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Behavioral Agency Model: a target-oriented approach for executive incentives

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Abstract*—Recent empirical studies in Behavioral Agency Model (see Pepper and Gore, 2012) on executive compensations make evidence how the agent attitude to risk influences the subjectively perceived incentive value. The paper sets out a compensation schedule matching multiple goals: (1) aligning the incentives with the executive subjectively perceived fair and equitable compensation; (2) discouraging the executive excessive risk-taking; (3) providing an approach to calculate the certainty equivalent of the uncertain compensation. To hit the first goal we suggest to use the target-oriented decision approach (see Bordley and LiCalzi, 2000) able to guide the agent in eliciting her subjective value function through the assessment of the (uncertain) target to hit. The proposed approach is compatible with prospect theory (see Kahneman and Tversky, 1979). With reference to the second goal involving the problem on how prevent moral hazard phenomena, we suggest to insert an event-linked option. That warranty ties the compensation payment to the outgoing a set of given performance indicators taken as benchmarks. The third goal is achieved using the notion of actuarial zero-utility premium principle extended to prospect theory (see Kaluszka and Krzeszowiec, 2012, 2013). To explicit the agent subjective value function we suggest an interactive graphical method proposed by Goldstein and Rothschild (2014) based on the Distribution Builder (see Sharpe et al., 2000). Our approach generalizes the Pepper and Gore (2012, 2013) compensation formula and provides a normative foundation for constructing compensation schemes, which are coherent with Savage's (1954) rationality axioms and prospect theory as well.

***Keywords*— Behavioral Agency Model; Behavioral Theory of the firm; Executive incentives; Utility function assessment; Contract theory; Moral hazard; Risk.**

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I. Introduction

The origin of the Agency Theory can be traced back to the seminal papers of Ross (1973) and Mitnick (1973). The theory has been subsequently developed along different multi-disciplinary research streams, see the in-depth survey of Mitnick (2013). Nowadays it is become a central component of the modern theory of the firm and a dominant theoretical framework for academic research on executive compensation (Jensen, 2000; Roberts, 2004). Yet, as discussed by Pepper and Gore (2012) much experimental evidence has confirmed that Agency Theory flaws down in describing the relationship among executive compensation, agent behavior and firm performance. To overcome these drawbacks Pepper and Gore (2012) set out the so called "Behavioral Agency Model" (BAM) that integrates ideas from behavioral economics and specifically from prospect theory (Kahneman and Tversky, 1979; 1991). Recent empirical studies confirm that to understand how the executive incentives drive the manager to make firm-oriented choices it is necessary to consider her subjective perception of compensation with respect to the outperformance of firm targets (see Pepper and Gore, 2013; Martin, 2013).

The aim of the present paper is to go a step further in the path of Pepper and Gore (2012, 2013) by designing executive compensation mechanisms able to match the following targets: (1) eliciting the compensation perceived as fair and equitable by the executive in accordance with the BAM and providing an user-oriented approach to explicit the agent subjective value function; (2) including a mechanism to prevent agent's excessive risk-taking; and (3) calculating the certainty equivalent of the uncertain compensation under actuarial fairness principles.

To achieve the first point we suggest a target-oriented decision approach (see Bordley and LiCalzi, 2000) that couples the user-friendly applicability with normative rules. Assessing the objectives in terms of meeting targets instead of function values appears a natural task for handling decisions in management context. Targets imposed by the principal may be uncertain to the executives. In such a case, the agent opinions on the distribution of the (uncertain) targets get information on her value function (see Castagnoli and LiCalzi, 1996). In Games Theory that method for value function elicitation is called the benchmarking procedure (see Castagnoli and LiCalzi, 2006). With reference to the second question, to prevent the executive moral hazard phenomena, we suggest to include a warranty that ties the executive compensation to outperform a set of "Key Performance Indicators" (KPIs) tailored to the firm and stakeholders goals. With reference to the third point, the calculation of the certainty equivalent of the uncertain compensation is achieved through the actuarial zero-utility premium principle extended to prospect theory (see Kaluszka and Krzeszowiec, 2012, 2013). To explicit the agent subjective value function we suggest an interactive graphical method based on the Distribution Builder (see Goldstein and Rothschild, 2014).

The remainder of this paper is organized as follows. In Section II, we discuss the Behavioral Agency Theory. In Section III we illustrate the benchmarking procedure. In Section IV we list the Pepper and Gore (2012) behavioral features assumed for the agent. In the subsequent we add a moral hazard prevention-oriented warranty in the modelling. Graphical tests aimed at guiding the agent to assess personal preferences under risk are illustrated in Section VI. A normative way to calculate the certainty equivalent of the uncertainty compensation is proposed in Section VII. Section VIII concludes the article.

