Corporate Investment Policy

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Dipl.-Wi.-Ing. Daniel Hoang, MBA

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Referent: Prof. Dr. Martin E. Ruckes
Koreferent: Prof. Dr. Siegfried Berninghaus

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Chapter 1

Introduction

The fundamental goal of scholars in corporate finance is to understand how financial resources of investors channel through financial markets, intermediaries, and within corporations to their most efficient uses. This thesis explores the economics of one of these aspects – corporate investment – and investigates how problems of asymmetric information and strategic interaction influence the efficiency of investment behavior.

Traditional finance theory rests on the assumption of frictionless markets with symmetric information and has provided many insights: portfolio theory (Markowitz, 1952), the Modigliani and Miller theorems (Modigliani and Miller, 1958), the capital asset pricing model (Sharpe, 1964; Lintner, 1965), the efficient market hypothesis (Fama, 1970), and option pricing theory (Black and Scholes, 1973; Merton, 1973). But beginning with the path-breaking works by Jensen and Meckling (1976), Leland and Pyle (1977), Ross (1977), and Bhattacharya (1979) researchers in the field of corporate finance began to realize that both informational asymmetries and strategic interaction between economic agents are essential in understanding corporate financial policies. Since then, the economics of information and game theoretic techniques have provided numerous explanations of empirical phenomena that previously had been difficult to reconcile. Much progress has been made in virtually every area of corporate finance: capital structure (Myers, 1984; Myers and Majluf, 1984), payout policy (Miller and Rock, 1985; John and Williams, 1985), initial public offerings (Rock, 1986; Allen and Faulhaber, 1989), financial intermediation (Stiglitz and Weiss, 1981; Diamond and Dybvig, 1983), and corporate control (Shleifer and Vishny, 1986; Hirshleifer and Titman, 1990). The shift of attention to information problems in theoretical corporate finance has also motivated and received considerable support from an enormous body of empirical work in these fields (see Eckbo, 2008, for a recent review of the empirical literature).

Most of this theoretical work shares at least two common elements. First, informational problems can be pervasive in economic relationships at all levels of the corporate structure. For instance, managers may know more about the value of assets in place or more about realized income than their creditors; shareholders may not observe whether managers carefully select investments or provide the necessary efforts to make the firm profitable; firms may not be able to distinguish between whether product market rivals are financially strong or financially weak. The second element that connects these theories is the notion of conflicts of interests. Objectives of economic parties that interact strategically are typically not identical. Thus, incentives can diverge and may create strong distortionary forces on the financial decisions firms make. If economic agents also have different information about characteristics that can affect their payoffs, matters become even worse. Among the most widely studied aspects are two particular kinds of conflicts: those between managers and equityholders and those between equityholders and bondholders. Managers, for instance, have incentives to pursue their private interests (remuneration, perks, extravagant investments, entrenchment, avoiding unpopular decisions) rather than those of equityholders (shareholder wealth). Alternatively, equityholders of a levered firm may have, among others, an incentive to take excessive risk because they receive the surplus if things go well, whereas bondholders bear the costs if things go poorly and default occurs.

Informational asymmetries and strategic interaction with conflicting incentives also play a material role in this thesis. The first two parts of my thesis study the impact of informational asymmetries and strategic interaction on corporate investment behavior *within firms*. As I show, informational asymmetries between a firm's top management and divisional managers can strongly impact the ways in which capital gets allocated across a firm's divisions. The third part puts corporate investment in an industrial context by adding strategic interactions of product-market competitors and risk management activities. Here, informational asymmetries are externally generated by a policy-maker who may or may not mandate disclosures of accounting items.

While the second part presents empirical results from a survey of financial executives, both the first and last part of this thesis are of theoretical nature. Conceptually, they make use of non-cooperative game theory under asymmetric information and apply equilibrium concepts belonging to the family of (Perfect) Bayesian equilibria. At their core is the insight that lack of transparency, in the sense of more informational asymmetries, can be efficient from a social perspective. So if social planners could enforce more transparency, they would not do so. Finally, although many economic situations exist in which agents with superior information aim to reveal their information, the equilibrium behavior in the theories I present is more subtle. Economic agents seek to remain silent about their information or even try to manipulate their counterparts' inferences through real actions. These findings are further developed in the three chapters that follow.

In chapter 2, I propose a positive theory of resource allocation in internal capital markets. The presented theoretical work extends existing theories of corporate investment and provides a novel explanation for why firms cross-subsidize weaker divisions at the expense of stronger ones ("corporate socialism"). I propose that in allocating scarce resources to competing projects, private information of corporate headquarters causes firms to engage in socialistic capital allocations. The argument is as follows. When capital productivities of divisions are persistent, capital allocations in the present may serve as a signal to divisional managers about those in the future. To provide effort incentives to managers with empire-building tendencies, headquarters allocates capital more evenly than capital productivities suggest. The reasoning is subtle. Top management holds ownership rights and can change the rules of capital allocation at any time. Hence, the only way to motivate divisional managers, who compete for a firm's limited capital budget, is by credibly communicating that their effort will produce investment opportunities that may turn out to be more profitable than those of other divisions. This is unlikely to be the case when current capital budgets are heavily tilted toward certain divisions, because then investment policy signals that intrinsic productivities of divisions favor some of them. The theory proves consistent with existing empirical evidence and makes a number of testable cross-sectional and longitudinal predictions that are complementary to those of existing models. In particular, I show that socialism is more likely to occur in periods prior to large investments, when a firm's divisions operate in unrelated businesses, and when investment opportunities across divisions are diverse. The notion of headquarters being better informed about divisional capital productivities than managers themselves is natural but unique and novel to the literature.

In chapter 3, I present results from a survey of 69 chief financial officers to examine the practice of resource allocation in internal capital markets of diversified firms. The survey addresses four areas of academic theory: internal capital budgeting processes, the financial motives for corporate diversification, the effects of diversification when raising capital, and whether and why firms engage in corporate socialism. With regard to the latter, this chapter can be understood as an effort to supplement the findings of the previous chapter. The survey results contribute in a number of ways. First, I present existing capital budgeting practices and procedures in diversified firms. In doing so, my results allow firms to learn from other firms' practices to improve financial decision-making. Second and more importantly, I extend existing empirical evidence by comparing numerous (and often competing) theoretical concepts on corporate investment with the perspectives of financial executives. These findings are particularly interesting given that empirical research in the area of internal capital allocation traditionally suffers from data constraints. I find that although many arguments make sense theoretically and are also consistent with survey evidence, others do not seem to reflect the actual rationales of

financial executives. In particular, the explanatory power of many theories of corporate socialism is unsatisfactory. The survey evidence, however, provides strong support for the propositions I suggest in chapter 2 of my thesis.

In chapter 4, I propose a theory of strategic investment, risk management, hedge disclosure, and product-market competition. I find that under current accounting standards, firms engage in risk-reducing risk management activities since product-market competition forces them to do so. The resulting equilibrium is desirable from a social standpoint and encourages strategic investments by competing firms. As I show, attempts for greater transparency through mandated hedge disclosures may destroy these "natural incentives" and create forces to engage in excessive risk-taking. The basic reasoning of the theory is as follows. Risk management generally improves the informativeness of corporate earnings as a signal of the value of investment opportunities in a market. For instance, if a car manufacturer hedges currency fluctuations, the extraneous noise in earnings relative to the volatility associated with the firm's investments will become low. Now suppose an established firm ("the incumbent") is threatened by a rival considering an investment to enter the market. Then, additional hedge disclosures credibly communicate the established firm's risk management strategy and may – if the incumbent hedges – reveal proprietary information about the quality of investment projects in the market. The fact that the product-market rival may exploit this information to the disclosing firm's disadvantage, namely, a more precise competitive move, can create incentives to engage in excessive risk-taking in order to manipulate the rival's inferences. This equilibrium behavior of an established firm may deter entry and result in adverse effects on the nature of competition in industries. Note that the propositions I suggest here are not limited to market entry that occurs at the start of new industries – they are more general. Market entry encompasses all investment decisions about projects that differ in some way from firms' current business paradigms. So entry is ubiquitous and naturally occurs at many times during the lifecycle of an industry. Hence, my findings shed light on the desirability of more transparent accounting standards and suggest that more disclosure on risk management frequently changes both risk management and corporate investment in undesirable ways.

Chapter 2

A Theory of Socialistic Internal Capital Markets

Well-functioning internal capital markets channel scarce financial resources into their most productive uses. In multi-division firms, headquarters has ownership rights and is therefore able to allocate capital across divisions (Gertner, Scharfstein, and Stein, 1994). This allows headquarters to steer funds towards divisions with relatively favorable investment opportunities (Stein, 1997). However, the value of such internal capital markets has recently been questioned. Empirical research points to the distortion of capital allocation, such that headquarters favors divisions with poor growth prospects at the expense of those with good growth opportunities (Scharfstein, 1998; Shin and Stulz, 1998; and Rajan, Servaes, and Zingales, 2000).[1]

These findings have led to a number of theoretical characterizations of the workings of internal capital markets, which are consistent with such "socialistic" allocations of financial resources. Scharfstein and Stein (2000) argue that managers of divisions with poor investment opportunities have stronger incentives to spend time lobbying to increase their capital allocations. When there is a preference of top management to compensate these managers with capital allocations rather than higher salaries, this behavior leads to larger–than–efficient allocations to weaker divisions. Rajan, Servaes, and Zingales (2000) show that a very uneven resource allocation can lead divisional managers to steer their investment policies away from efficient cooperative investments and towards those that benefit only the managers' own divisions. To avoid such inefficiencies, headquarters tilts capital allocations towards divisions with fewer investment opportunities. In a setting in

[1]These empirical studies are not free of measurement and endogeneity problems. Maksimovic and Phillips (2007) provide a comprehensive discussion of these issues in the literature on internal capital markets. In addition, plant-level evidence in Maksimovic and Phillips (2002) shows that in case of positive demand shocks, multi-industry firms reallocate resources in favor of strong divisions.

which divisional managers have private information about project quality and in addition need to be incentivized to provide effort, Bernardo, Luo, and Wang (2006) show that headquarters optimally biases project choice in favor of weaker divisions, thus permitting less expensive incentive provision for managers in stronger divisions.

This chapter provides an alternative explanation of socialistic internal capital markets. I present a model in which headquarters has private information about divisional capital productivity. The argument is as follows. When capital productivity of divisions is persistent, current capital allocations by headquarters are indicative of future allocations. Divisional managers learn from current allocations about their own division's relative capital productivity. When divisional managers prefer larger allocations to smaller ones this is relevant information. The reason is that managers choose to engage in productivity improvements based on the expected increase in capital allocation that is caused by such efforts. The initial capital allocation allows each manager to form a more accurate estimate of the expected marginal effect of effort provision on her utility. A headquarters that acts strategically has an incentive to allocate capital evenly in order to suggest equal capital productivity across divisions. In this case, managers' expected relative increase in next-period's capital allocation from exerting effort is maximized. When divisions differ in their productivity, the cost of such a policy is inefficient capital allocation in the present, but higher capital returns in the future due to stronger managerial efforts to improve productivity. In situations in which divisional managers' effort is sufficiently important, the benefits of an even capital allocation across divisions outweigh the costs. This behavior implies that divisions with better investment opportunities do not receive as much capital as their capital productivity would imply.

A number of arguments can be made to underpin the notion that top management (acting as headquarters) has information that divisional managers do not have. First, headquarters is well-informed about all the divisions of the firm, whereas divisional managers have detailed knowledge only about their own divisions. Thus, it is reasonable to assume that headquarters holds better information about the relative productivity of capital across divisions than do divisional managers. Second, top management is likely to be better informed on issues influencing the profitability of several divisions, such as general economic conditions, political developments, strategic intentions, potential merger opportunities, or possible spillovers across divisions.[2] Such informational advantages often result from top managers' activities beyond the realm of the firm, including board memberships, activities

[2]The literature on strategic management recognizes the informational advantages of CEOs and other higher-ranking individuals. Mintzberg (1975), for example, sums it up as follows: "The manager may not know everything but typically knows more than subordinates do. Studies have shown this relationship to hold for all managers, from street gang leaders to U.S. presidents."

in professional associations, or the use of personal contact networks.[3] To derive the implications of headquarters' private information for capital allocation in the simplest way, I develop a model in which headquarters has private information about capital productivity in one of its two divisions, whereas capital productivity in the other division is commonly known.

The argument advanced in this chapter is based on the notion that headquarters' ability to reallocate capital across divisions may stifle managerial initiative. This has also been noted by Brusco and Panunzi (2005) and Gautier and Heider (2009), who assume that effort leads to increased income in the period of its provision. In contrast, Inderst and Laux (2005) model, like I do, managerial effort directed at generating future investment opportunities. Inderst and Laux (2005) show that managerial incentives of financially constrained firms increase when divisions display similar capital productivities. Neither of these papers studies the implications of a privately informed headquarters on capital allocation.

While this chapter focuses on information asymmetries within the firm, these are not the only information asymmetries that affect capital allocation. De Motta (2003) and Goel, Nanda and Narayanan (2004) include the impact of informational asymmetries between corporate insiders and financial markets on the distribution of capital across divisions.

[3]In the sample of Mintzberg (1975), chief executives spent an average of 44 percent of their contact time with individuals outside the organization. He writes that "...liaison contacts expose the manager to external information to which subordinates often lack access. Many of these contacts are with managers of equal status, who are themselves nerve centers in their own organization. In this way, the manager develops a powerful database of information."

2.1 The Model

I model an internal capital market with three agents: headquarters and two divisional managers i, $i = A, B$. There are two periods, $t = 1, 2$. Agents are risk-neutral. Headquarters distributes a fixed amount of funds I_t based on expected performance, i.e., capital productivity $q_{i,t}$, of divisions A and B. Available funds $I_t > 0$ are deterministic and are derived from investments in previous periods. There is no access to external financing.

I allow for strictly positive expected investment returns with decreasing returns to scale and assume that divisional periodical payoffs $\Pi_{i,t}$ are given by

$$\Pi_{i,t} = q_{i,t} I_{i,t} - \frac{1}{2} k I_{i,t}^2, \tag{2.1}$$

where $I_{i,t}$ denotes the period t capital investment in division i and $k > 0$ parametrizes returns to scale. Divisional capital productivity $q_{i,t} > 1$ depends linearly on a baseline productivity $\overline{q} > 1$, which is commonly known, and a productivity parameter $x_i \in \{0, \overline{x}\}$, which is private to headquarters. I refer to the sum of these productivity parameters as a division's intrinsic productivity. In addition, divisional managers can exert effort during period 1, $e_i \in \{0, \overline{e}\}$, $\overline{e} > 0$, in order to increase capital productivity of their divisions during the next period. In this formulation, effort can be interpreted as engaging in restructuring production or distribution, repositioning part of the product portfolio, mentoring employees, furthering long-term relationships with customers or suppliers, or simply searching for investment opportunities to be implemented during the upcoming period. Concretely, divisional capital productivities are given by

$$q_{i,1} = \overline{q} + x_i \text{ and } q_{i,2} = \overline{q} + x_i + e_i. \tag{2.2}$$

I assume that divisions have sufficiently profitable investment opportunities such that available funds are fully invested during any period.[4] For simplicity, I assume that payoffs from investments in $t = 1, 2$ are additively separable and do not accrue before the end of period 2. Hence, second-period payoffs are independent of headquarters' first-period capital allocation. The interest rate is normalized to zero. Let $\alpha_t \in [0, 1]$ denote the period t portion of available funds I_t invested in division A and $\Pi_t(\alpha_t)$ denote headquarters' periodical payoff when allocating α_t. Thus, considering equation (2.1), for all $t = 1, 2$, $\Pi_t(\alpha_t)$ equals

$$\Pi_t(\alpha_t) = q_{A,t} \alpha_t I_t - \frac{1}{2} k (\alpha_t I_t)^2 + q_{B,t} (1 - \alpha_t) I_t - \frac{1}{2} k ((1 - \alpha_t) I_t)^2. \tag{2.3}$$

[4] A richer setting in which the intertemporal transfer of funds from the first to the second period is optimal would not qualitatively change the conclusions.

In the model, divisional managers have empire-building preferences and strictly prefer more capital to less. Concretely, I follow the literature (for example, Harris and Raviv, 1996; De Motta, 2003; and Brusco and Panunzi, 2005) in assuming private benefits ν proportional to assets under control. I consider the admittedly extreme case in which empire-building motives are sufficiently strong that no feasible incentive payment can alter managers' behavior (see also Hart and Moore, 1995; and Aghion and Tirole, 1997).[5] Effort creates a private cost to the manager $c(e_i)$ which is $c > 0$, if $e_i = \overline{e}$ and 0, if $e_i = 0$. Consequently, in this two-period setting, managers seek to maximize utility, which is described by the sum of private benefits derived from assets under control in both periods less the cost of exerting effort in period 1:

$$U_i(e_i) = \nu \left(I_{i,1} + I_{i,2}\right) - c(e_i). \tag{2.4}$$

Headquarters has access to a private signal θ, which reveals perfectly the quality of investment projects in division A in $t = 1, 2$.[6] θ can take two values: H (high-quality investments) or L (low-quality investments). These signals imply $x_A = \overline{x}$ and $x_A = 0$, respectively. For simplicity, the investment quality in division B is commonly known and assumed to be low with $x_B = 0$. Consequently, if headquarters observes signal H, intrinsic productivities differ and $x_A = \overline{x} \wedge x_B = 0$. If headquarters observes signal L, however, intrinsic productivities of divisions are identical and $x_A = x_B = 0$. In the following, I refer to these states as headquarters' *type H* and *type L*.[7]

The sequence of actions and events is shown in Figure 2.1.

1. Before any capital allocation occurs, headquarters receives signal $\theta \in \{H, L\}$ that is informative about the intrinsic capital productivity in divisions A and B in $t = 1, 2$.
2. Headquarters distributes available funds I_1 based on observation of $q_{i,1} = \overline{q} + x_i$.
3. After observing capital allocation α_1, divisional managers simultaneously choose effort e_i.

[5] Even if divisional cash flows are verifiable, providing effective contractual incentives for the search for new investment opportunities is difficult to achieve. Due to the typically considerable time lag between search effort and investment cash flows, divisional cash flows in each period are influenced by a multitude of factors that are at best weakly related to the effort in question.

[6] While I recognize that divisional managers may possess information that headquarters does not have, I abstract from it in order to isolate the effects of headquarters' private information.

[7] This approach provides a natural (and probably the simplest) way to incorporate headquarters' private information into the model. A more general approach would be an information structure in which headquarters is well-informed about the true prospects of all divisions, whereas divisional managers have detailed knowledge only about their own divisions. The formulation is made for reasons of tractability and captures the idea that both managers do not know their position relative to each other. As will become clear, the main implications of the analysis would be unaffected with a more general structure.

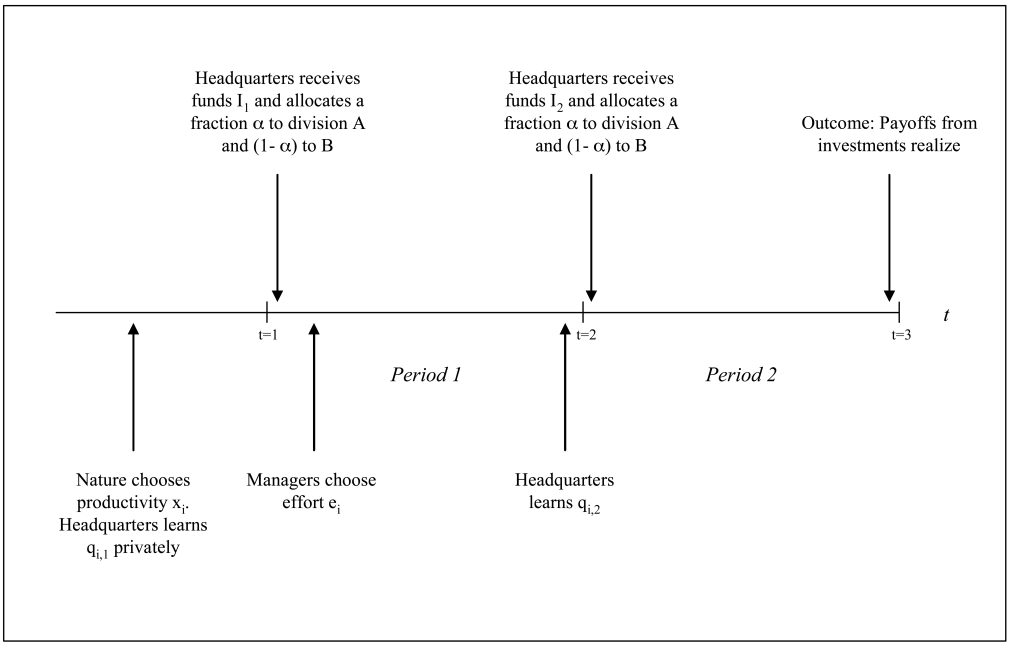

Figure 2.1: Sequence of actions and events

4. After learning $q_{i,2} = \overline{q} + x_i + e_i$, headquarters allocates available funds I_2. Distribution of funds now depends on managers' effort levels e_i.

5. At the end of period 2, payoffs $\Pi_{i,t}$ from investments made in the previous periods are realized.

As it is apparent from the sequence of the game and given the assumption that periods are additively separable, headquarters' two-period decision problem simplifies into a pair of problems, one for each period. So I can write headquarters' total payoff as $\Pi_1(\alpha_1)+\Pi_2(\alpha_2)$.

2.2 Analysis

In the next sections, I examine optimal capital allocation of headquarters and equilibrium behavior of divisional management. I decompose the analysis of two-period capital allocation into three stages: a first stage, in which headquarters chooses first-period capital allocation; a second stage, in which divisional managers choose their levels of effort; and a third stage, in which headquarters makes its second-period capital allocation choice after productivity-enhancing activities of divisional management have been realized. Since equilibrium behavior is sequentially rational, I solve the game backwards beginning with headquarters' second-period capital allocation. I restrict attention to pure strategy equilibria.

2.2.1 Capital Allocation in Period 2

By the beginning of period 2, headquarters learns about second-period productivity of its divisions $q_{i,2}$ with certainty. Hence, headquarters solves:

$$\max_{\alpha_2} q_{A,2}\alpha_2 I_2 - \frac{1}{2}k(\alpha_2 I_2)^2 + q_{B,2}(1-\alpha_2)I_2 - \frac{1}{2}k[(1-\alpha_2)I_2]^2 + \Pi_1(\alpha_1) \tag{2.5}$$

subject to

$$\alpha_2 \in [0,1].$$

Considering the strict concavity of (2.5), the optimal rule for capital allocation in period 2 is:

$$\alpha_2^* = \begin{cases} 0 & \text{if } q_{B,2} - q_{A,2} \geq kI_2 \\ 1 & \text{if } q_{A,2} - q_{B,2} \geq kI_2 \\ \frac{q_{A,2}-q_{B,2}+kI_2}{2kI_2} & \text{otherwise,} \end{cases} \tag{2.6}$$

which implies that headquarters shifts all funds to division i if $q_{i,2}$ relative to $q_{j,2}$ is sufficiently large, and headquarters splits funds evenly if $q_{A,2} = q_{B,2}$. Given the assumptions above, using equation (2.2) establishes the following lemma.

Lemma 2.1 *In period 2, headquarters' allocation is a function of managerial effort e_i, the type-dependent value of x_A, and the level of diminishing returns to scale k.*

$$\alpha_2^* = \begin{cases} 0 & \textit{if } e_B - e_A - x_A \geq kI_2 \\ 1 & \textit{if } e_A - e_B + x_A \geq kI_2 \\ \frac{e_A-e_B+x_A+kI_2}{2kI_2} & \textit{otherwise.} \end{cases} \tag{2.7}$$

Exerting effort weakly increases a manager's own capital allocation and thereby weakly decreases the other manager's allocation. In addition, second-period capital allocation, for example to division A, α_2^*, weakly increases in x_A and weakly decreases in k.

2.2.2 Managerial Effort in Period 1

I turn to the previous stage of the game in which managers choose first-period effort levels e_i. Divisional management anticipates that headquarters reacts optimally given profitabilities $q_{i,2}$, and that it allocates capital according to (2.7). Since funds I_2 are scarce, managers compete for their share of the limited total capital budget. This competition for funds represents a game of incomplete information: each manager chooses whether to exert effort or not, while the (type-dependent) value of x_A and the (unobservable) effort choice of her counterpart are uncertain.

To examine equilibrium strategies, I first solve for managers' effort choice as if headquarters' type were common knowledge. This stage of the model then becomes a game of complete information. In order for the effort pair (e_1^*, e_2^*) to be a Nash equilibrium of this subgame, each manager's strategy must be a best response to the other's, while considering headquarters' optimal allocation for arbitrary levels of managerial effort. Given the structure of the model, managers' strategies under incomplete information follow immediately.

2.2.2.1 Common Knowledge: Headquarters is Type L

When headquarters is type L and $x_A = x_B = 0$, intrinsic capital productivities of divisions are identical. Hence, utility functions of managers are symmetric. When the two managers work equally intensely, the contest ends in a tie, headquarters splits funds equally in period 2, and both managers receive payoffs yielding $\frac{1}{2}\nu I_2$. Otherwise, the manager who works harder receives strictly more funds than the other. For the sake of exposition and without loss of generality, let $\overline{e} \geq kI_2$. Then, if one divisional manager chooses a high level of effort and the other does not, headquarters allocates total available funds to the former and no funds to the latter. The normal-form of this subgame is given in Figure 2.2. By convention, managers A and B represent the row and column players, respectively.

	$\overline{e}$		0	
$\overline{e}$	$\frac{1}{2}\nu I_2 - c$	$\frac{1}{2}\nu I_2 - c$	$\nu I_2 - c$	0
0	0	$\nu I_2 - c$	$\frac{1}{2}\nu I_2$	$\frac{1}{2}\nu I_2$

Figure 2.2: Competition for funds when headquarters is type L

Thus, if the cost of managers' effort is sufficiently small relative to their empire-building preferences and

$$\frac{1}{2}\nu I_2 - c \geq 0 \quad \Leftrightarrow \quad c \leq \frac{1}{2}\nu I_2, \tag{2.8}$$

$e_i^* = \overline{e}$ is the dominant strategy for each player and the effort pair $(\overline{e}, \overline{e})$ is a unique Nash equilibrium of this subgame. Then, it turns out that managers have an incentive to work hard and managers' interests align with those of headquarters' to maximize firm profits. For the remainder of this chapter, I assume that condition (2.8) holds.

2.2.2.2 Common Knowledge: Headquarters is Type H

When headquarters is type H and $x_A = \overline{x} \wedge x_B = 0$, intrinsic capital productivities of divisions differ, such that division A has higher productivity. Hence, utility functions of

managers are asymmetric. When managers exert equal effort, $\alpha_2^* > 0.5$ and headquarters allocates strictly more to division A. I make the simplifying assumption that diversity in productivities $\overline{x}$ dominates effort and $\overline{x} - \overline{e} \geq kI_2$. Then, the more profitable division A receives all funds, regardless of whether its manager works hard or not. More precisely, profitability of division A relative to that of B is sufficiently different, that marginal return on the last unit I_2 invested in A is smaller than the marginal return on the first unit invested in B. This straightforwardly captures the disincentive effect of headquarters' authority to allocate scarce resources to the most profitable projects, as suggested by Brusco and Panunzi (2005) and Inderst and Laux (2005). It also reduces the number of different cases to be considered, without changing the important conclusions.[8] The winner of the game, manager A, is determined ex ante and both managers do not exert effort in equilibrium, $e_i^* = 0$, as long as $c > 0$. This subgame is depicted in Figure 2.3.

	$\overline{e}$		0	
$\overline{e}$	$\nu I_2 - c$	$-c$	$\nu I_2 - c$	0
0	νI_2	$-c$	νI_2	0

Figure 2.3: Competition for funds when headquarters is type H

Let me now examine equilibrium levels of effort in the more interesting case, in which information on productivity parameter x_A is private to headquarters and information regarding investment prospects is incomplete.

2.2.2.3 Incomplete Information: Headquarters' Type is Private

In the case of incomplete information, managers do not know the true productivities ex ante (either their "opponent's" or their own), which implies that managers are unable to distinguish one type of headquarters from the other. Let $p(L) = \mu \in (0, 1)$ and $p(H) = 1 - \mu$ denote managements' common prior belief about headquarters' type.

Before choosing e_i, managers observe headquarters' current capital allocation α_1. When capital productivity in divisions is persistent, this is relevant information and α_1 is indicative of future allocations. Hence, divisional managers may learn from current allocations

[8]The loss of managerial incentives associated with winner-picking is a consequence of lower marginal benefits of increased effort when managers have identical capabilities but the "rules of the game" favor one of them. Tournament-style models produce a similar result when contestants have unequal chances of winning (see e.g., Lazear and Rosen, 1981; and O'Keeffe, Viscusi, and Zeckhauser, 1984; and Schotter and Weigelt, 1992).

about headquarters' private information and may update prior probabilities about headquarters' type. For example, a particular capital allocation may reveal to managers that headquarters is type L, leading managers to exert effort. However, other allocations may not disclose such additional information. I denote the resulting posterior beliefs as $p(L|\alpha_1) = \eta(\alpha_1)$ and $p(H|\alpha_1) = 1 - \eta(\alpha_1)$.

Since knowing about diverse intrinsic profitabilities (a type H headquarters) weakens managerial incentives to engage in productivity-enhancing activities, the equilibrium effort a manager is willing to exert depends on posterior beliefs. To make this point clear, for example, consider manager B. When both managers exert effort, $e_i = \overline{e}$, manager B has the chance to end up in a tie and receive $\frac{1}{2}I_2$ with probability $\eta(\alpha_1)$ (if headquarters is type L), but she also faces the risk of losing and getting nothing with probability $1 - \eta(\alpha_1)$ (if headquarters is type H). Thus, managers are uncertain about both their counterpart's and their own payoff functions. By applying this logic to all possible payoffs of this subgame, managers' competition for funds can be represented as in Figure 2.4. For brevity, I omit parameter α_1 on the posterior $\eta(\alpha_1)$.

	$\overline{e}$		0	
$\overline{e}$	$\nu I_2 - \frac{1}{2}\eta\nu I_2 - c$	$\frac{1}{2}\eta\nu I_2 - c$	$\nu I_2 - c$	0
0	$(1-\eta)\,\nu I_2$	$\eta\nu I_2 - c$	$\nu I_2 - \frac{1}{2}\eta\nu I_2$	$\frac{1}{2}\eta\nu I_2$

Figure 2.4: Competition for funds under incomplete information

It is straightforward to derive equilibrium levels of effort. The results are given in the following lemma.

Lemma 2.2 *Posterior beliefs reflect any information conveyed by headquarters' capital allocation in period 1. Equilibrium levels of effort* (e_A^*, e_B^*) *are sensitive to these beliefs and weakly increase with the belief that headquarters is type L*

$$(e_A^*, e_B^*) = \begin{cases} (\overline{e}, \overline{e}) & \text{if } 2\frac{c}{\nu I_2} \leq \eta \leq 1 \\ (0,0) & \text{if } 0 \leq \eta < 2\frac{c}{\nu I_2} \end{cases}$$

The intuition is as follows: When managers with empire-building tendencies choose to engage in productivity improvements, they do so based on the expected increase in capital allocation that results from such efforts. The incentive to choose a high level of effort is strong, provided that posterior beliefs suggest that heterogeneous productivity across divisions is not too likely. In addition, cost of effort c must be sufficiently low relative to

empire-building benefits νI_2; in this case, even a small posterior belief $p(L|\alpha_1) = \eta(\alpha_1)$ induces managers to work hard.

2.2.3 Capital Allocation in Period 1

I now move to the first stage of the game in which headquarters decides on the optimal capital allocation in period 1. I begin by studying optimal capital allocation in the case of complete information. This characterization is then used to examine capital allocation in situations in which information on productivities is private to headquarters and managers are unable to distinguish headquarters' type.

2.2.3.1 The Benchmark Case: Complete Information

Since periods are additively separable I can derive the optimal capital allocation α_1^* under complete information simply by maximizing $\Pi_1(\alpha_1) + \Pi_2(\alpha_2)$ with respect to α_1. Analogous to (2.6), α_1^* depends on marginal returns in divisions A and B. The difference is that returns are exogenously given and therefore independent from other decisions. Considering that $\alpha_1 \in [0, 1]$, I obtain

$$\alpha_1^* = \begin{cases} \frac{1}{2} & \text{if headquarters is type } L \\ \min\left\{\frac{\overline{x}+kI_1}{2kI_1}, 1\right\} & \text{if headquarters is type } H. \end{cases} \tag{2.9}$$

Hence, if headquarters is type L, headquarters' efficient allocation is to split funds evenly, since marginal divisional returns are identical and strictly decreasing. If headquarters is type H, $\alpha_1^* \in (0.5, 1]$. To simplify the presentation of the results, I set $\overline{x} \geq kI_1$. As a consequence, headquarters invests all available funds in division A. Using the findings of the previous section, I can establish the following result.

