CHAPTER 26

TIMING AND CORRELATION OF REPORTS IN A MULTI-PERIOD *LEN* MODEL

This is the second of four chapters that examine multi-period principal-agent models. As in Chapter 25, we assume the principal and the agent can commit to a long-term contract without subsequent renegotiation. The key innovation in this chapter is that we relax the Chapter 25 assumptions that the performance reports are stochastically and technologically independent.

The impact of correlated noise is examined in depth using a multi-period *LEN* model.[1] This model is a relatively straightforward extension to the multi-period *LEN* model introduced in Section 25.4. We establish that the timing of performance measure reports is irrelevant if the agent has exponential *AC-EC* (aggregate-consumption/effort cost) preferences, but early reporting can have strictly positive value to the principal if the agent has exponential *TA-EC* (time-additive/effort cost) preferences. The key, of course, is whether early reporting permits the agent to more fully smooth his consumption. Interestingly, the results differ for action-informative reports (those influenced by the agent's actions) versus reports that are "purely insurance" informative (i.e., they are not influenced by the agent's productive acts but are correlated with the noise in action-informative reports). Early reporting of the former is generally valuable to the principal, whereas it is not valuable to report the latter before the insured action-informative report is issued. The analysis also considers how the inter-period correlation of the reports affects the principal's expected net payoff.

Section 26.2 explores the impact of report characteristics in a two-period setting, other than timing, on the principal's expected utility and his preference for two versus a single agent. These characteristics include the level of correlation between reports, the sensitivity of the reports, and the aggregation of reports.

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[1] Much of the analysis in this chapter is based on Christensen, Feltham, Hofmann, and Şabac (2004) (CFHS).

26.1 IMPACT OF CORRELATED REPORTS IN A MULTI-PERIOD *LEN* MODEL

In Section 25.4 we considered a *LEN* model in which there are T technologically and stochastically independent periods. We now extend that model by allowing the noise in one report to be correlated with the noise in other reports, so the stochastic independence assumption no longer holds.

The analysis in Chapter 20 considers the impact of correlation in a single-period *LEN* model, and many of the results in that chapter can be extended to the multi-period model considered here. We leave that to the reader and focus on the implications of correlation among signals released at different dates. Inter-period correlation implies that the agent's uncertainty about the noise in future reports is reduced as correlated reports are issued. There are two key issues to be examined. First, if we hold the correlations fixed, how does the timing of the reports affect the agent's consumption and action choices, the contract offered by the principal, and the principal's expected utility? Second, if we hold the timing of reports fixed, what impact does the level of correlation have?

26.1.1 Impact of Report Timing on the Agent's Utility with Exogenous Incentive Rates

While our analysis in this section emphasizes the relaxation of the stochastic independence assumption, we also relax the technological independence assumption. In particular, the general form of the j^{th} performance measure is

$$y_j = \sum_{\tau=1}^{\bar{t}_j} \mathbf{M}_{j\tau}\mathbf{a}_\tau + \varepsilon_j,$$

where $\mathbf{a}_\tau$ is the $m_\tau \times 1$ vector of actions taken at the start of period τ, $\mathbf{M}_{j\tau}$ is the $1 \times m_t$ matrix of sensitivities for the j^{th} performance measure with respect to the actions $\mathbf{a}_\tau$ in period τ, $\bar{t}_j$ is the date of the latest action that impacts y_j, and $\varepsilon_j \sim N(0,1)$ is the noise in the j^{th} performance measure. The reports issued at date t are represented by the vector $\mathbf{y}_t$, which consists of all y_j such that $j \in J_t$. Similarly, the reports issued up through date t are represented by $\bar{\mathbf{y}}_t$, which includes all y_j such that $j \in \bar{J}_t \equiv J_1 \cup \ldots \cup J_t$.[2] Conversely, the reports issued subsequent to date t are represented by $\vec{\mathbf{y}}_{t+1}$, which includes all y_j such that $j \in \vec{J}_{t+1} \equiv J_{t+1} \cup \ldots \cup J_T$.

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[2] We assume date 1 is the earliest report date. CFHS consider both pre- and post-contract reports at date 0, but for simplicity we exclude these types of reports from the current analysis.