II. Behavioral Agency Theory and beyond

The underlying assumptions of classical Agency Theory are the following: (1) organizations are profit seeking, (2) agents are rational and (3) there is the absence of non-pecuniary agent motivation.

It is further assumed that principals are risk neutral, the agents risk averse and that agent's utility is positively contingent on pecuniary incentives and negatively contingent on effort, and that time preferences are discounted using an exponential discount function. As a consequence, the effort and motivation are assumed increasing functions in additional reward. However, empirical studies have shown that this model is too simplistic, and Pepper and Gore (2012) propose four modifications that we briefly summarize:

a) Agents' human capital: Classical Agency Theory places small relevance to the connection between the agent performance and work motivation. So, intangible factors are included in the modelling the value function according to the prospect theory.

b) Risk and uncertainty: According to BAM executives are more loss averse than risk averse (Wiseman and Gomez-Mejia, 1998). Gains and losses are calculated by each individual agent in relation to a reference point which is subjectively determined. Experimental studies make evidence that risk preferences differ in gains and losses, that induces the value function from being strictly concave to being "S-shaped". This means that, below the reference point, agents will be loss averse, resulting in an increase in her appetite to take short term risk. Above the reference point agents will generally be risk averse, but decision weights will vary depending on subjective probability assessment; for example, small probabilities are over-weighted and large probabilities are under-weighted.

c) Time preferences: According to BAM agents heavily discount long term compensations, so a personalized discounting rate structure is introduced.

d) Inequity aversion: If agents feel that their efforts and skills are fairly and adequately rewarded, they will be motivated to continue to contribute at their best; vice versa the agents may become demotivated, this latter attitude is called "inequity aversion".

In addition to the above listed points we suggest to consider a further modification. Executives are asked to manage the firm and stakeholders interests but have incentive to pursue their own. To discouraging executive's excessive risk-taking, we introduce a mechanism of:

e) Moral hazard prevention: To discourage moral hazard phenomena we insert a performance-linked option.

Specifically, the mechanism is designed as a "event-index" option that bounds the executive to receive the compensation only if a basket of selected performance indicators satisfactorily match prudential, strategic and operational goals.

III. The agent behavioral decision setup: the benchmarking procedure

In line with Steel and König (2006) and Pepper and Gore (2012) we propose an extended version of the von Neumann and Morgenstern (1947) expected utility model able to embrace the ideas of prospect theory.

In the following we focus on agent's viewpoint, because our aim is to catch the compensation that is perceived fair and equitable by the agent.

In Decision Theory under uncertainty that problem is solved ranking all possible acts defined on a given state space. To achieve a consistent ranking the standard approach consists in axiomatize the agent preferences. Yet, in the management context that appears an extremely tricky issue, because laypeople is not in habit to express preferences in terms of axioms. To overcome this difficulty, we suggest to use a user-oriented procedure based on the so called benchmarking evaluation, able to rank a set of options by the probability that they meet a given target (see Castagnoli and LiCalzi, 2006). The benchmarking procedure is more general than it may appear, in fact it includes standard expected utility as a special case, and is compatible with Savage's (1954) rationality axioms and prospect theory principles, as discussed in Bordley et al. (2014).

Suppose that the agent has to choose among a feasible set A of actions $d \in A$. Denote by X_d the random outcome with probability distribution P_d associated with the action d. The von Neumann-Morgenstern (1947) expected utility model states that the ranking should be consistent with the utility function

$$v(d) = EU\left(X_d\right) = \sum_x U\left(x\right) P_d\left(x\right) \quad (1)$$

where $U\left(x\right)$ is the agent value function over outcomes.

A new interpretation of $U\left(x\right)$ is given through a target-oriented decision-making model. To make the paper self-contained we recall the main passages (see Castagnoli and LiCalzi, 1996 and Bordley and LiCalzi, 2000). Let rewrite the utility function

$$v(d) = P\left(X_d \geq T\right) = \sum_x P\left(x \geq T\right) P_d\left(x\right) \quad (2)$$

Where T is the uncertain target with cumulative distribution function that the agent feels she is expected to match. To better grasp the probabilistic nature of the target let $T = t + \varepsilon$, where t is a given constant interpretable as the mean value of the target T and ε the subjective zero-mean error term that is stochastically independent of X, where X is the random variable of outcomes.

It turns out, that after a trivial normalization, we can shift from the utility-based framework to the target-oriented one by simply interpreting the utility function as the probability that a consequence X will meet the stochastic target T. We can thus $U\left(x\right)$ view as the probability that x equals or exceeds the target T; that is

$$U(x) = P\left(x \geq T\right) \quad (3)$$

Equation (3) makes Equation (1) and Equation (2) formally identical. Then the agent value function $U\left(x\right)$ coincides with the probability of meeting the uncertain goal T.

