

CHAPTER 25

MULTI-PERIOD CONTRACTS WITH FULL COMMITMENT AND INDEPENDENT PERIODS

In this and the following three chapters, we examine principal-agent models in which the principal owns a technology that is operated by an agent for two or more periods. The key feature of a multi-period model is that the agent takes a sequence of actions and his information may change from period to period. Furthermore, there may be consumption and/or compensation at the end of each period, and their timing may be significant.

Obviously, introducing multiple periods raises several new issues. For example, how are the agent's preferences affected by the timing of information and consumption? Can the timing of consumption differ from the timing of the compensation (i.e., does the agent have access to personal borrowing and saving)? Can a different agent be hired at the start of each period? If an agent is hired for more than one period, can the principal and agent commit to a contract for all periods? If full commitment is not feasible, what commitments (if any) are feasible, e.g., is it possible to preclude renegotiation between when an action is taken and a report is released (to avoid the Fudenberg and Tirole problem discussed in Chapter 24)? To what extent are the production and reporting systems characterized by technological or stochastic independence?

In Chapters 25, 26, and 27 we assume full commitment is feasible. That is, the principal and the agent are precluded from renegeing on or renegotiating the contract. Chapter 28 then considers limited commitment, e.g., the contract cannot preclude a mutually agreeable change in the contract at the end of each period, or subsequent to release of a report, but renegotiation is precluded at other dates.

After specifying a basic model in Section 25.1, the current chapter explores full commitment contracting in settings in which the production and reporting systems are technologically and stochastically independent. This permits uncluttered exploration of the basic implications of differences in the form of the agent's preferences for time-dependent consumption, and differences in the agent's access to personal borrowing and saving. For most of our analysis we exogenously assume the principal contracts with the same agent for each period, but in Section 25.5 we discuss the desirability of hiring a new agent at the start of each period.

The multi-period model can be viewed as a variation of the multi-task models considered in Chapter 20. A key difference is that the agent takes actions sequentially, and his information may change over time. Furthermore, in the basic multi-task model there is a single consumption date. We consider sequential choice models with both single and multiple consumption dates.

In Sections 25.2 and 25.3 we consider complete, full-commitment contracts in settings in which the reporting system produces period-specific reports that are technologically and stochastically independent. The initial model (Section 25.2) assumes the agent's preferences are defined in terms of aggregate consumption and the sequence of actions. Interestingly, a sequence of identical periods generally does not result in a sequence of identical contracts. The exception is the type of setting considered in Section 19.2.2, i.e., a single consumption date model with multiplicatively separable exponential utility.

We consider time-additive preferences in Section 25.3. A key result is that even though past performance levels are uninformative about future performance, every Pareto optimal contract is such that the agent's current consumption depends on both the current and past performance. Furthermore, under those conditions, current actions may also depend on past performance.

With time-additive preferences, the terms of the contract depend on whether the agent has access to personal banking, i.e., can he borrow and save? The principal is often better off (and the agent is no worse off) if the principal can preclude the agent from borrowing and saving. If such restrictions are not feasible, then we solve for the optimal contract for which the agent will have no incentive to borrow or save. With banking, the risk averse agent smooths his consumption across periods (or the principal smooths his compensation).

Some aspects of the analysis and results in Sections 25.2 and 25.3 are further illustrated in Section 25.4, in the context of a multi-period version of the *LEN* model (linear contracts, exponential utility, and normally distributed performance measures). This analysis is further extended in Chapter 26 for settings in which there are both stochastic and technological interdependence. The differences between time-additive and aggregate consumption (i.e., single consumption date) utility functions are particularly emphasized. In the time-additive case, most of our analysis assumes the agent and market have the same rate of time-preference, but in this section we characterize the optimal consumption choice in settings in which those rates may differ. Identical rates result in flat consumption smoothing. Differences in rates result in planned "smooth" growth or decay in consumption.

In the first four sections of this chapter we assume that at date $t = 0$ the principal contracts with a single agent who will operate his firm for T periods. In Section 25.5 we examine the desirability of contracting with a new agent at the start of each period. The results are significantly affected by whether the agent's direct preferences for his actions are represented as "monetary" costs within an exponential utility for net consumption, or those preferences are represented as