Three essays in corporate finance and corporate governance

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THREE ESSAYS IN CORPORATE FINANCE AND CORPORATE GOVERNANCE

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Summary

This dissertation consists of three self-contained essays on corporate finance and corporate governance.

The first essay models the firm's decision on whether to go public or stay private. The explanation for the going public decision is based on the catering-to-market motive. The private ownership allows greater flexibility in operation decisions. In contrast, the business strategy in the public firm is subject to investor sentiment. The model suggests that managers' willingness to take efficient strategic actions depends on the relative importance of corporate strategic decisions and external shocks on future profitability. If the strategic decision is less important than the random shock, then a large proportion of the firm performance is determined by the exogenous shock, and thus managers will never choose initial public offering (IPO) because of risk of experiencing severe underpricing. If the strategic decision plays a bigger role than the external shock on the future profit, managers can launch IPO to raise capital but IPO provides managers with the incentives to select the strategy to please investors instead of selecting the best strategy perceived by managers. Aware of this temptation, managers choose to stay private. If managers determine to swim against the tide, they have to issue more equity to raise the same amount of capital because investors underprice the shares. The baseline model assumes that investors are boundedly rational. This essay also develops a parallel model assuming that investors are fully rational. However, full rationality cannot entirely eliminate inefficiency.

The second essay examines the interactions among three corporate governance mechanisms of the U.S. public firms, namely, the board structure, product market competition, and incentive compensation. The board structure and product market competition serve as monitoring devices that provide a disciplinary '*stick*' to managers. The former is an internal monitoring device, while the latter is an external monitoring device. In contrast, incentive compensation provides a '*carrot*' to align the incentive of managers with that of owners. This essay evaluates the change in the board structure following the enactment of the Sarbanes-Oxley (SOX) act in 2002 on the strength of incentive compensation provision. It employs the combination of the difference-in-difference-in-difference approach and the propensity score matching in an attempt to mitigate the endogeneity problem. The results show that pay-to-

performance sensitivity on average decreases because of SOX enactment, and this decrease is bigger in more competitive industries.

The last essay examines how the corporate cash policy is affected by the industry financial dependence. The main finding is that firms effectively use tangible assets to signal pledgeability to investors and debt holders as to reduce excessive cash holdings, and this negative relationship between cash holdings and asset tangibility is more pronounced in financially dependent industries. It further finds evidence consistent with the hypothesis that asset tangibility is indeed a choice variable of the firm rather than an exogenously determined industry attribute.

Chapter 1 Introduction

Modern corporations are characterized by the separation of ownership and management. In the presence of information asymmetry, this separation may lead to the moral hazard problem. Much academic thinking has discussed a variety of corporate governance mechanisms that need to be installed to mitigate the moral hazard problem. For a contemporary firm, the internal governance mechanisms may include, among others, direct monitoring by shareholders, structure of the board of directors, and the executive compensation scheme. The various external governance mechanisms may include, e.g. debt-holders monitoring, lobbying by suppliers and consumers, etc. All of these mechanisms, to a certain degree, direct and control the nature and the extent of accountability of the involved economic agents. This dissertation consists of three self-contained essays on corporate finance and governance, each of which is developed as a separate chapter.

The dissertation is organized as follows. Chapter 2 models the firm's decision on whether to go public or to stay private. Whether to go public is an important decision for private firms. In chapter 2, the explanation for the going public decision is based on the catering-to-market motive. As emphasized by Aghion and Stein (2008), firms generally face a tradeoff between the growth orientation strategy and the margins orientation strategy. The interplay between a public firm's strategic decision and the market pricing rule leads to excessive volatility in real variables due to the manager's incentive to cater to the market. Under private ownership, the catering-to-market motivation is absent. It thus allows firms to have greater flexibility in the business strategy. The main finding is that managers' willingness to take efficient strategic actions depends on the relative importance of corporate strategic decisions and external shocks to future profitability. If the strategic decision is less important than the random shock, then a large proportion of the firm performance is determined by the exogenous shock, and managers will never choose initial public offering (IPO) because of the risk of experiencing severe underpricing. If the managerial decision plays a bigger role than the external shock on the future profit, managers can launch IPO to raise capital but IPO provides managers with the incentives to select the strategy to please investors

instead of selecting the best strategy perceived by managers. Aware of this temptation, managers choose to stay private. If managers determine to swim against the tide, they have to issue more equity to raise the same amount of capital because investors underprice the shares. The baseline model assumes that investors are boundedly rational. We also develop a parallel model assuming that investors are fully rational. We show, however, full rationality cannot entirely eliminate inefficiency.

