Decision Support

Allocation of risk capital on an internal market

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ABSTRACT

We propose an allocation process for economic risk capital using an internal sequential auction in which investment allowances are based on marginal risk contributions. Division managers have incentive to give truthful bids because of bonus payments, which are linear in the division's profit and linked to the auction bids. With our model, the auction process reaches an equilibrium identical to the optimal allocation if division managers have no diverging interests. When division managers do have diverging preferences in terms of empire building, headquarters faces a trade-off between incurring opportunity costs for achieving a suboptimal allocation and bonus costs paid to division managers to overcome their diverging interests. However, bonus costs are partially offset by proceeds from the auction. Depending on the model parameters, total agency costs can become negative. We show that for large values of new risk capital to be allocated, headquarters can always choose a level of bonus payments so that total costs are negative.

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1. Introduction

The efficient allocation of limited resources is a key problem for a firm's central management. Academic literature has dealt with the issue of asymmetric information and diverging interests by analyzing this principal-agent relationship and providing strategies for headquarters to optimize the allocation.[1] However, these strategies require independent investment opportunities among the divisions and do not work when they are interconnected. In this paper, we consider the allocation of risk capital, a problem that exhibits this interconnection among divisional investment opportunities.

The risk policy of many firms is based on maximum risk-bearing capacity. Banks are required by regulatory constraints to limit risk in their business. In addition to such external restrictions, internal concerns about the ability and willingness of banks to take risks lead to a policy that limits the total risk in terms of a maximum tolerated loss level. To avoid bankruptcy, this maximum tolerated loss level must be underlaid with risk capital.

When a firm undertakes a new project, that endeavor will usually increase the firm's overall risk, which implies the consumption of risk capital. If the aggregated consumption of several potential projects would exceed the available risk capital, the firm must then select the most valuable projects, taking into consideration both expected returns and required risk capital.

We look at a firm with centralized headquarters and a number of decentralized divisions led by division managers. Headquarters' task is to optimally allocate risk capital to the divisions. In contrast to the problem of allocating financial funds, risk capital, seen as a risk-bearing capacity, is not additive among the divisions. Instead, the well-known benefits of diversification reduce total risk (and thus, required risk capital) at the corporate level, compared to the sum of divisional risks. As a consequence, the consumption of risk capital for one division depends on the investments of the other divisions. This interconnection makes the allocation of risk capital different from other allocation problems discussed in the literature.

Most common in practice for the risk-capital-allocation process is central budgeting. Headquarters equips the decentralized divisions with a capital budget, which can be seen as a risk limit the division must not exceed. The problem with this approach lies in the information asymmetry between headquarters and the division managers. Information about the value-adding abilities of the divisions is held by the division managers, who know their particular business better than headquarters does.

An alternative to such central budgeting would be an allocation based on an internal market mechanism. Because markets in an economy have proven to be successful institutions for efficiently allocating resources, it is promising to "bring the power of free enterprise"[2] into the hierarchically organized firm. A number of organizations have adopted this idea and implemented an internal

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[1] Among these strategies are a number of mechanisms that are relatively easy to implement, e.g., via transfer prices (Harris, Kriebel, & Raviv, 1982), via a budget with the possibility of an *ex-post* increase (Harris & Raviv, 1996; Harris & Raviv, 1998), and, more recently, via a dynamic spending account with a threshold division of authority (Malenko, 2012).

[2] Halal, Geranmayeh, and Pourdehnad (1993).

market for various goods, such as production capacity, computing power, or conference rooms.[3] In this paper, we apply this idea for the allocation of risk capital. Within such an internal market, the divisions compete for risk capital by demanding this limited resource at headquarters. They submit bids for risk capital to headquarters, and those divisions giving the highest bids receive the largest amounts of allocated capital.

We develop an auction design which addresses the particular challenges of risk capital allocation. First, according to interdependencies between the divisions, the consumptions of risk capital are in general not additive. This means that because of diversification effects, the required risk capital of the firm as a whole will usually be less than the sum of risk capital consumptions of the divisions, calculated alone. To exhaust the total available risk capital, we base the required risk capital for the divisions on their contribution to overall risk, rather than on stand-alone risk. Second, because a change in the level of investment by a single division can directly impact the risk contributions of all other divisions, the available risk capital is not auctioned all-at-once, but instead, sequentially. Third, headquarters must establish incentives for the division managers to give reasonable bids according to an accurate estimation of their own value-adding ability. This is achieved with profit-based compensation which depends linearly on the division's performance and is measured relative to the bid the division has placed in the risk capital auction. Thus, the bonus payment is a fraction of the division profit minus the price paid for the risk capital within the auction.

