda_2 = \frac{c'(s(x_i))}{\tilde{u}'_s(w(x_i), s(x_i))} \) also writes:

\[
\lambda_2 = \frac{c'(s(x_i))}{\tilde{u}'_s[\phi(\lambda_2, s(x_i)), s(x_i)]}
\]

Let us denote \( \frac{c'(s(x_i))}{\tilde{u}'_s[\phi(\lambda_2, s(x_i)), s(x_i)]} \) 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. Hence we have \( \mu_2 > 0 \). The optimal mixed monetary/non-monetary incentives scheme is given by:

\[
\left\{ \{w^*_{mix}(x_i)\}_{i=1}^n, \{s^*_{mix}(x_i)\}_{i=1}^n \right\}
\]

such that

\[
\frac{\tilde{u}'_w(w^*_{mix}(x_i), s^*_{mix}(x_i))}{\tilde{u}_w(w^*_{mix}(x_i), s^*_{mix}(x_i))} = c'(s^*_{mix}(x_i)), \quad \forall x_i \in X.
\]

\( \square \)

**Proof of proposition 2.** Applying the same reasoning as in the proof of proposition 1, we have \( \lambda_3 > 0 \) and \( \mu_3 > 0 \). The optimal incentives scheme is given by:

\[
\left\{ \bar{w}, \{s^*_{mix2}(x_i)\}_{i=1}^n \right\}
\]

such that

\[
\frac{\tilde{u}'_w(\bar{w}, s^*_{mix2}(x_i))}{c'(s^*_{mix2}(x_i))} = \frac{1}{\lambda_3 + \mu_3 \left(1 - \frac{\mu_3}{\mu_2}\right)}, \quad \forall x_i \in X.
\]

The Agent is indifferent between the solution of (PMIX2) and the one of (PMON) because in both case he gets his reservation utility. However his risk exposure w.r.t. the monetary wage is reduced since he gets the (riskless) fixed wage \( \overline{w} \) which is, by construction, greater than \( I_\Lambda \) the certainty equivalent of \( \Lambda = (p^H_1, w^*(x_1); \ldots; p^H_n, w^*(x_n)) \), the lottery faced by the Agent in the pure monetary incentives mechanism (PMON). \( \square \)
Lemma 1. Let denote by $q$ the following random variable

$$ q = w^* (x) - c(s^*_{\text{mix}}(x)) - w^*_{\text{mix}} (x) $$

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

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

Proof of lemma 1.

\[
\Pi^*_\text{MON} = \sum_{i=1}^{n} p^H_i (x_i - w^* (x_i)) \\
\Pi^*_\text{MIX} = \sum_{i=1}^{n} p^H_i [x_i - c(s^*_{\text{mix}}(x_i)) - w^*_{\text{mix}} (x_i)]
\]

Thus:

$$ \Pi^*_\text{MIX} \geq \Pi^*_\text{MON} \iff \sum_{i=1}^{n} p^H_i [w^* (x_i) - c(s^*_{\text{mix}}(x_i)) - w^*_{\text{mix}} (x_i)] \geq 0 $$

That is:

$$ \mathbb{E}[q] \geq 0 \quad \square $$

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

$$ \Pi^*_\text{MIX} > \Pi^*_\text{MON}. $$

Let:

\[
C = \left\{ \{w(x_i)\}_{i=1}^{n}, \{s(x_i)\}_{i=1}^{n} : \sum_{i=1}^{n} p^H_i \tilde{u}(w(x_i), s(x_i)) - v(e^H) = U \right. \\
\left. \text{and} \sum_{i=1}^{n} (p^H_i - p^L_i) \tilde{u}(w(x_i), s(x_i)) = v(e^H) - v(e^L) \right\}
\]

Clearly, the optimal solution $(\{w^*_{\text{mix}} (x_i)\}_{i=1}^{n}, \{s^*_{\text{mix}} (x_i)\}_{i=1}^{n})$ of program (PMIX) belongs to $C$.

Let us remark that $C$ also writes:

\[
C = \left\{ \{w(x_i)\}_{i=1}^{n}, \{s(x_i)\}_{i=1}^{n} : \sum_{i=1}^{n} p^H_i \tilde{u}(w(x_i), s(x_i)) = U + v(e^L) \right\}
\]

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

\[
(6.4) \quad w^* (x_i) = \bar{w}(x_i) + \bar{s}(x_i) \quad , \quad i = 1...n
\]

Such a $(\{\bar{w}(x_i)\}_{i=1}^{n}, \{\bar{s}(x_i)\}_{i=1}^{n})$ necessarily exists and by assumption 2, we have:

$$ \sum_{i=1}^{n} p^H_i \bar{s}(x_i) > \sum_{i=1}^{n} p^H_i c(\bar{s}(x_i)) \quad , \quad \forall \ i = 1...n $$
We finally get:
\[
\sum_{i=1}^{n} p_i^H (x_i - w^*(x_i)) < \sum_{i=1}^{n} p_i^H [x_i - \bar{w}(x_i) - c(\bar{s}(x_i))]
\]
\[\Pi^*_{MON} \quad \Pi^*_{MIX}\]

Let recall that \(\{w^*_{mix}(x_i)\}_{i=1}^{n}, \{s^*_{mix}(x_i)\}_{i=1}^{n}\) the optimal solution of program (PMIX) belongs to \(C\). Moreover by definition we have: \(\Pi^*_{MIX} \geq \Pi^*_{MIX}\). Hence:
\[
\Pi^*_{MIX} > \Pi^*_{MON}.
\]

It remains to show that:
\[
\sum_{i=1}^{n} p_i^H \tilde{u}(w^*_{mix}(x_i), s^*_{mix}(x_i)) - v(e^H) = \sum_{i=1}^{n} p_i^H u(w^*(x_i)) - v(e^H)
\]
This comes directly from the fact that the Agent has the same reservation utility under (PMIX) and (PMON).

**Proof of Corollary 1.** We know that
\[
\Pi^*_{MIX} > \Pi^*_{MON}.
\]
If we take for example \(0 < \varepsilon < \Pi^*_{MIX} - \Pi^*_{MON}\), and if we build another non-purely monetary incentive scheme with:
\[
\begin{align*}
  w(x_i) &= w^*_{mix}(x_i) + \varepsilon \\
  s(x_i) &= s^*_{mix}(x_i), \quad \forall i = 1...n
\end{align*}
\]
then we get our result.

**Proof of proposition 3.** Applying the same reasoning as in the proof of proposition 1, we have \(\lambda_4 > 0\) and \(\mu_4 > 0\). The optimal incentives scheme is given by:
\[
\left(\{w^*_{mix3}(x_i)\}_{i=1}^{n}, s'\right)
\]
\[
\text{such that } \tilde{u}'(w^*_{mix3}(x_i), s') = \frac{1}{\lambda_4 + \mu_4 \left(1 - \frac{p^L_{0i}}{p^H_{0i}}\right)}, \quad \forall x_i \in X.
\]
Finally, using the same technology of proof as for theorem 1, we get that the solution of (PMIX3) Pareto-dominates purely monetary incentives.
References