So, the agent who makes choices to maximize the expected value function, in practice, maximizes the probability of meeting the (uncertain) goal T, in formula

$$EU\left(X\right) = \sum_{d=1}^{n} EU\left(X_d\right) = E\left[P\left(x \geq T\right)\right] \quad (4)$$

The above benchmarking procedure appears appropriate in business and management context, where decision makers are familiar to express the objectives in terms of meeting targets *T*, that it may happen these targets are uncertain. That is the case the target depends on the performance of the competitors or the target is simply uncertain at the moment of decision as in the case the principal is planning risky investments and fixing uncertain benchmarks.

IV. The Pepper and Gore (2012) behavioral features

In line with Steel and König (2006) and Pepper and Gore (2012, 2013) we focus on modelling the agent behavior according to Prospect Theory's principles, and agent's value function *U* characterized by the following three features:

(i) Reference dependence (framing a decision problem around a reference point): managers are concerned about changes with respect to some reference point, rather than about their final state of wealth.

(ii) Reflection effect: the marginal impact of both positive changes (gains) and negative changes (losses) decreases with their magnitudes.

(iii) Loss aversion: Kahneman and Tversky (1979)'s famous adage "losses loom larger than gains of equivalent amount" brilliantly captures the fact that agents asymmetrically behave concerning outcomes which are around the reference point, overweighting losses with respect to comparable gains.

Due to (i)-(ii)-(iii), outcomes are transformed following an S-shaped function *U* as defined in Equation (3), that is concave for gains, convex for losses, and steeper for losses than for gains. The choice of the reference point deserves a further discussion. As Kahneman and Tversky (1979) diffusely highlight, the reference point used to discriminate bad from good outcomes, may differ from the status quo and may shift over time. In the target-based model, the reference point coincides with the modal outcome of the distribution of the uncertain target *T*. This is coherent with the assumption that the target is subjectively assessed and may be updated over time. For a more detailed discussion on the psychological interpretation of (i)-(ii)-(iii) see LiCalzi (1999).

To the above listed behavioral features (i)-(ii)-(iii), we suggest to add a further feature aimed at driving the agent towards firm-oriented choices.

V. A further feature: a moral hazard prevention warranty

Situations in which people make decisions on behalf of others under uncertainty are often associated with moral hazard phenomena. To prevent these situations and induce executives to behave in a firm-oriented perspective, we suggest to incorporate in the contract a warranty that links the compensation to the outperformance of a basket of selected KPIs. The indicators to include in the basket depend on which business areas the principal aims at controlling.

Among the numerous KPIs known in the literature (Baginski and Hassel, 2004; Giroux, 2003; Higgins, 2007; Ingram, Albright and Baldwin, 2002) and commonly used in management control, we suggest the following ones:

a) Return On Equity (ROE).

b) Return On Investment (ROI).

c) Debt Ratio.

d) Revenues increase rate with the condition of constant or increasing Return On Sales (ROS).

The first, the second and the fourth indicators have omogeneous behaviour (the higher they are the higher the firm performances), while the third ratio can have a positive or a negative impact on performances, according to the relationship between the Return on Investment (ROI) and the interest rate of the capital taken to loan (*i*). In particular, when ROI is bigger than *i*, the higher the debt ratio the higer the ROE and *vice versa*.

However, recent studies have shown that financial indicators are too short-term oriented, and how management control systems should be able to measure a wide range of strategic variables on a long time horizon and integrate financial indicators with non-financial indicators by following the logic of cause-and-effect links (Bhimani and Langfield-Smith, 2007). With this assumption about the function of management control systems, there is an awareness of the difficulties of implementing a strategy and independently translating it into operational terms based on the effectiveness of the strategy itself. Indeed, even if a company's executive formulate excellent long-term strategies, they often have serious difficulties in implementing them, as the organisation struggles to translate strategic objectives into daily operations. Kaplan and Norton (1996) proposed to balance financial indicators with non-financial ones in a Balanced Scorecard (BSC) such as: i) customer satisfaction rate; ii) employees turnover; iii) innovation rate; etc.

To make the executive aware of the relevance of long-term firm-oriented objectives, we suggest to include in the contract a warranty that induces to keep under control a number of KPIs. So, the uncertain compensation displays characteristics similar to the final uncertain payout of an event-linked security. Let us formalize the setup.

Let denote by $c(X)$ the executive compensation calculated on the outcome of the random variable X. Function c is assumed an increasing function of the possible outcomes. The contract may tie the payment of $c(X)$ to the outperformance of the selected KPIs. The final executive payout can be structured in different fashions, as :

- Binary option: if the basket of performance indices is coded by only two possible values (overall positive/negative evaluation), i.e. it is a binomial random variable, then the final payout is representable as structured cash-or-nothing option, where the executive get the amount or nothing at all in the case the KPIs do not meet satisfactorily levels.

- Compound option: if the outperformance of the performance indicators is coded by different marks, then the final payout can be structured according to a penalty scheme.

