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Foreword (2022)

The present study began with Jerry Feltham's invitation to present at the Stanford Summer Camp in August 2003. As we were variously involved in related work on performance measurement and dynamic incentives, Peter, Jerry, Christian, and Florin teamed up and the result was Christensen, Feltham, Hofmann, and Sabac (2003). The present study is an update of the unpublished Stanford Summer Camp version dated July 3, 2003, when Peter Christensen was at the University of Southern Denmark in Odense and Jerry Feltham was at the University of British Columbia in Vancouver. Both Peter and Jerry are now deceased. The 2003 manuscript was a team effort under Jerry's guidance, the current update was completed by Christian and Florin. We thank the Editor and an anonymous reviewer for their helpful comments and suggestions.

Contents

Timeliness, Accuracy, and Relevance in Dynamic Incentive Contracts

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ABSTRACT

We examine managerial performance measures from the perspective of timeliness, accuracy, and relevance in multi-period incentive problems. Although many insights are general, we employ a simple linear framework where managerial actions do not affect risk. We compare and contrast consumption risk for a manager's preferences with single and multiple consumption dates, respectively. We consider both full commitment to and renegotiation of long-term contracts. Under full commitment, timely and accurate information is usually relevant and desirable; the only differences arise from the modeling of managerial preferences, through the manager's consumption risk. In particular, the timeliness of performance reports can be irrelevant; then, delaying reports is desirable if it can increase their accuracy.

Under renegotiation of long-term contracts, the timeliness of information release relative to renegotiation is essential.

[†] Deceased.

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Any information released prior to renegotiation is incorporated into an ex post efficient (renegotiated) contract and is particularly useful in insuring the manager against future consumption risk. Delayed reporting destroys this insurance value and can make late reports irrelevant, independent of the modeling of managerial preferences. But timely reports can create ex ante inefficient action incentives for managers, and then accuracy can be costly as well.

1

Introduction

The genesis for this monograph goes back to the mid 1960's, when a committee of the American Accounting Association (AAA), among others, challenged accounting researchers to pay greater attention to accounting's role as a source of information for various decision makers (American Accounting Association, 1966). In his response to this challenge, Feltham (1968, 1972), examined the economic impact of the timeliness, accuracy, and relevance of information in a dynamic decision environment, with illustrations using an inventory control model. As was common at that time, the focus was on what Demski and Feltham (1976) would later call the *decision facilitating* role of information. Agency models in accounting research began to appear in the mid 1970's, for example Demski and Feltham (1978), emphasizing what Demski and Feltham (1976) called the *decision influencing* role of information. The decision influencing role is also commonly framed as the stewardship role of accounting information (in contrast to its valuation role, although information is normally used for both purposes, e.g., Feltham and Wu, 2000), particularly Holmström (1979) and Gjesdal (1981, 1982).

In the wider context of agency theory, an early question was whether multi-period agency models would yield new insights over the prevailing

one-period models. Very early on, Fama (1980) suggested that multi-period labor markets might solve agency problems without the need for explicit incentive contracts. But, as Holmström (1999, originally written in 1982) showed by formally modeling Fama's suggestion, moral hazard and explicit contracts persist in a dynamic perspective on incentives. Fama and Holmström thus launched the work on career concerns (with no, or one-period contracts) but only partially answered the question of multi-period insights.

Around the same time as Fama and Holmström, Lambert (1983) shifted the focus to the nature of dynamic incentives with (finite horizon) long-term contracts. However, it was only with Fudenberg *et al.* (1990) that it became clearer when a multi-period agency is "truly" dynamic and not merely a sequence of fully separable one-period problems. Fudenberg *et al.* (1990) characterize a set of sufficient conditions for commitment to long-term contracts to have no value; then, long-term contracts can be replicated by a sequence of short-term contracts, and for these separate one-period models suffice. The central insight of Fudenberg *et al.* (1990) was that, if commitment to long-term contracts is to be valuable, and thus for there to be a "true" multi-period agency, then at least one of their sufficient conditions should not hold. Of these conditions, perhaps the most relevant to accounting research is that managerial performance in future periods is neither directly nor conditionally informative about current managerial effort. But this does not hold when managers take long-term actions that are reflected in performance over multiple periods, or accounting performance measures include stochastic elements that either persist or reverse in future periods. Thus, managerial performance evaluation is a "truly" dynamic agency problem of interest to accounting research.[1]

Mirroring the development of agency theory, for the first two decades, the majority of the agency analyses in accounting have been single-period models, whereas the analysis of multi-period models has been more significant over the last three decades. But most have treated the dates at which reports are released as fixed. Our objective is to

[1] Violating one of the Fudenberg *et al.* (1990) conditions is only necessary, but not sufficient, for commitment to long-term contracts to have value.

examine, in a multi-period agency model, the timeliness, accuracy, and relevance of decision influencing information, with a particular emphasis on timeliness.

