

Article

# Incentive Systems for Risky Investment Decisions Under Unknown Preferences: Ortner et al. Revisited

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**Abstract:** Ortner et al. (*Manage. Account. Res.* 36(1):43–50, 2017) propose the State-Contingent Relative Benefit Cost Allocation Scheme as an incentive system for risky investment decisions. The note at hand reveals the information distribution implicitly assumed within the framework of this study. Based on this information distribution, both simpler and more powerful ways to induce consistency exist.

**Keywords:** investment decision; performance measure; relative benefit cost allocation

**JEL Classification:** D82; G31; M46

## 1. Introduction

Ortner et al. [1] examine how to design incentive systems for value-maximizing risky investment decisions in settings containing unknown time and risk preferences of the manager. Under these conditions, the well-known Relative Benefit Cost Allocation (RBCA) Scheme introduced by Rogerson [2] and Reichelstein [3] generally cannot provide for consistent incentives. Instead, Ortner et al. [1] propose a state-dependent cost allocation corresponding to the State-Contingent Relative Benefit Cost Allocation Scheme. The note at hand revisits the analysis of Ortner et al. [1] and reveals the information distribution implicitly supposed. Based on these findings, it is shown that both simpler and more effective incentive systems exist. In particular, there is no need to use residual income as a performance measure.

The remainder of the note progresses as follows. Section 2 outlines the analysis of Ortner et al. [1]. In Section 3, the information requirements in order to implement the State-Contingent Relative Benefit Cost Allocation Scheme are examined and their consequences are demonstrated, while Section 4 discusses the results.

## 2. An Outline of Ortner et al. (2017)

Ortner et al. [1] analyze an investment incentive problem between an owner (principal) and a better-informed manager (agent). The agent faces (one or more) investment opportunities at time  $t = 0$ . If he/she decides to invest, each investment requires a deterministic initial investment expenditure  $I$  and subsequently produces risky cash flows  $c_{ts}$  in state  $s$  at time  $1 \leq t \leq T$ .

The state-specific cash flows are given as

$$c_{ts}(I) = \psi_{ts} \cdot E(c_t(I)) = \psi_{ts} \cdot x_t \cdot y(I) \text{ with } E(\psi_t) = 1. \quad (1)$$

Here,  $\psi_{ts}$  denotes the state-specific variation factor with respect to the expected cash flow at time  $t$ . The latter can be expressed as the product of a temporal growth factor  $x_t$  and a profitability factor  $y(I)$ .

Concerning the distribution of information, the following is assumed: “Only the manager has complete information of possible investment projects, i.e. only he knows the investment expenditures,

possible future periodic cash flows  $c_{ts}$  in the different states and the probability of each environmental state  $p_{ts}$ . The realized initial investment expenditure  $I$ , and all realized cash flows  $c_{ts}$  are observable by the owner" ([1], p. 44).

In line with previous literature, the principal is supposed to be risk-neutral. With regard to the agent, the article of Ortner et al. [1] extends existing research as both the agent's time and risk preferences are assumed to be unknown. In particular this means that risk aversion is possible.

To align the financial interests of the parties involved, the principal establishes an incentive system composed of periodical compensation functions

$$\omega_t = \omega_t(\pi_{ts}),$$

together with (possibly) state-dependent performance measures

$$\pi_{ts} = \pi_{ts}(I, c_{1s}, \dots, c_{ts}).$$

Performance measurement should be based on the investment expenditure and realized cash flows.

An incentive system is said to be consistent if the agent, while maximizing the expected utility of future compensation payments, simultaneously maximizes the expected net present value of project cash flows, which is the principal's objective function. As to the latter, literature on the topic distinguishes the cases where compensation costs are taken into account (preference similarity) or neglected (goal congruence) [4].

For the case of a single risky project that generates merely positive cash flows ( $\forall t, s : x_t > 0 \wedge \psi_{ts} > 0$ ), Ortner et al. [1] derive the following result (Proposition 1 in the paper of Ortner et al. [1]). Within the class of residual income-based performance measures

$$\pi_{ts} = c_{ts}(I) - A_{ts} \cdot I,$$

consistent incentives are induced by cost allocations  $A_{ts}$  according to the so-called State-Contingent Relative Benefit Cost Allocation (State-Contingent RBCA) Scheme, i.e.,

$$A_{ts} = \psi_{ts} \cdot \frac{x_t}{\sum_{\tau=1}^T x_{\tau} \cdot \gamma_p^{\tau}},$$

and suitably defined compensation functions  $\omega_t(\pi_{ts})$ . Here,  $\gamma_p^{\tau}$  denotes the principal's time preference. In excess of the information requirements to construct the original RBCA scheme [2,3], the approach proposed by Ortner et al. [1] presumes knowledge of the variation factor  $\psi_{ts}$  of the realized state.

The State-Contingent Relative Benefit Cost Allocation Scheme can be transferred to a setting with multiple projects in connection with a value-conserving transformation of all projects into the same time and risk structure (Proposition 2 in the paper of Ortner et al. [1]).

### 3. Implicit Information and Consequences

To implement the State-Contingent RBCA Scheme, the principal needs specific knowledge of the time and risk structure, in particular the temporal growth factors  $x_t$  and the variation factor  $\psi_{ts}$  of the realized state  $s$ .