Proposition 2.1 *Under the assumptions previously imposed, there is a unique subgame perfect equilibrium under complete information. Subgame perfect equilibrium behavior* $(\alpha_1^*, (e_A^*, e_B^*), \alpha_2^*)$ *is given by*

$$(\alpha_1^*, (e_A^*, e_B^*), \alpha_2^*) = \begin{cases} (\frac{1}{2}, (\overline{e}, \overline{e}), \frac{1}{2}) & \textit{if headquarters is type } L \\ (1, (0,0), 1) & \textit{if headquarters is type } H \end{cases}$$

Using these results, second-period firm profits yield

$$\Pi_{L,2}^* = \Pi_{L,2}^*(\alpha_2^*, e_A^*, e_B^*) = (\overline{q} + \overline{e})I_2 - \tfrac{1}{4}kI_2^2 \quad \textit{if headquarters is type } L$$

$$\Pi_{H,2}^* = \Pi_{H,2}^*(\alpha_2^*, e_A^*, e_B^*) = (\overline{q} + \overline{x})I_2 - \tfrac{1}{2}kI_2^2 \quad \textit{if headquarters is type } H$$

and total expected payoffs result in

$$\Pi_L^* = \Pi_{L,1}^* + \Pi_{L,2}^* = \overline{q}(I_1 + I_2) + \overline{e}I_2 - \frac{1}{4}k(I_1^2 + I_2^2)$$

$$\Pi_H^* = \Pi_{H,1}^* + \Pi_{H,2}^* = (\overline{q} + \overline{x})(I_1 + I_2) - \frac{1}{2}k(I_1^2 + I_2^2).$$

Consequently, when productivities of divisions are common knowledge among headquarters and managers, the model implies: if divisions differ in their investment opportunities (type H), headquarters uses its allocative authority and consistently steers all funds to its strongest division A. Managers foresee headquarters' optimal strategy, anticipating that effort has no impact on ex ante predetermined capital allocation. Hence, there is no incentive for either manager to be productive. In contrast, if divisions have similar investment opportunities (type L), headquarters' right to allocate funds to the most productive use creates the incentive for managers to work hard. Headquarters allocates capital evenly in both periods.

2.2.3.2 Capital Allocation with Incomplete Information

2.2.3.2.1 *Perfect Bayesian Equilibria and Refinements*

Under incomplete information, the model conceptually defines a signaling game. An informed headquarters moves first with its first-period allocation, which may reveal additional information. Then, uninformed managers update their beliefs about headquarters' type and react to these allocations, according to the policy described by Lemma 2.2. Throughout this section I employ the notion of Perfect Bayesian Equilibrium.

Definition 2.1 *In the model, a Perfect Bayesian Equilibrium (PBE) is a set of strategies and a belief function* $\eta(\alpha_1) \in [0,1]$ *satisfying each of the following conditions:*

1. *For each type* θ*, headquarters' strategy is optimal given managers' strategies and managers' posterior beliefs.*

2. *Both managers share a common posterior belief derived from the prior belief* $p(L) = \mu$ *and headquarters' allocation* α_1*, following Bayes' rule where applicable.*

3. *For each choice of* α_1*, managers' effort levels following* α_1 *constitute a Nash equilibrium of a simultaneous-move game in which the probability that managers face a headquarters of type L is given by their posterior belief* $\eta(\alpha_1)$*.*

Condition (2) implies that when α_1 is not part of headquarters' optimal strategy for any type, any belief $\eta(\alpha_1)$ is admissible, since in equilibrium observing α_1 is a zero probability event and beliefs cannot be derived from Bayes' rule. Thus, any effort pair (e_1, e_2) may be chosen as long as it is a best response for some beliefs. In the model, beliefs are common knowledge between all players. In addition, managers' beliefs are identical after *any* message, not just an equilibrium allocation. Condition (3) says that, given headquarters' allocation α_1 and given their updated posterior beliefs $\eta(\alpha_1)$ about θ, managers react optimally to headquarters' allocation α_1.

I determine the set of *separating* and *pooling* equilibria in pure strategies. In a separating equilibrium, both types of headquarters choose different allocations, and managers can learn headquarters' type. In contrast, in a pooling equilibrium, both types of headquarters set the same allocation and managers can infer nothing from the allocation. As usual, a multiplicity of equilibria arises since PBE does not impose any restrictions on managers' beliefs following out-of-equilibrium allocations. To provide sharp predictions on likely equilibrium outcomes, I restrict the set of out-of-equilibrium beliefs by jointly applying two well-known refinements: the notion of *Undefeated Equilibrium* introduced by Mailath, Okuno-Fujiwara, and Postlewaite (1993) and the notion of *D1* introduced by Cho and Kreps (1987).[9]

In the model, *Undefeated Equilibrium* applies intuitively as follows. Consider a *proposed* PBE[10], some out-of-equilibrium allocation α not chosen in this equilibrium as well as an *alternative* PBE in which some set T of headquarters' types plays α in equilibrium. If

[9]See also Nöldeke and Samuelson (1997) for the joint relevance of both refinement concepts in an evolutionary model of job-market signaling.

[10]In general, *Undefeated Equilibrium* is applied to the notion of Sequential Equilibrium (Kreps and Wilson, 1982). Here, PBE and Sequential Equilibria coincide (see Fudenberg and Tirole, 1991).

each member of T strictly prefers the alternative equilibrium to the proposed one, the latter is said to be defeated.[11]

D1 is based on the idea of *Divinity* (Banks and Sobel, 1987). It tests whether an out-of-equilibrium deviation α is *more likely* to come from some headquarters' type i than from type j and, if so, managers should put zero probability on j, $p(j|\alpha) = 0$. Applying *D1*, an out-of-equilibrium deviation is said to be *more likely* to occur from type i if the set of managers' best responses that motivate i to deviate is strictly larger than the corresponding set of type j.

Refinement *D1* puts restrictions on out-of equilibrium beliefs focusing on one single equilibrium, while *Undefeated Equilibrium* compares among equilibrium outcomes and therefore requires a characterization of the full set of PBE, considering all degrees of freedom with respect to out-of-equilibrium beliefs. Consequently, I start with the analysis of Perfect Bayesian Equilibria.

2.2.3.2.2 *Pooling Perfect Bayesian Equilibria*

I begin with a characterization of the set of pooling equilibria. It is helpful to recall that $\Pi^*_{\theta,2}$ refers to type θ's second-period equilibrium profit under complete information. Let $\Pi_{\theta,1}(\alpha)$ denote type θ's first-period profit when it allocates α.

In a pooling equilibrium, both types of headquarters choose α^p and managers learn nothing from capital allocation.[12] Bayesian updating implies that managers' beliefs after observing α^p equal the prior belief, $p(L|\alpha^p) = \mu$. Off-equilibrium beliefs $p(L|\hat{\alpha})$ are arbitrary as long as beliefs and corresponding off-equilibrium allocations $\hat{\alpha} \neq \alpha^p$ deter both types from deviating from α^p. I assume that a priori probabilities

$$p(L) = \mu \geq 2\frac{c}{\nu I_2}, \tag{2.10}$$

such that managers' best response after observing α^p is to exert effort $e_i = \overline{e}$.[13] Thus, I obtain type θ's pooling profits Π^P_θ:

$$\begin{aligned} \Pi^P_H &= \Pi_{H,1}(\alpha^p) + \Pi^*_{H,2} + \overline{e}I_2 \\ \Pi^P_L &= \Pi_{L,1}(\alpha^p) + \Pi^*_{L,2} \end{aligned}$$

[11] This definition of *Undefeated Equilibrium* is valid, since the model allows to avoid issues connected with payoff ties of headquarters' types. For a general definition, the reader is referred to the original work.

[12] I disregard index t since second-period allocations are made implicit in managers' contest for funds.

[13] For completeness, I examine the case in which condition (2.10) is violated in Section 2.4.

The easiest way to support α^p as an equilibrium allocation is to restrict off-equilibrium beliefs such that managers do nothing unless they observe α^p. Then, off-equilibrium payoffs are lowest and deviating is least beneficial for all types of headquarters. I set $p(L|\hat{\alpha}) = \eta(\hat{\alpha}) = 0$ for any $\hat{\alpha} \neq \alpha^p$, since this belief function supports the largest set of pooling equilibria. To determine the set of admissible α^p, I maximize over all potential off-equilibrium allocations to solve for the highest out-of-equilibrium allocation given these beliefs. Thus, for any pooling equilibrium choice α^p, the following conditions must apply:

$$\begin{aligned} \Pi_{H,1}(\alpha^p) + \Pi^*_{H,2} + \overline{e}I_2 &\geq \max_{\alpha} \Pi_{H,1}(\alpha) + \Pi^*_{H,2} \\ \Pi^*_{H,1} - \Pi_{H,1}(\alpha^p) &\leq \overline{e}I_2 \end{aligned} \tag{2.11}$$

$$\begin{aligned} \Pi_{L,1}(\alpha^p) + \Pi^*_{L,2} &\geq \max_{\alpha} \Pi_{L,1}(\alpha) + \Pi^*_{L,2} - \overline{e}I_2 \\ \Pi^*_{L,1} - \Pi_{L,1}(\alpha^p) &\leq \overline{e}I_2 \end{aligned} \tag{2.12}$$

Both conditions characterize an interval of permissible $\alpha^p \in [\underline{\alpha}^p, \overline{\alpha}^p]$, where $\underline{\alpha}^p/\overline{\alpha}^p$ denotes the lower/upper bound of the interval solving (2.11)/(2.12).[14] I illustrate this formulation in Figure 2.5, for the interesting case in which

$$\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) < \overline{e}I_2. \tag{2.13}$$

When (2.13) does not hold, type H has no incentive to imitate L's full information allocation $\alpha^*_1 = 0.5$, since the cost of moving away from its full information optimum, $\Pi^*_{H,1} - \Pi_{H,1}(\alpha_1 = 0.5)$, outweighs the gain from imitating type L, $\overline{e}I_2$. In this case, both types of headquarters are better off following their full information strategy.[15] If condition (2.13) is met, a pooling equilibrium always exists, since $\overline{e}I_2$ is sufficiently high relative to headquarter's cost of inefficient investment at the crossing point of both curves, which also implies that condition (2.12) is non-binding.[16] Hence, I obtain a continuum of pooling equilibrium allocations α^p on the interval $[\underline{\alpha}^p, 1]$, where $\underline{\alpha}^p < 0.5$.

[14]The proof is quite straightforward, given the strict convexity of the left-hand side of inequalities (2.11) and (2.12), type H's and type L's full information choices at $\alpha^*_1 = 1$ and $\alpha^*_1 = 0.5$ as well as the resulting single-crossing point of $\Pi^*_{L,1} - \Pi_{L,1}(\alpha^p)$ and $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p)$ on the interval $(0.5, 1)$.

[15]Although a pooling PBE may exist, it can easily be shown that it will not survive the application of any of the standard refinements.

[16]It can be easily shown that $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) \geq \Pi^*_{L,1} - \Pi_{L,1}(\alpha^p = 0) \Leftrightarrow \frac{1}{2}\overline{x}I_1 - \frac{1}{4}kI_1^2 \geq \frac{1}{4}kI_1^2$ always holds given the assumption that $\overline{x} \geq kI_1$.

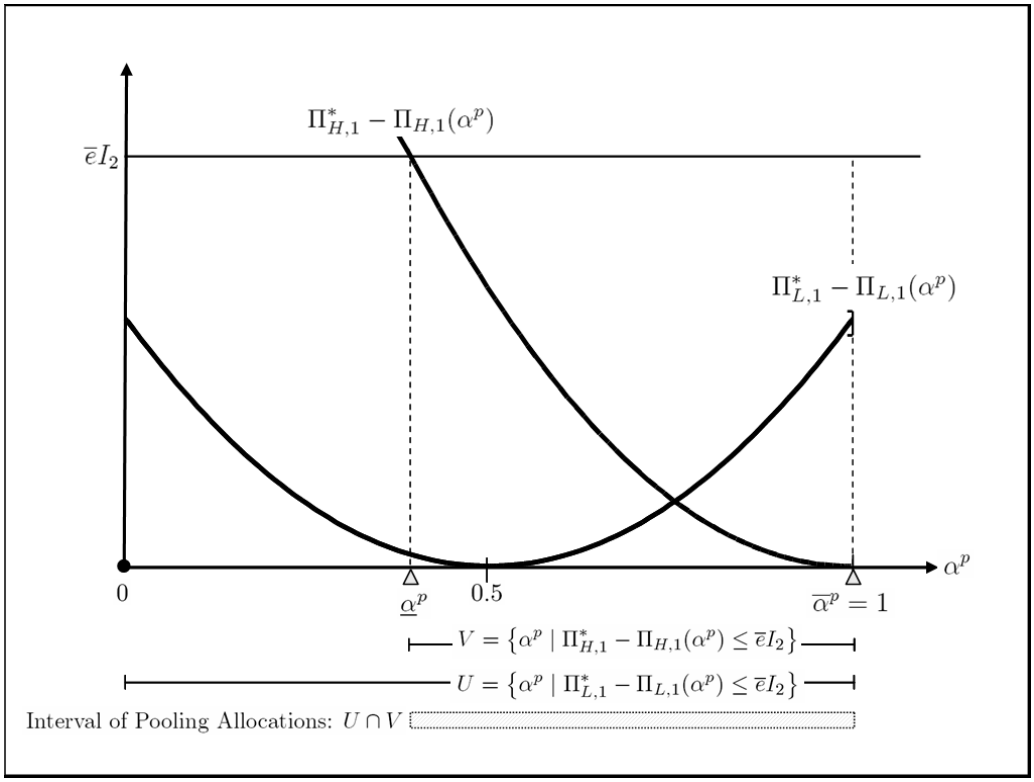

Figure 2.5: Interval of Pooling Allocations α_P

The conditions $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p) \leq \overline{e}I_2$ (2.11) and $\Pi^*_{L,1} - \Pi_{L,1}(\alpha^p) \leq \overline{e}I_2$ (2.12) characterize the set of feasible pooling equilibrium allocations α^p: The left-hand side of these conditions, $\Pi^*_{\theta,1} - \Pi_{\theta,1}(\alpha^p)$, $\theta \in \{L, H\}$, depicts a type's cost from inefficient investment if it chooses the pooling equilibrium allocation α^p compared to its first-period profit $\Pi^*_{\theta,1}$ under full information. $\overline{e}I_2$ denotes the second-period productivity gain induced by managerial effort provision.

The findings to this point can be summarized in the following lemma.

Lemma 2.3 *Let $p(L) = \mu \geq 2\frac{c}{\nu I_2}$. Any first-period pooling equilibrium allocation α^p must belong to an interval defined by (2.11) and (2.12). The associated pooling PBE can be supported by $p(L|\hat{\alpha}) = \eta(\hat{\alpha}) = 0$ for any off-equilibrium allocation $\hat{\alpha} \neq \alpha^p$. Other beliefs that do not motivate some type of headquarters to deviate from α^p are also permissible. If $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) < \overline{e}I_2$, a pooling PBE always exists, and both types of headquarters split funds according to $\alpha^p \in [\underline{\alpha}^p, 1]$, where $\underline{\alpha}^p < 0.5$.*

2.2.3.2.3 *Separating Perfect Bayesian Equilibria*

I have so far considered equilibria in which managers remain uninformed after observing headquarters' first-period choice. Let me now characterize the set of separating equilibria. α^*_L denotes a separating equilibrium allocation, if headquarters is type L, and α^*_H, if headquarters is type H. I show that in any separating equilibrium, a type H headquarters

chooses $\alpha_H^* = 1$, i.e., distributes all funds to its most profitable division A, while a type L headquarters selects an allocation α_L^* that belongs to an interval.

In a separating equilibrium, headquarters' private information is revealed by its first-period allocation. Posterior beliefs yield $\eta(\alpha_L^*) = 1$ and $\eta(\alpha_H^*) = 0$ and managers react optimally as under complete information. For the equilibrium to be separating, I must guarantee that $\alpha_L^* \neq \alpha_H^*$ and assure that allocations are incentive compatible. This implies that a type H headquarters does not want to pick type L's allocation and vice versa. In addition, off-equilibrium allocations (i.e., allocations that differ from α_L^* and α_H^*) and corresponding beliefs must deter both types from deviating from their equilibrium action.

In a separating equilibrium, each type prefers its own allocation as long as the following incentive-compatibility constraints apply:

$$\Pi_{H,1}(\alpha_H^*) + \Pi_{H,2}^* \geq \Pi_{H,1}(\alpha_L^*) + \Pi_{H,2}^* + \overline{e}I_2 \tag{2.14}$$

$$\Pi_{L,1}(\alpha_L^*) + \Pi_{L,2}^* \geq \Pi_{L,1}(\alpha_H^*) + \Pi_{L,2}^* - \overline{e}I_2 \tag{2.15}$$

Under incomplete information, a type H headquarters, for instance, could deploy type L's allocation α_L^* to induce effort and thereby raise divisional payoff in period 2 by $\overline{e}I_2$. However, if (2.14) holds, H has no incentive to do so. Condition (2.15) follows from similar reasoning.

In any separating equilibrium, type H selects its full information allocation $\alpha_H^* = 1$ and distributes all funds to division A. The intuition is that any other putative equilibrium allocation $\alpha_H^* \neq 1$ would motivate type H to deviate from the equilibrium strategy and increase allocations to the more profitable division A with no further negative effect on managers' effort levels.[17] Using this finding, H's incentive compatibility constraint, condition (2.14), simplifies to:

$$\Pi_{H,1}^* - \Pi_{H,1}(\alpha_L^*) \geq \overline{e}I_2. \tag{2.16}$$

Condition (2.16) has a straightforward interpretation: for α_L^* to be incentive compatible, such that H prefers its own allocation $\alpha_H^* = 1$, H's first-period cost due to inefficient investment, $\Pi_{H,1}^* - \Pi_{H,1}(\alpha_L^*)$, must be larger than its second-period gain, $\overline{e}I_2$, earned by mimicking a type L headquarters.

[17] Any putative equilibrium allocation $\alpha_H \neq 1$ would yield a strictly smaller payoff than a putative out-of-equilibrium strategy $\alpha_H^* = 1$, even if most "favorable" off-equilibrium beliefs, namely $\eta(\alpha_H^* = 1) < 2\frac{c}{\nu I_2}$ (which would induce $e_i = 0$), sustained this equilibrium, since: $\Pi_{H,1}(\alpha_H) + \Pi_{H,2}^* < \Pi_{H,1}(\alpha_H^* = 1) + \Pi_{H,2}^* = \Pi_{H,1}^* + \Pi_{H,2}^*$.

I now analyze type L's incentive-compatibility constraint. A type L headquarters would never want to imitate H since $\alpha_H^* = 1$ makes managers believe that headquarters is type H, inducing them to do nothing. This immediately lowers productivity in period 2 by $\overline{e}I_2$. At the same time, α_H^* clearly makes L's first-period investment weakly less efficient than any other allocation. Hence, (2.15) holds for any $\alpha_L^* \in [0,1]$. Consequently, the sole rationale for headquarters to move away from its full information optimum and to select separating allocation α_L^* is to prevent type H from deviating and to make pooling sufficiently costly.[18]

However, in order to credibly signal its type, type L generally cannot select arbitrary α_L^*'s satisfying (2.16) as for any out-of-equilibrium allocation, there must exist (at least) some belief that would prevent type L from deviating from α_L^*. Hence, analogous to the previous analysis of pooling equilibria, in order to determine the maximum set of admissible α_L^*, I need to maximize over all off-equilibrium allocations to solve for the highest out-of-equilibrium allocation under beliefs that do not induce effort and impose

$$\Pi_{L,1}(\alpha_L^*) + \Pi_{L,2}^* \geq \max_{\alpha} \Pi_{L,1}(\alpha) + \Pi_{L,2}^* - \overline{e}I_2$$

which yields

$$\Pi_{L,1}^* - \Pi_{L,1}(\alpha_L^*) \leq \overline{e}I_2. \tag{2.17}$$

This result has an interesting yet simple interpretation: for α_L^* to be an equilibrium candidate, L's cost due to inefficient investment in period 1 must be weakly smaller than the productivity gain from defending second period gain from managerial effort. Also, if condition (2.17) is violated, the cost of inefficient investment relative to $\overline{e}I_2$ is "too high", such that type L may be better off not to signal its type. Consequently, in a separating equilibrium, type L chooses an allocation α_L^* which belongs to the interval $[\underline{\alpha}_L^*, \overline{\alpha}_L^*]$, where $\overline{\alpha}_L^*$ and $\underline{\alpha}_L^*$ denote the lower bounds of the interval solving (2.16) and (2.17), respectively. For exposition, I resume the case of the previous section in which condition (2.13) holds, and I depict the set of separating equilibrium allocations in Figure 2.6. α_L^* is on the interval $[0, \overline{\alpha}_L^*]$, where $\overline{\alpha}_L^* < 0.5$. The findings can be summarized as follows.

[18] Thereby, type L's ability to separate stems from the fact that type L finds inefficient investment marginally less costly than does type H, while both types of headquarters prefer more managerial effort to less: $\frac{\delta[\Pi_{H,1}(\alpha) - \Pi_{L,1}(\alpha)]}{\delta\alpha} > 0$. Thus, for type L, the incentive to separate (i.e., to defend higher period 2 productivity) and the ability to separate (due to low signaling cost) are aligned.

Lemma 2.4 *In any separating equilibrium, a type H headquarters' optimal first-period choice equals its choice under full information,* $\alpha_H^* = 1$. *A type L headquarters chooses to allocate* α_L^*, *which must belong to the interval defined by (2.16) and (2.17). The associated separating PBE can be supported by* $p(L|\hat{\alpha}) = \eta(\hat{\alpha}) = 0$ *for any off-equilibrium allocation* $\hat{\alpha}$. *Other beliefs that do not motivate some type of headquarters to deviate from* α_H^* *and* α_L^* *are also permissible. If a separating PBE exists and* $\Pi_{H,1}^* - \Pi_{H,1}(\alpha^p = 0.5) < \overline{e}I_2$, *a type L headquarters splits funds according to* $\alpha_L^* \in [0, \overline{\alpha}_L^*]$, *where* $\overline{\alpha}_L^* < 0.5$.

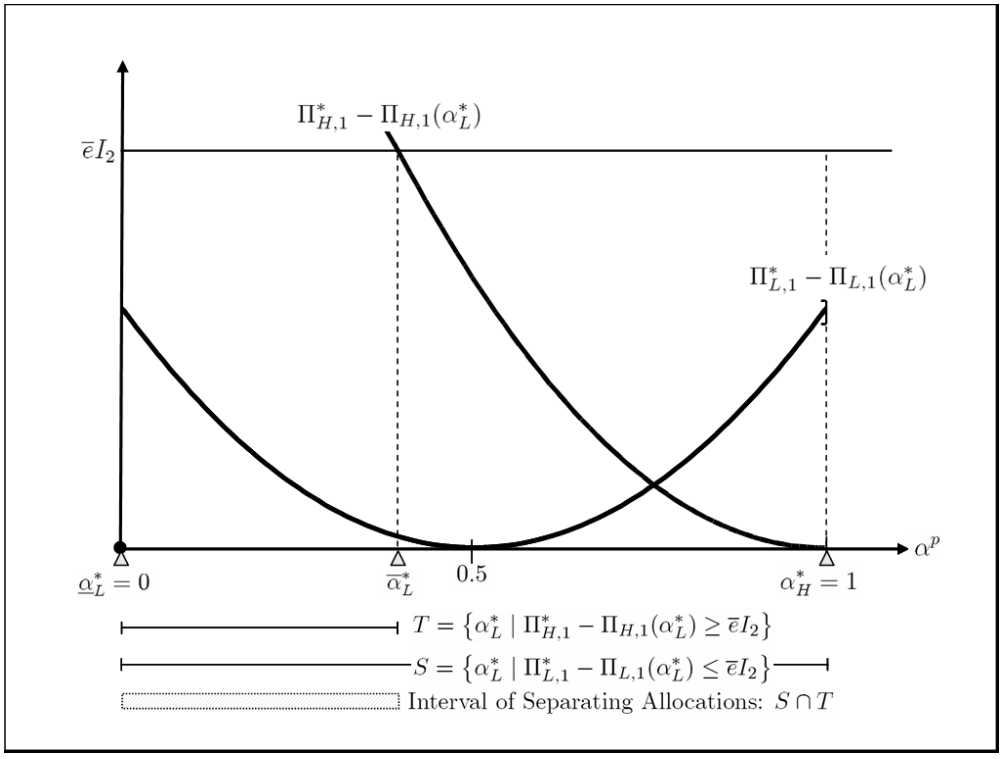

Figure 2.6: Interval of Separating Allocations α_L^*

The conditions $\Pi_{H,1}^* - \Pi_{H,1}(\alpha_L^*) \geq \overline{e}I_2$ (2.16) and $\Pi_{L,1}^* - \Pi_{L,1}(\alpha_L^*) \leq \overline{e}I_2$ (2.17) characterize a type L's set of feasible separating equilibrium allocations α_L^*: The left-hand side of these conditions, $\Pi_{\theta,1}^* - \Pi_{\theta,1}(\alpha_L^*)$, $\theta \in \{L, H\}$, depicts a type's cost from inefficient investment if it chooses allocation α_L^* compared to its first-period profit $\Pi_{\theta,1}^*$ under full information. $\overline{e}I_2$ denotes the second-period productivity gain induced by managerial effort provision.

2.2.3.2.4 *Equilibrium Refinement*

In the previous sections, I have shown that there are two kinds of Perfect Bayesian Equilibria in pure strategies for the case in which condition (2.13) holds. Pooling equilibria are given by $\alpha^p \in [\underline{\alpha}^p, 1]$ and separating equilibria by $\alpha_H^* = 1$ and $\alpha_L^* \in [0, \overline{\alpha}_L^*]$, where $\underline{\alpha}^p = \overline{\alpha}_L^* = z < 0.5$. I show that jointly applying the notions of *Undefeated Equilibrium* and *D1* eliminates all equilibria except the pooling equilibrium in which $\alpha^p = 0.5$.

The rationale behind the equilibrium refinement is straightforward. I require headquarters and managers to reason "forward" in such a way, that any deviation from a conjectured equilibrium would lead managers to form beliefs according to some hierarchy. By applying *Undefeated Equilibrium*, I require that managers initially interpret an off-equilibrium allocation as an attempt by some type of headquarters to consciously shift to another, preferred equilibrium, thereby leading managers to adjust their off-equilibrium beliefs accordingly. If such an interpretation is not possible, managers ask which type of headquarters is more likely to gain from this deviation relative to the conjectured equilibrium, applying the notion of *D1*. Once all off-equilibrium beliefs have been restricted according to this hierarchy, a conjectured equilibrium is reasonable only if neither of the informed headquarters' types has an incentive to deviate.

Applying the refinement requires several steps. Without loss of generality, I focus on the case in which both pooling and separating PBE exist. It is helpful to recall that both pooling allocations α^p and type L's separating allocations α_L^* induce managerial effort $\overline{e}$. First, diminishing returns to scale and L's optimum at $\alpha = 0.5$ make any separating equilibrium allocation $\alpha_L^* < z$ strictly less profitable from type L's perspective than the least-cost separating equilibrium in which $\alpha_L^* = z$. Hence, L has an incentive to shift to its least-cost separating equilibrium, which defeats any other separating equilibrium. Second, notice that if headquarters is of type L, marginal productivities of divisions A and B are equal, which implies that any capital allocation $\alpha = \bar{\alpha}$ is payoff-equivalent to an allocation $\alpha = 1 - \bar{\alpha}$, $\bar{\alpha} \in [0, 1]$. Hence, pooling equilibria at $\alpha^p > 1 - z$ are not reasonable: if headquarters turns out to be L, the separating equilibrium at $\alpha_L^* = z$ yields a strictly higher payoff to this type. Third, consider any conjectured pooling equilibrium in which $\alpha^p < 0.5$ and a deviation to $\alpha = 0.5$. Managers infer that the pooling equilibrium at $\alpha^p = 0.5$ is being played, since both types' payoff function strictly increases on the interval $[z, 0.5]$. Since pooling at $\alpha^p = 0.5$ also renders either type strictly better off than the least-cost separating equilibrium, the latter is also defeated. *Undefeated Equilibrium* therefore leaves an interval of pooling equilibria $\alpha^p \in [0.5, 1 - z]$.

Let me now show that pooling equilibria at $\alpha^p \in (0.5, 1 - z]$ do not survive *D1*. Consider any conjectured *Undefeated Equilibrium* on this interval and also a deviation to $\bar{\alpha} = 0.5$. Following *D1*, managers immediately eliminate H as the potential defector. By defecting, type H strictly loses, regardless of managers' beliefs (and corresponding effort levels) as the cost of inefficient investment increases whereas managerial effort in equilibrium is already at a maximum. In other words, the set of managers' best responses inducing H to deviate is empty. On the other hand, type L clearly deviates to $\bar{\alpha} = 0.5$ (its full information optimum) if managers form a belief that causes them to exert effort. Therefore, *D1* requires that managers' beliefs following such defection should put all the

weight on type L, which in turn forces type L to deviate from the conjectured pooling equilibrium.

Finally, I show that there exists a unique *Undefeated Equilibrium* satisfying *D1:* the pooling equilibrium at $\alpha^p = 0.5$. By following its equilibrium strategy, L is strictly better off than with any other allocation, regardless of managers' beliefs. Type H may obtain a higher payoff by defecting to $\bar{\alpha} \in (0.5, 1]$ only if $\bar{\alpha}$ causes managerial effort. Consequently, since H has a greater incentive to allocate $\bar{\alpha}$ (whereas L has none), *D1* requires that the posterior belief conditioned on $\bar{\alpha}$ should be concentrated on type H. This argument in fact restricts off-equilibrium beliefs, but does not rule out the equilibrium. H prefers to stick to the equilibrium, since any allocation $\bar{\alpha}$ induces managers to reduce effort and condition (2.13) holds.

2.2.3.2.5 *Equilibrium Implications and Results*

The following proposition summarizes the results from the previous section.

Proposition 2.2 *Let* $p(L) = \mu \geq 2\frac{c}{\nu I_2}$.

a) If $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) < \overline{e}I_2$, *there is a unique (Undefeated Equilibrium and D1) pooling equilibrium outcome, in which both types of headquarters split funds evenly according to* $\alpha^p = 0.5$. *Equilibrium strategies are given by*

$$(\alpha^*_1, (e^*_A, e^*_B), \alpha^*_2) = \begin{cases} (\frac{1}{2}, (\overline{e}, \overline{e}), \frac{1}{2}) & \textit{if headquarters is type } L \\ (\frac{1}{2}, (\overline{e}, \overline{e}), 1) & \textit{if headquarters is type } H \end{cases}$$

First-period allocation α^p *is uninformative with respect to divisional productivity, hence managers' beliefs equal their prior,* $p(L|\alpha^p) = p(L) = \mu$ *. Managers assign zero probability to type L following an off-equilibrium deviation on the interval* $\bar{\alpha} \in (0.5, 1]$ *and form arbitrary beliefs otherwise.*

Equilibrium payoffs to headquarters equal

$$\begin{cases} \Pi^*_{L,1} + \Pi^*_{L,2} & \textit{if headquarters is type } L \\ \Pi_{H,1}(\alpha^p = 0.5) + \Pi^*_{L,2} + \overline{e}I_2 & \textit{if headquarters is type } H \end{cases}$$

b) If $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) > \overline{e}I_2$, *there is a unique (Undefeated Equilibrium and D1) separating equilibrium outcome, which is the complete information outcome described in Proposition 2.1.*

Proposition 2.2 establishes that the incentive of headquarters not to disclose information on divisional productivity through capital allocation can be important enough to dominate the equilibrium outcome. This incentive is sufficiently strong when heterogeneous productivity across divisions is not too likely ex ante. Then, uninformed managers expect their effort to have an impact on second-period capital allocation and they therefore engage in value-enhancing activities, regardless of their relative rank with respect to productivities. In addition, the benefit of increased second-period capital productivity must be sufficiently large to a type H headquarters relative to first-period cost due to inefficient investment, in order for pooling to be profitable.

Corollary 2.1 *Under the assumptions of Proposition 2.2a, headquarters with private information on the productivity of their divisions allocate first-period funds I_1 evenly according to $\alpha^p = 0.5$, whereas capital allocation under full information is characterized by $\alpha_1^* = 0.5$ if headquarters is type L and by $\alpha_1^* = 1$ if headquarters is type H.*

Corollary 2.1 follows from Propositions 2.1 and 2.2 and implies socialism in internal capital markets. The model predicts that if investment opportunities across divisions are diverse (headquarters is type H), the firm takes capital away from its more profitable division, thereby allocating too little to its "higher q" division A and too much to its "lower q" division B. The model predicts a pooling equilibrium when the benefits to pooling are large for headquarters.

Corollary 2.2 *The pooling equilibrium under incomplete information renders a type H headquarters better off than its full information equilibrium. For a type L headquarters, equilibria under complete and incomplete information are payoff-equivalent.*

Proof. Equilibrium outcome under complete and incomplete information for type H yields $\Pi_{H,1}(\alpha^p = 0.5) + \Pi_{H,2}^* + \overline{e}I_2$ and $\Pi_{H,1}^* + \Pi_{H,2}^*$, respectively; whereas payoff equals $\Pi_{L,1}^* + \Pi_{H,2}^*$ for type L. $\Pi_{H,1}(\alpha^p = 0.5) + \Pi_{H,2}^* + \overline{e}I_2 > \Pi_{H,1}^* + \Pi_{H,2}^*$ follows from condition (2.13). ■

Thus, private information improves the equilibrium outcome for headquarters. From the perspective of the two-period investment cycle, either type of headquarters is (weakly) better off following a policy of nondisclosure (via capital allocation), which implies that the pooling equilibrium outcome dominates the full information outcome for both homogeneous and heterogeneous intrinsic productivities. Withholding information about true capital productivities thus raises firm value. The following result describes how these benefits are related to the relative capital productivity of divisions A and B and the levels of investment in the two periods.

Corollary 2.3 *Under the assumptions of Proposition 2.2a, ceteris paribus, an increase in I_2 and $\overline{e}$ and a decrease in I_1 and $\overline{x}$ expand the set of remaining parameter values that yield the pooling equilibrium outcome as described in Proposition 2.2a.*

Proof. $\bar{\Pi} = \Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) - \overline{e}I_2 = \frac{1}{2}\overline{x}I_1 - \frac{1}{4}kI_1^2 - \overline{e}I_2 \Rightarrow \frac{\partial\bar{\Pi}}{\partial\overline{x}} > 0$, $\frac{\partial\bar{\Pi}}{\partial I_1} > 0$, $\frac{\partial\bar{\Pi}}{\partial\overline{e}} < 0$, $\frac{\partial\bar{\Pi}}{\partial I_2} < 0$ since $\overline{x} \geq kI_1$ and $\overline{x}, I_1, k > 0$. ■

Corollary 2.2 implies that pooling occurs if I_1 is low compared to I_2 and $\overline{x} < \overline{x}_{\max}$, where $\overline{x}_{\max}$ solves $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) = \overline{e}I_2$.