We consider multi-period extensions of the single-period LEN model-linear contracts, exponential utility, and normally distributed performance reports-see, for example, Feltham and Xie (1994), Holmström and Milgrom (1991). Randomness is due solely to the noise in performance reports, and that noise is additive.[2] Hence, the agent's actions do not vary with the reports received, although his actions do depend on the incentive rates that will be applied to his reported performance.[3] The principal chooses those incentive rates and, in so doing, she considers the gross payoff she will receive from the agent's actions and the compensation she must pay the agent. The compensation must cover the agent's personal action costs plus what we call his *consumption risk premium*. The decision influencing information can affect which actions can be induced (which pertains to the relevance or goal congruence issue), but the primary effect examined in this monograph pertains to the consumption risk premium that must be paid for a given level of induced effort. Obviously, the amount of noise in a report and the correlation across reports affects the agent's risk premium (which pertains to the accuracy or precision issues). Interestingly, the timeliness of the reports can also affect the agent's consumption risk premium, and exploration of this effect is a major component of this study.

As we demonstrate, the impact of timeliness on the agent's consumption risk premium depends significantly on the extent to which the principal and agent can commit to a long-term contract and on the agent's preferences. We initially assume full commitment is feasible (in

[2]It is also important that we assume preferences are represented by exponential functions in which the agent's disutility for effort is expressed as a personal cost reducing his consumption. These assumptions remove all wealth effects. Normal distributions is another important assumption that ensures that the posterior risk is independent of the realization of prior reports.

[3]In a multi-period setting, the decision-influencing information reported after an action has been taken can also serve as decision-facilitating information for selecting subsequent actions. We examine a principal-agent model in which that is not the case.

Sections 4–6) and later examine the impact of limited commitment (in Section 7).

There are two basic ways of extending the agent's exponential utility function to encompass multiple consumption and action dates in LEN models. The first, which we term *PM* (short for multiplicatively separable preferences, for reasons that are elaborated upon later in the monograph) follows papers such as Gibbons and Murphy (1992), Meyer and Vickers (1997), Indjejikian and Nanda (1999), Christensen *et al.* (2003, 2005) and assumes that the agent's utility is expressed as a function of the net present value (NPV) of his consumption. We explicitly allow for a positive interest rate, whereas the papers mentioned assume a zero interest rate, and as we shall see, this can have a profound impact on how we can interpret results with *PM*. The second extension, which we term *PA* (short for additively separable preferences) follows Dutta and Reichelstein (1999, 2003) and Șabac (2007, 2008), and assumes that the agent's utility function is the sum of a discounted sequence of exponential functions applied to the consumption at each date. The timing of consumption and compensation can differ, since the agent can borrow or save at the market interest rate. Interestingly, the agent's certainty equivalent for a given compensation contract has the same general form for both *PM* and *PA*. The only difference is the *effective risk aversion* (see Dutta and Reichelstein, 1999) used in calculating the consumption risk premium. While the difference appears "small," the impact is significant. Under *PM*, the timing of consumption, compensation, and performance reports are immaterial when there is full commitment.

On the other hand, under *PA*, whereas the timing of compensation is immaterial, the optimal timing of the agent's consumption for a given incentive contract is unique. In particular, the additive preferences result in consumption smoothing, which we characterize as going short or long in annuities that spread the agent's bank balance plus his certainty equivalent for future compensation over his consumption planning horizon (which may be finite or infinite, if he considers his heirs). Consequently, *PA* implies that the earlier the agent receives information about his risky compensation, the lower is his consumption risk premium, and the larger is the NPV of the principal's expected net payoff.

A report is purely insurance-informative if it is not influenced by any action, but is correlated with the noise in some action-informative report (e.g., the performance of competitors or information about economy- or industry-wide events that will influence the noise in the agent's performance reports).[4] The impact of the timing of this type of report highlights the fact that incentive risk (i.e., the risk associated with compensation that varies with action-informative reports) is mitigated by the agent's consumption smoothing and by the principal's provision of "insurance" based on insurance-informative reports. The latter is less costly to the principal than the former, because she is risk neutral and the agent is risk averse. The efficient use of a report may depend on the timing: *ex ante* efficient use in contracting, prior to the issuance of the report, may differ from *ex post* efficient use. In that case, early reporting would reduce the agent's risk premium if, after the insurance-informative report is issued, it is not efficiently used by the principal *ex post*. Otherwise, there is no benefit to early reporting of pure insurance information, if it is efficiently used by the principal *ex post*, provided the report is issued before or with the first action-informative report with which it is correlated. If issued after the latter date, then the earlier it is reported, the better.

