Designing Incentive-Alignment Contracts in a Principal-Agent Setting in the Presence of Real Options

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In many situations it is in a company's best interest to manage its business in such a way as to optimize the value of its real options. One example we consider here a firm considering outsourcing its Information Technology (IT) needs to a specialist firm, such as an Integrated Service Vendor (ISV). The challenge is to construct a contract that does not destroy the real options value. More generally, real options present an interesting twist on the classical principal-agent problem where the shareholders want to offer management incentives that are not in conflict with the presence of the real options.

There have been several high profile contracts involving outsourcing IT work where a firm has engaged a consulting firm to provide IT services and transferred its own IT division to the ISV. The value in this seems to arise largely from the release of real options value for the contractee (i.e. the firm needing IT resources). The ISV may be in a better position to create the real options for the contractee because of economies of scale in maintaining a state of the art specialist facility. For example, the contractee may need to build a web-based storefront for its operations that is tightly coupled with its order, manufacturing and inventory system. This is largely an IT problem, and would require hiring many employees to design an implement the system and then falling back to a smaller maintenance group for the mature system. Recruiting and retaining this workforce with changing job descriptions can be a daunting task. Moreover, employees would often prefer to work for the ISV because of the broader range of problems that they could deal with than they could with a single contractee firm.

A related problem arises when the firm considers software and hardware upgrade strategies. They often treat their IT department as a mysterious black box that makes capital budgeting requests and points out that not meeting the requests jeopardizes corporate activity in a variety of ways involving poor reliability, security, compatibility, for example. The contractee could choose to outsource hardware and software purchases and maintenance to an ISV. Some organizations do this on an "evergreen" basis, whereby hardware and software is upgraded to the latest standards on a specific schedule (e.g. every 3 years). However, such a fixed schedule destroys the value associated with optionality. The user may prefer to delay an upgrade to get a newer version of the hardware or software or to wait until the bugs are removed from an existing version. The needs change from user to user within the contractee company. The requirements to delay will change with the circumstances and will really be a real option. The problem that Stern Stewart proposes is to first model or frame these as real options problems. This requires specifying relevant driver variables (stochastic processes describing the fundamental uncertainty in the problem) as well as the decision opportunities that the participants may have to manage these risks. The problem should really be modelled as two real options. One is the real option from the perspective of the contractee, and the other is the problem from the perspective of the ISV contractor. The second step is to investigate various ways the two parties could form a contract that would allow them to work together and create more value than if IT were not outsourced. More importantly, they want to form an optimal contract that minimizes the amount of real option value that

is lost to the two parties that arises because the contract inherently has inflexible terms that kill real option value. For example, a contract that specifies delivery of a new midrange computer system (hardware plus software suite) every three years is inflexible and kills real option value. A contract that specifies specific performance such as mips of processor power, gigabytes of storage or packets of network activity is also inflexible. The important issue is to find performance measures that can be used (reliability, response time to deal with problems, etc.) in a contract. It is also important to specify how the parties can achieve flexibility in their divisions. E.g. should upgrades be made after specific technology becomes available and reliable? Does this make the ISV subject to congestion as every client strives to have the same problem solved at the same time (such as the Y2K problem)? What is a suitable way to specify contract decision opportunities in a way that they can be priced? If a contract is formed, how will the parties react and what is the outcome (this could be a sequential game problem). The problem is potentially very large, so one of the first issues to resolve is what variables are important and what will be left aside. Then the real option problems can be framed, and specific contracts proposed and studied in the context of games, simulation or some other metric that the mathematical team may propose.

Concerning the more general principal-agent problem, we will examine the setting where the principal is the shareholders of the firm, acting as one. The agent is the management of the firm. In these problems, the agent knows more about the organization than the principal and there is no way to reliably convey all the information to the principal. Thus, if the firm's income falls one year, it may be a result of poor management decisions or a result of exogenous market risks that went against the firm. The principal-agent problem is usually couched in terms of forming an optimal contract between the principal and agent for compensation. The compensation will be based on observable variables that are partially under the control of the agent. If the principal (shareholders) could determine the precise actions (effort) of the agent, it is known that a Pareto optimal contract can be defined using the actions of the agent as the basis for compensation. The problem becomes difficult and interesting when the principal can only observe the actions with error.

Now, Stern Stewart has a first-best Pareto optimal solution to a broad class of these problems, which suggests compensating managers on the basis of Economic Value Added (EVA). In the briefest possible terms, EVA is the profit for the firm (or division of a firm) minus the product of the cost of capital and capital employed (book value of assets). If EVA 0, the firm is generating profit in excess of what investors expected for the year, and if EVA ¡ 0, they are generating less profit. The EVA of a project will vary over time and a very important result is that the present value of the stream of EVA generated by a project equals the net present value of the project (NPV). In finance, maximizing NPV amounts to maximizing shareholder value. (Calculating NPV in the presence of real options and derivatives is a more difficult problem than computing simple discounted cash flow, which is often the basis for NPV, however.) Thus, Stern Stewart advocates annual incentive compensation for the manager (agent) that is a linear function of EVA. This has the property of aligning the incentives of the principal and the agent. If the agent rationally selects projects to maximize the present value of their compensation they will also be selecting projects that maximize the NPV of the firm. This is a first-best solution to the principal-agent problem.

This incentive alignment requires two assumptions that may not hold in some organizations. To the extent that they do not hold, there may be merit in exploring alternative

compensation schemes that minimize the social loss (called "agency cost") arising from misaligned incentives. One problem is that managers (agents) and shareholders (principals) might discount for or adjust for risk in different ways because the managers are not diversified like the shareholders. This could be modelled with von-Neumann Morgentstern utility preference models. Is there merit in offering non-linear compensation (e.g. options) in an effort to offset the fact that the managers cannot be as diversified as can the shareholders.

The other problem is that the managers might anticipate that they will leave the division or firm before the completion of all the projects that they have under their control. This leads to the misaligned incentive to exercise real options early. Is there a way of allowing the manager a menu of incentive compensation options that compensates for the possibility of leaving early, while restoring some approximation to a first-best incentive compatibility? E.g. could the manager be allowed to defer incentive compensation to years when the real options are likely to be exercised? Does this create more problems than it solves, or can parameters of alternative compensation systems be chosen to mitigate the deadweight agency cost that arises?

There are two ways to model the solution to this principal- agent problem. One is to search for an optimal contract that maximizes utility for the principal subject to the agent earning a reservation level of utility that can be attained by leaving for a job elsewhere. This is a classic framework in economics and could be explored in this context for numerical and analytic solutions. Another way to address the problem is to examine various contract regimes to find contracts that provide either the first-best optimal outcome for the principal or the first- best optimal outcome for the agent and then studying the agency cost that is borne by the other party. This would allow investigating the contracts in terms of the dollar cost that is imposed on the counterparty.