2.3 Discussion of Results and Empirical Implications

In this section I discuss the model's results. The theory of internal capital markets I suggest makes a number of testable predictions and proves consistent with existing empirical evidence.

a) Socialism in Internal Capital Markets

Corollary 2.1 implies the existence of socialism in internal capital markets. The model predicts that multi-business firms bias their investment levels in favor of divisions with weaker investment prospects. This distortion of capital allocations has been documented in empirical studies by Scharfstein (1998), Shin and Stulz (1998) and Rajan, Servaes, and Zingales (2000). Compared to previous research, the model provides an alternative explanation for socialistic internal capital market allocations. The key argument is that headquarters uses funds to control managerial expectations about prospective assets under control which affects effort levels and future capital productivities. To boost managerial effort, privately informed headquarters distributes capital more evenly than it would, if information were distributed symmetrically.

b) Relatedness of Businesses and Information Sharing

In Corollary 2.2, I raise the point that equal capital allocation in equilibrium is uninformative about the performance of divisions and either type of headquarters is (weakly) better off compared to full information. Consequently, the model also provides an argument for limiting access to information about other divisions' business opportunities and, in this respect, for strategic lack of transparency within multi-business firms. It also may serve as a rationale for why firms may oppose regulation that increases transparency about individual units such as detailed segment reporting.

This argument leads to the question of what circumstances make it more feasible to withhold private information about capital productivities from divisional managers. This

opportunity may be more pronounced when multi-business firms operate strictly unrelated businesses and managers do not operate in the same or similar industries, assuming that managers report investment quality directly to headquarters. In this case, predictions on other division's investment opportunities and hence relative performance assessment may be more challenging to achieve, since managers may rely less on their own knowledge about industry, technology, products, and regulations. This implication is consistent with the empirical study by Khanna and Tice (2001), whose findings suggest that firms with operations in related industries do not appear to subsidize weaker divisions.

c) Levels of Investments

An immediate empirical implication emerges from Corollary 2.3. Pooling, and therefore evenly distributed capital investment, should prevail during periods in which available internal funds are scarce compared to future periods. Then, the cost of inefficient investment is less significant compared to the gain from inducing managerial effort in upcoming periods when funds are less constrained and sacrificing short-run profits is less costly relative to long-term profits. The argument has two major implications. First, we may interpret socialistic investment behavior as one action to motivate the search for new opportunities during periods when funds are temporarily constrained (I_1). Second, pooling may enhance the incentives for managers to strongly exploit growth opportunities and prepare for periods of large investments (I_2), for instance prior to capacity expansions or market entry. These longitudinal implications of investment distortions stem from the explicitly dynamic nature of the model and complement the findings of the static approaches to socialistic investment cited above.

d) Industry Shocks and Diversity of Investment Opportunities

Corollary 2.3 also implies that a pooling equilibrium is less likely if $\overline{x}$ is especially large and divisions are strongly heterogeneous with respect to profitable investment opportunities. For instance, consider a type H multi-business firm that allocates capital evenly. Suppose also that one division is affected by an exogenous industry shock that alters relative investment prospects in favor of division A. Industry shocks may include innovations, deregulation, policy changes, or a significant change in input cost. As a consequence, relative differences in investment prospects $\overline{x}$ may increase such that $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) > \overline{e}I_2$. In this case, the model predicts that headquarters is expected to move from a pooling equilibrium to another equilibrium, namely the separating equilibrium with the firm investing as under full information. In fact, separation in which case all funds I_1 are used for investments in a firm's strongest division emerges (if divisions are heterogeneous) when firms reorganize their businesses in cash-generating/low growth and cash-consuming/high growth businesses. For instance, General Electric views their portfolio as two distinct groups: *Cash Generators* provide strong cash flow to the *Growth Engines,* businesses

with many profitable investment opportunities and strong growth (see General Electric's Annual Report 2003). On the other hand, if capital productivities across *Growth-Engine*-businesses are not too different, capital allocation among those may well be governed by the pooling equilibrium described above.

2.4 Extension

The analysis of the preceding sections focuses on the situation in which divisional managers choose to exert effort in case they don't learn anything from first-period capital allocation ($p(L) = \mu \geq 2\frac{c}{\nu I_2}$). In this section, I briefly discuss the situation in which this condition is violated ($p(L) = \mu < 2\frac{c}{\nu I_2}$) and hence managers do not exert effort if first-period allocation is uninformative.

In this case, as long as $\Pi^*_{H,1} - \Pi_{H,1}(\alpha^p = 0.5) < \overline{e}I_2$, a pooling equilibrium does not exist, since pooling is not an attractive proposition for either type of headquarters. In addition, the complete information outcome characterized in Proposition 2.1 is not an equilibrium outcome, since a type H headquarters has still an incentive to mimic a type L headquarters' complete information allocation of $\alpha_L = 0.5$. I omit a detailed analysis here, but it can be shown that under some additional parametric restrictions, there exists a unique separating equilibrium outcome in which $\alpha^*_L \in (0, 0.5)$ and $\alpha^*_H = 1$. The reason is that a type L headquarters has a strong incentive to signal its type to restore managerial effort incentives. It does so by allocating more first-period capital to division B than to division A, despite equal capital productivities. This renders it too costly for a type H headquarters to mimic L's strategy.

This result implies that, on average, division B obtains a larger first-period capital allocation than it would under complete information. Therefore, the internal capital market displays "socialistic" behavior also under circumstances in which pooling does not lead to effort provision. One difference to the pooling equilibrium outcome characterized in Proposition 2.2 is that in the separating outcome described here, ex ante expected profits are lower than under complete information. This implies that ex ante headquarters has an incentive to commit to creating transparency about investment opportunities across divisions.

2.5 Conclusion

This chapter provides a novel explanation for the existence of socialistic capital allocations in internal capital markets. I present a model based on the notion that headquarters possesses private information about capital productivity of divisions. I find that this "socialism" arises as a consequence of a headquarters' attempt to not disclose this information, since capital allocations in the present may serve as a signal about those in the future. When capital allocation provides effort incentives to divisional managers, this is material information. Headquarters chooses an even capital allocation in order to create competition for funds, which in turn triggers improvements in capital productivity in the future. Although this investment policy appears to be inefficient from a one-period angle, the benefits of such a policy outweigh its costs over the full investment cycle. In addition to the existence of managers' empire-building preferences, there are other factors that are relevant for the occurrence of socialistic investment behavior. The model predicts that socialism is more prevalent during periods when funds are temporarily constrained and prior to periods of large investments. The extent of asymmetric information between headquarters and managers is also important: socialism is more pronounced when multi-business firms operate unrelated businesses. In this case, it is more feasible to withhold information about relative performance from divisional managers. Finally, the theory also provides insight into why firms may reorganize their businesses when investment prospects across divisions become too diverse.

The key argument of my analysis is that superior information of a corporate headquarters is useful in understanding how firms allocate capital to its business units. I believe that this notion might also contribute to the understanding of related areas of capital management, such as the design of budgeting procedures, delegation of authority, reporting practices, and general resource allocation. The exploration of these topics may provide interesting avenues for future research.

Chapter 3

Internal Capital Markets: Evidence from the Field

Economists have been building theories of the internal capital allocation in diversified firms for many years (see Stein, 2003, for a comprehensive literature review). Due to data limitations, empirical work in this field is at an early stage, however. So many of the most interesting and most important research questions remain incompletely resolved.[1]

In the following work, I am able to overcome some of these limitations. I analyze a unique dataset from surveys of European chief financial officers (CFOs) to examine the practice of internal capital markets in diversified firms. I extend existing empirical evidence by comparing CFOs' perspectives with academic theory and investigate whether corporate actions are consistent with theoretical concepts.

Specifically, the survey addresses four areas of corporate finance theory: (i) internal capital budgeting processes, (ii) the financial motives for corporate diversification, (iii) the financial effects of diversification when raising capital, and – most importantly – (iv) whether and why firms engage in "corporate socialism" – the practice of weaker divisions being cross-subsidized by stronger ones. With regard to the latter, this chapter can be understood as an effort to supplement the findings of the previous chapter.

I organize the chapter as follows. Section 3.1 presents research methodology, survey design, and summary statistics. Section 3.2 provides survey evidence and interprets the main results. Section 3.3 concludes.

[1]Most data on internal resource allocation decisions that firms make is not publicly available, hard to acquire, and/or subject to reporting biases. Also, many empirical studies suffer from measurement and endogeneity problems. See Maksimovic and Phillips (2007) for a comprehensive discussion of these issues in the literature on internal capital markets.

3.1 Methodology

3.1.1 Survey Design and Sample

The survey was conducted in the spring of 2010.[2] In preparing the questionnaire, I reviewed the existing literature and carefully extracted theoretical predictions and arguments to develop a draft questionnaire. This draft was extensively pre-tested with a group of chief financial officers through personal interviews lasting 60-90 minutes. I also mailed the survey instrument to a group of prominent academics in finance, marketing, and management science for review and feedback.[3]

I identified 992 diversified firms in 11 Western European countries (Austria, Belgium, Denmark, Finland, France, Germany, Netherlands, Norway, Switzerland, Sweden, and UK) and mailed the questionnaire along with a personalized and signed cover letter. The definition of diversified firms I apply is common and follows previous studies (Lang and Stulz, 1994; and Rajan, Servaes, and Zingales, 2000). These studies define firms as diversified if a multi-segment firm generates less than 90% of revenues in a single SIC code industry at the 3-digit level. I exclude pure financial firms from the sample (firms with no segment outside the financial services industries, i.e., the SIC code range starting with 6) because some parts of the questionnaire are applicable to industrial corporations but difficult to transfer to financial institutions. Also, I restrict the sample to firms with sales of €10M and more. Smaller firms are not likely to meet the requirements for those types of multi-segment firms I have in mind for large parts of the questionnaire: firms that organize business activities in (distinct) operating segments overseen by a corporate headquarters. Firm and CFO contact information were obtained from several data sources, primarily, Thomson Reuters Worldscope, but also Bloomberg, Compustat, and Capital IQ. To increase the response rate, financial executives were offered an advanced report of the results. Also, I employed a team of three graduate students for follow-up calls and re-mailing of a second copy of the questionnaire if requested.

Sixty-nine CFOs returned useable questionnaires. The resulting response rate of 7.0 percent is slightly lower than those of comparable corporate finance studies in the United States such as Graham, Harvey, and Puri (2010) with 7.9 percent or the seminal paper

[2]Principles proposed by Dillman (1978), Bertrand and Mullainathan (2001), Bednar and Westphal (2006), and Baruch and Holtom (2008) inspired large parts of the survey design.

[3]The comprehensive overview of theories that informed the survey instrument is provided in Appendix A. I give brief summaries of each theory and link these to the corresponding questions. I also present the final versions of cover letter and questionnaire.

of Graham and Harvey (2001) with 8.9 percent.[4] The response rate, however, compares nicely with studies in Europe such as Brounen, de Jong, and Koedijk (2004) with 4.8 percent or global studies such as Campello, Graham, and Harvey (2010) with 6.8 percent.

3.1.2 Summary Statistics

Table 3.1 presents descriptive statistics of both the firms in the sample and the CFOs who returned a useable survey.

Firm characteristics and personal characteristics of CFOs

Annual sales revenue	*%*	*n*	*Ownership*	*%*	*n*	*CFO gender*	*%*	*n*
10-25 million €	2.9	2	Public	89.9	62	Male	98.6	68
25-100 million €	4.3	3	Private	10.1	7	Female	1.4	1
100-500 million €	24.6	17		**100**	**69**		**100**	**69**
0.5-1 billion €	17.4	12						
1-5 billion €	31.9	22	*No. of Operating Segments*	*%*	*n*	*CFO tenure*	*%*	*n*
5-10 billion €	5.8	4	2 segments	30.4	21	<3 yrs	21.7	15
>10 billion €	13.0	9	3-4 segments	46.4	32	3-5 yrs	43.5	30
	100	**69**	>4 segments	23.2	16	>5 yrs	34.8	24
				100	**69**		**100**	**69**
Industry	*%*	*n*	*Country*	*%*	*n*	*CFO education*	*%*	*n*
Manufacturing	27.0	30	Germany	29.0	20	College degree	1.4	1
Construction	13.5	15	Austria	13.0	9	Non-MBA Master's	26.1	18
Retail and Wholesale	9.9	11	Switzerland	11.6	8	MBA, CPA, FCA	58.0	40
Transport	7.2	8	United Kingdom	10.1	7	Dr./PhD	13.0	9
Tech (Software, Biotech)	7.2	8	Sweden	8.7	6	Other	1.4	1
Energy	6.3	7	Netherlands	7.2	5		**100**	**69**
Pharma, Healthcare	3.6	4	Belgium	5.8	4	*CFO age*	*%*	*n*
Consulting, Service	3.6	4	Norway	5.8	4	<40	5.8	4
Communication, Media	1.8	2	France	4.3	3	40-50	47.8	33
Bank, Finance, Insurance	1.8	2	Denmark	2.9	2	51-60	40.6	28
Mining	0.9	1	Finland	1.4	1	>60	5.8	4
Other	17.1	19		**100**	**69**		**100**	**69**

Table 3.1: Summary statistics

The sample is balanced between small firms (49%, firms with €1 billion in sales or less) and large firms (51%, firms with more than €1 billion in sales). All firms in the sample operate at least two divisions. These divisions are active in several industries, including manufacturing (27%), construction (14%), retail and wholesale (10%), transportation

[4]These studies enjoy unique access to members of the U.S. association of financial executives (FEI) and the subscribers of the CFO magazine.

(7%), high-tech (7%), and energy (6%), among others.[5] Of the 69 responses, I received more than half (54%) from German-speaking countries (Germany, Austria, Switzerland).

I also asked for personal characteristics of the financial executives. Almost all are male (99%), more than half of them (54%) are of age 50 or younger, and 71 percent have an MBA or a doctoral degree. Consistent with previous studies (for instance, Graham and Harvey, 2001), the sample indicates that financial executives change jobs frequently – nearly 60 percent have been in their job for a maximum of five years. In unreported analysis, I find that relative to the Worldscope universe from which I obtained most of the datasets, the firms in the sample have somewhat higher sales and more footprint in the construction industry. It is important to note that private firms are underrepresented in Worldscope which is not surprising given that their financial data is generally not available. The sample is fairly representative of diversified firms in Worldscope.

3.2 Survey Evidence

The survey contains 80 questions in 5 sections. In this chapter, I restrict attention to the most important findings related to the internal capital markets in diversified firms. I follow previous surveys (Graham and Harvey, 2001) in performing univariate analyses on the survey responses conditional on firm characteristics. I report conditional results if they are related to the previous chapter on internal capital markets.[6]

3.2.1 Motives for Maintaining Corporate Diversification

I begin the survey by investigating the relative importance of different motives for corporate diversification. Aside from operational and market-power factors, I ask firms about the importance of financial motives related to the literature of internal capital markets. For this purpose, I ask executives to indicate their level of agreement with each motive on a scale of 1 to 5 – with 1 meaning "not important" and 5 meaning "highly important." Figure 3.1 summarizes the results.

[5] In Table 3.1, I present the "major industries" in which the divisions of these firms are engaged. A "major industry" accounts for at least 10% of a firm's sales. Numbers do not add to 69 due to firms being engaged in several industries.

[6] Concretely, I present univariate analyses conditional on the following characteristics: firm size (small, large), capital constraints (yes, no), and degree of diversification (unrelated, related). The definition of these controls follows below. I performed correlation analyses of the control variables with ϕ, which measures the degree of association between two binary variables and Kendall's τ which measures correlations between rankable categorical variables. Among the control variables, firm size is correlated with whether

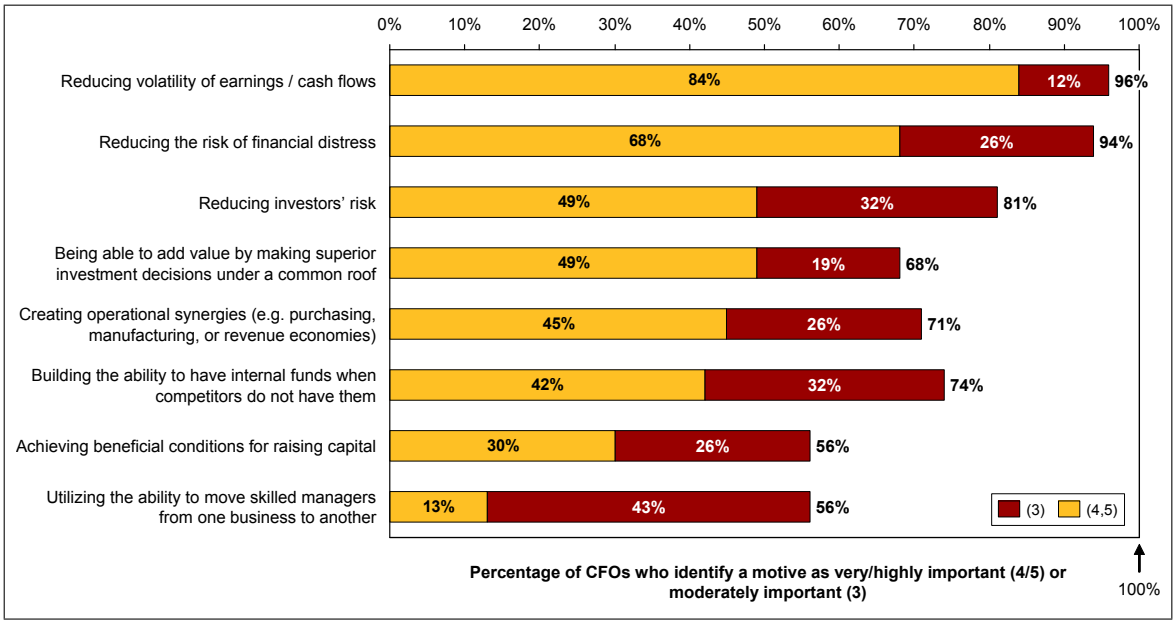

Figure 3.1: Survey evidence on the question (n=69): "How important are the following motives for operating more than one line of business for your company?"

Surprisingly, risk management is the dominant motive for corporate diversification. A majority of 84 percent of firms indicates that the "reduction of volatility in earnings/cash flows" is very or highly important. This finding is consistent with a number of theories in accounting and finance. For instance, it is argued that less volatile earnings/cash flows reduce the estimation risk for investors (Jorion, 1985; Xia, 2001), expected corporate taxes (Smith and Stulz, 1985), or underinvestment (Froot, Scharfstein, and Stein, 1993). Two related motives, "reducing the risk of financial distress" and "reducing investors' risk" (Smith and Stulz, 1985; Stulz, 1996), are ranked second and third with 68 percent and 49 percent of agreement.[7]

Financial executives perceive the benefits of operating an internal capital market as only moderately important. I ask firms about financing advantages and superior investment decision-making in diversified firms – often referred to as the "more-money" and "smarter-money" effects (Stein, 2003). Only 30 percent of CFOs indicate that "achieving beneficial conditions for raising capital" is an important motive for diversifying their firm (Lewellen, 1971).[8] Further, I ask about the ability to make efficient capital allocations within diver-

firms' are capital constrained (small firms are more likely to be capital constrained). I report findings with respect to this control variable only if they hold after controlling for size.

[7]Note that the motive of "reducing the volatility of earnings/cash flows" is not unrelated to the latter two arguments. To make the findings clearer, I thought that presenting the most important risk-related arguments separately rather than sticking to a single category would be more interesting.

[8]I will further elaborate this "debt co-insurance" argument below.

sified firms. This argument has a long tradition. According to Alchian (1969), Weston (1970), Williamson (1975), and Stein (1997), diversified firms are able to allocate capital more efficiently than the external capital market. About half (49%) of the respondents indicate that "making superior investment decisions under a common roof" is a very or highly important motive for corporate diversification. So my results indicate that although firms acknowledge the benefits of operating an internal capital market (as I will also show below), survey evidence does not provide much support that establishing internal capital markets is the primary economic rationale for diversification.

The literature on strategic management and industrial organization suggests motives for diversification that corporate finance theory does not cover traditionally (see Ramanujam and Varadarajan, 1989; and Montgomery, 1994, for an overview). One stream of the literature argues that firms diversify in order to utilize economies of scope and scale. From this *resource-based view*, diversification helps to create "operational synergies" in terms of cost and revenues because firms cannot easily sell indivisible resources, such as brand names and managerial capabilities, or excess capacity of physical assets in the marketplace (Penrose, 1959; Teece, 1980 and 1982; Prahalad and Hamel, 1990). I ask CFOs about the importance of these motives for diversification. Forty-five percent of CFOs indicate that "creating operational synergies" is a very or highly important motive for operating multiple business lines.

The *market-power view* of diversification emphasizes the notion of "deep pockets" for predatory pricing and potential anti-competitive effects of diversification (Bernheim and Whinston, 1990; Caves, 1981). I find low to moderate evidence (42%) in support of these arguments.

A third class of conceptual arguments concerns the motives of corporate diversification: *agency theories*. Among these theories are, for instance, "empire-building" and "free-cash-flow" (Jensen, 1986), "managerial entrenchment" (Shleifer and Vishny, 1989), and "employment concern" (Amihud and Lev, 1981) arguments. However, these motives are not consistent with shareholder-wealth-maximizing behavior of managers. Hence, CFOs would probably not be likely to truthfully represent their intents. So I decided to exclude all agency-related arguments in order to present unbiased results.

3.2.2 Financing Effects of Corporate Diversification

The fundamental difference between a multi-divisional diversified firm and a stand-alone firm is that a corporate headquarters generally raises capital on behalf of its divisions, and capital is pooled at the firm level.[9] In the sample, 64 out of 69 firms raise capital at the headquarters' level. I ask CFOs about the effects of diversification when raising capital.[10] Figure 3.2 displays the results.

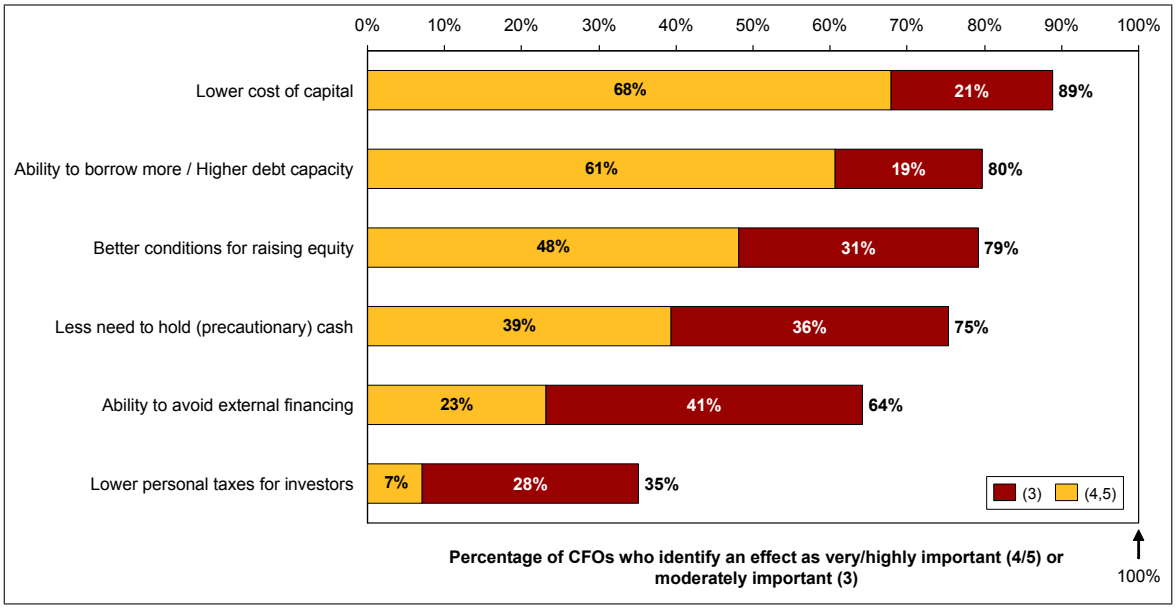

Figure 3.2: Survey evidence on the question (n=57): "How important are the following effects of diversification for your company? – Please answer compared to the situation where your divisions were stand-alone and had to raise funds by themselves."

Interestingly, despite the conventional textbook view that diversification does not impact the capital cost of the firm (see Brealey and Myers, 2003; or Ross, Westerfield, and Jaffe, 2006), more than two thirds (68%) of the CFOs indicate that the most important financial effect of diversification is "lower cost of capital."[11] In this sense, CFOs' beliefs are in line

[9] In "business groups" with legally distinct firms, group companies (also) have their own access to financial markets (see Cestone and Fumagalli, 2005).

[10] Eighty percent of firms (52 out of 64) in the sample act as the *single* and centralized provider of finance with divisions *not* raising funds by themselves. I exclude private firms from the analysis because the equity-related questions are not directly applicable to them.

[11] For instance, in their chapter on the opportunity cost of capital, Brealey and Myers (2003, p. 177) write, "Diversification is undoubtedly a good thing, but that does not mean that firms should practice it. If investors were not able to hold a large number of securities, then they might want firms to diversify for them. But investors can diversify. In many ways they can do so more easily than firms...If investors can diversify on their own account, they will not pay any extra for firms that diversify."

with recent theoretical arguments from Hann, Ogneva, and Ozbas (2009) who argue that diversification may reduce a firm's systematic risk if co-insurance enables the firm to avoid systematic risk from financial distress.

Also, the implications of "debt co-insurance" arguments (Lewellen, 1971) – "the ability to borrow more" – are of importance for a large proportion of the respondents (61%). Given the mixed empirical evidence on the validity of the "more-money" argument in previous studies, this result is particularly surprising. For instance, Berger and Ofek (1995) and Comment and Jarrell (1995) find either no or low associations between diversification and leverage. However, recent evidence from the financial crisis (Kuppuswamy and Villalonga, 2010) suggests the "more-money" effect has been particularly value-enhancing during the financial crisis. In fact, all CFOs in the pre-testing group particularly emphasized their higher debt capacity from diversification. One pointed out that the degree of diversification is a key rating factor of rating agencies for many industries.

Previous research also argues that diversification can affect the conditions for raising equity. Hadlock, Ryngaert, and Thomas (2001) posit that diversification helps to alleviate adverse selection problems of the Myers and Majluf (1984) type in the external equity market. Their argument is that the errors the market makes in valuing divisions balance out across divisions. Hence, equity announcements are viewed less negatively by the market. Forty-eight percent of the CFOs believe diversification provides better conditions for raising equity.

Moderate evidence supports the idea that diversified firms have "less need to hold (precautionary) cash." Thirty-nine percent of the CFOs find this cash-holding argument very or highly important. So my results are consistent with recent evidence from Duchin (2010) who finds that diversified firms carry less cash than their stand-alone peers because of smoother investment opportunities. Somewhat surprisingly, CFOs rate the relative importance of diversified firms' "ability to avoid external financing" unexpectedly low with 23 percent. For instance, Matsusaka and Nanda (2002) and Rajan (1994) provide the corresponding theoretical concepts of internal capital markets rendering project funding independent of both market conditions and costly external financing.

3.2.3 Internal Capital Budgeting Processes

I also devoted one part of the questionnaire to capital budgeting processes and investment. Given the theoretical presumption of *decentralized* bottom-up project initiation in the divisions but *centralized* capital allocation at the level of headquarters, I thought it would be interesting to investigate firms' internal capital budgeting processes. In 66 of 69 firms in the sample, decision-making authority regarding major investments resides centralized

with headquarters. All of these 66 responding CFOs indicate a *threshold amount* above which firms centralize decision-making authority and that requires headquarters for formal analysis. I also ask for the exact threshold amount firms use. Given the confidentiality of this information, only 48 out of 69 firms answered this question. Figure 3.3 reports the results.

Quartiles / Mean	Threshold Amount		No. of Investment Proposals	
	Small firms (n=24)	Large firms (n=24)	Small firms (n=28)	Large firms (n=31)
25%	€35k or less	€0.4M or less	4 or less	13 or less
50%	€100k or less	€1.0M or less	15 or less	20 or less
75%	€200k or less	€4.8M or less	29 or less	30 or less
100%	€1M or less	€50M or less	200 or less	75 or less
Mean	€210k	€5.3M	24.9	25.9

Figure 3.3: Threshold amount and number of investment proposals p.a.

Threshold amounts range between €0 and €50M and are driven primarily by firm size. The median threshold amount in the group of large firms is €1M, whereas the median threshold amount in the group of small firms is €100k. The mean threshold amounts in both groups are €210k and €5.3M, respectively. Figure 3.3 also displays the number of investment proposals that operating divisions submit to headquarters for formal analysis in an average year. Surprisingly, the difference in the average number of investment proposals that reach headquarters in small and large firms is unexpectedly low (24.9 vs. 25.9). The median number of proposals – 15 for small firms and 20 for large firms – supports this result. I also ask firms about the acceptance rate for projects that reach headquarters for formal analysis. Consistent with previous studies, project acceptance rates of firms in the sample are 78 percent (Gitman and Forrester, 1977: 76%).

Finally, I ask firms to indicate the approximate percentage of their annual capital expenditures that does *not* require explicit approval from headquarters – for instance, because investments are smaller than the threshold amount. On average, top management does *not* review 41 percent of annual capital expenditures. Conditional analysis reveals this number is significantly higher in large firms (49% vs. 33%).[12] Finally, I ask firms whether they impose a limit on total investments of the firm, in other words, whether management

[12]For the remainder of the chapter, "significant" denotes a statistically significant difference across groups at the 1% or 5% level.

engages in capital rationing. Fifty-seven percent of the responding firms indicate "yes." Not surprisingly, this number is significantly higher for firms with external capital constraints (75%) relative to firms with no capital constraints (50%). The more surprising number, however, is that half of the firms with no capital constraints impose an upper limit on investments. In other words, every second firm engages in "soft rationing", i.e., top management tells its divisions that capital is limited although no external capital constraints exist.

3.2.4 Capital Budgeting Methods

Another section of the survey focused on the criteria firms apply when evaluating investment proposals. I first asked CFOs to indicate the relative importance of the most popular capital budgeting criteria from corporate finance textbooks: NPV, IRR, hurdle rate, payback period, sensitivity analysis, and real-option valuation methods. Financial executives were asked how important they consider several financial criteria for their capital allocation decision. The criteria that most CFOs find very or highly important are: IRR (72%), NPV (64%), payback period (64%), and sensitivity analysis (64%). Quite surprisingly, executives in practice rarely apply real-option valuation methods (taught in almost any finance class) – very few firms, only three in the sample (4%), find them very or highly important in evaluating investment projects.

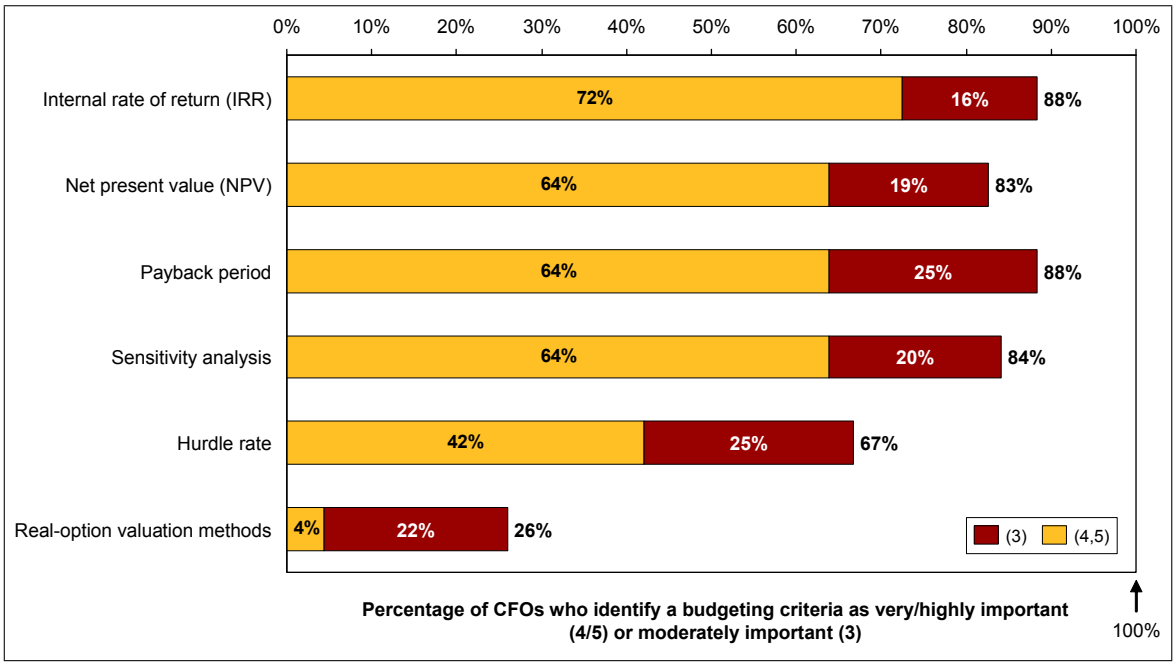

Figure 3.4: Survey evidence on the question (n=69): "How important are the following financial criteria for your capital allocation decision?"