Reports are defined to be stochastically independent if their noise terms are independently distributed across periods, and the reports are defined to be technologically independent if only the current period's actions influence the current report. The reports are fully independent if both conditions are satisfied, and deriving the optimal contract is particularly straightforward in this case (for a comprehensive analysis of this case, see Section 25.4 in Christensen and Feltham, 2005). Under full independence, there is no value to commitment to not renegotiate long-term contracts or even to having long-term contracts in the first place (which do require some limited form of commitment). In this case, long-term contracts can be implemented as a series of independent one-period contracts, both in the general case (Fudenberg *et al.*, 1990) and

[4] Such a report is conditionally controllable in the sense of Antle and Demski (1988), see also Christensen *et al.* (2010). For further details on action-informative vs. insurance-informative reports, see Christensen and Feltham (2005, 26.1.2).

for linear contracts in LEN models (Șabac, 2008). From this perspective, there are no dynamic issues in the agency.

We demonstrate the noise terms can always be transformed so that they are stochastically independent (see also Section 27.2 in Christensen and Feltham, 2005). The transformation deducts the start-of-period posterior mean, which is a linear function of prior noise terms. Using the same linear transformation on the reports yields an equivalent representation of the information in terms of stochastically independent reports. This transformation yields fully independent reports if the reports are generated by an auto-regressive process, but in general the transformed reports are not fully independent. We use this transformation in proving the results pertaining to the value of early versus delayed reporting and, in particular, how this pertains to purely insurance-informative reports.

With full commitment, if delaying performance information achieves greater accuracy at no extra cost, then the delay is strictly preferred with *PM*, but with *PA* the improvement in accuracy must be sufficient to offset the effect of reduced consumption smoothing. Furthermore, if a more precise report is preferred and it is a sufficient statistic for both it and an early report, then the early imprecise report is redundant with *PM*, but is still valuable with *PA*. The key is that, for example, the early release of an imprecise forecast of the "actual" report is valuable under *PA* because it facilitates additional consumption smoothing.

Many of the results are illustrated using a simple single action-date example. However, we also use a two action-date example to illustrate the effect of a two- versus one-period reporting interval, and the impact of aggregation versus disaggregation in a two-period reporting interval.

The last major section (Section 7) explores the impact of the timeliness of reports when the principal and agent are limited in the contract commitments they can make. We assume they can commit to an incentive contract for at least one period (beginning before the action for the period is taken and continuing until after any report for the period is issued, but before the next period's action is taken, see the timeline in Figure 2.1). We further assume the principal and agent cannot leave the contract until it terminates. Rather than model limited commitment as short-term contracts, we model it as a long-term contract that is subject to renegotiation either at the end of each period, or after a

report is issued. The optimal linear contract is then represented by a long-term renegotiation-proof contract (i.e., the principal and agent can make mutually agreed to changes, but no such changes will exist, Șabac, 2007). The explicit incentives under this approach yield the same results as the explicit plus implicit incentives that arise in short-term contracting (with renegotiation, see Șabac, 2008).

Whereas the timeliness results for full-commitment differ significantly under *PA* versus *PM*, the destructive effect of delayed reporting when there is renegotiation is very similar under *PA* and *PM*. A key feature of limited commitment is that at the renegotiation date the principal makes her *ex post* optimal choice of the incentive contract for the forthcoming period, ignoring the impact this has on the agent's choice of prior actions. As we demonstrate, reporting delays or long reporting intervals can cause the reports to have zero, or even negative, value if there is renegotiation based on the calendar date. For example, with full commitment, the late issuance of an insurance-informative report reduces its value relative to early reporting, but with renegotiation, the report has insurance value if issued before the first renegotiation date following the relevant action, but has zero value if issued afterwards. At renegotiation time, insurance for past events is of no concern. Similarly, delays in issuing an action-informative report, e.g., to reduce its cost or to obtain a more precise report, will be totally unattractive. Of course, the latter effect does not occur when renegotiation is triggered by the issuance of a report (as opposed to the time on the clock).

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