In addition to asymmetric information, there need to exist diverging interests of divisional managers and headquarters to create an agency situation which requires a sophisticated allocation mechanism. In the absence of diverging interests, headquarters could simply ask the divisional managers to reveal their private information, and managers would have no incentive to lie. We justify the need for a decentralized allocation process by the preference of divisional managers for larger amounts of capital under their control ("empire building").

Before concentrating on this actual agency situation, we first show the effectiveness of the auction-based solution in the absence of empire building. Under mild conditions, the allocation through the internal auction is identical to the first-best solution without asymmetry of information between headquarters and divisional managers. The solution is nonetheless costly for headquarters, as it involves the payments of bonuses to divisional managers, which diminishes headquarters' overall profit.

When we introduce divisional empire building, two things happen. First, the resulting allocation is no longer optimal, as divisional managers display bidding behavior in the auction that reflects their objective of increasing the amount of capital under their control. This sub-optimal allocation results in a decrease in total profits for headquarters, which can be seen as opportunity costs induced by the agency relation. Second, as more capital under control increases divisional managers' utilities, they are willing to place higher bids within the auction. As the price paid in the auction is deducted from the bonus payments, higher bids mean lower net bonus payments. The utility of capital under control can offset the utility of bonus payments, so that managers may be willing to receive negative bonus payments in exchange for increasing their empire. The saving of bonus payments results in an increase in total profits for headquarters. We show that the saving of bonus payments may be larger than the opportunity costs in some situations. This means that total agency costs may be negative. The total profit of the firm may accordingly be larger in an agency situation than it would be otherwise.

The remainder of the paper is organized as follows. Section 2 relates the paper to three major strands of literature: intrafirm resource allocation, internal capital markets, and risk budgeting. The model setup is outlined in Section 3,, together with the solution in the case of symmetric information as a benchmark. Section 4 analyzes the allocation based on the internal auction with asymmetric information, but without diverging interests. The general situation with asymmetric information and diverging interests is analyzed in Section 5. Section 6 concludes the paper.

2. Relation to the literature

The literature dealing with divisionalized firms was pioneered by Hirshleifer (1957). He analyzes the situation of a firm division that internally supplies an intermediate commodity to other divisions. Introducing the idea of transfer prices, he shows that defining the transfer price as the marginal production costs of the supplying division leads to optimal decisions. Harris et al. (1982) are the first to develop a model based on asymmetric information and incentive problems. They consider a firm with headquarters, one internal intermediate supplier, and a number of divisions that use the intermediate commodity. The information asymmetry is resolved using a transfer pricing system. The general idea is very similar to the incentive scheme in our model, in the sense that the cost of the resource allocated to the division manager at the chosen transfer price is deducted from the manager's compensation. Bernardo, Cai, and Luo (2004) build on these lines, presenting a model for the allocation of capital in the presence of an agency conflict. They derive an optimal managerial compensation contract, which offers greater performance pay and a lower salary when managers report a higher quality project.[4] The idea of auctioning internal resources is already mentioned by Harris et al. (1982), although they do not explain it in detail. Baiman et al. (2007) pick up the idea, analyzing an internal auction of an indivisible auxiliary good. Following their model, we consider the auctioning of a resource by headquarters to divisions on the same hierarchical level, although our model setup differs by capturing the specific features of risk capital as the auctioned resource.

Another strand of literature that this paper draws upon deals with "internal capital markets". In this context, the terminus "market" is not understood in its literal sense, that is, as a free market place where division managers compete for financial resources, but rather as any internal reallocation method maintained by headquarters. In general, the internal capital markets literature analyzes the efficiency of the internal allocation method in various ways, for example, in the presence of information asymmetries, compared to external markets on which the division raises funds outside the company, etc. Gertner, Scharfstein, and Stein (1994) emphasize that control rights are the key difference between an external and internal supplier of capital. Stein (1997) presents a model in which headquarters actively makes use of these control rights in shifting funds from one division to another. In his model, headquarters is able to acquire (possibly noisy) information about the division returns. Because headquarters bases the decision on this information, the paper does not focus on the agency conflict between headquarters (as the principal) and division managers, but instead on the conflict between headquarters (as the agent) and investors.

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[3] See Baiman, Fischer, Rajan, and Saouma (2007).

[4] Bernardo et al. (2004) explicitly model two divisions. Other papers dealing with the agency conflict between headquarters and managers in the single division case are Harris and Raviv (1996), Harris and Raviv (1998), Bernardo, Cai, and Luo (2001).