More interestingly, I also asked CFOs about factors for their capital allocation decision that go beyond pure financial criteria (see Figure 3.5).[13]

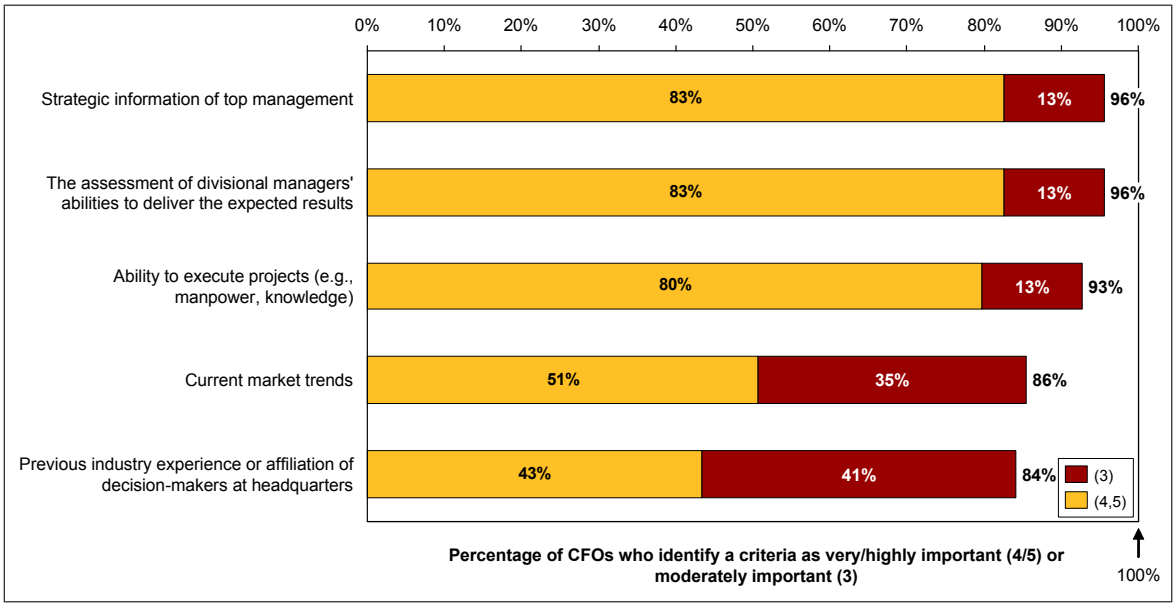

Figure 3.5: Survey evidence on the question (n=69): "How important are the following factors that go beyond pure financial criteria for your capital allocation decision?"

A majority of CFOs indicates that "soft factors" are important. The top two soft factors they mentioned are the "assessment of divisional managers' abilities to deliver expected results" (83%) and "strategic information of headquarters" (83%). In unreported analysis, I find that the proportion of CFOs identifying the assessment of managers' abilities as very or highly important is significantly higher in firms with unrelated diversification (93% vs. 76%).[14] This result is very interesting since informational asymmetries may increase with the degree of unrelatedness of a firm's divisions. So, in allocating capital efficiently, headquarters must rely more on the (subjective) evaluation of the managers' skills than on the assessment of the project at hand. In this regard, survey responses are consistent with the theoretical arguments that I suggest in chapter 2.[15]

The importance of headquarters' strategic information (though rarely reflected in academic theory) is not surprising. As Brealey and Myers (2003) phrase it, "A firm's capital

[13]These questions are similar in spirit but complementary in content to recent work by Graham, Harvey, and Puri (2010).

[14]Firms with unrelated diversification operate segments that belong to different industries according to the industry definition of the survey instrument.

[15]Note that the informational advantage of headquarters can be interpreted in terms of divisional capital productivity *or* managerial ability.

investment choices should reflect both bottom-up and top-down processes...Plant and division managers, who do most of the work in bottom-up capital budgeting, may not see the forest for the trees. Strategic planners may have a mistaken view of the forest because they do not look at the trees one by one."

Also, non-financial constraints of the firm may be important. 80 percent of the executives indicate the importance of a firm's "ability to execute projects" (Bromiley, 1986). So even if capital is available, skilled labor and management time may significantly influence the allocation of capital. Finally, more than half of the respondents (51%) find following "current market trends" very or highly important. This evidence is moderately strong and consistent with "herding" arguments (Scharfstein and Stein, 1990; Banerjee, 1992; and Bikhchandani, Hirshleifer, and Welch, 1992). Still, 43 percent of the CFOs feel that "previous industry experience or affiliation of decision-makers at headquarters" plays an important role for their capital allocation. This behavior might be either an indication of empire-building/entrenchment arguments at headquarters (Shleifer and Vishny, 1989) or simply of lower asymmetric information on the part of headquarters.

3.2.5 Corporate Socialism

I devote the final part of this chapter to *corporate socialism* (see chapter 2). I ask CFOs on a scale of 1 to 5 how frequently they allocate financial resources more evenly than pure financial criteria suggest (1=never, 2=rarely, 3=sometimes, 4=often, 5=always). This question is particularly interesting given the enduring debate about whether and why multi-divisional firms seem to favor divisions with poor growth opportunities at the expense of those with good growth opportunities (Scharfstein, 1998; Shin and Stulz, 1998; Rajan, Servaes, and Zingales, 2000; Ozbas and Scharfstein, 2010).

Only 23 percent of the respondents *never* engage in corporate socialism. This number is interesting and sharply contrasts with recent findings from Graham, Harvey, and Puri (2010) who find that 6 to 18 percent of CFOs engage in corporate socialism.[16] According to my study, a significantly larger proportion of diversified firms acknowledges and practices corporate socialism: 42 percent of CFOs *sometimes*, *often*, or *always* cross-subsidize with a balanced capital allocation across divisions.

[16]Their question design is somewhat different. Graham, Harvey, and Puri (2010) ask, "Which of the following factors are important in your allocation of capital across divisions?" The survey response "Moving towards an even balance of capital allocation across divisions" is meant to capture the notion of corporate socialism. In their study, 7% (6%) of U.S. CEOs (CFOs) and 14% (18%) of non-U.S. CEOs (CFOs) say a balanced allocation is important. Their study does not display responses by country, however. So numbers are not directly comparable. Also, they are not able to distinguish between diversified and focused firms.

I also examine responses conditional on firm characteristics. Interestingly, the prevalence of corporate socialism increases with the degree of unrelatedness of divisions. I find that socialism is significantly more common in firms with unrelated diversification (52% vs. 37%). This finding is consistent with the propositions of the previous chapter. Recall that these propositions suggest that cross-subsidization is more pronounced in firms with unrelated businesses because their capital allocation is more likely to convey headquarters' private information about divisional capital productivity to uninformed divisional managers. Furthermore, firms with limited capital budgets (either market- or management-imposed) are more likely to engage in socialism (45% vs. 38%). However, the differences are not statistically significant.

The corporate finance literature suggests a few motivations for why firms might engage in corporate socialism. I therefore ask financial executives about their motives for an even capital allocation. Figure 3.6 summarizes the results.

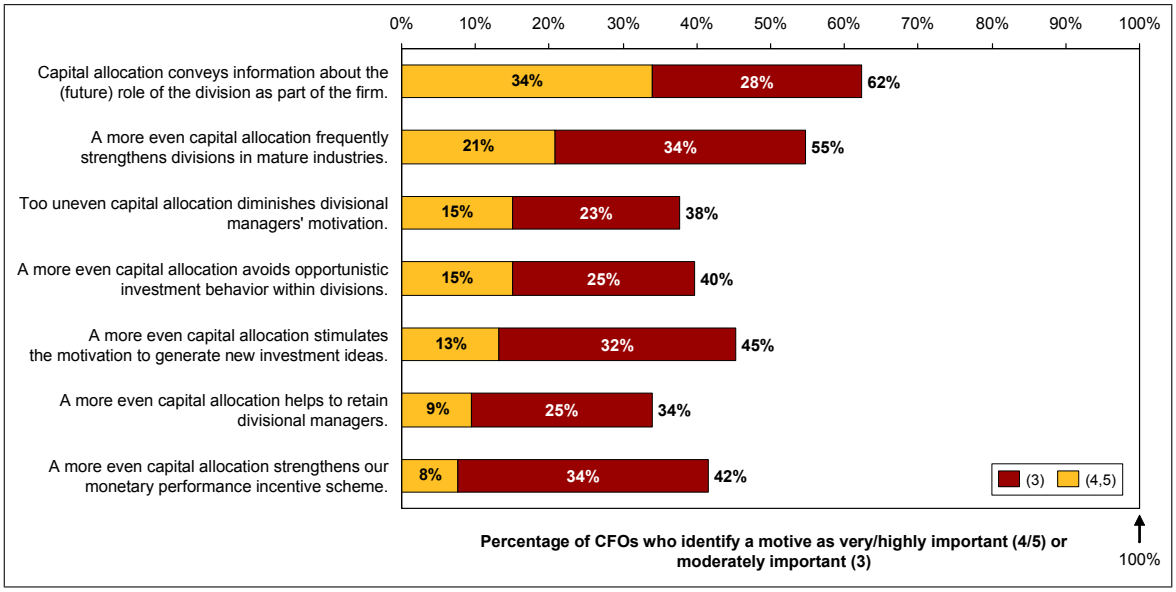

Figure 3.6: Survey evidence on the question (n=53): "Please think about situations where you have decided to allocate capital more evenly than pure financial criteria suggested. How important were the following factors for your allocation?"

In chapter 2, I posit that the informational effects of capital allocation cause firms to allocate capital more evenly than pure financial criteria suggest. Consistent with this argument, 34 percent of firms indicate they engage in cross-subsidization because "capital allocation conveys information about the (future) role of the division as part of the firm." Although the absolute importance is moderate at best, the argument ranks first in terms of importance. The idea that "a more even capital allocation strengthens divisions in mature industries" ranks second with 21 percent. The theoretical arguments are two-fold:

on one hand, cash flows from mature businesses are more informative about managerial talent than those of young and emerging businesses (Goel, Nanda, and Naranyan, 2004). On the other hand, mature and established divisions happen to wield the most influence in their organizations (Hellwig, 2000 and 2001). Few CFOs find arguments related to managerial effort incentives very or highly important. The notion of uneven capital allocation to "diminish divisional managers' motivation" (Brusco and Panunzi, 2005) and the notion of even capital allocation to stimulate managers "to generate new investment ideas" (Inderst and Laux, 2005) are of importance only for a relatively small proportion of 15 percent and 13 percent, respectively. Little evidence supports a theory by Rajan, Servaes, and Zingales (2000). They argue that cross-subsidization helps to "avoid opportunistic investment behavior within divisions" and cultivates more cooperative, joint-surplus-maximizing investment behavior. Only 15 percent of CFOs find this motive very or highly important. Finally, CFOs perceive arguments by Scharfstein and Stein (2000) and Bernardo, Luo, and Wang (2006) as relatively unimportant. I find little evidence (9%) that firms use a more even capital allocation to "retain divisional managers" (Scharfstein and Stein, 2000). Also, Bernardo, Luo, and Wang's (2006) notion that "a more even capital allocation strengthens a firm's monetary performance incentive scheme" (8%) does not appear to cause corporate socialism.

3.3 Conclusion

In this chapter, I present results from surveys of European chief financial officers on the allocation of capital in diversified firms. The work contributes in a number of ways: First, I present existing capital budgeting practices and procedures in diversified firms. In doing so, my results may allow firms to learn from other firms' practices and allow them to improve financial decision-making. Second, I investigate the consistency of theory and practice of "internal capital markets." I find that although some arguments make sense theoretically and are also consistent with the survey evidence, others do not seem to reflect the actual rationales of financial executives. In particular, the explanatory power of many theories of corporate socialism is unsatisfactory. Third, I am able to rate the relative importance of competing theories on investment inside firms. These findings are particularly interesting given that empirical research in this area traditionally suffers from data constraints. Finally, I hope these findings may help to confirm, abandon, and revisit widely held opinions on the workings of internal capital markets and will help to inform future research in this field.

Chapter 4

A Theory of Strategic Investment, Risk Management, Disclosure, and Product-Market Competition

Research in accounting, finance, and economics has devoted considerable attention to understanding the economic consequences of financial reporting and disclosure regulation (see Leuz and Wysocki, 2008, for a comprehensive survey). In light of corporate scandals and the financial crisis, a better understanding of these effects is a matter of urgency.

This chapter aims to develop a clearer understanding of four important but somewhat underexplored areas of disclosure research: strategic investment, hedge disclosure, corporate risk management, and product-market competition. I find that under current accounting standards, firms engage in risk management activities since product-market competition forces them to do so. The resulting equilibrium is desirable from a social standpoint and encourages strategic investments by competing firms that seek to enter the market. As I show, attempts for more transparency by additional hedge disclosure may destroy these "natural incentives" and create forces to engage in excessive risk-taking. This equilibrium behavior may deter market entry and adversely effect the nature of competition in industries. The findings hence shed light on the desirability of more transparent accounting standards and suggest that more disclosure on risk management may change risk management in undesirable ways.[1]

The model I present is a signal-jamming model related in spirit to those studied by Holmström (1982, 1999), Fudenberg and Tirole (1986), and Scharfstein and Stein (1990). I focus on a simple market structure with an incumbent and an entrant. The entrant is

[1] I will use the terms "hedging" and "risk management" interchangeably throughout this chapter.

uncertain of his future profitability in the market and uses current profits of the incumbent to decide whether to enter the market. The established firm can engage in risk management that – given the disclosure regime in effect – may or may not be observable by the entrant. I thereby follow DeMarzo and Duffie (1995) in assuming that risk management improves the informativeness of corporate earnings. Surprisingly, under current disclosure regimes and quite general conditions, the incumbent does not want to "jam" the signal by engaging in excessive risk-taking to discourage entry. Since entrants may interpret high profits as favorable market conditions, firms are "trapped" into risk management activities. They seek to minimize the variance of realized profits to minimize the probability of entry. Competition hence creates strong forces to reduce risk, even though firms are risk-neutral. The resulting equilibrium is socially desirable: the market is well informed about the profitability in the market, and entry is "relatively efficient." This finding contrasts with equilibrium results under additional hedge disclosures, which may be enforced by a policy-maker in an attempt for greater transparency. Then, the incumbent may be discouraged from engaging in risk management at all because being forced to credibly communicate its exposure would reveal proprietary information that an entrant may exploit.

Much anecdotal evidence confirms the concern that accounting items on derivatives may reveal proprietary information to competitors. Although these competitive costs of disclosure have received relatively little attention from researchers, the notion is well known among firms and financial analysts alike. The following quotation from a publication of the CFA Institute illustrates some dimensions of the concerns: "The analyst needs to know what price exposure exists, how much of this exposure is covered, and how hedges are managed. Company managers may be hesitant to be fully transparent about some portion of this information for fear that it could be used by the company's competitors (Kawaller, 2004)." This fear may also serve as the rationale for why firms oppose regulation that increases transparency of their risk management activities. As General Motors phrases it: "If GM disclosed the volume of its commodity derivatives contracts and their anticipated cash flows, a competitor could calculate the purchase price of GM's components" (Miller and Culp, 1996).

I develop these arguments further in the following four sections. In sections 4.1 and 4.2, I elaborate on current literature and institutional background. In section 4.3, I present structure and assumptions of the model. In section 4.4, I analyze equilibrium strategies under current standards and beyond. Furthermore, I elaborate on the implications of my results for disclosure regulation, corporate risk management, and anti-trust policy. Finally, section 4.5 contains concluding remarks.

4.1 Related Literature

The work I present is related to previous *finance* and *accounting* literature on hedge disclosure. DeMarzo and Duffie (1995) analyze a model of risk management where corporate profits serve as a signal of a manager's ability. They demonstrate that with nondisclosure of hedging activity, full hedging is an equilibrium policy for managers. If hedge decisions are disclosed, however, managers have an incentive to forego risk management opportunities to render inference about their ability difficult for outside investors. Kanodia, Mukherji, Sapra, and Venugopalan (2000) investigate the desirability of hedge disclosures and their informational effect on futures prices. They show that disclosure of hedge activities improves price efficiency in the futures market and improves industry output. Sapra (2002) studies hedge disclosures with a focus on the trade-offs between production and risk management distortions. He finds that mandatory hedge disclosure drives a firm to take extreme positions in the futures market. I follow these papers in evaluating risk management decisions under a mandatory hedge disclosure regime relative to the benchmark situation in which firms cannot disclose their risk management activities.[2] None of these papers considers product-market competition.

However, Liu and Parlour (2009), Adam, Dasgupta, and Titman (2007), and Mello and Ruckes (2005) have studied the relationship between risk management and competition. Liu and Parlour (2009) consider the interaction between hedging and bidding in a winner-takes-all auction context in which hedging renders winning more valuable and losing more costly. They find that the ability to hedge with financial instruments (that are not contingent on who wins the auction) makes firms bid more aggressively because of running the risk of overhedging if they lose. Adam, Dasgupta, and Titman (2007) investigate firms' risk management decisions in the context of an industry equilibrium in which endogenous output prices are a function of aggregate investment and hedging decisions. They illustrate that an individual firm's incentive to hedge increases as more firms in the industry choose not to hedge and vice versa. They also relate industry characteristics to the proportion of firms that hedge. Mello and Ruckes (2005) study optimal hedging and production strategies of financially constrained firms in imperfectly competitive markets. They find that oligopolistic firms hedge the least when they face intense competition and firms' financial conditions are similar. I follow this literature in assuming that firms' risk management activities are not observable under current accounting standards. None

[2]These papers – as I do – implicitly assume that hedge disclosure is sufficiently costly. In fact, current hedge accounting standards already impose substantial *direct costs* of disclosure on firms, mainly because they are complicated to implement. Some indication of these costs is provided in the CFO Magazine. In 2006, more than 40 people worked full time to ensure the adequacy of hedge accounting at General Electric (Corman, 2006) – not counting the opportunity costs of those business managers involved in the preparation process.

of these papers studies the informational effects of hedge disclosures. Also, they focus on situations in which firms face post-entry competition (or situations in which entry is relatively costless). The theory I present explicitly investigates pre-entry competition.

4.2 Institutional Background

The results of this theory are sensitive to the notion that firms' risk management activities – and therefore their post-risk-management (=*net*) exposure – is non-observable under current accounting standards. Given the significant attempts for more expanded disclosure on financial instruments in the late 90s, it might not seem obvious whether or not current accounting standards provide this information. Practitioners are aware that financial statements generally do not. Examining the institutional environment in more detail might therefore be worthwhile. I argue that current accounting regimes help to discipline less sophisticated users of financial derivatives, but they at best give an indication of the effectiveness of a firm's risk management activities.[3]

In June 1998, the Financial Accounting Standards Board (FASB) issued SFAS No. 133 (1998), entitled *Accounting for Derivative Instruments and Hedging Activities,* a detailed and complex set of (200 pages of) accounting and disclosure requirements. According to these accounting rules – meanwhile amended mainly by SFAS No. 138 (2000), SFAS No. 149 (2003), SFAS No. 155 (2006) – accounting treatment generally requires derivatives to be "marked-to-market" on the balance sheet as either gross assets or liabilities with changes in fair value recorded in a firm's net income as they occur. Under prior accounting standards, derivatives were either netted against the hedged item or not recognized in the balance sheet at all. The standard, however, permits special accounting treatment – "hedge accounting" – if firms meet a set of requirements regarding hedge effectiveness and documentation. Roughly speaking, if a transaction qualifies for this treatment, gains and losses of financial instrument and hedged item are recognized in net income in the same period: "Fair value hedge accounting" expands fair value accounting to the hedged item. "Cash flow hedge accounting" allows firms to recognize changes in the fair value of derivatives in "other comprehensive income (owner's equity)" on the balance sheet until the hedged transaction affects earnings. "Hedge accounting for net investments in a foreign operation" does not allow to account for gains or losses in net income; rather, firms must recognize changes directly in "other comprehensive income."

[3]This section owes much to Ryan (2007) and several publications of the CFA Institute, most notably Gastineau, Smith, and Todd (2001).

There is a *second* accounting standard that addresses financial instruments. In January 1997, the Securities and Exchange Commission (SEC) issued a new standard for the disclosure of market risk inherent in financial instruments: *Disclosure of accounting policies for derivative financial instruments and derivative commodity instruments and disclosure of quantitative and qualitative information about market risk inherent in derivative financial instruments, other financial instruments and derivative commodity instruments (FRR No. 48).* FRR No. 48 sought to address the SEC's concern that risk of financial instruments was neither understood well enough by firms' top management nor presented in financial reports transparently and completely. The new rule requires public companies to report *forward-looking* numerical measures of their market risk exposures (i.e., to changes in interest rates, exchange rates, commodity prices, equity prices) *related to financial instruments and derivatives.* Firms may choose from three alternative methods to disclose these risk categories: the tabular approach, the value-at-risk approach, and the sensitivity approach.

In this thesis, I posit that (despite SFAS No. 133 and FRR No. 48) risk management activities of firms are neither (fully) observable nor do they manifest themselves in a publicly observable way such that outsiders might be able to infer them (fully) from public reports. A number of reasons motivate this postulate – some of them result from current accounting standards and some from the nature of risk management per se: First, under SFAS No. 133, gains and losses of financial instruments, although accounted for in earnings, are in large parts invisible. Firms generally are not required to disclose the location of their derivative gains or losses on the income statement; indeed, they can and do classify them in any of several line items – in cost of goods sold, SG&A expenses, or directly in earnings. Unless a firm chooses to disclose this information, disentangling the effects of financial instruments is impossible.[4] More importantly, even if a firm does so, each accounting alternative ("marked-to-market," "cash flow hedge accounting," and so forth) produces substantially different interim statements. Their informativeness as well as market participants' ability to use these in order to understand risk management activity is unclear.[5] In fact, the FASB is currently evaluating whether current accounting

[4]Another major concern is the mixing of *realized* and *realizable* results that cannot be distinguished properly. As a FASB member in the Energy Trading Working Group phrases it in a comment letter, "It is very difficult even for sophisticated investors to extract this information by carefully comparing and contrasting the statement of operations, the balance sheet and the statement of cash flows. In fact, for many individual investors, and for most practical purposes, it is impossible" (Goodman, 2005).

[5]The information content of hedge disclosures and the ability of market participants to understand these has received little attention in finance and accounting research. Notable exceptions are Gigler, Kanodia, and Venugopalan (2007), who study the information content of "cash flow hedge accounting" in terms of providing an early warning of financial distress. As they put it, "In its application, mark-to-market accounting sometimes results in a mixed-attribute-model, whereby some items are marked-to-market while others are carried at historical cost. While...academics have...noted this less than perfect application, they tend...to abstract away from the issue." In a more recent study, Campbell (2009)

standards add more confusion rather than more transparency (FASB, 2008 and FASB, 2010).[6]

Second, the usefulness of the disclosures made under FRR No. 48 is limited, mostly due to the wide discretion over how firms may report and measure risk as well as due to the resulting inconsistency of methods and reporting periods. Similar to the case of SFAS No. 133, each reporting alternative has its own information content in terms of level of aggregation, time horizons over which risk is measured, and indication of nonlinear exposures and covariances. This issue is even amplified as firms may not need to consistently choose the same method across different types of risk. Firms may also define the dimension of "risk" in terms of value, earnings, or cash flows. Despite the obvious interconnections, these alternative measures are not identical and are likely to be inconsistent. Clearly, this reasoning might not be applicable to all types of risk management activities or all types of firms. However, taken together, these arguments (among many others) certainly imply that current disclosure standards at least render the assessment of risk management activities by outsiders extremely difficult.

Third, and most importantly, SFAS No. 133 and FRR No. 48 apply to risk management with financial instruments only. In practice, however, corporate hedging is not limited to a risk transfer with marketable securities. For instance, purchase of insurance or contractual agreements with suppliers to lock-in prices can also provide effective risk management. Many of these alternative instruments are off-balance and, by nature, not observable by third parties; just like actions often referred to as "natural hedges" that are at best imperfectly observable. Examples are the choice of plant locations to have costs and revenues in the same currency or strong market power to pass on cost shocks to customers (Gaspar and Massa, 2006).[7] Finally, observability of risk management activity might be hardly justifiable in the case of non-public firms.

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examines the information content of unrealized cash flow hedge positions about future cash flow levels and investigates how capital markets incorporate this information into their valuation of the firm.

[6]In June 2008, the FASB released proposed amendments to SFAS No. 133 with the intent to "simplify accounting for hedging activities; improve the financial reporting of hedging activities to make the accounting model and associated disclosures more useful and easier to understand for users of financial statements;...and address differences resulting from recognition and measurement anomalies between the accounting for derivative instruments and the accounting for hedged items" (FASB, 2008).

[7]For instance, in a recent survey by Servaes, Tamayo, and Tufano (2009), 44% of the firms in their sample implement risk management decisions through operating means unrelated to financial instruments. The most frequently used risk management instrument of firms in their sample is simply the purchase of insurance. I refer to Smith (1995) for a comprehensive overview on financial and non-financial risk management instruments.

4.3 The Model

4.3.1 Overview

I model a non-cooperative game among an established firm (or *incumbent*) I and a market entrant (or *rival*) R. The model consists of two periods, $t = 1, 2$. In the first period, the incumbent operates as a monopolist. The entrant observes the incumbent's first-period earnings and uses these to decide whether or not to enter the market in the second period. Firms are risk-neutral, and discount rates are zero.

4.3.2 Payoffs

The realization of first-period earnings of the incumbent is publicly observable. I assume these earnings y_1 are uncertain and given by

$$y_1 = \eta + \epsilon, \tag{4.1}$$

where η denotes the quality of the market and ϵ a stochastic noise term. Nature chooses η from a normal distribution with mean $\bar{\eta} > 0$ and variance σ_η^2. The pre-entry earnings are also exposed to the stochastic component ϵ, which can be interpreted as the firm's aggregated transitory exposure. It is independently distributed from η and also drawn from a normal distribution with variance σ_ϵ^2. I set its mean to zero for convenience. ϵ may incorporate both market-wide uncertainty, such as fluctuations in commodity prices, as well as firm-specific uncertainty, such as payoffs from R&D projects. The prior distributions over η and ϵ are common knowledge. Neither η nor ϵ are directly observed, and they are unknown to the entrant. Market quality η is persistent in both periods.[8]

The incumbent may engage in (partial) hedging transactions that allow for controlling the distribution of ϵ. Let $h \in [0, 1]$ denote this hedging strategy, where the resulting variance of ϵ is linear in h and given by $(1 - h)\sigma_\epsilon^2$. Thus, $h = 0$ if the incumbent does not engage in hedging, and $h = 1$ if the incumbent fully hedges. As a consequence, the resulting distribution of y_1 given the *prior estimate* of the market quality η is normal with mean

[8] Using these distributional assumptions enhances the tractability of the results. The posterior will also be distributed normally, and parameters can be updated by simple rules well-known from the literature on "conjugate priors." As we will see below, although using the normal distribution is convenient for ease of exposition, non-positive profits are possible such that either attracting entry or exit from the industry may be optimal if exit barriers are absent. For the sake of technical convenience, I follow convention in the literature (e.g., Vives, 1984; Gal-Or, 1985; Darrough, 1993) and ignore this artificial possibility by assuming relatively small variance. Then, such an event becomes unlikely. In section 4.4.1.2, I formalize this assumption explicitly.

$\bar{\eta}$ and variance $\sigma_y^2 := \sigma_\eta^2 + (1-h)\sigma_\epsilon^2$. I follow the literature (e.g., Froot, Scharfstein, and Stein, 1993) in assuming that hedging is costless and has no effect on the expected level of y_1. Recall that the incumbent may hedge in a number of ways. Corporate hedging is not limited to a risk transfer with marketable securities. Rather, operational activities or insurance contracts may also provide effective risk management to reduce the incumbent's exposure.

In the second period, earnings of both firms are given by

$$y_{i,2} = (1-\delta_i)\eta, \tag{4.2}$$

where $i \in \{I, R\}$ and $\delta_i \in (0,1)$ parameterize the duopoly profit from post-entry competition if entry has occurred.[9] The case of the incumbent enjoying a monopoly position in the second period is normalized to $\delta_I = 0$ and $\delta_E = 1$.

The formulation of pre- and post-entry earnings in (4.1) and (4.2) is worth exploring in more detail. First, profits are serially correlated. High first-period earnings of the incumbent therefore provide favorable news about second-period profitability. Second, earnings of both firms are positively correlated and move in the same direction given a change in the market quality η. Taken together, these characteristics capture the notion that high profits of an established firm lead potential entrants to believe their own future profits are likely to be high as well. This raises the probability of entry by other firms.[10] Hence, in my formulation, η can be interpreted as a permanent and common measure of market profitability that similarly affects firm performance across the industry – factors such as the size of the market, the responsiveness of demand to changes in product prices, the firms' access to distribution channels, product differentiation over substitute products, or bargaining power over customers.

4.3.3 Information Structure

I make two informational assumptions. First, although first-period earnings of the incumbent are publicly observable, the realization of the firm's aggregated transitory exposure ϵ

[9]The parameter δ_i captures effects from duopoly competition that remain unspecified in this reduced-form model. These effects are well-known from the literature on industrial organization. First, if entry occurs, the entrant takes market share away from the incumbent. Second, entry intensifies price competition, as more firms imply lower prices. The magnitude of these effects may vary with the type of competition (quantity vs. price), the degree of product differentiation (homogeneous vs. heterogeneous), as well as demand and cost conditions. For reference, see Tirole (1988). Note that the results do not depend on particular parameter choices of δ_i.

[10]There is strong empirical support that high historical profits are positively related to market entry. I refer to surveys by Geroski (1995) and Siegfried and Evans (1994).

is not. In this regard, thinking of ϵ as an unspecified function of both the numerous risks to which a firm is exposed and the firm's sensitivity to changes in these risks is useful. As a consequence, even if the hedging choice of the incumbent were observable, the entrant could not distinguish whether profits are high due to favorable market conditions or due to positive realizations of ϵ.

Second, I assume that neither firm knows the quality of the market. Hence, the incumbent and the entrant share the prior distribution of the market quality while making their decisions. Therefore, the model is not a signaling model. In particular, the incumbent may not strategically exploit an informational advantage. The intuition is reasonable. Industries are constantly subject to random shocks that can be caused by factors such as general economy, technological innovations, regulation, and so forth. After such shocks, uncertainty about the quality of a market will likely remain similarly unresolved for both firms. Although I recognize that firms attempt to acquire information about the realization of these shocks and may also possess access to superior information, I abstract from these considerations in order to isolate the effects of hedging. Symmetric information about the quality of the market enables a clear-cut analysis without adding another effect from private information. I summarize the sequence of actions and events in Figure 4.1.

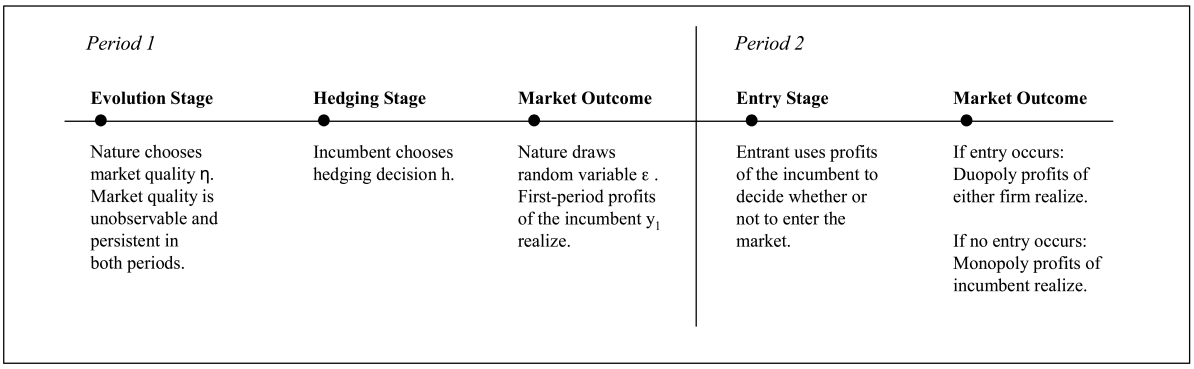

Figure 4.1: Sequence of actions and events

4.4 Analysis

In the next sections, I examine equilibrium strategies for two informational regimes: (i) a regime that closely corresponds to current accounting standards, namely, one in which risk management activity is not observable; (ii) a regime with mandatory hedge disclosures that go beyond current standards and with risk management activity being revealed.

4.4.1 Current Accounting Standards – Non-disclosure Regime

If hedging activity of the incumbent is non-observable/not disclosed, the entrant may condition its belief about the quality of the market only on the observed profits of the incumbent and not on whether the incumbent hedges or not. Then, given the informational assumptions made above, even though the game has a sequential structure, I can solve it "as if" the two firms' choices were simultaneous. Each firm formulates and responds to a belief about what the other firm's actual choice is. As a consequence, to solve for equilibrium, I can proceed as follows. I begin with the analysis of entry conditional on a particular belief of the entrant about the incumbent's action. Conditional on this conjecture, I can solve for endogenous entry thresholds as a function of observed profits. Then, I investigate the incumbent's optimal hedging strategy and ask which strategy is preferred given a particular conjecture of the entrant. In equilibrium, the incumbent's optimal strategy and the entrant's conjecture converge.

4.4.1.1 Updating and Entry Strategies

Let market entry incur sunk costs to the entrant of K. The entrant chooses to enter if entry costs are less than expected post-entry profits. Since entry does not occur in period 1, it is reasonable to assume that the entrant's ex-ante perception of post-entry profitability relative to its costs of entry is too low to justify entry and

$$(1 - \delta_R)\bar{\eta} < K\,. \tag{4.3}$$

Given a situation in which an incumbent is already operating in the market, the arguments to motivate this assumption are manifold. For instance, a market's ex-ante profitability may justify the entry of a pioneering firm with a technological lead. Clearly, such a firm may enjoy a monopoly rent. However, this rent may not (completely) be available to prospective entrants given strong post-entry competition (a high δ_R). As a consequence, a potential entrant may decide to stay out. More importantly, even if post-entry competition is relatively mild (a low δ_R) and competitors are symmetric, the entrant may not choose to enter if its entry costs K are significantly higher than those expended by a pioneering firm. These additional costs may result, for instance, from barriers to entry such as reputational effects and marketing advantages of incumbency (Bain, 1956) or exclusive contracts between buyers and the incumbent seller (Aghion and Bolton, 1987).[11]

[11] Note that the economics literature has proposed numerous and conflicting definitions of entry barriers (see Carlton, 2004; and Schmalensee, 2004). The argument I present most closely follows the recent definition by McAfee, Mialon, and Williams (2004): a barrier to entry is a cost that a new entrant must

However, at the end of period 1, new information arrives. The entrant observes the first-period profits y_1 of the incumbent. Since distributions of η and ϵ are common knowledge, the entrant can draw inferences from y_1. Concretely, conditional on the conjecture about the unobservable hedging choice of the incumbent h^*, the entrant updates prior beliefs about market quality η according to Bayes' rule. The mode of Bayesian learning considered here follows from the normality and independency of η and ϵ and is well known from DeGroot (1970) and Cyert and DeGroot (1974). Note that the posterior distribution of η is also normal.

