

## CHAPTER 29

# CONTRACTING WITH MULTIPLE PRODUCTIVE AGENTS

Up to this point, our discussion of contracting has focused on settings in which there is one principal (possibly acting on behalf of investors) and one agent. In this and the following chapter, we move to settings in which there are multiple agents. The models in this area are diverse, but we limit our discussion to a few basic issues. In this chapter, we consider settings in which there are multiple productive agents, while Chapter 30 considers settings in which there is a single productive agent, and a non-productive agent who is hired by the principal merely to monitor the productive agent.

In Section 29.1 we consider a partnership setting in which the contracting parties are both agents and principals. This is an extension of our Chapter 4 discussion of risk sharing in partnerships. In that earlier discussion we assumed that the partners had no direct preferences with respect to their action choices – their preferences in that setting depend only on their share of the firm’s outcome. Furthermore, if all partners had HARA utility functions with identical risk cautiousness and homogeneous beliefs, then the efficient risk sharing contract gives each partner a linear share of the firm’s aggregate outcome and they have the same preferences over action choices. The form of the efficient contract changes significantly if the partners have direct preferences with respect to their actions, e.g., disutility for effort. We briefly explore the form of the efficient contract in a setting in which each partner is risk and effort averse. A key issue in this setting is whether the partnership contract is based solely on the firm’s aggregate outcome, or whether there are partner-specific performance measures, such as a partner-specific component of the firm’s outcome. As pointed out by Holmström (1982), a key issue in the first setting is what has been termed the “budget balancing” constraint, i.e., any reduction in one partner’s share necessarily results in an increase in some other partner’s share. This constraint is much less significant if there are partner-specific performance measures.

Most of the analysis in this chapter considers settings in which a principal (who does not take a costly action) contracts with multiple risk and effort averse agents. Obviously, if the principal is risk neutral and agents generate independent outcomes and performance measures, then the principal can separately solve the incentive contracting problem for each agent. This changes somewhat

if the principal is risk averse, since then it is optimal for the principal to share risks with the agents, as well as impose risk on them for incentive purposes. We briefly characterize the optimal contract with a risk averse principal and independent agents, and then assume in the remainder of the chapter that the principal is risk neutral.

Multi-agent issues arise even if the principal is risk neutral, provided the agents' performance measures are not independent. A key feature of these settings is that an agent's compensation is a function of performance measures that are influenced by both agents' actions. This raises some interesting incentive compatibility issues, which are explored in Section 29.2. The principal's problem can be described as selecting an optimal strategy in a game in which he moves first (specifying the terms of the agents' compensation contract) and the agents then play either a simultaneous or sequential move game among themselves. In anticipating the outcome of the game, the principal must consider how his choices will affect the choices made by the agents. Those choices are assumed to be a Nash equilibrium in the second-stage game, and if there are multiple Nash equilibria in that game, then the principal must predict which equilibrium the agents will choose.

In Section 29.3 we shift from assuming contracting is centralized to also considering decentralized contracting. Under centralized contracting, the principal contracts directly with both agents. On the other hand, with decentralized contracting, the organization is hierarchical. The principal acts on behalf of the owners, the first agent is a branch manager, and the second manager is a branch worker. Only the latter two take productive actions. The principal offers the branch manager a contract that specifies how the branch compensation pool will be determined. The branch manager then offers the branch worker a contract that specifies the worker's share of the branch compensation pool. To avoid the subgame issues explored in Section 29.2, we assume in Section 29.3 that the outcomes from the effort of the two agents are stochastically independent. Section 29.3.1 establishes that decentralized contracting provides the same result as centralized contracting if the agents do not have direct preferences with respect to their actions. On the other hand, Section 29.3.2 demonstrates that decentralized contracting is less efficient than centralized contracting if the agents have direct effort preferences. These incentives create incentive risk. The loss of efficiency occurs because the manager allocates the compensation risk between the two agents, thereby reducing each agent's effort incentives.

Initially, we assume disaggregate performance measures are available for both contracts. In Section 29.3.3 we assume only an aggregate performance measure is available. Then, in Section 29.3.4, we assume the branch compensation pool must be based on an aggregate performance measure, whereas disaggregate information is available for contracting at the branch level. We establish that centralized contracting is strictly preferred if it is based on disaggregate performance measures. However, decentralized contracting is pre-