In the language of the probability, the final random payout is nothing but a compound lottery based on two random variables: the compensation $c(X)$ and the basket of the performance indicators. This kind of lotteries have been thoroughly studied in the Game Theory and in recent years also in Finance and Actuarial Sciences for pricing structured products. For example, the final payout presents similarities with the CAT-bonds and the parametric insurance contracts. Translating into the insurance language, we can state that if the triggering catastrophic event occurs, i.e. the selected KPIs flaw down in matching the principal desired benchmarks, then the executives can lose most or all of the compensation $c(X)$ accordingly to a properly graduated penalty scheme.

VI. Probability of Meeting Targets: from numerical vs. graphical tests

Empirical investigations have made evidence on how laypeople feel uncomfortable in assessing their subjective risk preferences in terms of value function U. Although a variety of different methodologies have been proposed in the literature, the question is still open (for an overview of the prevailing approaches ranked according to their complexity see Charness et al., 2013).

Using the benchmarking approach, Equation (4) permits to shift the problem from the value function elicitation towards the probability distribution of the perceived (unknown) target T elicitation. That latter appears a much easier task than the former, because of the presence on the market of graphical interactive software aimed at this purpose. In recent years, Goldstein et al. (2008) have set up an efficient methodology based on the Distribution Builder, an interactive process seminally introduced by Sharpe et al. (2000), able to guide individuals to assess their risk/return tradeoffs by means of graphic examples.

This procedure has advantages over the traditional approaches based on simple gamble choices, including: the reference dependence and the risk aversion detection; the possibility to easily calculate the basic statistical measures, as the mean, the median, the mode and the maximum and minimum outcomes. Empirical evidences of these advantages are discussed in Goldstein and Rothschild (2014).

VII. How to calculate the certainty equivalent of the uncertain compensation?

A spontaneous question that may arise after having set up a model under uncertainty and elicited the agent value function, is how to deal with the practical calculation of the certainty equivalent of the uncertain payout $c(X)$, possibly modified by the presence of the moral hazard prevention warranty. Translating the question into the language of insurance, we discuss how to calculate the premium that the agent is willing to pay to get rid off an uncertain loss.

The most common method of pricing insurance contracts is the zero-utility principle (see Gerber, 1979) based on the axiomatic framework of the von Neumann-Morgenstern (1947) expected utility model. In this context people (the insurer and insured, as well) are assumed to act as risk-averse decision makers endowed with concave utility functions, with possible different risk profiles. To embrace the Kahneman and Tversky (1979) behavioral ideas, this principle has been recently extended by Kaluszka and Krzeszowiec (2012, 2013). The concave utility functions are replaced with S-shaped value functions and more general definitions of insurance premia are given (see Kaluszka and Krzeszowiec, 2012, Equation 5). Now we restate that definition in the management context-wording.

Let denote with ω the initial wealth of the agent endowed with the value function U, the certainty equivalent π for the uncertain compensation $c(X)$, possibly modified by the presence of the moral hazard prevention-warranty, is defined as the (unique) solution of

$$U(w) = EU\left(w + \pi - e^{-\delta t} c(X)\right) \qquad (5)$$

Where $e^{-\delta t}$ is the financial discount factor, with force of interest δ and lifetime *t*. In Equation (5) the left-hand side term $U(w)$ indicates the situation in which the agent takes no-action *d* so no compensation is due, whereas the right-hand side term $EU\left(w + \pi - e^{-\delta t} c(X)\right)$ indicates the discounted sure amount π that the agent feels equitable to the random compensation $c(X)$ payable after a lifetime *t*.

To assess the agent subjective value function *U*, thanks to Equation (3) it is sufficient to test the subjectively perceived probability distribution function of the (uncertain) target *T*. To this purpose an interactive procedure proposed by Goldstein and Rothschild (2014) discussed in Section V can be set up. Then, as the value function *U* is achieved, Equation (5) can be solved, and the desired value π turns out.

VIII. Conclusion

In the present paper we develop in different directions a line of argument first advanced by Pepper and Gore (2012), more precisely: (1) we suggest an user-oriented benchmarking procedure compatible with both the expected utility and the prospect theory; (2) we introduce a warranty to prevent moral hazard; (3) we calculate the certainty equivalent of the uncertainty compensation through a generalization of the zero-utility extended to Prospect Theory. As by-product we show that the agent value function coincides with her subjectively perceived probability distribution function of the (uncertain) target (see Equation (3)). That is an important result from the practical point of view. Principally because the elicitation of the latter function is a much easier task compared with that of the value function. In fact, we have at disposal interactive graphical procedures introduced by Goldstein and Rothschild (2014) and based on a software called Distribution Builder (see Sharpe et al., 2000 and Goldstein et al., 2008), guiding the agent in ranking risky actions in a coherent and natural way.

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