Specifically, following the observation of y_1 and given a conjecture about the unobservable hedging choice of the incumbent, h^*, posterior mean and variance of η are

$$\bar{\eta}' = E(\eta \mid y_1, h^*) = \alpha y_1 + (1-\alpha)\bar{\eta} \tag{4.4}$$

and

$$\sigma_\eta^{2\prime} = \sigma_\eta^2(1-\alpha), \tag{4.5}$$

where

$$\alpha := \frac{\sigma_\eta^2}{\sigma_\eta^2 + (1-h^*)\sigma_\epsilon^2}\ . \tag{4.6}$$

Equations (4.4) to (4.6) have natural interpretations. First, from equation (4.4), the revised mean $\bar{\eta}'$ is a weighted average of the observed profit y_1 and the unconditional mean $\bar{\eta}$. Hence, observing a *higher-than-expected* first-period profit of the incumbent, $y_1 > \bar{\eta}$, lifts the prior mean upward since strong profits of the incumbent are more likely for a high η and vice versa. Second, from equations (4.5) and (4.6), $\sigma_\eta^{2\prime} < \sigma_\eta^2$: the entrant has a more precise (i.e., higher quality) estimate of the market than it had ex-ante. In the extreme case, when the incumbent fully hedges, $\sigma_\eta^{2\prime}$ equals zero. Third, posterior estimates put more weight on signal y_1 if α is large. In fact, α strictly increases in h and decreases in σ_ϵ^2. The intuition is straightforward. The more a firm hedges (a high h) and the lower the initial variance of the noise term σ_ϵ^2, the more informative realized profits are about the quality of the market relative to the initial estimate. Hence, the entrant attributes a strong first-period result rather to favorable market quality than to good luck. The consequence is a large revision of the prior.

Considering these results leads to the entrant's revised perception about post-entry profits and establishes the following entry rule. Given a conjecture h^* about the unobservable hedging choice of the incumbent, entry occurs if (and only if) expected post-entry profits

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and that incumbents do not or have not had to incur. For comprehensive treatments of barriers to entry, see also von Weizsäcker (1980) and Tirole (1988).

exceed the cost of entry

$$(1 - \delta_R)E(\eta \mid y_1, h^*) > K,$$

which, by using (4.4), implies entry if y_1 satisfies

$$y_1 > \beta + \gamma(1 - h^*) := y^*, \tag{4.7}$$

where

$$\beta := \frac{K}{1 - \delta_R} \text{ and } \gamma := \frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1 - \delta_R} - \bar{\eta}\right).$$

The threshold value y^* denotes the first-period profit of the incumbent above which the entrant chooses to enter the market.

A number of interesting properties are associated with the entry threshold y^*. These characteristics obviously are corollaries of the properties of conditions (4.4) to (4.6). Using (4.3) implies $\gamma > 0$; hence, $y^* > \bar{\eta}$. In addition, more hedging strictly decreases y^*. The reason is straightforward. If the incumbent engages in more hedging activities, first-period profits become less noisy and reveal more about the true value of η and hence the expected post-entry profitability of the entrant. As a result, realized profits must rise less sharply above the prior mean to trigger entry. In contrast, increases in entry costs K and increases in (the intensity of competition) δ_R negatively affect post-entry profitability of the entrant, which in turn raises y^*. Clearly, the opposite is true for the prior mean $\bar{\eta}$.

4.4.1.2 Hedging Strategies and Equilibrium

I am now ready to analyze equilibrium strategies using the findings of the previous section. In equilibrium, the firms' expectations about each other's strategies are consistent, and each firm is choosing a best response to what it believes the other firm will do. Constructing an equilibrium of the game between the incumbent and the entrant hence involves several steps. I start from a postulate on the entrant's conjecture about the incumbent's hedging strategy h^*, which implies an entry threshold value y^* computed from the updating rules derived above. Then, I solve for the incumbent's best response to this particular conjecture and finally derive the conditions under which h^* is indeed the optimal strategy for the incumbent.

The incumbent chooses h^* to maximize the expected profits given its belief on what the entrant is likely to think about the incumbent's strategy. Although the choice of the incumbent may influence the entrant's learning through the information content of first-period profits y_1, hedging does not alter its expected value $E(y_1)$. Therefore, to solve for equilibrium, considering the incumbent's expected second-period profits is sufficient. So I need not explicitly account for first-period profits in the incumbent's maximization.

Suppose the entrant anticipates a hedging strategy h^* by the incumbent. Let this conjecture by (4.7) imply an entry threshold y^*. What is optimal for the incumbent given this conjecture? Recall that the entrant's entry decision depends on the realization of first-period profits y_1 relative to the entry threshold y^*. If $y_1 > y^*$ then entry occurs and the incumbent receives $(1-\delta_I)E(\eta \mid y_1, h)$; otherwise, the entrant chooses not to enter and the incumbent remains monopolist with monopoly profit $E(\eta \mid y_1, h)$. Note that the expression $E(\eta \mid y_1, h)$ is the expected market quality conditional on the realization of first-period profits y_1 and given the actual hedging strategy h.[12] Since $E(\eta \mid y_1, h)$ is a function of the random variable y_1, it is itself a normally distributed random variable. Let $f(y_1 \mid h)$ denote the density of y_1 given hedging choice h. Then, the incumbent's expected second-period earnings – from an *ex-ante* perspective – are

$$(1-\delta_I)\bar{\eta} + \underbrace{\delta_I \int_{-\infty}^{y^*} E(\eta \mid y_1, h) f(y_1 \mid h) dy_1}_{:=\text{Monopoly Rent } V}, \tag{4.8}$$

where the first expression in (4.8) represents the *expected profit from duopoly* and the second gives the *expected rent from remaining monopolist*. I denote this rent by V ("*Value of Incumbency*") in the following. Note that the integral may be interpreted as the first moment of the normal variable $E(\eta \mid y_1, h)$ that is *censored* on the interval $y_1 \in (y^*, +\infty)$.

Since the expected duopoly profit, $(1-\delta_I)\bar{\eta}$, is independent from the hedging choice h, restricting attention to the incumbent's expected monopoly rent V is convenient in the following. V can be written as

$$\begin{aligned} V: &= \delta_I \left(\alpha \left[\bar{\eta} F(y^* \mid h) - \sigma_y^2 f(y^* \mid h)\right] + (1-\alpha)\bar{\eta} F(y^* \mid h)\right) \\ &= \delta_I \left[\bar{\eta} F(y^* \mid h) - \sigma_\eta^2 f(y^* \mid h)\right] \\ &= F(y^* \mid h) \underbrace{\delta_I \left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^* \mid h)}{F(y^* \mid h)}\right)}_{:=\delta_I E(E(\eta \mid y_1, h) \mid y_1 \leq y^*)}, \end{aligned} \tag{4.9}$$

where $F(\cdot)$ is the cumulative distribution of y_1. Note that the first line follows from using (4.4) as well as well-known results concerning *censored normal distributions*.[13] The second line follows from substituting α from condition (4.6). I find the third line particularly useful for the subsequent analysis. It captures the basic relationship between means of

[12] Recall that realized profits y_1 are only an imprecise signal of second-period earnings (induced by η) as long as $h \neq 1$.

[13] Suppose a random variable $x \sim N(\mu, \sigma^2)$. Let x^* denote a random variable transformed from x such that $x^* = x$ if $x^* \leq a$ and $x^* = 0$, otherwise. Then, the mean of the censored normal variable x^* yields

truncated and *censored* normal distributions.[14] Note that

$$F(y^* \mid h) \tag{4.10}$$

denotes the probability that the incumbent remains monopolist since first-period profits have realized below the entry threshold y^*.

Equation (4.9) has an intuitive interpretation. The monopoly rent V equals to the probability of the incumbent remaining monopolist, $F(y^* \mid h)$, multiplied by the expected rent conditional on the incumbent remaining monopolist, $\delta_I E(E(\eta \mid y_1, h) \mid y_1 \leq y^*)$.[15] Thus, in choosing the optimal hedging strategy h^* to maximize the monopoly rent V, the incumbent solves

$$\max_{h \in [0,1]} F(y^* \mid h)\delta_I \left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^* \mid h)}{F(y^* \mid h)} \right). \tag{4.11}$$

The solution to (4.11) characterizes the set of strategies that is individually optimal for the incumbent, given a conjecture that implies an entry threshold of y^*. Then, by assuming a positive monopoly rent V with

$$\bar{\eta} > \sigma_\eta, \tag{4.12}$$

the optimal hedging choice of the incumbent can be summarized as follows.[16]

$E(x^*) = \int_{-\infty}^{a} x f(x) dx = \mu F(a) - \sigma^2 f(a)$, where f is the density and F the cumulative distribution of x (see, e.g., Greene, 2003).

[14] Suppose a normally distributed random variable x truncated at $x = a$. Then, its mean yields $E(x \mid x \leq a) = \int_{-\infty}^{a} x f(x \mid x \leq a) dx = \frac{E(x^*)}{Prob(x \leq a)} = \frac{E(x^*)}{F(a)}$, where $f(x \mid x \leq a) = \frac{f(x)}{Prob(x \leq a)}$ and $E(x^*)$ denotes the mean of the censored normal variable x^*. The intuition is that in recognizing the truncation, the conditional density is scaled in such a way that it integrates to one on the interval below a. The properties of truncated normal distributions have been studied extensively in Johnson, Kotz, and Balakrishnan (1995).

[15] Note that the first expectation is with respect to first-period profit y_1 and the second expectation with respect to market quality η.

[16] This assumption corresponds to the hitherto implicit assumption on the distribution of η that I elaborated in footnote 8. Section C.3 of the appendix contains a formal treatment. It is important to note that the admissible range of parameters to ensure $V > 0$ cannot be pinned down analytically, as only estimates for $\bar{\eta} - \sigma_\eta^2 \frac{f(y^*|h)}{F(y^*|h)} > 0$ exist (see the literature on the *Mill's Ratio*, $\frac{1-F(y^*|h)}{f(y^*|h)}$; e.g., Patel and Read, 1996; and DasGupta, 2008). Clearly, the parameter restriction is made for reasons of tractability and does not qualitatively affect any of the results.

Lemma 4.1 *Given any conjecture about the entry threshold y^*, the monopoly rent V has no local maximum*[17] *on $h \in [0,1]$. Its maximum h^* is attained on the boundaries of $h \in [0,1]$. A unique cutoff $\hat{y} \in (A,B)$ exists such that if $y^* > \hat{y}$ then $h^* = 1$, whereas if $y^* < \hat{y}$ then $h^* = 0$, and if $y^* = \hat{y}$ then the incumbent is indifferent between $h^* = 1$ and $h^* = 0$; where*

$$A := \frac{1}{2}(\bar{\eta} + \sqrt{\bar{\eta}^2 + 4\sigma_\eta^2}) \text{ and } B := \frac{\bar{\eta}(\sigma_\eta^2 - \sigma_\epsilon^2)}{2\sigma_\eta^2} + \frac{1}{2}\sqrt{\frac{(\sigma_\eta^2 + \sigma_\epsilon^2)(4\sigma_\eta^2 + \bar{\eta}^2(\sigma_\eta^2 + \sigma_\epsilon^2))}{\sigma_\eta^4}}.$$

Proof. see appendix. ■

The important insight of *Lemma 4.1* is that the incumbent either chooses to fully hedge ($h^* = 1$) or chooses to leave its exposure completely open ($h^* = 0$). For example, if the incumbent believes the entrant will enter at a first-period profit higher than $\hat{y}$, the best response is $h^* = 1$. The cutoff $\hat{y}$ denotes the value of y^* for which the incumbent is indifferent between *hedging* with $h^* = 1$ and *no hedging* with $h^* = 0$. To capture the intuition for this result, it is helpful to explore the effects of a marginal change in h on the monopoly rent V in more detail.

Following the decomposition proposed in (4.9), the total change in V with respect to h

$$\frac{\partial V}{\partial h} = \underbrace{\frac{\partial F(y^* \mid h)}{\partial h}\delta_I\left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^* \mid h)}{F(y^* \mid h)}\right)}_{\text{(a) "Probability Effect" (+)}} + \underbrace{F(y^* \mid h) \times \frac{\partial}{\partial h}\delta_I\left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^* \mid h)}{F(y^* \mid h)}\right)}_{\text{(b) "Value Effect" (+/-)}} \quad (4.13)$$

can be decomposed into two very intuitive effects:[18] I find that (4.13) is simply the sum of (a) the marginal change in the probability of remaining monopolist weighted by the *conditional* monopoly rent if y_1 is *not* exceeding y^* ("Probability Effect") and (b) the marginal change in this conditional monopoly rent weighted by the probability of remaining monopolist ("Value Effect"). The first expression, the "Probability Effect," is *positive* as

$$\frac{\partial F(y^* \mid h)}{\partial h} = \frac{(y^* - \bar{\eta})\sigma_\epsilon^2}{2\sigma_y^2} f(y^* \mid h) > 0. \quad (4.14)$$

Here, the important insight is that hedging increases the probability of deterring entry.

The interpretation is intuitive. More hedging lowers the dispersion of the incumbent's realized first-period profit y_1. As a consequence, hedging shifts probability mass below the entry threshold and makes outliers to the right tail of the distribution less likely. It

[17] *A global extreme point that is not an interior point of the domain of V is not a local extreme point.*

[18] The reformulation has some similarity to the Tobit decomposition McDonald and Moffitt (1980) introduce.

simply affects the probability that the observation will fall in the part of the distribution that induces the entrant to stay out of the market. Figure 4.2 gives an intuitive graphical representation.

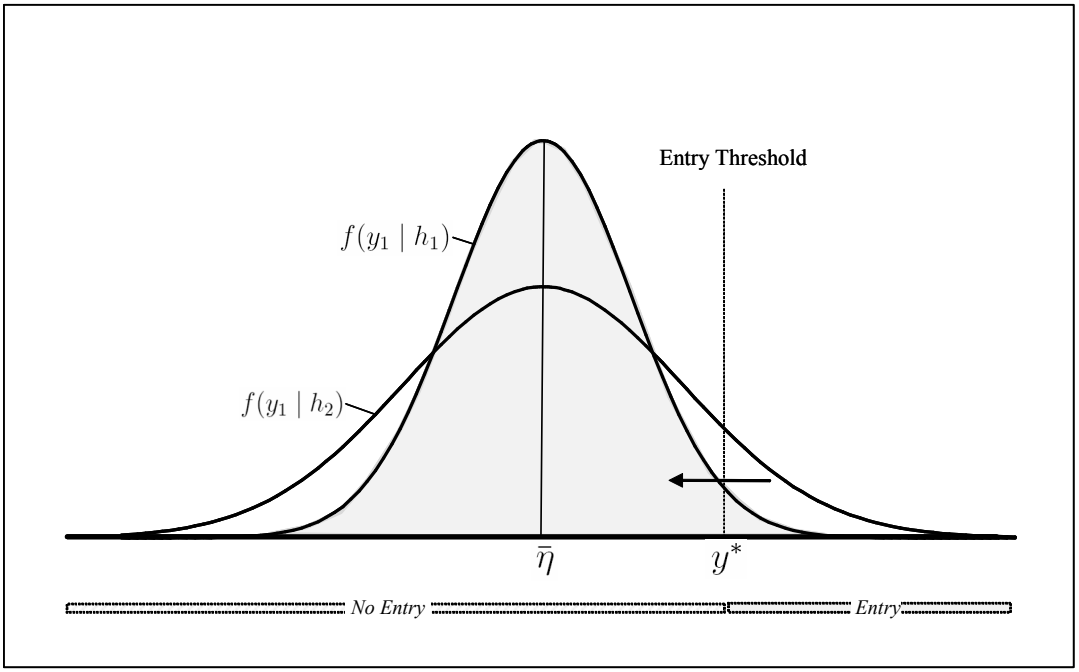

Figure 4.2: "Probability Effect" for strategies h_1 and h_2, where $h_1 > h_2$

The second part of (4.13), the "Value Effect," reflects the effect of h on the conditional monopoly rent in the second period given that y_1 is *not* exceeding y^*. While the "Probability Effect" suggests the incumbent has clear incentives to fully hedge, the "Value Effect" is ambiguous. From (4.13), the sign of the "Value Effect" (and therefore the overall sign of the derivative) obviously is contingent on $-\frac{f(y^*|h)}{F(y^*|h)}$ being increasing or decreasing in h. For instance, it is straightforward to verify that if $-\frac{f(y^*|h)}{F(y^*|h)}$ is increasing in h, then the "Value Effect" and therefore the total monopoly rent V is increasing in h as well. As a consequence, the incumbent chooses a full hedge, $h^* = 1$.

More generally, applying the quotient rule

$$-\frac{\partial}{\partial h}\frac{f(y^* \mid h)}{F(y^* \mid h)} = \underbrace{-\frac{\frac{\partial}{\partial h}f(y^* \mid h)F(y^* \mid h)}{F(y^* \mid h)^2}}_{(+/-)} + \underbrace{\frac{\frac{\partial}{\partial h}F(y^* \mid h)f(y^* \mid h)}{F(y^* \mid h)^2}}_{(+)}$$

and equation (4.14) (namely, $\frac{\partial F(y^*|h)}{\partial h} > 0$) reveals the key for the "Value Effect" being increasing or decreasing is how the density $f(y^* \mid h)$ changes at the threshold level y^*. The "Value Effect" increases in h, either if $\frac{\partial}{\partial h}f(y^* \mid h) < 0$ or if $f(y^* \mid h)$ increases not too rapidly in h. In fact, it can be easily shown that this is true if y^* is sufficiently large.

The "Value Effect" decreases in h, however, if $\frac{\partial}{\partial h} f(\cdot)$ increases quickly in h, which is true if y^* is sufficiently small. It is interesting that in this case, either of the two effects – "Probability Effect" or "Value Effect" – may actually dominate the equilibrium outcome.

As a consequence, it is useful to think of the three entry threshold regions that Lemma 4.1 implicitly proposed: (i) Region 1 ("low"): $y^* \leq A$, (ii) Region 2 ("medium"): $A < y^* < B$, (iii) Region 3 ("high"): $y^* \geq B$. As I show in the proof of Lemma 4.1, when the conjectured threshold $y^* \geq B$ then the "Probability Effect" is dominating the "Value Effect" and the value from incumbency V strictly increases in $h \in [0, 1]$. Thus, the incumbent has clear incentives to fully hedge and $h^* = 1$. In contrast, when $y^* \leq A$, the "Value Effect" is dominating and V is strictly decreasing in h. Finally, when $A < y^* < B$, the optimal hedging strategy becomes less clear-cut. Conditional on the particular conjecture y^*, either of two outcomes may occur: $h^* = 0$ or $h^* = 1$. It is in this region in which the unique cutoff $\hat{y}$, which I proposed in Lemma 4.1 and above which the incumbent chooses to engage in risk management with $h^* = 1$, exists.[19]

Now I am ready to construct the equilibrium, which the following proposition summarizes. Recall that (4.7) gives the entrant's best response curve to an arbitrary conjecture h^*, and *Lemma* 4.1 gives the incumbent's best response to an arbitrary conjecture y^*. The unique intersection of the best response curves – as depicted in Figure 4.3 – pins down the pure-strategy equilibrium. Then, the best response of either firm is consistent with the other firm's belief. For ease of notation, let y^* and h^* denote the equilibrium strategies in the following. I find a unique equilibrium.

Proposition 4.1 *In a* ***non-disclosure*** *regime with unobservable risk management activity, a unique equilibrium exists. Depending on parameter values, the equilibrium strategy of the incumbent is either: (a) full hedging* ($h^* = 1$) *with an entry threshold of* $y^* = \frac{K}{1-\delta_R}$, *where* $y^* > \hat{y}$; *(b) no hedging* ($h^* = 0$) *with an entry threshold of* $y^* = \frac{K}{1-\delta_R} + \frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R} - \bar{\eta}\right)$, *where* $y^* < \hat{y}$; *or (c) a mixed strategy between* $h^* = 1$ *(with probability* p^**) and* $h^* = 0$ *(with probability* $1 - p^*$*) with an entry threshold of* $y^* = \hat{y}$.

Proof. A graphical illustration to the proof of the (a) and (b) parts of Proposition 4.1 follows in Figure 4.3. It is easy to show that the best reaction curves of incumbent and entrant can cross only once. Recall from (4.7) that the reaction curve of the *entrant* is given by $y^* = \beta + \gamma(1 - h^*)$, where from (4.3) $\beta > 0$ and $\gamma > 0$. This implies that $h^* = 1 + \frac{\beta}{\gamma} - \frac{1}{\gamma} y^*$ is downward sloping. The pattern of the best response function of the *incumbent* – it is non-continuous and involves a *jump up* at $y^* = \hat{y}$, where $\hat{y} \in (A, B)$ – follows from *Lemma* 4.1. The mixed-strategy equilibrium, the (c) part of Proposition 4.1,

[19] Note that no closed-form solution for $\hat{y}$ exists. I show uniqueness and existence of $\hat{y}$ in the appendix.

can be easily derived. The incumbent is indifferent between playing $h^* = 1$ and $h^* = 0$ if $y^* = \hat{y}$. When the incumbent randomizes over these strategies, the induced outcome to the entrant corresponds to a lottery over the pure-strategy payoffs weighted by the probabilities with which $h^* = 0$ and $h^* = 1$ are being played. Hence, $p^* \in (0, 1)$ solves $(1 - \delta_R)\left(p^* E(\eta \mid \hat{y}, h^* = 1) + (1 - p^*) E(\eta \mid \hat{y}, h^* = 0)\right) = K$. ■

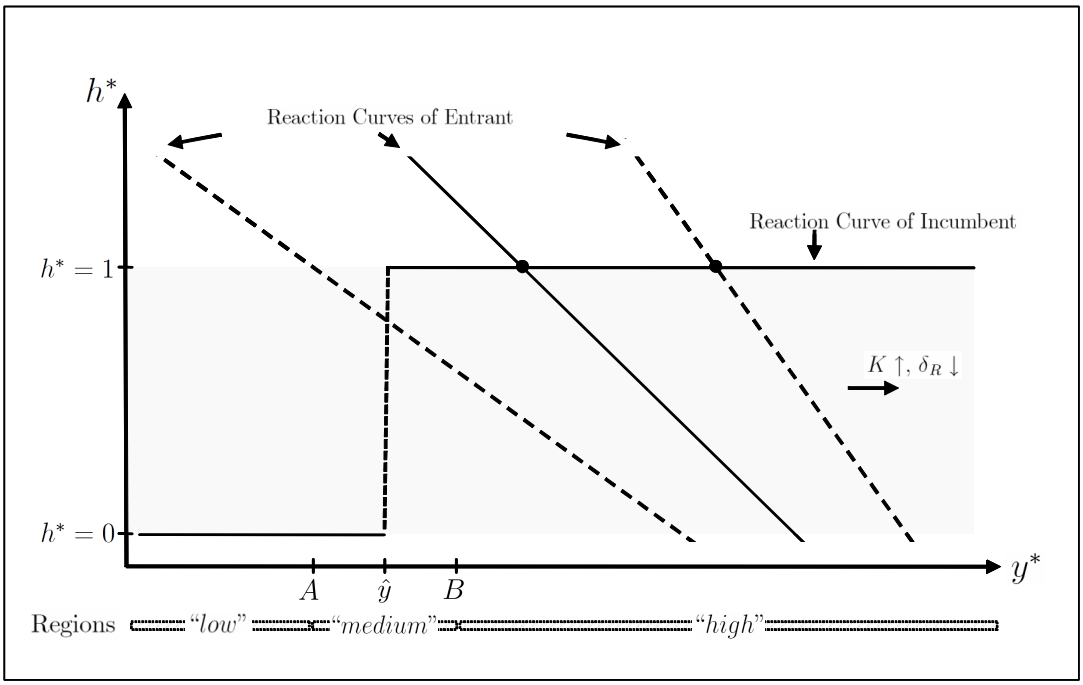

Figure 4.3: A graphical representation to the proof of Proposition 4.1

Proposition 4.1 demonstrates that three cases exist. In the first and most interesting case, when parameters are such that the equilibrium entry threshold is above the cutoff $\hat{y}$, engaging in risk management activities is optimal for the incumbent. The threat of entry creates strong forces to reduce risk – even if firms are risk-neutral.[20] In the second case, when the equilibrium entry threshold y^* is below the cutoff $\hat{y}$, the incumbent does not have an incentive for risk management. Although risk management still would increase the chances that the entrant stayed out of the market, the incumbent would suffer disproportionately from a decrease in the value of incumbency conditional on remaining monopolist. In the third case, a mixed strategy equilibrium occurs. The incumbent is indifferent and hence randomizes between *hedging* and *no hedging*. The entrant remains uncertain about the risk management strategy of the incumbent.

[20] In this regard, I also provide a reasonable explanation for why firms may wish to engage in risk management activities.

4.4.1.3 A Numerical Example

I illustrate Proposition 4.1 with a numerical example for three straightforward settings. Table 4.1 presents equilibria for various entry cost K with all other parameters held fixed. Each column shows, for a particular entry cost K, the equilibrium strategies (h^*, y^*), the *expected* second-period profits of incumbent and entrant (Π_I^*, Π_R^*), and the entry probability (q^*). The examples involve a market quality η that is drawn from a normal distribution with mean $\bar{\eta} = 50$ and standard deviation $\sigma_\eta = 20$. The incumbent's exposure ϵ is drawn from a normal distribution with mean zero and standard deviation $\sigma_\epsilon = 10$. The effects of competition are captured by $\delta_I = \delta_E = 0.6$, which implies (as in the standard Cournot situation) total profits in a duopoly are lower than in a monopoly. Given these parameter values, it is easily verified that the interval [57.02, 57.18] contains the discrete jump of the incumbent's best reaction function $h(y^*)$ at $\hat{y}$ as shown in Figure 4.3.

Recall that $\hat{y}$ cannot be solved for analytically. Nevertheless, a numerical solution, which is $\hat{y} = 57.096$, can be obtained. Then, it is straightforward to show that if $K \leq 22.27$, the incumbent does not hedge $(h^* = 0)$, whereas if $K \geq 22.84$, the incumbent engages in risk management $(h^* = 1)$.[21] Otherwise, the incumbent chooses a mixed strategy $p^* \in (0, 1)$. Therefore, each of the three entry cost levels in Table 4.1, namely $K = 21.9$, $K = 22.6$, and $K = 23.2$, corresponds to one of the three different regions described above. Notice also that the expected second-period profits of the incumbent Π_I^* strictly increase in K, whereas the expected second-period profits of the entrant Π_R^* and the entry probability q^* strictly decrease in K.

Parameters	$\bar{\eta} = 50$, $\sigma_\eta = 20$, $\sigma_\epsilon = 10$, $\delta_I = 0.6$, $\delta_R = 0.6$		
	Region "low"	Region "medium"	Region "high"
Entry cost	$K = 21.9$	$K = 22.6$	$K = 23.2$
Equilibrium results	$h^* = 0$	$p^* = 0.5$	$h^* = 1$
	$y^* = 56$	$y^* = \hat{y} = 57.096$	$y^* = 58$
	$\Pi_I^* = 34.0$	$\Pi_I^* = 34.6$	$\Pi_I^* = 35.2$
	$\Pi_R^* = 2.0$	$\Pi_R^* = 1.91$	$\Pi_R^* = 1.8$
	$q^* = 0.394$	$q^* = 0.368$	$q^* = 0.345$

Table 4.1: A numerical example illustrating the effect of rising entry cost K

[21] These bounds for K can be easily derived by solving for K in the two cases in which the reaction curve of the entrant crosses either $(\hat{y}, 0)$ or $(\hat{y}, 1)$.

4.4.2 Mandatory Hedge Disclosure Regime

In this section, I consider the case in which the entrant observes h. This case corresponds to a regime in which regulation mandates firms to disclose all risk management activities. I explore the economic consequences of such reporting regulation on the equilibrium hedging behavior of firms given the competitive threat of market entry.

In contrast to the earlier situation in which h was not observable and therefore the entrant was unaware of the risk management choice previously made by the incumbent, the incumbent now must disclose its level of hedging. Risk management activities are perfectly revealed. The important implication is that both situations differ in their timing. In the earlier analysis, the entrant reacts to a conjecture about the hedge decision of the incumbent and both firms act "as if" they moved simultaneously. Now the firms decide truly sequentially. As we will see below, the incumbent's hedge decision therefore has an additional informational and strategic effect on the entrant's entry threshold.

Solving for (subgame perfect) equilibrium is straightforward. The incumbent must anticipate the optimal reaction of the entrant to both, the *hedging strategy* h of the incumbent and the observed *first-period profit* y_1. Entry takes place if (and only if) expected post-entry profits exceed the cost of entry

$$(1 - \delta_R)E(\eta \mid y_1, h) > K,$$

which by using (4.4) implies entry, if y_1 exceeds the threshold value

$$y^*(h) := \beta + \gamma(1 - h), \tag{4.15}$$

where

$$\beta := \frac{K}{1 - \delta_R} \text{ and } \gamma := \frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1 - \delta_R} - \bar{\eta}\right).$$

A similar condition for market entry appeared in the analysis of the non-disclosure regime in section 4.4.1.1 (recall the entrant's optimal entry decision from equation (4.7)). However, observe that in the regime I consider here, the threshold value $y^*(h)$ is truly the entrant's reaction to the *observed* hedging strategy h (and hence a function of h), whereas in the earlier analysis, y^* is the entrant's response to an *unobserved, hypothesized, and fixed* hedging choice. To put it differently, $y^*(h)$ gives an entry schedule specifying the entrant's optimal choice for each *observed* action of the incumbent, h, and each first-period profit realization, y_1. Since the incumbent can solve for the entrant's optimal choice as

easily as the entrant can, the incumbent anticipates that its hedge decision h will be met with the reaction $y^*(h)$.

As a consequence, the incumbent's maximization over the monopoly rent V as characterized in (4.8) to (4.11) now yields

$$\max_{h\in[0,1]} \underbrace{\delta_I \int_{-\infty}^{y^*(h)} E(\eta \mid y_1, h) f(y^*(h), h) dy_1}_{:=\text{Monopoly Rent } V} . \tag{4.16}$$

This maximization problem is similar to the one analyzed in section 4.4.1.2. The difference is that the incumbent may now select a point on the entrant's reaction function $y^*(h)$ that maximizes its own profits. Before proceeding with the analysis of equilibrium, I state the central result.

Proposition 4.2 *In a **mandatory hedge disclosure** regime with observable risk management activity, a unique (subgame perfect) equilibrium exists. In this equilibrium, the incumbent does not hedge ($h^* = 0$). The threshold value $y^*(h^*)$ above which the entrant chooses to enter the market in equilibrium is given by* $y^*(h^* = 0) = \frac{K}{1-\delta_R} + \frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R} - \bar{\eta}\right)$.

Proof. see appendix. ■

The striking result is that a mandatory hedge disclosure regime may drive firms to decrease risk management activities. The reason is subtle and combines two notions. First, recall that hedging eliminates noise from the incumbent's profits, thereby increasing the informativeness of first-period profits about market quality. Second, if hedging choices are disclosed, the entrant conditions its posterior belief about the market quality on one additional and credible signal (besides the first-period profit y_1), namely, the hedge decision h. Therefore, in contrast to the previous case of *current* accounting standards, risk management now has a *direct influence* on the entry threshold above which the entrant chooses to enter the market. Mandatory hedge disclosures give rise to a strategic benefit to the incumbent of not engaging in risk management activities.

To see the intuition, differentiate (4.15) – the upper limit of the integration in (4.16) – with respect to h. Using (4.3) implies $\gamma > 0$; hence, *more hedging* strictly *decreases* $y^*(h)$. If the incumbent engages in more hedging activities, first-period profits are less noisy, reveal more about the true quality of the market η, and allow the entrant to better infer from first-period profits. On the other side, if the incumbent does not hedge at all, realized profits y_1 are a less precise signal of η, which results in an upward shift of the entry threshold $y^*(h)$. This upward shift in the entry threshold (induced by the strategic

influence of the observable hedge decision on the entrant's behavior) is clearly beneficial to the incumbent and is in fact the dominating effect in Proposition 4.2.[22]

Therefore, the implication of Proposition 4.2 is that in a mandatory disclosure regime, hedging is not in the incumbent's interest as hedging leads to an entrant making a more precise competitive move. In fact, the result establishes that the incumbent has an incentive to garble the information conveyed through the first-period profit y_1 and that mandatory disclosure encourages excessive risk-taking. The natural incentives to engage in hedging activity under many circumstances as Proposition 4.1 posits is destroyed.

Corollary 4.1 *Under the parameter values of Proposition 4.1a, the volatility of the incumbent's first-period profit is strictly higher in a* ***mandatory hedge disclosure*** *regime than in a* ***non-disclosure regime.*** *Also, the informativeness of profits about a firm's intrinsic value in a* ***mandatory hedge disclosure*** *regime is strictly lower than the informativeness of profits in a* ***non-disclosure regime.***

Proof. The variance of first-period profits is given by $\sigma_\eta^2+\sigma_\epsilon^2$ (mandatory hedge disclosure regime) and σ_η^2 (non-disclosure regime). Comparing the "signal-to-noise ratios" yields $\frac{\sigma_\eta^2}{\sigma_\eta^2+\sigma_\epsilon^2} < \frac{\sigma_\eta^2}{\sigma_\eta^2} = 1$. This establishes the corollary. ■

Two implications immediately emerge from the corollary. First, profits in a mandatory disclosure regime are more volatile as firms' risk management activities go down. As a result, we should observe a higher variability in firms' profits following a regulatory act, even though the variability of the underlying fundamentals (here: η) is kept constant. Second, profits are less informative about a firm's *intrinsic value/quality*, thereby and c.p. increasing informational asymmetries between firms and stakeholders.[23] As a consequence, earnings become less useful as indicators for a firm's intrinsic value not only for competitors but also for other uninformed parties, in particular, outside investors. The reason is that less risk management implies a lower signal-to-noise ratio due to more total variance in profits from noise. Interestingly, the model suggests that a mandatory disclosure regime, which is a regulator's attempt for greater transparency, is associated with a higher magnitude of informational asymmetries and less "real transparency" about a firm's current condition.