Yet, if it is possible to identify  $\psi_{ts}$  for every realized state, one can conclude that the principal has much more information. From Equation (1), i.e.,

$$c_{ts}(I) = \psi_{ts} \cdot x_t \cdot y(I)$$

or

$$y(I) = \frac{c_{ts}(I)}{\psi_{ts} \cdot x_t},$$

and the fact that  $c_{ts}$  is (also) observable by the principal, it follows that the profitability factor  $y(I)$  is known to the principal upon realization of the first cash flow, at the latest<sup>1</sup>. However, given  $y(I)$ , the principal is able to calculate the expected net present value  $E(NPV(I))$  of the project. It is thus possible to replace the state-dependent performance measure according to Ortner et al. [1] at each point in time  $1 \leq t \leq T$  with a state-independent measure that is proportional to  $E(NPV(I))$

$$\pi_t = \kappa_t \cdot E(NPV(I)) = \kappa_t \cdot \left( \sum_{\tau=1}^T x_\tau \cdot y(I) \cdot \gamma_P^\tau - I \right), \quad (2)$$

together with  $\kappa_t > 0$  and suitably defined functions  $\omega_t(\pi_t)$ . The (project-independent) proportionality factors may be constant, i.e.,  $\kappa_t = \bar{\kappa}$ , or may not<sup>2</sup>. The prospect of positive compensation in case of a favorable project (i.e., positive NPV) and negative compensation in case of an unfavorable project (i.e., negative NPV) induces the agent, irrespective of his risk aversion, to act in the best interest of the principal. Ortner et al. ([1], p. 49) claim “that appropriate performance measures necessarily have to be state-dependent”. Obviously, this statement is valid only with respect to a narrowly defined class of accounting measures.

Performance measurement in accordance with Equation (2) perfectly protects the principal’s interest. Moreover, implementation is warranted<sup>3</sup>. Generally, incentive systems should be based only on observable and also third-party verifiable information. According to Ortner et al. [1], the temporal growth factor  $x_t$ , the realizations of the cash flow  $c_{ts}(I)$ , and the state-specific variation factor  $\psi_{ts}$  are verifiable. Consequently, it should be possible to contract on a (deterministic and explicitly defined) function of these parameters, i.e.,  $y(I) = f(c_{ts}(I), x_t, \psi_{ts}) = c_{ts}(I) / (\psi_{ts} \cdot x_t)$ .

Beyond that, the State-Contingent RBCA Scheme is afflicted with two serious drawbacks. First, it is restricted to so-called “normal” projects that always generate positive cash flows ( $\forall t, s : x_t > 0 \wedge \psi_{ts} > 0$ ), a requirement rarely met in practice. Second, in the case of multiple risky projects, an additional value-conserving transformation of the available projects into the same risk and time structure is necessary. It is unclear how this can be done, since Ortner et al. [1] only state the conditions to be satisfied, but do not provide precise functional relationships or an algorithm to follow. The disadvantages mentioned can be avoided if performance measurement adheres to Equation (2).

#### 4. Discussion

As the performance measure proposed in this note (see Equation (2)) imposes no compensation risk on the (perfectly informed) agent, the problem of efficient risk sharing will not arise [6]. Moreover, further agency problems (beyond the considered investment decision) could be solved in a way analogously to (and with the restrictions mentioned by) Ortner et al. [1]. I therefore arrive at the following conclusion. In the light of the information distribution implicitly assumed by Ortner et al. [1], a principal who wants to induce consistent incentives can resort to both simpler and more powerful methods as compared with the State-Contingent Relative Benefit Cost Allocation Scheme. Early literature on consistent incentive systems emphasizes the role played by contractual relationships (for an overview, see [7]). In particular, Rogerson ([2], p. 793) states that his paper “provides a theory of both why [residual] income may be used as a performance measure for management and how [residual] income should be calculated for this purpose”. Clearly, Ortner et al. [1] show *how* to design residual income for the class of investment projects considered. Yet, I fail to see *why* one should do so.

<sup>1</sup> Earlier models on consistent incentive systems (e.g., [5]) assume additive noise whose realizations cannot be identified by the principal. Hence it is not possible to deduce the profitability factor. Yet, in the context developed by Ortner et al. [1], a further (i.e., second) source of noise would trigger the agent’s risk aversion and thus prevent consistency.

<sup>2</sup> Concerning the investment decision, it would be sufficient to compensate the manager at least at one point in time, i.e.,  $\forall t : \kappa_t \geq 0$  and  $\exists t : \kappa_t > 0$ .

<sup>3</sup> I thank an anonymous referee for making this point.

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## References

1. Ortner, J.; Velthuis, L.; Wollscheid, D. Incentive systems for risky investment decisions under unknown preferences. *Manag. Account. Res.* **2017**, *36*, 43–50. [[CrossRef](#)]
2. Rogerson, W.P. Intertemporal cost allocation and managerial investment incentives: A theory explaining the use of economic value added as a performance measure. *J. Polit. Econ.* **1997**, *105*, 770–795. [[CrossRef](#)]
3. Reichelstein, S. Investment decisions and managerial performance evaluation. *Rev. Account. Stud.* **1997**, *2*, 157–180. [[CrossRef](#)]
4. Pfeiffer, T.; Velthuis, L. Incentive system design based on accrual accounting: A summary and analysis. *J. Manag. Account. Res.* **2009**, *21*, 19–53. [[CrossRef](#)]
5. Mohnen, A.; Bareket, M. Performance measurement for investment decisions under capital constraints. *Rev. Account. Stud.* **2007**, *12*, 1–22. [[CrossRef](#)]
6. Ross, S.A. On the economic theory of agency and the principle of similarity. In *Essays on Economic Behavior Under Uncertainty*; Balch, M.S., McFadden, D.L., Wu, S.Y., Eds.; North-Holland: Amsterdam, The Netherlands, 1974; pp. 215–237.
7. Lambert, R.A. Contracting theory and accounting. *J. Account. Econ.* **2001**, *32*, 3–87. [[CrossRef](#)]



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