[22]By comparing the upper limits of the integration in (4.8) and (4.16), it is easy to see that this strategic effect of hedging does not exist in the earlier analysis of unobservable hedging.

[23]To see why, observe that the quality of the market η defines the value of assets/projects in the market, which clearly determines a firm's intrinsic value.

Corollary 4.2 *Under the parameter values of Proposition 4.1a, the probability of entry in a* ***mandatory hedge disclosure*** *regime is strictly lower than the probability of entry in a* ***non-disclosure regime****.*

Proof. In a **mandatory hedge disclosure** regime, the entry threshold is given by

$$y_D^* = \frac{K}{1-\delta_R} + \frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R} - \bar{\eta}\right),$$

whereas the entry threshold in a **non-disclosure regime** under the parameter values of Proposition 4.1a is

$$y_{ND}^* = \frac{K}{1-\delta_R}.$$

Clearly, $y_D^* > y_{ND}^*$. Note that the probability of entry is given by $1 - \Phi(\frac{y_D^* - \bar{\eta}}{\sqrt{\sigma_\eta^2 + \sigma_\epsilon^2}})$ and $1 - \Phi(\frac{y_{ND}^* - \bar{\eta}}{\sqrt{\sigma_\eta^2}})$, respectively, where $\Phi(\cdot)$ denotes the cdf of the standard normal distribution. Observe that $\frac{\partial \Phi(x)}{\partial x} > 0$ for all x. Showing that $\frac{y_D^* - \bar{\eta}}{\sqrt{\sigma_\eta^2 + \sigma_\epsilon^2}} > \frac{y_{ND}^* - \bar{\eta}}{\sqrt{\sigma_\eta^2}}$ establishes the corollary. ■

Corollary 4.2 implies that the mandatory disclosure regime may negatively affect industry structure. The increase of uncertainty about the quality of the market raises barriers to entry. Therefore, disclosure fosters more concentrated industry structures, inhibits competition, and reduces social surplus. This externality of disclosure policy would be hardly desirable from a social and economic point of view for most industries.

4.5 Conclusion

This chapter analyzes three important areas of disclosure research: hedge accounting, corporate risk management, and product-market competition. I demonstrate that accounting standards substantially affect equilibrium hedging strategies. Under current accounting standards, even risk-neutral firms have strong incentives to engage in risk management activities. In this regard, I provide a novel explanation for why firms may wish to engage in risk management. The model also demonstrates that under a more transparent disclosure regime, hedging may not be an equilibrium strategy if firms face the threat of entry in their product markets. Hence, my findings shed light on the desirability of more transparent accounting standards and suggest that more disclosure on risk management may change risk management incentives of firms in undesirable ways.

Chapter 5

General Conclusion

In corporate finance, it has become indisputable that informational asymmetries significantly distort the financial decisions firms make. While this is certainly true, one theme in this thesis, however, is that *more* informational asymmetries between economic parties are not always *more* detrimental.

Headquarters' attempt to withhold private information about the productivities of its divisions through socialistic capital allocations is an example of this point. On one hand, this investment policy leads to inefficient investments from a one-period perspective, and headquarters' ability to allocate funds efficiently does not appear to be successful. On the other hand, headquarters acts strategically and the benefits of such a policy outweigh its costs over the full investment cycle because capital allocations typically provide effort incentives to search for new corporate investment projects. Clearly, if managerial effort were fully contractible or could be enforced otherwise, headquarters could directly stipulate managers to act in the best interest of the firm. However, finding an efficient enforcement mechanism is typically difficult to achieve given the long-term nature of corporate investment decisions.

Attempts by policy-makers for more disclosure about accounting items related to risk management are another example. The economics differ here, however. First, firms typically dislike to reveal certain kinds of proprietary information that, once disclosed, provide strategic information to potential competitors. Second, risk management improves the informativeness of corporate earnings as a signal of the value of investment opportunities in a market. Taken together, these arguments imply that more transparent accounting standards on the risk management activities of firms can create incentives to engage in excessive risk-taking. The reason is that foregoing risk management renders a rival's inferences about the quality of investment projects in the market difficult. Of course, the distortions at hand would not exist under full information if rivals could distinguish

between whether earnings are high due to favorable market conditions or due to positive realizations of extraneous noise.

Although more information asymmetries carry clear benefits in the settings I present in this thesis, I limit attention to the informational impact on parties in *one single* market in which a firm may operate. However, a firm/headquarters may be reluctant to convey information to potential entrants/managers but eager to signal its private information to other uninformed third parties that condition their behavior on this information. For instance, if firms raise capital from uninformed outside investors, the presence of asymmetric information typically makes external financing more costly (Myers and Majluf, 1984). Given such circumstances, the firm would clearly face a trade-off between the gains and costs associated with informational asymmetries. The economics of these sorts of tradeoffs, however, remain for future research.

Appendix A

Cover Letter and Questionnaire

Karlsruhe Institute of Technology

Institute of
Finance, Banking, and Insurance
Prof. Dr. Martin E. Ruckes

Kaiserstraße 12
76131 Karlsruhe, Germany

Prof. Dr. Martin E. Ruckes

Phone: +49 721 608-3427
Fax: +49 721 359 200
Email: martin.ruckes@kit.edu
Web: http://finance.fbv.uni-karlsruhe.de/

Karlsruhe Institute of Technology | Kaiserstraße 12 | 76131 Karlsruhe, Germany

Dr. Kurt Bock
BASF SE
Chief Financial Officer
Carl-Bosch-Strasse 38
67056 Ludwigshafen

Date: April 23, 2010

Research project – Corporate diversification from a CFO's perspective

Dear Dr. Bock,

Diversified firms often work unusually hard to retain the faith of investors. Analysts and banks push them for more focus – and often also to unbundle themselves into standalone companies.

Researchers at the ***University of California, Berkeley*** and at the ***Karlsruhe Institute of Technology*** have therefore joined forces to investigate an important and novel stream of academic research – ***the effects of diversification from a corporate finance perspective.***

For this purpose, our research team is surveying ***1,100 top-ranking CFOs of diversified firms*** in ***11 European countries***. Our interest focuses on a CFO's most fundamental day-to-day choices: ***capital investment*** and ***financing***. It is hoped that our study will benefit CFOs who wish to better understand financial decision-making in diversified firms to improve their performance.

We very much encourage you to complete the enclosed questionnaire. It will only take a few minutes of your time to answer, and you may find doing so an enjoyable experience. As only a ***very small number of companies in each country*** are being surveyed, your response is very important to us.

To express our gratitude, we offer you ***an exclusive report of the survey's results***. You may find this report useful for benchmarking and financial decision-making within your firm. In addition, for each returned survey, we will ***donate 5 EUR*** to ***UNICEF International*** to help survivors of the earthquake in Haiti.

Your answers, of course, will be ***strictly confidential***, and the study will be used for ***academic purposes only***. Survey responses will be recoded in such a way that even we will not be able to identify individual answers. The final results will consist of aggregated summaries only.

With your participation, you will contribute significantly to improving our understanding of diversified firms. If you have any further questions about the project, please contact me by phone at ***+49 721 608-3427*** or by email at ***martin.ruckes@kit.edu***.

Thank you in advance for your time and effort.

Sincerely,

Prof. Dr. Martin E. Ruckes

Figure A.1: Cover letter (english)

Karlsruhe Institute of Technology

Institut für Finanzwirtschaft,
Banken und Versicherungen
Prof. Dr. Martin E. Ruckes

Kaiserstraße 12
76131 Karlsruhe, Germany

Karlsruhe Institute of Technology | Kaiserstraße 12 | 76131 Karlsruhe, Germany

Prof. Dr. Martin E. Ruckes

Telefon: +49 721 608-3427
Fax: +49 721 359 200
E-Mail: martin.ruckes@kit.edu
Web: http://finance.fbv.uni-karlsruhe.de/

Datum: 19. Mai 2010

Internationales Forschungsprojekt – Unternehmensdiversifikation aus Sicht des CFOs

Sehr geehrter Herr Damen und Herren,

mehrdivisionale Unternehmen haben es mitunter schwer Eigentümer von ihrer Attraktivität zu überzeugen. Analysten und Banken fordern nicht selten eine stärkere Fokussierung der Geschäftstätigkeit bis hin zu einer Abspaltung ganzer Divisionen aus dem Verbund des Gesamtunternehmens. Dabei konnte in jüngster Zeit wissenschaftlich belegt werden, dass gerade in mehrdivisionalen Unternehmen überlegene ***Finanzierungs-*** und ***Investitionsentscheidungen*** getroffen werden können.

Aus diesem Grund untersuchen Forscher der ***University of California, Berkeley*** und dem ***Karlsruher Institut für Technologie (KIT)*** ein gänzlich neuartiges Feld der Wissenschaft – Unternehmensdiversifikation aus einer finanzwirtschaftlichen Perspektive. Dafür befragt unser Forscherteam ***1,100 Finanzvorstände*** diversifizierter Unternehmen aus ***11 westeuropäischen Ländern***.

Von den Ergebnissen unserer Studie wird erwartet, dass sie in vielerlei Hinsicht zu einem besseren Verständnis von finanzwirtschaftlichen Entscheidungen in diversifizierten Unternehmen beitragen kann. Wir würden uns daher sehr freuen, wenn Sie unsere Forschung unterstützen. Es wird sicher nur einige Minuten Ihrer Zeit in Anspruch nehmen den Fragebogen auszufüllen.

Im Anschluss an unsere Forschung senden wir Ihnen einen ***ausführlichen Bericht unserer Ergebnisse*** zu. Wir sind fest davon überzeugt, dass unsere Studie auch für Ihr Unternehmen wichtige Erkenntnisse liefern wird. Zusätzlich spenden wir für jede Rückantwort ***5 Euro an UNICEF International***.

Selbstverständlich behandeln wir Ihre Daten ***streng vertraulich*** und die Studie dient einem ausschließlich akademischen Zweck. Ihre Angaben werden wir so verschlüsseln, dass Sie keine Rückschlüsse auf den Absender zulassen. Die Endergebnisse werden wir nur aggregiert veröffentlichen.

Für Fragen stehe ich Ihnen jederzeit telefonisch unter +49 721 608-3427 oder unter martin.ruckes@kit.edu zur Verfügung.

Vielen herzlichen Dank für Ihre Hilfe!

Hochachtungsvoll,

Prof. Dr. Martin E. Ruckes

Figure A.2: Cover letter (German)

Karlsruhe Institute of Technology

Survey on Diversification from a Financial Perspective

THANK YOU for taking the time to complete the survey. We estimate that the survey will take about **15 minutes**. Please note that we will not share your responses with anyone. We will use only aggregate results and will do so exclusively for research purposes. Individual responses are strictly confidential. To ensure the high quality of this study, we would highly appreciate your filling out the entire questionnaire.

Please fax your responses to **(+49) 721 608-9145** or **(+49) 721 359-200** by **MAY 7**. Alternatively, mail to: Prof. Martin Ruckes - Karlsruhe Institute of Technology, Institute of Finance, Banking, and Insurance, Kaiserstr. 12, 76131 Karlsruhe, Germany. For further questions, please email martin.ruckes@kit.edu or call +49 721 608 3427.

Section A: Motives for Diversification

1. How important are the following *motives* for operating more than one line of business *for your company* (1 = not important at all, 5 = highly important)? *Note: Some of these motives will be further investigated below.*

	Not important 1	2	3	4	Highly important 5
a) Creating operational synergies (e.g. purchasing, manufacturing, or revenue economies)	☐	☐	☐	☐	☐
b) Utilizing the ability to move skilled managers from one business to another	☐	☐	☐	☐	☐
c) Achieving beneficial conditions for raising capital	☐	☐	☐	☐	☐
d) Being able to add value by making superior investment decisions under a common roof	☐	☐	☐	☐	☐
e) Reducing the risk of financial distress	☐	☐	☐	☐	☐
f) Reducing investors' risk	☐	☐	☐	☐	☐
g) Building the ability to have internal funds when competitors do not have them	☐	☐	☐	☐	☐
h) Reducing volatility of earnings / cash flows	☐	☐	☐	☐	☐
i) Other: _____	☐	☐	☐	☐	☐

Section B: Financing Effects of Diversification

1. Does headquarters raise funds on behalf of the divisions? ☐ **Yes** ☐ **No** (if "No", please continue with **Section C**)

2. Do divisions *also* raise funds by themselves? ☐ **Yes** ☐ **No, never** ☐ **No, only in exceptional situations**

3. How important are the following *effects of diversification* for *your company*? *Please answer compared to the situation where your divisions were stand-alone companies and had to raise funds by themselves.*

	Not important 1	2	3	4	Highly important 5
a) Lower cost of capital	☐	☐	☐	☐	☐
b) Ability to borrow more / Higher debt capacity	☐	☐	☐	☐	☐
c) Better conditions for raising equity	☐	☐	☐	☐	☐
d) Less need to hold (precautionary) cash	☐	☐	☐	☐	☐
e) Ability to avoid external financing	☐	☐	☐	☐	☐
f) Lower personal taxes for investors	☐	☐	☐	☐	☐
g) Other: _____	☐	☐	☐	☐	☐

4. If your divisions were spun off as stand-alone firms, they would have to raise money in outside markets rather than going to headquarters for financing. How strongly would you agree with the following statements that *compare your headquarters with an external investor* directly providing financing to the divisions?

	I strongly disagree 1	2	3	4	I strongly agree 5
a) Headquarters reacts more understandingly in the event that a project faces financial difficulties.	☐	☐	☐	☐	☐
b) Headquarters can directly intervene in the divisions' businesses, while outside investors cannot.	☐	☐	☐	☐	☐
c) Headquarters has better information about the divisions' businesses than an external provider of financing.	☐	☐	☐	☐	☐
d) Sensitive information such as detailed strategic and operating plans can be reported to headquarters without leaking to the public.	☐	☐	☐	☐	☐

Figure A.3: Questionnaire (page 1 of 4)

5. If another corporate manager made the following statements, how strongly would you agree or disagree with each of them when you think about the ***divisional management in your company***?

	I strongly disagree 1	2	3	4	*I strongly agree* 5
a) If divisional management were running their divisions as stand-alone companies, they would *act more entrepreneurial*.	☐	☐	☐	☐	☐
b) If divisional management were running their divisions as stand-alone companies, they would *work harder*.	☐	☐	☐	☐	☐
c) If divisional management were running their divisions as stand-alone companies, they would *feel more committed to raising the firm's attractiveness to capital markets*.	☐	☐	☐	☐	☐
d) Divisional managers have superior information / knowledge about their businesses compared to the information that headquarters has.	☐	☐	☐	☐	☐
e) Divisional managers try to influence the capital allocation decisions of headquarters.	☐	☐	☐	☐	☐
f) Divisional managers prefer running large divisions with more capital under their control over running small divisions with less capital under their control.	☐	☐	☐	☐	☐

Section C: Headquarters and Investment Decisions

1. Does headquarters have the decision-making authority regarding major investments? ☐ Yes ☐ No (if "No", please continue with **Section D**)

2. Does your company use an ***investment committee*** for some of these decisions? ☐ Yes ☐ No

3. Is ***approval from headquarters*** required ***beyond a certain size*** of investment? ☐ Yes ☐ No (if "No", please continue with **Question 4**)
   If yes, from which project size ***(threshold amount)*** on does the authority to make decisions reside with headquarters? _____ €

4. In an average year, how many ***investment proposals*** are submitted to headquarters for approval? _____

5. On average, how many of these ***obtain approval***? _____

6. On average, how many proposals receive ***close scrutiny*** by headquarters? _____

7. What is the ***total amount*** of ***capital expenditures*** of your company in an average year?
   ☐ <1 million € ☐ 1 million €– 10 million € ☐ 10 million €– 50 million € ☐ 50 million €– 100 million € ☐ 100 million €– 500 million € ☐ 500 million €– 1 billion € ☐ >1 billion €

8. What percentage of this total amount ***does not*** require explicit approval by the headquarters (e.g., because it is part of an initial divisional budget)? _____ %

9. Does divisional management provide financial information such as cash flow forecasts or NPV calculations as part of their investment proposals? ☐ Yes ☐ No (if "no", please continue with **Question 11**)

10. From your personal experience: ***On average***, the forecasts provided in investment proposals are ...

. . . substantially higher than actual outcomes		*. . . in accordance with actual outcomes*		*. . . substantially lower than actual outcomes*
☐	☐	☐	☐	☐

11. How important are the following ***business practices*** ***in your company*** to ensure that divisional managers provide ***truthful forecasts*** and ***do not overstate*** the attractiveness of investment projects?
    If you use these practices for other reasons and not for truthful reporting, please check "Not Important."

. . . for truthful reporting	*Not important* 1	2	3	4	*Highly important* 5
a) We link the performance-based pay of divisional managers to overall firm performance.	☐	☐	☐	☐	☐
b) We adopt criteria (e.g., payback rules) that discount distant long-horizon cash flows more heavily than does the NPV method.	☐	☐	☐	☐	☐
c) We rotate divisional managers across divisions.	☐	☐	☐	☐	☐
d) We set the required hurdle rate for project approval in excess of the "true" cost of capital.	☐	☐	☐	☐	☐
e) The proportion of performance-based pay relative to base salary is high if a divisional manager claims *better* expected investment prospects.	☐	☐	☐	☐	☐
f) We put a relatively high weight on industry information that is gathered externally compared to internal information.	☐	☐	☐	☐	☐
g) We require divisional managers to produce investment proposals with information that can be verified by headquarters.	☐	☐	☐	☐	☐
h) We grant each division a minimum level of capital budget / investment.	☐	☐	☐	☐	☐
i) We have institutionalized post-investment audits.	☐	☐	☐	☐	☐
j) Other: _____	☐	☐	☐	☐	☐

Figure A.4: Questionnaire (page 2 of 4)

12. From your perspective, how ***effective*** are ***monetary incentives***, such as bonuses, in stimulating ***divisional managers'*** . . .

	Very ineffective 1	2	3	4	Very effective 5
a) …motivation to work hard?	☐	☐	☐	☐	☐
b) …searching for long-term investment opportunities?	☐	☐	☐	☐	☐

Section D: Headquarters and Allocation of Capital

1. When capital markets are operating normally, is your company ***capital constrained***? ☐ Yes ☐ No
   In other words: Does your financing capacity ***limit*** your ability to pursue attractive ***investment projects***?

2. Does your company's top management impose ***a limit on total investments*** of the firm by a predetermined, fixed budget? ☐ Yes ☐ No

3. Is the capital allocation to a division restricted by the division's ***own*** generated cash flow? ☐ Yes ☐ No

4. Diversified firms may use the ability to move funds from divisions that are generating ***strong cash flow*** to divisions with ***less cash flow but strong investment opportunities***. How frequently do you use this ability in order to achieve the highest capital productivity?

   ☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

5. How important are the following ***financial criteria*** for your capital allocation decision?

	Not important 1	2	3	4	Highly important 5
a) Net present value (NPV)	☐	☐	☐	☐	☐
b) Internal rate of return (IRR)	☐	☐	☐	☐	☐
c) Hurdle rate	☐	☐	☐	☐	☐
d) Payback period	☐	☐	☐	☐	☐
e) Sensitivity analysis	☐	☐	☐	☐	☐
f) Real-option valuation methods	☐	☐	☐	☐	☐
g) Other: _____	☐	☐	☐	☐	☐

6. How important are the following ***factors*** that ***go beyond pure financial criteria*** for your capital allocation decision?

	Not important 1	2	3	4	Highly important 5
a) The assessment of divisional managers' abilities to deliver the expected results	☐	☐	☐	☐	☐
b) Previous industry experience or affiliation of decision-makers at headquarters	☐	☐	☐	☐	☐
c) Strategic information of top management	☐	☐	☐	☐	☐
d) Ability to execute projects (e.g., manpower, knowledge)	☐	☐	☐	☐	☐
e) Current market trends	☐	☐	☐	☐	☐
f) Other: _____	☐	☐	☐	☐	☐

7. How frequently do you allocate financial resources ***more evenly across divisions*** than pure financial criteria (e.g., NPV) suggest?

   ☐ Never ☐ Rarely ☐ Sometimes ☐ Often ☐ Always

   (if "Never" please continue with the **Closing Section**)

8. Please think about situations where you have decided to ***allocate capital more evenly*** than pure financial criteria suggested. How important were the following factors for your allocation?
   Please check "Not important", if a statement does not apply.

	Not important 1	2	3	4	Highly important 5
a) Too uneven capital allocation diminishes divisional managers' motivation.	☐	☐	☐	☐	☐
b) Capital allocation conveys information about the (future) role of the division as part of the firm.	☐	☐	☐	☐	☐
c) A more even capital allocation stimulates divisional managers' motivation to generate new investment ideas.	☐	☐	☐	☐	☐
d) A more even capital allocation helps to retain divisional managers.	☐	☐	☐	☐	☐
e) A more even capital allocation avoids opportunistic investment behavior within divisions.	☐	☐	☐	☐	☐
f) A more even capital allocation frequently strengthens divisions in mature industries.	☐	☐	☐	☐	☐
g) A more even capital allocation strengthens our monetary performance incentive scheme.	☐	☐	☐	☐	☐
h) Other: _____	☐	☐	☐	☐	☐

Figure A.5: Questionnaire (page 3 of 4)

Closing Section – Valuation of Diversified Companies

1. On average, by what percentage do you feel your stock is ***misvalued*** because you run a ***diversified company*** (-20% means 20% undervalued; 0 means correctly valued; +10% means 10% overvalued)?
   Write NONE if your company has no publicly traded shares. _____%

Closing Section – Company-related Characteristics

1. Annual sales revenue at my company is in the range of:
   ☐ < 25 million € ☐ 25 million €– 100 million € ☐ 100 million €– 500 million € ☐ 500 million €– 1 billion € ☐ 1 billion €– 5 billion € ☐ 5 billion €– 10 billion € ☐ >10 billion €

2. How many lines of business (i.e., distinct operating divisions such as autos, food, and retail) is your company running? _____

3. What broad industries are you working in?
   (Check only if an industry accounts for at least 10% of total sales. Fill in multiple squares if needed.)
   ☐ Retail and Wholesale ☐ Transport ☐ Tech (Software / Biotech / etc.)
   ☐ Mining ☐ Energy ☐ Healthcare / Pharmaceutical
   ☐ Construction ☐ Communication / Media ☐ Consulting / Service
   ☐ Manufacturing ☐ Bank / Finance / Insurance ☐ Other: _____

4. What is the highest / lowest ***expected sales growth rate*** among your divisions?
   Division expecting the highest sales growth: _____% (e.g., 15% p.a.)
   Division expecting the lowest sales growth: _____% (e.g., 1% p.a.)

5. The following questions help us understand your ownership structure.
   a) **Ownership** ☐ Public ☐ Private
   b) **If all options were exercised, what percentage of your company's equity would be owned by the *top 3 managers* (e.g., 5%)?** _____%
   c) **Does a *single investor* own *more than 10%* of your company's equity?** ☐ Yes ☐ No

6. What is your ***credit issuer rating*** (e.g., AA-, B+)? Write NONE if debt is not rated. _____

7. What is your ***debt-to-asset ratio*** (e.g., 0.2, 0.3)? _____

Closing Section — CFO Demographics

1. Gender of CFO: ☐ Male ☐ Female

2. Age of CFO: _____

3. Tenure (time in current job) of CFO: _____

4. Educational background of CFO (Fill in multiple squares if needed):
   ☐ Undergraduate (or domestic equivalent)
   ☐ Non-MBA Master's (or domestic equivalent)
   ☐ MBA
   ☐ Dr. / PhD
   ☐ Other: _____

5. In which country is your firm based?
   ☐ Germany ☐ Netherlands ☐ Belgium ☐ Denmark
   ☐ France ☐ Austria ☐ Sweden ☐ Norway
   ☐ United Kingdom ☐ Switzerland ☐ Finland

6. Do you have further comments?

Check if you would like to receive an exclusive report of this study.
☐ Yes, I would like to receive a copy

a) *We need your email or postal address if you want a copy. Please note: we will store your contact details separately from the questionnaire responses. The confidentiality of your responses is very important to us.*

b) *Each questionnaire holds a unique tracking number. This number is only used to identify those companies that have not yet responded. It is recorded separately from the responses of the survey. If you do not want the number to be recognizable, please feel free to blacken it.* 1589

THANK YOU for completing this survey! Please fax your responses to **(+49) 721 608-9145** or **(+49) 721 359-200** by **MAY 7, 2010**.

Figure A.6: Questionnaire (page 4 of 4)

Appendix B

Summary of Internal Capital Markets Theories

A	Question 1	Theory / Concept	Author	Argument
(a)	Creating operational synergies (e.g. purchasing, manufacturing, or revenue economies)	Resource-based view	*Penrose (1959); Panzar, Willig (1981); Teece (1980, 1982)*	"Economies of scope" and "economies of scale": Excess resources (tangible assets) cannot be sold easily in the marketplace and require expansion in scope or scale to exploit them; also: indivisibility of intangible assets, such as brand names.
(b)	Utilizing the ability to move skilled managers from one business to another	Internal labor transfer	-	Internal labor market, argument from practitioners in pre-testing group.
(c)	Achieving beneficial conditions for raising capital	More-money effect	*Lewellen (1971); Hadlock et al. (2001); Hann, Ogneva, Ozbas (2009); Stein (2003)*	More-money effect (Stein, 2003), see also below.
(d)	Being able to add value by making superior investment decisions under a common roof	Smarter-money effect	*Williamson (1975); Stein (1997); Matsusaka, Nanda (2002); Stein (2003)*	Smarter-money effect (Stein, 2003). Headquarters adds value by incorporating residual control and monitoring incentives. Headquarters generates more information and can engage in winner-picking.
(e)	Reducing the risk of financial distress	Financial distress cost	*Corollary of Smith, Stulz (1985)*	Given imperfectly correlated divisions' cash flows, diversification is a way to decrease the probability and therefore the cost of financial distress.
(f)	Reducing investors' risk	Portfolio selection	*Corollary of Smith, Stulz (1985); Stulz (1996)*	Diversification can eliminate idiosyncratic risk. This may benefit investors if they can not diversify more efficiently by themselves (e.g. large shareholders) or do not want to (e.g. family ownership).
(g)	Building the ability to have internal funds when competitor's do not have them	Financial strength in product markets	*Bernheim, Whinston (1990); Edwards (1955); Montgomery (1994); Inderst, Müller (2003)*	Related to "market-power-view": Firms diversify because of the ability of predatory pricing in other divisions ("deep pockets").
(h)	Reducing volatility of earnings / cash flows	Risk management	*Graham, Harvey, Rajgopal (2005)*	Argument from practitioners in pre-testing group. See also Graham, Harvey, Rajgopal (2005): "An overwhelming 96.9% of the survey respondents indicate that they prefer a smooth earnings path." Idea: diversification into businesses with imperfectly correlated cash flows. Some overlap to other arguments above.

Table B.1: Motives for Diversification – Theoretical Concepts and Survey Evidence: How important are the following motives for operating more than one line of business for your company?

B	Questions	Theory / Concept	Author	Argument
(1)	Does headquarters raise funds on behalf of the divisions?	Provider of finance	*Stein (2003)*	Headquarters as the single centralized provider of finance.
(2)	Do divisions also raise funds by themselves?	Internal labor transfer	*Kolasinski (2009); Cestone, Fumagalli (2005)*	If "No": Kolasinski (2009): Subsidiary debt mitigates “corporate socialism”.

Table B.2: Financing Effects of Diversification – Theoretical Concepts and Survey Evidence

B	Question 3	Theory / Concept	Author	Argument
(a)	Lower cost of capital	Lower cost of capital	*Hann, Ogneva, Ozbas (2009)*	Integrating imperfectly correlated cash flows can lead to a reduction of systematic risk and hence lead to a lower cost of capital.
(b)	Ability to borrow more / Higher debt capacity	Coinsurance-effect	*Lewellen (1971); Inderst, Müller (2003); Comment, Jarrell (1995); Stein (1997)*	Lewellen (1971): The debt capacity of diversified firms is increased because of coinsurance across imperfectly correlated divisions. Also, Stein (1997): Unused borrowing capacity of one division may be used to raise additional financing.
(c)	Better conditions for raising equity	Information div. hypothesis (Superior issuing)	*Hadlock, Ryngaert, Thomas (2001)*	Risk pooling helps to alleviate Myers and Majluf (1984) adverse selection problems in the external equity market. Price effects in the case of issuing equity are less severe.
(d)	Less need to hold (precautionary) cash	Less cash holding	*Duchin (2010)*	Diversified firms can hold less cash because diversification reduces the ex-ante probability of financing shortages that might lead to underinvestment.
(e)	Ability to avoid external financing	Costly external funding	*Matsusaka, Nanda (2002); Henderson (1970, 1979); Liebeskind (2000); Rajan (1994)*	Matsusaka, Nanda (2002): Internal capital markets (ICMs) give firms a real option to finance their investment opportunities with internal funds to avoid the (transaction) costs of external financing; also: ICMs enhance the reliability of the capital supply and make the project funding independent of market conditions.
(f)	Lower personal taxes for investors	Tax advantage	*Bhide (1990)*	Owning multiple businesses allows a diversified company to transfer cash from units with excess funds to units facing cash deficits without the tax payment that might result if the transfer were to be made between two independent companies.

Table B.3: Motives for Diversification – Theoretical Concepts and Survey Evidence: How important are the following effects of diversification for your company? Please answer compared to the situation where your divisions were stand-alone companies and had to raise funds by themselves.

B	Question 4	Theory / Concept	Author	Argument
(a)	Headquarters reacts more understandingly in the event that a project faces financial difficulties.	Soft budget constraints	*Bolton, Scharfstein (1996); Dewatripont, Maskin (1995)*	Bolton and Scharfstein investigate the benefits and costs of a small number of creditors. Transferred to an ICM setting, the CEO's inability to pre-commit not to renegotiate with divisional managers leads to a "soft budget constraint" for them.
(b)	Headquarters can directly intervene in the divisions' businesses, while outside investors cannot.	Control rights	*Grossman, Hart (1986); Hart, Moore (1990); Hart (1995)*	Headquarters can unilaterally decide what to do with the firm's assets, while the same is not true of a banker if the firm is not currently in default.
(c)	Headquarters has better information about the divisions' businesses than an external provider of financing.	More monitoring	*Gertner, Scharfstein, Stein (1994); Stein (1997)*	Even if internal and external providers of capital have the same ability to monitor, internal providers will choose to monitor more intensively (compared to a bank, for example) because of residual control rights.
(d)	Sensitive information such as detailed strategic and operating plans can be reported to headquarters without leaking to the public.	Keeping secrets	*Liebeskind (2000, 1997); Cheung (1982)*	Internal funding is valuable as crucial information has to be transferred to external investors in the case of external funding.

Table B.4: Financing Effects of Diversification – Theoretical Concepts and Survey Evidence: If your divisions were spun off as stand-alone firms, they would have to raise money in outside markets rather than going to headquarters for financing. How strongly would you agree with the following statements that compare your headquarters with an external investor directly providing financing to the divisions?

B	Question 5	Theory / Concept	Author	Argument
(a)	If divisional management were running their divisions as stand-alone companies, they would act more entrepreneurial.	Entrepreneurial incentives	*Gertner, Scharfstein, Stein (1994); Aghion, Tirole (1997)*	Divisional managers' entrepreneurial incentives are reduced in multi-business companies as a consequence of headquarters intervening to often in the form of "winner-picking". The missing entrepreneurial incentives are correlated with the proportion of centralized decision-making.
(b)	If divisional management were running their divisions as stand-alone companies, they would work harder.	Effort incentives	*Brusco, Panunzi (2005)*	"Winner-picking" (i.e. optimizing capital allocation ex post and after managerial effort has been exerted) reduces effort incentives ex-ante if managers are empire-builders. also see: Milgrom (1988), Milgrom and Roberts (1988), Meyer, Milgrom, and Roberts (1992)
(c)	If divisional management were running their divisions as stand-alone companies, they would feel more committed to raising the firm's attractiveness to capital markets.	Free-rider problem	*de Motta (2003)*	Divisional managers may free-ride on the perception of the multi-divisional firm as a whole when accessing external capital markets.
(d)	Divisional managers have superior information / knowledge about their businesses compared to the information that headquarters has.	Information asymmetry	*Proxy for informational asymmetry*	Their specific human capital and expertise in the corporation make divisional managers very knowledgeable, which acts as a proxy for informational asymmetry.
(e)	Divisional managers try to influence the capital allocation decisions of headquarters.	Influencing activities	*Meyer, Milgrom, Roberts (1992)*	Divisional managers waste their time and effort in their attempt to influence the CEO.
(f)	Divisional managers prefer running large divisions with more capital under their control over running small divisions with less capital under their control.	Empire-building	*Jensen (1986,1993)*	A basic assumption of ICM-theory concerns "empire building tendencies by divisions": managers may have an excessive taste for running large firms or large divisions.

Table B.5: Financing Effects of Diversification – Theoretical Concepts and Survey Evidence: If another corporate manager made the following statements, how strongly would you agree or disagree with each of them when you think about the divisional management in your company?

C	Questions	Theory / Concept	Author	Argument
(1)	Does headquarters have the decision-making authority regarding major investments?	Decision-making authority	*Grossman, Hart (1986); Hart, Moore (1990); Hart (1995)*	Control rights of headquarters.
(2)	Does your company use an investment committee for some of these decisions?	Investment committee	-	-
(3)	Is approval from headquarters required beyond a certain size of investment? If "Yes", from which project size (threshold amount) on does the authority to make decisions reside with headquarters?	Threshold amount	*Harris, Raviv (1996); Gitman, Forrester (1977); Ross (1986)*	-
(4)	In an average year, how many investment proposals are submitted to headquarters for approval?	Number of proposals	-	-
(5)	On average, how many of these obtain approval?	Approval rate	-	-
(6)	On average, how many proposals receive close scrutiny by headquarters?	Proposals under detailed investigation	-	-
(7)	What is the total amount of capital expenditures of your company in an average year?	Total CAPEX	-	-
(8)	What percentage of this total amount does not require explicit approval by the headquarters (e.g., because it is part of an initial divisional budget)?	% of CAPEX w/o approval	-	-

Table B.6: Headquarters and Investment Decisions – Theoretical Concepts and Survey Evidence

C	Questions	Theory / Concept	Author	Argument
(9)	Does divisional management provide financial information such as cash flow forecasts or NPV calculations as part of their investment proposals?	Financial forecasts	*Bower (1970)*	Bottom-up budgeting process
(10)	From your personal experience: On average, the forecasts provided in investment proposals are ... ...substantially higher / ...in accordance / ...substantially lower than actual outcomes	Quality of forecasts	*See below – section on business practices to ensure truthful reporting.*	Divisional managers have incentives to misrepresent their private information.

Table B.7: Headquarters and Investment Decisions – Theoretical Concepts and Survey Evidence

C	Question 12	Theory / Concept	Author	Argument
(a)	...motivation to work hard?	Effort incentives	-	-
(b)	...searching for long-term investment opportunities?	Innovation incentives	*Hoang, Ruckes (2008)*	Contracting on (long-term) investment outcomes is necessarily incomplete.

Table B.8: Headquarters and Investment Decisions – Theoretical Concepts and Survey Evidence: From your perspective, how effective are monetary incentives, such as bonuses, in stimulating divisional managers'...

C	Question 11	Theory / Concept	Author	Argument
(a)	We link the performance-based pay of divisional managers to overall firm performance.	DM - equity holding or options	*Wulf (2002)*	Capital allocation is more efficient and less biased when divisional managers' compensation is linked to the performance of the entire company.
(b)	We adopt criteria (e.g., payback rules) that discount distant long-horizon cash flows more heavily than does the NPV method.	Budgeting Techniques	*Bernardo, Cai, Luo (2001)*	Future research question from Bernardo, Cai, and Luo (2001).
(c)	We rotate divisional managers across divisions.	Management rotation	*Ozbas (2005)*	Management rotation programs are used to reduce rent-seeking behavior. The incentives to misreport are smaller for a manager with bad assets if there is some chance that he might be assigned to more profitable assets. Only truthful reporting would bring about a new assignment.
(d)	We set the required hurdle rate for project approval in excess of the "true" cost of capital.	Hurdle Rate	*Antle and Eppen (1985); Harris et. al. (1982); Bernardo et. al. (2001); Berkovitch, Israel (2004); Poterba, Summers (1995)*	In general: The tradeoff is foregone NPV versus informational rent (slack, effort and private benefit). Antle and Eppen: To mitigate the effects of the manager's having private information, firms promise to pay off the manager when he reports returns above a hurdle rate. The optimal hurdle rate balances inefficiencies from slack (private benefit) and rationing (foregone NPV) in an ex ante sense.
(e)	The proportion of performance-based pay relative to base salary is high if a divisional manager claims *better* expected investment prospects.	Compensation contracts	*Bernardo, Cai, Luo (2001, 2004)*	Headquarters can reduce a manager's incentives to overstate project quality by allocating more capital and giving more incentive-based pay (relative to fixed wages) when the manager reports higher project quality. Reverse causality: Managers receive greater performance-based pay because they manage higher-quality projects; greater performance-based pay does not cause firm value to increase.
(f)	We put a relatively high weight on industry information that is gathered externally compared to internal information.	External information	*Wulf (2009)*	Headquarters rely more on noisy external information than on internal information, which are distortable through influence activities. High (industry-) q divisions (which is public information) receive relatively more capital. Note that this should be less prevalent if the "external" q is intrinsically noisier, for example in pharmaceuticals.
(g)	We require divisional managers to produce investment proposals with information that can be verified by headquarters.	Hard information	*Stein (2002)*	In multi-business firms, information must be credibly transmittable. Headquarters must be able to verify information.
(h)	We grant each division a minimum level of capital budget / investment.	Minimum Budget	*Ozbas (2005)*	Making a portion of the capital budget non-contingent can reduce the intensity of internal competition and reduce gains from exaggeration by bad managers.
(i)	We have institutionalized post-investment audits.	Auditing	*Antle, Eppen (1985)*	Auditing represents the possibility of reviewing investment outcomes and might be less costly than capital rationing as a way to address information asymmetry and moral hazard.

Table B.9: Headquarters and Investment Decisions – Theoretical Concepts and Survey Evidence:
How important are the following business practices in your company to ensure that divisional managers provide truthful forecasts and do not overstate the attractiveness of investment projects? If you use these practices for other reasons and not for truthful reporting, please check "Not Important".

D	Questions	Theory / Concept	Author	Argument
(1)	When capital markets are operating normally, is your company capital constrained? In other words: Does your financing capacity limit your ability to pursue attractive investment projects.	Capital constraints (external)	-	Capital constrained or unconstrained. Relevant to the importance of winner-picking.
(2)	Does your company's top management impose a limit on total investments of the firm by a predetermined, fixed budget?	Capital constraints (internal)	*Gitman, Forrester (1977); Ross (1986); Zhang (1997)*	The CFOs in our pre-testing group (Deutsche Bahn AG, Deutsche Telekom AG, EnBW AG) stressed the importance of a "limit placed on investing by top management" (see also Gitman and Forrester, 1977). Also, Ross (1986) shows in a sample of twelve firms that six of them used capital rationing in which projects compete for a fixed budget. Zhang (1997): If investment funds are limited, managers with shirking tendencies are less tempted to underreport project quality, since doing so reduces funding. Limited investment spending creates a competition for funds among managers.
(3)	Is the capital allocation to a division restricted by the division's own generated cash flow?	Winner-Picking	*Stein (1997)*	Important characteristic of an internal capital market.
(4)	Diversified firms may use the ability to move funds from divisions that are generating strong cash flow to divisions with less cash flow but strong investment opportunities. How frequently do you use this ability in order to achieve the highest capital productivity?	Winner-Picking	*Stein (1997)*	Headquarters has the ability and the incentives to reallocate resources between divisions and to add value by picking superior investment projects. The effect is influenced by budget constraints and relatedness of divisions.

Table B.10: Headquarters and Allocation of Capital – Theoretical Concepts and Survey Evidence

D	Question 5	Theory / Concept	Author	Argument
(a)	Net present value (NPV)	Budgeting criteria	-	Questions help to introduce the subsequent question. Measures the relative importance of different budgeting criteria in diversified firms (see also: Graham, Harvey, 2001).
(b)	Internal rate of return (IRR)	Budgeting criteria	-	
(c)	Hurdle rate	Budgeting criteria	-	
(d)	Payback period	Budgeting criteria	-	
(e)	Sensitivity analysis	Budgeting criteria	-	
(f)	Real-option valuation methods	Budgeting criteria	-	

Table B.11: Headquarters and Allocation of Capital – Theoretical Concepts and Survey Evidence: How important are the following financial criteria for your capital allocation decision?

D	Question 6	Theory / Concept	Author	Argument
(a)	The assessment of divisional managers' abilities to deliver the expected results	Managerial abilities	*Hoang, Ruckes (2008)*	Argument related to Ross' (1986) field analysis of 12 firms, which indicates that a divisional manager's investment projects are more often approved when he has delivered larger returns in the past. Also, this item is in the spirit of "Informed Headquarters" (Hoang, Ruckes, 2008).
(b)	Previous industry experience or affiliation of decision-makers at headquarters	Empire-building / Bridge-Building	*Shleifer, Vishny (1989); Xuan (2009)*	Empire-building argument (Shleifer, Vishny, 1989): CEOs prefer to invest in industries where they have more personal experience, as this makes them indispensable. Bridge-building argument (Xuan, 2009): Specialist CEOs use the capital budget as a bridge-building tool to elicit cooperation from powerful divisional managers in previously unaffiliated divisions.
(c)	Strategic information of top management	Strategic information	*Hoang, Ruckes (2008)*	Headquarters has informational advantages regarding strategic intentions, possible spillovers, and political developments, among others. These advantages result from top managers' activities beyond the realm of the firm, e.g. board memberships, activities in professional associations, or the use of personal contact networks.
(d)	Ability to execute projects (e.g., manpower, knowledge)	Capability to implement	*Bromiley (1986)*	Bromiley (1986, p.129) emphasizes that "manpower and the ability to implement projects could constrain investment when funds and good projects are available".
(e)	Current market trends	Trends	*Scharfstein, Stein (1990); Banerjee (1992); Bikhchandani, Hirshleifer, Welch (1992)*	Some CFOs in our pre-testing group (Deutsche Bahn AG, Deutsche Telekom AG, EnBW AG) stressed the importance of following long-term trends and the industry. Related to herding arguments.

Table B.12: Headquarters and Allocation of Capital – Theoretical Concepts and Survey Evidence: How important are the following factors that go beyond pure financial criteria for your capital allocation decision?

D	Question 7	Theory / Concept	Author	Argument
(1)	How frequently do you allocate financial resources more evenly across divisions than pure financial criteria (e.g. NPV) suggest?	Socialistic Cross-Subsidization	*See below – section on corporate socialism.*	Headquarters cross-subsidizes relatively „weak" divisions at the expense of „strong" divisions.

Table B.13: Headquarters and Allocation of Capital – Theoretical Concepts and Survey Evidence

D	Question 8	Theory / Concept	Author	Argument
(a)	Too uneven capital allocation diminishes divisional managers' motivation.	Socialism	*Brusco, Panunzi (2005); Hoang, Ruckes (2008); Inderst, Laux (2005)*	Motivation for providing high effort cannot be retained in a strong form of winner-picking.
(b)	Capital allocation conveys information about the (future) role of the division as part of the firm.	Socialism	*Hoang, Ruckes (2008)*	Somehow related to Hoang and Ruckes (2008) - without specifying stakeholders.
(c)	A more even capital allocation stimulates divisional managers' motivation to generate new investment ideas.	Socialism	*Inderst, Laux (2005)*	The incentives for generating new investment opportunities are reduced in a strong form of winner-picking.
(d)	A more even capital allocation helps to retain divisional managers.	Socialism	*Scharfstein, Stein (2000)*	Weaker divisions' managers are given more compensation because they have stronger incentives to rent-seek (=increase outside options in the job market). If the CEO is himself an agent of outside investors, he would prefer to pay this added compensation in the form of capital because this may be less personally costly.
(e)	A more even capital allocation avoids opportunistic investment behavior within divisions.	Socialism	*Rajan, Servaes, Zingales (2000)*	Divisional managers invest in defensive projects that protect them from the redistribution of surplus to other divisions.
(f)	A more even capital allocation frequently strengthens divisions in mature industries.	Socialism	*Goel, Nanda, Naranyan, 2004; also: Hellwig (2000, 2001)*	Goel, Nanda, and Naranyan, 2004: Career concerns model à la Holmström (1982). Divisions whose cash flows are more informative about managerial talent (mature businesses) are subsidized at the expense of less informative ones (young and emerging businesses). Hellwig: “Old”, established divisions happen to wield the most influence in the organization.
(g)	A more even capital allocation strengthens our monetary performance incentive scheme.	Socialism	*Bernardo, Luo, Wang (2006)*	Headquarters' decisions are made under optimal compensation considerations; a "quality hurdle" must be taken by stronger divisions because of an information rent paid for truthful reporting and because of the more costly effort incentives in strong (high-quality) divisions.

Table B.14: Headquarters and Allocation of Capital – Theoretical concepts and Survey Evidence: Please think about situations where you have decided to allocate capital more evenly than pure financial criteria suggested. How important were the following factors for your allocation?

Appendix C

Proofs

C.1 Proof of Lemma 4.1

The proof involves several steps. The procedure in the proof is (i) to show V has no local maximum (the first part of the lemma) and (ii) to determine the behavior of $\frac{\partial V(h)}{\partial h}$ on $h \in [0,1]$ for all admissible parameter values. The second step is the main difficulty. The proof involves three lemmas:

1. **Lemma C.1:** *The monopoly rent V has no* ***local maximum*** *on $h \in [0,1]$. A unique* ***local minimum*** *$h^0 \in (0,1)$ exists if and only if $A < y^* < B$, where*

$$B := \frac{\bar{\eta}(\sigma_\eta^2 - \sigma_\epsilon^2)}{2\sigma_\eta^2} + \frac{1}{2}\sqrt{\frac{(\sigma_\eta^2 + \sigma_\epsilon^2)(4\sigma_\eta^2 + \bar{\eta}^2(\sigma_\eta^2 + \sigma_\epsilon^2))}{\sigma_\eta^4}}$$

and

$$A := \frac{1}{2}(\bar{\eta} + \sqrt{\bar{\eta}^2 + 4\sigma_\eta^2}).$$

2. **Lemma C.2:** *On $h \in [0,1]$, if $y^* \geq B$, the monopoly rent V has a* ***global maximum****, which is $h^* = 1$,* whereas *if $y^* \leq A$, the* ***global maximum*** *is $h^* = 0$.*

3. **Lemma C.3:** *On $h \in [0,1]$, if $A < y^* < B$, a unique cutoff $\hat{y}$* exists *such that if $y^* > \hat{y}$ then $h^* = 1$, whereas if $y^* < \hat{y}$ then $h^* = 0$,* and if $y^* = \hat{y}$ the incumbent is indifferent between $h^* = 1$ and $h^* = 0$.

It is helpful to study Figures C.1 to C.3 before proceeding. They are meant to provide intuition behind the steps to prove the Lemmas C.1-C.3.

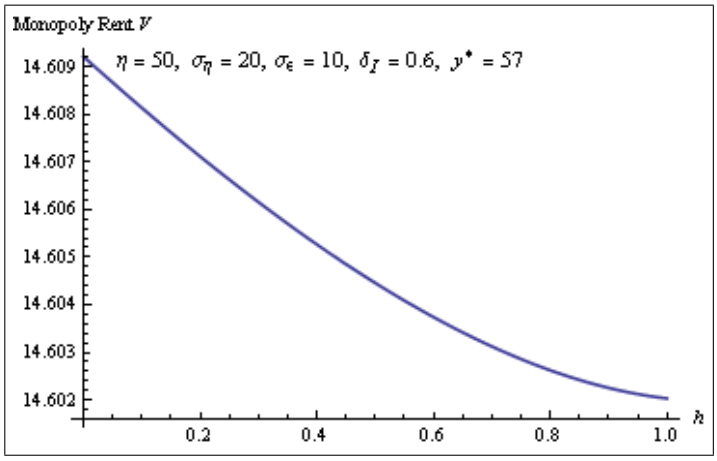

Figure C.1: Monopoly Rent V in Region 1 ("low"), when $y^* \leq A$

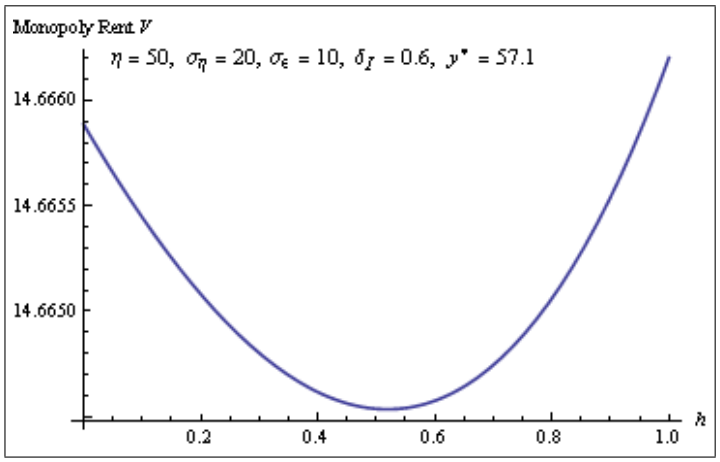

Figure C.2: Monopoly Rent V in Region 2 ("medium"), when $A < y^* < B$

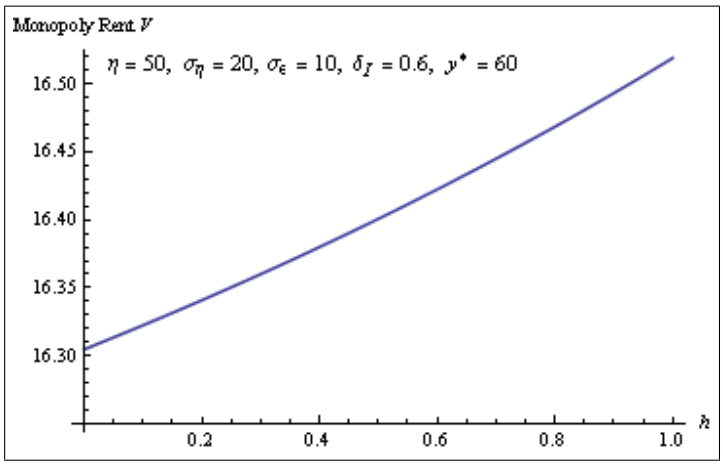

Figure C.3: Monopoly Rent V in Region 3 ("high"), when $y^* \geq B$

I construct the figures for an example in which $\eta = 50$, $\sigma_\eta = 20$, $\sigma_\epsilon = 10$, $\delta_I = 0.6$, and three different threshold levels $y^* = 57$, $y^* = 57.10$, and $y^* = 60$, each of which corresponds to the three different regions described above: (i) Region 1 ("low"): $y^* \leq A$; (ii) Region 2 ("medium"): $A < y^* < B$; and (iii) Region 3 ("high"): $y^* \geq B$ with $A = 57.02$ and $B = 57.18$. The expected monopoly rents V are on the vertical axes. The incumbent's hedging choices h are on the horizontal axes. Note that none of the general properties in each region depends on the specific parameters I use.

Figures C.1 and C.3 clearly suggest that if the conjectured entry threshold is in Region 1 ("low"), here $y^* = 57$, more hedging decreases the monopoly rent V; hence $h^* = 0$. If the entry threshold is in Region 3 ("high"), however, for instance, $y^* = 60$, hedging is

beneficial and $h^* = 1$. Figure C.2 points to the less straightforward case of $y^* = 57 \in (A, B)$ (Region 2, "medium") in which a local minimum h^0 exists and the graph of $V(h)$ is similar to a parabola that opens upward. Then, the global maximum of V is attained on the boundaries. In Figure C.2, $h^* = 1$. In the following, I show these properties hold in general in each region.

Lemma C.1 *The monopoly rent V has no **local maximum** on $h \in [0, 1]$. A unique local minimum $h^0 \in (0, 1)$ exists if and only if $A < y^* < B$, where*

$$B := \frac{\bar{\eta}(\sigma_\eta^2 - \sigma_\epsilon^2)}{2\sigma_\eta^2} + \frac{1}{2}\sqrt{\frac{(\sigma_\eta^2 + \sigma_\epsilon^2)(4\sigma_\eta^2 + \bar{\eta}^2(\sigma_\eta^2 + \sigma_\epsilon^2))}{\sigma_\eta^4}}$$

and

$$A := \frac{1}{2}(\bar{\eta} + \sqrt{\bar{\eta}^2 + 4\sigma_\eta^2}).$$

Proof. The procedure in the proof is straightforward. I solve for the usual first- and second-order conditions. To reduce the notational burden, define

$$\sigma_y^2 := \sigma_\eta^2 + (1 - h)\sigma_\epsilon^2; \tag{C.1}$$

thus, the density of y_1 at $y_1 = y^*$ given hedging choice h is

$$f(y^* \mid h) := \frac{1}{\sigma_y\sqrt{2\pi}} e^{-\frac{1}{2}(\frac{y^* - \bar{\eta}}{\sigma_y})^2}.$$

Recall from (4.9) that $V = \delta_I \left[F(y^* \mid h) \times \bar{\eta} - \sigma_\eta^2 \times f(y^* \mid h)\right]$; hence

$$\begin{aligned}
\frac{\partial V(h)}{\partial h} &= \delta_I \left[\bar{\eta}\frac{\partial F(y^* \mid h)}{\partial h} - \sigma_\eta^2 \frac{\partial f(y^* \mid h)}{\partial h}\right] \\
&= \delta_I \left[\bar{\eta}\frac{(y^* - \bar{\eta})\sigma_\epsilon^2}{2\sigma_y^2} f(y^* \mid h) + \sigma_\eta^2 \, \sigma_\epsilon^2 \frac{(y^* - \bar{\eta})^2 - \sigma_y^2}{2\sigma_y^4} \, f(y^* \mid h)\right] \\
&= \delta_I f(y^* \mid h) \left[\bar{\eta}\frac{(y^* - \bar{\eta})\sigma_\epsilon^2}{2\sigma_y^2} + \sigma_\eta^2 \, \sigma_\epsilon^2 \frac{(y^* - \bar{\eta})^2 - \sigma_y^2}{2\sigma_y^4}\right] \\
&= \delta_I f(y^* \mid h) \frac{\sigma_\epsilon^2}{2\sigma_y^4} \left[\bar{\eta}(y^* - \bar{\eta})\sigma_y^2 + \sigma_\eta^2 \, \left((y^* - \bar{\eta})^2 - \sigma_y^2\right)\right],
\end{aligned} \tag{C.2}$$

where the second line follows from both using (4.14) and using

$$\begin{aligned}\frac{\partial f(y^* \mid h)}{\partial h} &= -f(y^* \mid h)\frac{(y^*-\bar{\eta})^2\,\sigma_\epsilon^2}{2\sigma_y^4} + f(y^* \mid h)\frac{\sigma_\epsilon^2}{2\sigma_y^2} \\ &= -f(y^* \mid h)\sigma_\epsilon^2\frac{(y^*-\bar{\eta})^2 - \sigma_y^2}{2\sigma_y^4}. \end{aligned} \tag{C.3}$$

Substituting for (C.1) and solving the first-order condition $\frac{\partial V(h)}{\partial h} = 0$ yields

$$h^0 = \frac{\bar{\eta}(y^*-\bar{\eta})\sigma_\epsilon^2 + \sigma_\eta^2({y^*}^2 - y^*\bar{\eta} - \sigma_\epsilon^2) - \sigma_\eta^4}{\sigma_\epsilon^2(\bar{\eta}(y^*-\bar{\eta}) - \sigma_\eta^2)}. \tag{C.4}$$

Imposing $h^0 \in (0,1)$ implies that h^0 is on the interval $(0,1)$ if and only if

$$\underbrace{\frac{1}{2}(\bar{\eta} + \sqrt{\bar{\eta}^2 + 4\sigma_\eta^2})}_{:=A} < y^* < \underbrace{\frac{\bar{\eta}(\sigma_\eta^2 - \sigma_\epsilon^2)}{2\sigma_\eta^2} + \frac{1}{2}\sqrt{\frac{(\sigma_\eta^2+\sigma_\epsilon^2)(4\sigma_\eta^2 + \bar{\eta}^2(\sigma_\eta^2+\sigma_\epsilon^2))}{\sigma_\eta^4}}}_{:=B}. \tag{C.5}$$

Checking for the second-order condition yields

$$\frac{\partial^2 V(h^0)}{\partial h^2} = \underbrace{e^{\frac{\bar{\eta}(y^*-\bar{\eta})-\sigma_\eta^2}{2\sigma_\eta^2}}\frac{\sigma_\epsilon^4\left(\bar{\eta}(y^*-\bar{\eta})-\sigma_\eta^2\right)^4}{2\sqrt{2\pi}\sigma_\eta^2(y^*-\bar{\eta})^6}}_{>0}\sqrt{\underbrace{-\frac{(y^*-\bar{\eta})^2\sigma_\eta^2}{\bar{\eta}(y^*-\bar{\eta})-\sigma_\eta^2}}_{<0 \text{ from (C.5)}}} > 0. \tag{C.6}$$

Hence, if $h^0 \in (0,1)$ exists, it is a local minimum. Note that the expression under the square root in (C.6) is never negative if (C.5) holds.[1] This establishes that h^0 is the unique local extreme point, a minimum, iff $A < y^* < B$, where

$$A := \frac{1}{2}(\bar{\eta} + \sqrt{\bar{\eta}^2 + 4\sigma_\eta^2})$$

and

$$B := \frac{\bar{\eta}(\sigma_\eta^2 - \sigma_\epsilon^2)}{2\sigma_\eta^2} + \frac{1}{2}\sqrt{\frac{(\sigma_\eta^2+\sigma_\epsilon^2)(4\sigma_\eta^2 + \bar{\eta}^2(\sigma_\eta^2+\sigma_\epsilon^2))}{\sigma_\eta^4}}.$$

■

Lemma C.2 *On $h \in [0,1]$, if $y^* \geq B$, the monopoly rent V has a **global maximum**, which is $h^* = 1$, whereas if $y^* \leq A$, the **global maximum** is $h^* = 0$.*

[1] Calculating $\frac{\delta^2 V(h)}{\delta h^2}$ and substituting for h^0 is straightforward. However, the expression is lengthy and reveals no additional insight. I therefore omit its exposition here.

Proof. Recall that in (C.2) the term $\bar{\eta}\sigma_y^2(y^* - \bar{\eta}) + \sigma_\eta^2 \left((y^* - \bar{\eta})^2 - \sigma_y^2\right)$ alone determines the algebraic sign of the derivative, because the other terms are positive. It is straightforward to show that

$$\frac{\partial V(h)}{\partial h} > 0 \text{ on } h \in [0,1] \text{ if } y^* \geq B$$

and

$$\frac{\partial V(h)}{\partial h} < 0 \text{ on } h \in [0,1] \text{ if } y^* \leq A.$$

Hence, the incumbent's optimal strategy is attained at the boundaries: $h^* = 1$ if $y^* \geq B$ and $h^* = 0$ if $y^* \leq A$. This establishes the lemma. ■

Lemma C.3 *On $h \in [0,1]$, if $A < y^* < B$, a unique cutoff $\hat{y}$ exists such that if $y^* > \hat{y}$ then $h^* = 1$, whereas if $y^* < \hat{y}$ then $h^* = 0$, and if $y^* = \hat{y}$ the incumbent is indifferent between $h^* = 1$ and $h^* = 0$.*

Proof. From *Lemma C.1* it is known that if the conjectured entry threshold belongs to the interval $A < y^* < B$, a unique local minimum $h^0 \in (0,1)$ exists. This means that in this interval, the (global) maximum of V is attained on the boundaries $h^* = 0$ or $h^* = 1$. I prove existence and uniqueness of $\hat{y}$ by examining the behavior of the difference in the monopoly rent at the boundaries, $V(y^* \mid h = 0)$ and $V(y^* \mid h = 1)$ (see Figure C.2).

Define $\Delta V(y^*) = V(y^* \mid h = 1) - V(y^* \mid h = 0)$. Note that $\hat{y}$ solves $\Delta V(y^*) = 0$, which cannot be done explicitly since no closed-form solution for $\hat{y}$ exists. I therefore apply the intermediate value theorem to establish the lemma.

Clearly, $\Delta V(A) < 0$ and $\Delta V(B) > 0$ from *Lemma C.1*. Therefore, according to the intermediate value theorem, the continuous function $\Delta V(y^*)$ must have at least one zero on $[A, B]$. Since $\frac{\partial \Delta V(y^*)}{\partial y^*} > 0$ for all $y^* \in [A, B]$ (which I prove below), it follows that $\Delta V(y^*)$ has a unique zero.

First, differentiating $\Delta V(y^*)$ with respect to y^* yields

$$\frac{\partial \Delta V(y^*)}{\partial y^*} = f(y^* \mid h = 1)y^* - f(y^* \mid h = 0)\frac{\bar{\eta}\sigma_\epsilon^2 + y^*\sigma_\eta^2}{\sigma_\epsilon^2 + \sigma_\eta^2},$$

and therefore proving $\frac{\partial \Delta V(y^*)}{\partial y^*} > 0$ on $[A, B]$ is equivalent to proving

$$\begin{aligned} & \frac{f(y^* \mid h = 1)}{f(y^* \mid h = 0)} \frac{y^*}{\frac{\bar{\eta}\sigma_\epsilon^2 + y^*\sigma_\eta^2}{\sigma_\epsilon^2 + \sigma_\eta^2}} \\ = \quad & e^{-\frac{(y^* - \bar{\eta})^2 \sigma_\epsilon^2}{2\sigma_\eta^2(\sigma_\epsilon^2 + \sigma_\eta^2)}} \frac{y^*(\sigma_\epsilon^2 + \sigma_\eta^2)^{\frac{3}{2}}}{\sigma_\eta\left(\bar{\eta}\sigma_\epsilon^2 + y^*\sigma_\eta^2\right)} > 1. \end{aligned}$$

The solution is found by recognizing that e^{-x} is an upper bound of $\frac{1}{(x+1)^2}$ on $x \in [0,2]$ and observing that $0 \leq \frac{(y^*-\bar{\eta})^2\sigma_\epsilon^2}{2\sigma_\eta^2(\sigma_\epsilon^2+\sigma_\eta^2)} \leq 2$ for $y^* \in [A,B]$. Then, for $y^* \in [A,B]$,

$$\begin{aligned} & e^{-\frac{(y^*-\bar{\eta})^2\sigma_\epsilon^2}{2\sigma_\eta^2(\sigma_\epsilon^2+\sigma_\eta^2)}} \frac{y^*\left(\sigma_\epsilon^2+\sigma_\eta^2\right)^{\frac{3}{2}}}{\sigma_\eta\left(\bar{\eta}\sigma_\epsilon^2+y^*\sigma_\eta^2\right)} > \frac{1}{(\frac{(y^*-\bar{\eta})^2\sigma_\epsilon^2}{2\sigma_\eta^2(\sigma_\epsilon^2+\sigma_\eta^2)}+1)^2} \frac{y^*\left(\sigma_\epsilon^2+\sigma_\eta^2\right)^{\frac{3}{2}}}{\sigma_\eta\left(\bar{\eta}\sigma_\epsilon^2+y^*\sigma_\eta^2\right)} \\ = & \frac{4y^*\sigma_\eta^3\left(\sigma_\epsilon^2+\sigma_\eta^2\right)^{\frac{7}{2}}}{\left(\bar{\eta}\sigma_\epsilon^2+y^*\sigma_\eta^2\right)\left((y^*-\bar{\eta})^2\sigma_\epsilon^2+2\sigma_\epsilon^2\sigma_\eta^2+2\sigma_\eta^4\right)^2} > \frac{4\sigma_\eta^3\left(\sigma_\epsilon^2+\sigma_\eta^2\right)^{\frac{5}{2}}}{\left((y^*-\bar{\eta})^2\sigma_\epsilon^2+2\sigma_\epsilon^2\sigma_\eta^2+2\sigma_\eta^4\right)^2} \\ > & 1, \end{aligned}$$

where the second line follows from using $y^* > \bar{\eta}$ and the third from (4.12) after some lines of algebra. As a consequence, a unique solution $\hat{y} \in (A,B)$ exists such that $\Delta V(\hat{y}) = 0$. Hence, if $y^* > \hat{y}$ then $h^* = 1$, whereas if $y^* < \hat{y}$ then $h^* = 0$. By definition, $y^* = \hat{y}$ leaves the incumbent indifferent between $h^* = 1$ and $h^* = 0$. This establishes the lemma. ■

C.2 Proof of Proposition 4.2

By using (4.9) and (4.16), the incumbent's monopoly rent V in the mandatory hedge disclosure regime is

$$\begin{aligned} V(y^*(h),h) := & \quad \delta_I \int_{-\infty}^{y^*(h)} E(\eta \mid y_1,h) f(y^*(h),h) dy_1 \\ = & \quad F(y^*(h),h) \times \delta_I \left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^*(h),h)}{F(y^*(h),h)}\right), \end{aligned}$$

where $F(y^*(h),h)$ denotes the probability of remaining monopolist and $\delta_I\left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^*(h),h)}{F(y^*(h),h)}\right)$ denotes the value of incumbency conditional on y_1 *not* exceeding $y^*(h)$. Following the decomposition proposed in (4.9), the total change in the monopoly rent $V(y^*(h),h)$ with respect to h can be disaggregated into

$$\begin{aligned} \frac{dV(y^*(h),h)}{dh} = & \underbrace{\frac{dF(y^*(h),h)}{dh} \times \underbrace{\delta_I\left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^*(h),h)}{F(y^*(h),h)}\right)}_{>0 \text{ from (4.12)}}}_{\text{“Probability Effect”}} \\ & + \underbrace{\underbrace{F(y^*(h),h)}_{>0} \times \frac{d}{dh}\delta_I\left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^*(h),h)}{F(y^*(h),h)}\right)}_{\text{“Value Effect”}}. \end{aligned}$$

Proposition 4.2 follows immediately from showing that $\frac{dV(y^*(h),h)}{dh} < 0$ on $h \in [0,1]$. The proof clearly involves two lemmas:

1. **Lemma C.4:** *The probability of the incumbent remaining monopolist strictly decreases in the incumbent's hedging choice h; hence $\frac{dF(y^*(h),h)}{dh} < 0$.*
2. **Lemma C.5:** *The value of incumbency conditional on y_1 not exceeding $y^*(h)$ strictly decreases in the incumbent's hedging choice h; hence $\frac{d}{dh}\delta_I \left(\bar{\eta} - \sigma_\eta^2 \frac{f(y^*(h),h)}{F(y^*(h),h)}\right) < 0$.*

Both lemmas can be established as follows.[2]

Lemma C.4 *The probability of the incumbent remaining monopolist strictly decreases in the incumbent's hedging choice h; hence $\frac{dF(y^*(h),h)}{dh} < 0$.*

Proof. Taking the total derivative of $F(y^*(h),h)$ with respect to h yields

$$\begin{aligned}
\frac{dF(y^*(h),h)}{dh} &= \underbrace{\frac{\partial F(y^*(h),h)}{\partial y^*(h)}\frac{dy^*(h)}{dh}}_{\text{"Strategic Effect"}} + \frac{\partial F(y^*(h),h)}{\partial h} \\
&= f(y^*(h),h)\left(-\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R} - \bar{\eta}\right) + \frac{(y^*(h)-\bar{\eta})\sigma_\epsilon^2}{2\sigma_y^2}\right) \\
&= f(y^*(h),h)\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\underbrace{\left(\frac{K}{1-\delta_R} - \bar{\eta}\right)}_{>0 \text{ from (4.3)}}\left(-1+\frac{1}{2}\right) \\
&< 0. \qquad \text{(C.7)}
\end{aligned}$$

The first term in the first line reflects the incumbent's first-mover (i.e., Stackelberg leader) position. This "strategic effect" results from the influence of the hedging choice h on the entry threshold and does not exist in the earlier analysis of unobservable hedging activity. The second line follows from $\frac{\partial F(y^*(h),h)}{\partial y^*(h)} = f(y^*(h),h)$, $\frac{dy^*(h)}{dh} = -\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R} - \bar{\eta}\right)$, and $\frac{\partial F(y^*(h),h)}{\partial h} = \frac{(y^*(h)-\bar{\eta})\sigma_\epsilon^2}{2\sigma_y^2} f(y^*(h),h)$, which follows along the lines from (4.14). The third line substitutes $y^*(h)$ from (4.15). ■

[2]In what follows, I will omit the functional dependence of $f(\cdot)$ and $F(\cdot)$ on $y^*(h)$ and h for notational convenience where possible.

Lemma C.5 *The value of incumbency conditional on y_1 not exceeding $y^*(h)$ strictly decreases in the incumbent's hedging choice h; hence $\frac{d}{dh}\delta_I\left(\bar{\eta}-\sigma_\eta^2\frac{f(y^*(h),h)}{F(y^*(h),h)}\right)<0$.*

Proof. Taking the total derivative of $\delta_I\left(\bar{\eta}-\sigma_\eta^2\frac{f(y^*(h),h)}{F(y^*(h),h)}\right)$ with respect to h yields

$$\begin{aligned}&\frac{d}{dh}\delta_I\left(\bar{\eta}-\sigma_\eta^2\frac{f(y^*(h),h)}{F(y^*(h),h)}\right)\\ =\;& -\delta_I\sigma_\eta^2\frac{\frac{df(y^*(h),h)}{dh}F(\cdot)-\frac{dF(y^*(h),h)}{dh}f(\cdot)}{F(\cdot)^2}<0 \qquad \text{(C.8)}\end{aligned}$$

if the sign of the numerator in (C.8) is positive. This can be easily established by using $\frac{dF(y^*(h),h)}{dh}<0$ from (C.7) and

$$\begin{aligned}\frac{df(y^*(h),h)}{dh} &= \frac{\partial f(y^*(h),h)}{\partial y^*(h)}\frac{dy^*(h)}{dh}+\frac{\partial f(y^*(h),h)}{\partial h}\\ &= \left(\frac{(y^*(h)-\bar{\eta})}{\sigma_y^2}*\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R}-\bar{\eta}\right)-\frac{\sigma_\epsilon^2\left((y^*(h)-\bar{\eta})^2-\sigma_y^2\right)}{2\sigma_y^4}\right)f(\cdot)\\ &= \frac{\sigma_\epsilon^2\left(\sigma_\epsilon^2(1-h)(K-(1-\delta_R)\bar{\eta})^2+\sigma_\eta^2(K-(1-\delta_R)\bar{\eta})^2+\sigma_\eta^4(1-\delta_R)\right)}{2\sigma_\eta^4(1-\delta_R)^2\sigma_y^6}f(\cdot)\\ &> 0.\end{aligned}$$

Observe that the second line follows from $\frac{\partial f(y^*(h),h)}{\partial y^*(h)}=-\frac{(y^*(h)-\bar{\eta})}{\sigma_y^2}f(y^*(h),h)$, $\frac{dy^*(h)}{dh}=-\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R}-\bar{\eta}\right)$ and from using $\frac{\partial f(y^*(h),h)}{\partial h}=-\frac{\sigma_\epsilon^2\left((y^*(h)-\bar{\eta})^2-\sigma_y^2\right)}{2\sigma_y^4}f(y^*(h),h)$, which has been derived in (C.3). The third line follows from substituting for (4.15). The threshold value $y^*=\frac{K}{1-\delta_R}+\frac{\sigma_\epsilon^2}{\sigma_\eta^2}\left(\frac{K}{1-\delta_R}-\bar{\eta}\right)$ follows from (4.15). ■

C.3 A Formal Characterization of Positive Monopoly Rents

In the following, I prove that the monopoly rent V is positive on $h \in [0,1]$ if $\bar{\eta} > \sigma_\eta$, which is equivalent to proving $\frac{\bar{\eta}}{\sigma_\eta^2} > \frac{f(y^*|h)}{F(y^*|h)}$.

Proof. Observe that $\frac{f(y^*|h)}{F(y^*|h)}$ cannot be represented in terms of elementary functions. The solution is found by recognizing an upper bound for $\frac{f(y^*|h)}{F(y^*|h)}$, namely,

$$\sigma_y^{-1} \frac{2}{\frac{y^*-\bar{\eta}}{\sigma_y} + \sqrt{\left(\frac{y^*-\bar{\eta}}{\sigma_y}\right)^2 + 4}} > \frac{f(y^* \mid h)}{F(y^* \mid h)}, \text{ for } y^* > \bar{\eta}. \tag{C.9}$$

Then, by utilizing $y^* - \bar{\eta} > 0$ and $\bar{\eta} > \sigma_\eta$, it is straightforward to show that

$$\frac{\bar{\eta}}{\sigma_\eta^2} > \max_{h\in[0,1]} \sigma_y^{-1} \frac{2}{\frac{y^*-\bar{\eta}}{\sigma_y} + \sqrt{\left(\frac{y^*-\bar{\eta}}{\sigma_y}\right)^2 + 4}} = \frac{2}{y^* - \bar{\eta} + \sigma_\eta \sqrt{\left(\frac{y^*-\bar{\eta}}{\sigma_\eta}\right)^2 + 4}},$$

which establishes the claim. Inequality (C.9) follows from

$$\frac{2}{x + \sqrt{x^2+4}} > \frac{\varphi(x)}{\Phi(x)}, \text{ for } x > 0$$

and

$$\sigma_y^{-1} \frac{\varphi(\frac{y^*-\bar{\eta}}{\sigma_y})}{\Phi(\frac{y^*-\bar{\eta}}{\sigma_y})} = \frac{f(y^* \mid h)}{F(y^* \mid h)},$$

where $\varphi(x)$ denotes the pdf of the standard normal distribution and $\Phi(x)$ its cdf. ■

Bibliography

Adam, T., Dasgupta, S., and Titman, S., 2007. Financial Constraints, Competition, and Hedging in Industry Equilibrium. *Journal of Finance*, 62, 2445-2473.

Aghion, P. and Bolton, P., 1987. Contracts as a Barrier to Entry. *American Economic Review*, 3, 388-401.

Aghion, P. and Tirole, J., 1997. Formal and Real Authority in Organizations. *Journal of Political Economy*, 105(1), 1-29.

Alchian, A., 1969. Corporate Management and Property Rights, in Manne, H. (ed.): *Economic Policy and the Regulation of Corporate Securities*, Washington, DC: American Enterprise Institute, 337-360.

Allen, F. and Faulhaber, G.R., 1989. Signalling by Underpricing in the IPO market. *Journal of Financial Economics*, 23(2), 303-323.

Amihud, Y. and Lev, B., 1981. Risk Reduction as a Managerial Motive for Conglomerate Mergers. *Bell Journal of Economics*, 12(2), 605-617.

Antle, R. and Eppen, G.D., 1985. Capital Rationing and Organizational Slack in Capital Budgeting. *Management Science*, 31(2), 163-174.

Bain, J.S., 1956. *Barriers to New Competition*, Cambridge, MA: Harvard University Press.

Banerjee, A.V., 1992. A Simple Model of Herd Behavior. *Quarterly Journal of Economics*, 107(3), 797-817.

Banks, J.S. and Sobel, J., 1987. Equilibrium Selection in Signaling Games. *Econometrica*, 55(3), 647-661.

Baruch, Y. and Holtom, B.C., 2008. Survey Response Rate Levels and Trends in Organizational Research. *Human Relations*, 61(8), 1139-1160.

Bednar, M.K. and Westphal, J.D., 2006. Surveying the Corporate Elite: Theoretical and Practical Guidance on Improving Response Rates and Response Quality in Top Management Survey Questionnaires. *Research Methodology in Strategy and Management*, 3, 37-55.

Berger, P.G. and Ofek, E., 1995. Diversification's Effect on Firm Value. *Journal of Financial Economics*, 37(1), 39-65.

Berkovitch, E. and Israel, R., 2004. Why the NPV Criterion does not Maximize NPV. *Review of Financial Studies*, 17(1), 239-255.

Bernardo, A.E., Cai, H., and Luo, J., 2001. Capital Budgeting and Compensation with Asymmetric Information and Moral Hazard. *Journal of Financial Economics*, 61(3), 311-344.

Bernardo, A.E., Cai, H., and Luo, J., 2004. Capital Budgeting in Multidivision Firms: Information, Agency, and Incentives. *Review of Financial Studies*, 17(3), 739-767.

Bernardo, A.E., Luo, J., and Wang, J.J., 2006. A Theory of Socialistic Internal Capital Markets. *Journal of Financial Economics*, 80(3), 485-509.

Bernheim, B.D. and Whinston, M.D., 1990. Multimarket Contact and Collusive Behavior. *RAND Journal of Economics*, 21(1), 1-26.

Bertrand, M. and Mullainathan, S., 2001. Do People Mean What They Say? Implications for Subjective Survey Data. *American Economic Review*, 91(2), 67-72.

Bhattacharya, S., 1979. Imperfect Information, Dividend Policy, and "The Bird in the Hand" Fallacy. *Bell Journal of Economics*, 10(1), 259-270.

Bhide, A., 1990. Reversing Corporate Diversification. *Journal of Applied Corporate Finance*, 3(2), 70-81.

Bikhchandani, S., Hirshleifer, D., and Welch, I., 1992. A Theory of Fads, Fashion, Custom, and Cultural Change as Informational Cascades. *Journal of Political Economy*, 100(5), 992-1026.

Black, F. and Scholes, M., 1973. The Pricing of Options and Corporate Liabilities. *Journal of Political Economy*, 81(3), 637-654.

Bolton, P. and Scharfstein, D.S., 1990. A Theory of Predation based on Agency Problems in Financial Contracting. *American Economic Review*, 80, 93-106.

Bolton, P. and Scharfstein, D.S., 1996. Optimal Debt Structure and the Number of Creditors. *Journal of Political Economy*, 104(1), 1-25.

Bower, J., 1970. *Managing the Resource Allocation Process: A Study of Corporate Planning and Investment,* Boston, MA: Harvard Business School Press.

Brealey, R.A. and Myers, S.C., 2003. *Principles of Corporate Finance*, New York: McGraw-Hill/Irwin.

Bromiley, P., 1986. *Corporate Capital Investment*, Cambridge: Cambridge University Press.

Brounen, D., Jong, A.D., and Koedijk, K., 2004. Corporate Finance in Europe: Confronting Theory with Practice. *Financial Management*, 33(4), 71-101.

Brusco, S. and Panunzi, F., 2005. Reallocation of Corporate Resources and Managerial Incentives in Internal Capital Markets. *European Economic Review*, 49(3), 659-681.

Campbell, J.L., 2009. The Fair Value of Cash Flow Hedges, Future Profitability and Stock Returns. *Unpublished Working Paper*, University of Arizona.

Campello, M., Graham, J.R., and Harvey, C.R., 2010. The Real Effects of Financial Constraints: Evidence from a Financial Crisis. *Journal of Financial Economics*, 97(3), 470-487.

Carlton, D.W., 2004. Why Barriers to Entry are Barriers to Understanding. *American Economic Review*, 94(2), 466-470.

Caves, R.D., 1981. Diversification and Seller Concentration: Evidence from Change, 1963-1972. *Review of Economics and Statistics*, 63(2), 289-293.

Cestone, G. and Fumagalli, C., 2005. The Strategic Impact of Resource Flexibility in Business Groups. *RAND Journal of Economics*, 36(1), 193-214.

Cheung, S., 1982. Property Rights in Trade Secrets. *Economic Inquiry,* 20, 40-53.

Cho, I. and Kreps, D.M., 1987. Signaling Games and Stable Equilibria. *Quarterly Journal of Economics*, 102(2), 179-221.

Comment, R. and Jarrell G.A., 1995. Corporate Focus and Stock Returns. *Journal of Financial Economics*, 37(1), 67-87.

Corman, L., 2006. Lost in the Maze. *CFO Magazine*, 22(6), 66-70.

Cyert, R.M. and DeGroot, M.H., 1974. Rational Expectations and Bayesian Analysis. *Journal of Political Economy*, 82(3), 521-536.

DasGupta, A., 2008. *Asymptotic Theory of Statistics and Probability*, New York: Springer.

Darrough, M.N., 1993. Disclosure Policy and Competition: Cournot vs. Bertrand. *The Accounting Review*, 68(3), 534-561.

DeGroot, M.H., 1970. *Optimal Statistical Decisions,* New York: McGraw-Hill.

DeMarzo, P.M. and Duffie, D., 1995. Corporate Incentives for Hedging and Hedge Accounting. *Review of Financial Studies*, 8(3), 743-771.

De Motta, A., 2003. Managerial Incentives and Internal Capital Markets. *Journal of Finance*, 58(3), 1193-1220.

Dewatripont, M. and Maskin, E., 1995. Credit and Efficiency in Centralized and Decentralized Economies. *Review of Economic Studies*, 62(4), 541-555.

Diamond, D.W. and Dybvig, P.H., 1983. Bank Runs, Deposit Insurance, and Liquidity. *Journal of Political Economy*, 91(3), 401-419.

Dillman, D.A., 1978. *Mail and Telephone Surveys: The Total Design Method*, New York: John Wiley & Sons.

Duchin, R., 2010. Cash Holdings and Corporate Diversification. *Journal of Finance*, 65(3), 955-992.

Eckbo, B.E., 2008. *Handbook of Corporate Finance: Empirical Corporate Finance*, Oxford: Elsevier North-Holland.

Edwards, C.D., 1955. Conglomerate Bigness as a Source of Power. *Business Concentration and Price Policy*, 331-352.

FASB, 2008. *FASB Issues Exposure Draft on Accounting for Hedging Activities.* FASB News Release from June 6, 2008, http://www.fasb.org/jsp/FASB/Page/nr060608.shtml. Date accessed March 13, 2010.

FASB, 2010. *Accounting for Financial Instruments – Joint Project of the IASB and FASB.* Project Update from April 15, 2010, http://www.fasb.org/cs/ContentServer?c=FASBContent_C&pagename=FASB%2FFASBContent_C%2FProjectUpdatePage&cid=1175801889654. Date accessed March 13, 2010.

Fama, E.F., 1970. Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, 25(2), 383-417.

Froot, K.A., Scharfstein, D.S., and Stein, J.C., 1993. Risk Management: Coordinating Corporate Investment and Financing Policies. *Journal of Finance*, 48(5), 1629-1658.

Fudenberg, D. and Tirole, J., 1986. A "Signal-Jamming" Theory of Predation. *RAND Journal of Economics*, 17(3), 366-376.

Fudenberg, D. and Tirole, J., 1991. Perfect Bayesian Equilibrium and Sequential Equilibrium. *Journal of Economic Theory*, 53(2), 236-260.

Gal-Or, E., 1985. Information Sharing in Oligopoly. *Econometrica: Journal of the Econometric Society*, 53(2), 329-343.

Gaspar, J.M. and Massa, M., 2006. Idiosyncratic Volatility and Product Market Competition. *Journal of Business*, 79(6), 3125-3152.

Gastineau, G., Smith, D., and Todd, R., 2001. *Risk Management, Derivatives, and Financial Analysis under SFAS No. 133*, Research Foundation of AIMR, Charlottesville, VA: Blackwell.

Gautier, A. and Heider, F., 2009. The Benefit and Cost of Winner-Picking: Redistribution versus Incentives. *Journal of Institutional and Theoretical Economics*, 165, 622-649.

Geroski, P.A., 1995. What Do we Know about Entry? *International Journal of Industrial Organization*, 13(4), 421-440.

Gertner, R.H., Scharfstein, D.S., and Stein, J.C., 1994. Internal Versus External Capital Markets. *Quarterly Journal of Economics*, 109(4), 1211-1230.

Gigler, F., Kanodia, C., and Venugopalan, R., 2007. Assessing the Information Content of Mark-to-Market Accounting with Mixed Attributes: The Case of Cash Flow Hedges. *Journal of Accounting Research*, 45(2), 257-276.

Gitman, L.J. and Forrester, J.R., 1977. A Survey of Capital Budgeting Techniques Used by Major U.S. Firms. *Financial Management*, 6(3), 66-71.

Goel, A.M., Nanda, V., and Narayanan, M.P., 2004. Career Concerns and Resource Allocation in Conglomerates. *Review of Financial Studies*, 17(1), 99-128.

Goodman, G. E., 2005. Memo to FASB and IASB: How to Repair Statements. *GARP Risk Review,* 5(22), 22-25.

Graham, J.R. and Harvey, C.R., 2001. The Theory and Practice of Corporate Finance: Evidence from the Field. *Journal of Financial Economics*, 60(2-3), 187-243.

Graham, J.R., Harvey, C.R., and Puri, M., 2010. Capital Allocation and Delegation of Decision-Making Authority Within Firms. *Unpublished Working Paper*, Duke University.

Graham, J.R., Harvey, C.R., and Rajgopal, S., 2005. The Economic Implications of Corporate Financial Reporting. *Journal of Accounting and Economics*, 40(1-3), 3-73.

Greene, W.H., 2003. *Econometric Analysis*, New York: New York University.

Grossman, S.J. and Hart, O.D., 1986. The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration. *Journal of Political Economy*, 94(4), 691-719.

Hadlock, C.J., Ryngaert, M., and Thomas, S., 2001. Corporate Structure and Equity Offerings: Are There Benefits to Diversification? *Journal of Business*, 74(4), 613-635.

Hann, R.N., Ogneva, M., and Ozbas, O., 2009. Corporate Diversification and the Cost of Capital. *Unpublished Working Paper*, Stanford University.

Harris, M., Kriebel, C.H., and Raviv, A., 1982. Asymmetric Information, Incentives and Intrafirm Resource Allocation. *Management Science*, 28(6), 604-620.

Harris, M. and Raviv, A., 1996. The Capital Budgeting Process: Incentives and Information. *Journal of Finance*, 51(4), 1139-1174.

Hart, O., 1995. *Firms, Contracts, and Financial Structure*, Oxford: Oxford University Press.

Hart, O. and Moore, J., 1990. Property Rights and the Nature of the Firm. *Journal of Political Economy*, 98(6), 1119-1158.

Hart, O. and Moore, J., 1995. Debt and Seniority: An Analysis of the Role of Hard Claims in Constraining Management. *American Economic Review*, 85(3), 567-585.

Hellwig, M., 2000. On the Economics and Politics of Corporate Finance and Corporate Control, in: Vives, X. (ed.): *Corporate Governance*, Cambridge: Cambridge University Press, 95-134.

Hellwig, M., 2001. Corporate Governance and the Financing of Investment for Structural Change, in: Deutsche Bundesbank (ed.): *Investing Today for the World of Tomorrow: Studies on the Investment Process in Europe*, Berlin: Springer, 203-223.

Henderson, B., 1970. *The Product Portfolio*, Boston: Boston Consulting Group.

Henderson, B., 1979. *Henderson on Corporate Strategy*, New York: New American Library.

Hirshleifer, D. and Titman, S., 1990. Share Tendering Strategies and the Success of Hostile Takeover Bids. *Journal of Political Economy*, 98(2), 295-324.

Hoang, D. and Ruckes, M.E., 2008. Informed Headquarters and Socialistic Internal Capital Markets. *Unpublished Working Paper*, Karlsruhe Institute of Technology.

Holmström, B., 1982. Managerial Incentive Problems: A Dynamic Perspective. *Essays in Economics and Management in Honor of Lars Wahlbeck*, Helsinki: Swedish School of Economics, 303-328.

Holmström, B., 1999. Managerial Incentive Problems: A Dynamic Perspective. *Review of Economic Studies*, 66(1), 169-182.

Inderst, R. and Laux, C., 2005. Incentives in Internal Capital Markets. *RAND Journal of Economics*, 36(1), 215-228.

Inderst, R. and Müller, H.M., 2003. Internal versus External Financing: An Optimal Contracting Approach. *Journal of Finance*, 58(3), 1033-1062.

Jensen, M.C., 1986. Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers. *American Economic Review*, 76(2), 323-329.

Jensen, M.C., 1993. The Modern Industrial Revolution, Exit, and the Failure of Internal Control Systems. *Journal of Finance*, 48(3), 831-880.

Jensen, M.C. and Meckling, W.H., 1976. Theory of the Firm: Managerial Behavior, Agency Costs and Ownership Structure. *Journal of Financial Economics*, 3(4), 305-360.

John, K. and Williams, J., 1985. Dividends, Dilution, and Taxes: A Signalling Equilibrium. *Journal of Finance*, 40(4), 1053-1070.

Johnson, N.L., Kotz, S., and Balakrishnan, N., 1995. *Continuous Univariate Distributions: Vol. 1*, New York: John Wiley & Sons.

Jorion, P., 1985. International Portfolio Diversification with Estimation Risk. *Journal of Business*, 58(3), 259-278.

Kanodia, C., Mukherji, A., Sapra, H., and Venugopalan, R., 2000. Hedge Disclosures, Future Prices, and Production Distortions. *Journal of Accounting Research*, 38, 53-82.

Kawaller, I.G., 2004. What Analysts Need to Know about Accounting for Derivatives. *Financial Analysts Journal*, 60(2), 24-30.

Khanna, N. and Tice, S., 2001. The Bright Side of Internal Capital Markets. *Journal of Finance*, 56(4), 1489-1528.

Kolasinski, A.C., 2009. Subsidiary Debt, Capital Structure and Internal Capital Markets. *Journal of Financial Economics*, 94(2), 327-343.

Kreps, D.M. and Wilson, R., 1982. Sequential Equilibria. *Econometrica*, 50(4), 863-894.

Kuppuswamy, V. and Villalonga, B., 2010. Does Diversification Create Value in the Presence of External Financing Constraints? Evidence from the 2008-2009 Financial Crisis. *Unpublished Working Paper*, Harvard University.

Lang, L.H.P. and Stulz, R.M., 1994. Tobin's Q, Corporate Diversification, and Firm Performance. *Journal of Political Economy*, 102(6), 1248-1280.

Lazear, E.P. and Rosen, S., 1981. Rank-Order Tournaments as Optimum Labor Contracts. *Journal of Political Economy*, 89(5), 841-864.

Leland, H.E. and Pyle, D.H., 1977. Informational Asymmetries, Financial Structure, and Financial Intermediation. *Journal of Finance*, 32(2), 371-387.

Leuz, C. and Wysocki, P., 2008. Economic Consequences of Financial Reporting and Disclosure Regulation: A Review and Suggestions for Future Research. *Unpublished Working Paper*, University of Chicago.

Lewellen, W.G., 1971. A Pure Financial Rationale for the Conglomerate Merger. *Journal of Finance*, 26(2), 521-537.

Liebeskind, J.P., 1997. Keeping Organizational Secrets: Protective Institutional Mechanisms and their Costs. *Industrial and Corporate Change*, 6(3), 623-663.

Liebeskind, J.P., 2000. Internal Capital Markets: Benefits, Costs, and Organizational Arrangements. *Organization Science*, 11(1), 58-76.

Lintner, J., 1965. The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. *Review of Economics and Statistics*, 47(1), 13-37.

Liu, T. and Parlour, C.A., 2009. Hedging and Competition. *Journal of Financial Economics*, 94(3), 492-507.

Mailath, G.J., Okuno-Fujiwara, M., and Postlewaite, A., 1993. Belief-Based Refinements in Signalling Games. *Journal of Economic Theory*, 60(2), 241-276.

Maksimovic, V. and Phillips, G.M., 2002. Do Conglomerate Firms Allocate Resources Inefficiently Across Industries? Theory and Evidence. *Journal of Finance*, 57(2), 721-767.

Maksimovic, V. and Phillips, G.M., 2007. Conglomerate Firms and Internal Capital Markets, in Eckbo, B.E. (ed.): *Handbook of Corporate Finance: Empirical Corporate Finance*, North-Holland, Amsterdam, 423-477.

Markowitz, H., 1952. Portfolio Selection. *Journal of Finance*, 7(1), 77-91.

Matsusaka, J.G. and Nanda, V., 2002. Internal Capital Markets and Corporate Refocusing. *Journal of Financial Intermediation*, 11(2), 176-211.

McAfee, R.P., Mialon, H.M., and Williams, M.A., 2004. What Is a Barrier to Entry? *American Economic Review*, 94(2), 461-465.

McDonald, J.F. and Moffitt, R.A., 1980. The Uses of Tobit Analysis. *Review of Economics and Statistics*, 62(2), 318-321.

Mello, A.S. and Ruckes, M.E., 2005. Financial Hedging and Product Market Rivalry. *Unpublished Working Paper*, University of Wisconsin Madison.

Merton, R.C., 1973. Theory of Rational Option Pricing. *Bell Journal of Economics and Management Science*, 4(1), 141-183.

Meyer, M., Milgrom, P., and Roberts, J., 1992. Organizational Prospects, Influence Costs, and Ownership Changes. *Journal of Economics & Management Strategy*, 1(1), 9-35.

Milgrom, P., 1988. Employment Contracts, Influence Activities, and Efficient Organization Design. *Journal of Political Economy*, 96(1), 42-60.

Milgrom, P. and Roberts, J., 1988. An Economic Approach to Influence Activities in Organizations. *American Journal of Sociology*, 94, 154-179.

Miller, M.H. and Culp, C.L., 1996. The SEC's Costly Disclosure Rules. *The Wall Street Journal*, June 25.

Miller, M.H. and Rock, K., 1985. Dividend Policy under Asymmetric Information. *Journal of Finance*, 40(4), 1031-1051.

Mintzberg, H., 1975. The Manager's Job: Folklore and Fact. *Harvard Business Review*, 53(4), 49-61.

Modigliani, F. and Miller, M.H., 1958. The Cost of Capital, Corporation Finance and the Theory of Investment. *The American Economic Review*, 48(3), 261-297.

Montgomery, C.A., 1994. Corporate Diversification. *Journal of Economic Perspectives*, 8(3), 163-178.

Myers, S.C., 1984. The Capital Structure Puzzle. *Journal of Finance*, 39(3), 575-592.

Myers, S.C. and Majluf, 1984. Corporate Financing and Investment Decisions When Firms Have Information That Investors Do Not Have. *Journal of Financial Economics*, 13(2), 187-221.

Nöldeke, G. and Samuelson, L., 1997. A Dynamic Model of Equilibrium Selection in Signaling Markets. *Journal of Economic Theory*, 73(1), 118-156.

O'Keeffe, M., Viscusi, W.K., and Zeckhauser, R.J., 1984. Economic Contests: Comparative Reward Schemes. *Journal of Labor Economics*, 2(1), 27-56.

Ozbas, O., 2005. Integration, Organizational Processes, and Allocation of Resources. *Journal of Financial Economics*, 75(1), 201-242.

Ozbas, O. and Scharfstein, D.S., 2010. Evidence on the Dark Side of Internal Capital Markets. *Review of Financial Studies*, 23(2), 581-599.

Panzar, J.C. and Willig, R.D., 1981. Economies of Scope. *American Economic Review*, 71(2), 268-272.

Patel, J. and Read, C., 1996. *Handbook of the Normal Distribution*, New York: Marcel Dekker.

Penrose, E.T., 1959. *The Theory of the Growth of the Firm*, Oxford: Oxford University Press.

Poterba, J.M., and Summers, L.H., 1995. A Survey of U.S. Companies, Time Horizons, and Hurdle Rates. *Sloan Management Review,* 37(1), 43-53.

Prahalad, C.K. and Hamel, G., 1990. The Core Competence of the Firm. *Harvard Business Review*, 68(3), 79-91.

Rajan, R., 1994. Why Bank Policies Fluctuate: A Theory and some Evidence. *Quarterly Journal of Economics*, 109(2), 399-441.

Rajan, R., Servaes, H., and Zingales, L., 2000. The Cost of Diversity: The Diversification Discount and Inefficient Investment. *Journal of Finance*, 55(1), 35-80.

Ramanujam, V. and Varadarajan, P., 1989. Research on Corporate Diversification: A Synthesis. *Strategic Management Journal*, 10(6), 523-551.

Rock, K., 1986. Why New Issues are Underpriced. *Journal of Financial Economics*, 15(1-2), 187-212.

Ross, M., 1986. Capital Budgeting Practices of Twelve Large Manufacturers. *Financial Management*, 15(4), 15-22.

Ross, S.A., 1977. The Determination of Financial Structure: The Incentive-Signalling Approach. *Bell Journal of Economics*, 8(1), 23-40.

Ross, S.A., Westerfield, R.W., and Jaffe, J., 2006. *Corporate Finance*, New York: McGraw-Hill/Irwin.

Ryan, S.G., 2007. *Financial Instruments and Institutions: Accounting and Disclosure Rules*, New York: John Wiley & Sons.

Sapra, H., 2002. Do Mandatory Hedge Disclosures Discourage or Encourage Excessive Speculation? *Journal of Accounting Research*, 40, 933-964.

Scharfstein, D.S., 1998. The Dark Side of Internal Capital Markets II: Evidence from Diversified Conglomerates. *Unpublished Working Paper*, No. 6352, NBER.

Scharfstein, D.S. and Stein, J.C., 1990. Herd Behavior and Investment. *American Economic Review*, 80(3), 465-479.

Scharfstein, D.S. and Stein, J.C., 2000. The Dark Side of Internal Capital Markets: Divisional Rent-Seeking and Inefficient Investment. *Journal of Finance*, 55(6), 2537-2564.

Schmalensee, R., 2004. Sunk Costs and Antitrust Barriers to Entry. *American Economic Review*, 94(2), 471-475.

Schotter, A. and Weigelt, K., 1992. Asymmetric Tournaments, Equal Opportunity Laws, and Affirmative Action: Some Experimental Results. *Quarterly Journal of Economics*, 107(2), 511-539.

Servaes, H., Tamayo, A., and Tufano, P., 2009. The Theory and Practice of Corporate Risk Management. *Journal of Applied Corporate Finance*, 21(4), 60-78.

Sharpe, W.F., 1964. Capital Asset Prices: A Theory of Market Equilibrium under Conditions of Risk. *Journal of Finance*, 19(3), 425-442.

Shin, H. and Stulz, R.M., 1998. Are Internal Capital Markets Efficient? *Quarterly Journal of Economics*, 113(2), 531-552.

Shleifer, A. and Vishny, R.W., 1986. Large Shareholders and Corporate Control. *Journal of Political Economy*, 94(3), 461-488.

Shleifer, A. and Vishny, R.W., 1989. Management Entrenchment: The Case of Manager-specific Investments. *Journal of Financial Economics*, 25(1), 123-139.

Siegfried, J.J. and Evans, L.B., 1994. Empirical Studies of Entry and Exit: A Survey of the Evidence. *Review of Industrial Organization*, 9(2), 121-155.

Smith Jr., C.W., 1995. Corporate Risk Management: Theory and Practice. *Journal of Derivatives*, 2(4), 21-30.

Smith Jr., C.W. and Stulz, R.M., 1985. The Determinants of Firms' Hedging Policies. *Journal of Financial and Quantitative Analysis*, 20(4), 391-405.

Stein, J.C., 1997. Internal Capital Markets and the Competition for Corporate Resources. *Journal of Finance*, 52(1), 111-133.

Stein, J.C., 2002. Information Production and Capital Allocation: Decentralized versus Hierarchical Firms. *Journal of Finance*, 57(5), 1891-1921.

Stein, J.C., 2003. Agency, Information and Corporate Investment, in Constantinides, G., Harris, M., and Stulz, R. (ed.): *Handbook of the Economics of Finance*, Amsterdam, North Holland, 109-163.

Stiglitz, J.E. and Weiss, A., 1981. Credit Rationing in Markets with Imperfect Information. *American Economic Review*, 71(3), 393-410.

Stulz, R.M., 1996. Rethinking Risk Management. *Journal of Applied Corporate Finance*, 9(3), 8-25.

Teece, D.J., 1980. Economies of Scope and the Scope of the Enterprise. *Journal of Economic Behavior and Organization*, 1(3), 223-247.

Teece, D.J., 1982. Towards an Economic Theory of the Multiproduct Firm. *Journal of Economic Behavior and Organization*, 3(1), 39-63.

Tirole, J., 1988. *The Theory of Industrial Organization*, Cambridge: MIT Press.

Vives, X., 1984. Duopoly Information Equilibrium: Cournot and Bertrand. *Journal of Economic Theory*, 34(1), 71-94.

Von Weizsäcker, C.C., 1980. *Barriers to Entry: A Theoretical Treatment*, Berlin: Springer.

Weston, J.F., 1970. Diversification and Merger Trends. *Business Economics*, 5, 50-57.

Williamson, O.E., 1975. *Markets and Hierarchies: Analysis and Antitrust Implications*, London: Collier Macmillan.

Wulf, J., 2002. Internal Capital Markets and Firm-Level Compensation Incentives for Division Managers. *Journal of Labor Economics*, 20(2), 219-262.

Wulf, J., 2009. Influence and Inefficiency in the Internal Capital Market. *Journal of Economic Behavior and Organization*, 72(1), 305-321.

Xia, Y., 2001. Learning about Predictability: The Effects of Parameter Uncertainty on Dynamic Asset Allocation. *Journal of Finance*, 56(1), 205-246.

Xuan, Y., 2009. Empire-Building or Bridge-Building? Evidence from New CEOs' Internal Capital Allocation Decisions. *Review of Financial Studies*, 22(12), 4919-4948.

Zhang, G., 1997. Moral Hazard in Corporate Investment and the Disciplinary Role of Voluntary Capital Rationing. *Management Science*, 43(6), 737-750.