Chapter 2 makes two contributions. First, it extends Aghion and Stein (2008)'s model to IPO decisions. In a principal-agent model, Aghion and Stein (2008) show that stock market introduces excessive volatility into real variables. However, their model does not directly speak on IPO decisions and the stock shares that a manager will sell to the market are assumed to be exogenously determined. Our model makes richer predictions on the timing of the IPO decision and the shares sold to the market. Second, Aghion and Stein (2008)'s model does not provide insight on which type of the firms are more likely to avoid stock market due to the concern of investor sentiment. Our model suggests that firms whose external uncertainty outweighs the managerial action would be more vulnerable to the catering-to-market motive.

Once going public, the firm deals with a different set of governance mechanisms. To begin with, while going public gives away a fraction of firm ownership and leads to the initial owners losing some control over the firm's management decisions, the investors in the public firm are generally much more dispersed than those in the private firms. The greater information asymmetry between investors and managers calls for monitoring devices to align the interests of managers to those of shareholders. Moreover, the corporate regulations on public firms and private firms are vastly different. For example, public firms are required to form the board which is composed of the majority of independent directors and regularly report compensation packages for the top management team. Yet no such requirement is imposed on private firms.

Chapter 3 examines the interactions among three corporate governance mechanisms of the U.S. public firms, namely, the board structure, product market competition, and incentive compensation. While the interaction between board structure and incentive compensation has been evaluated in the literature before,

little is known about the extent of how the relationship between these two corporate governance mechanisms are affected by product market competition, which in itself is also a corporate governance mechanism. The board structure and product market competition serve as monitoring devices that provide a disciplinary '*stick*' to managers for ensuring that managers serve the best interests of owners. The former is an internal monitoring device, while the latter is an external monitoring device. In contrast, incentive compensation provides a '*carrot*' to align the incentive of managers with that of owners. In particular, we evaluate the change in the board structure following the enactment of the Sarbanes-Oxley (SOX) act in 2002 on the strength of the incentive compensation. The results show that pay-to-performance sensitivity on average decreases because of SOX enactment and this decrease is bigger in more competitive industries. This finding is consistent with the hypothesis that product market competition effectively serve as a disciplinary mechanism.

Chapter 3 has several contributions to the existing literature. First, it puts three corporate governance mechanisms together in an integrated framework while previous studies generally study the cross sectional relations between two mechanisms. Second, it contributes to the heated debate on the consequences and efficiency of SOX, the far-reaching act in corporate governance. It presents inputs to regulators for a comprehensive evaluation of the SOX act. Third, it provides a cleaner test of interactions between different corporate governance mechanisms: it exploits the exogenous change in the board structure; it focuses on product market competition, an industry level attribute which is less vulnerable to the endogeneity problem; it employs the combination of the difference-in-difference-in-difference approach and propensity score matching to mitigate the self-selection bias.

The previous two chapters examine firms' behavior as they seek additional capital from the equity market. Chapter 4 extends the sources of funds to firms' general dependence on external finance. More specifically, it examines how the corporate cash policy is affected by the industry financial dependence. The past literature has discussed a rich set of possible determinants of the cash holding decision. Nevertheless, much less attention is directed at examining to what extent the exogenous industry-level characteristics affect the decision of cash holding and to what extent firms may react to the built-in industry characteristics. This chapter

helps fill the gap by examining the role of the external financial dependence and the usage of tangible assets to reduce the negative consequences stemming from the external financial dependence. The main finding is that firms effectively allocate tangible assets to signal pledgeability to investors and debt holders as to reduce excessive cash holdings, and this negative relationship between cash holdings and asset tangibility is more pronounced in financially dependent industries. We further find evidence consistent with the hypothesis that asset tangibility is indeed a choice variable of the firm rather than an exogenously determined industry attribute.

Chapter 4 makes two contributions. First, although it has been documented that tangible assets are negatively related to cash assets, tangible assets holdings normally appear in the set of control variables. This chapter provides greater details on the role of tangible assets in the corporate cash policy. Second, instead of sweeping the inter-industry variations into the dummy variables as in many previous studies, we quantify the interaction of industry external financial dependence and corporate holdings of tangible assets.

Although the three chapters discuss three independent topics, they share certain general ideas from a broader perspective. Chapter 2 and Chapter 4 share the common theme that real variables and financial variables are correlated. In Chapter 2, the operation strategies on real variables such as sales and margins are liable to whether the source of funds is internal or external. In Chapter 4, the financial dependence structure at a given industry contains an important component of technological specification. Meanwhile, Chapter 3 and Chapter 4 both attempt to gain insights on how industry level attributes affect the firm level decisions. In Chapter 3, the industry competition intensity exerts an important impact on the governance mechanisms, namely, board independence and incentives. In Chapter 4, the industry financial dependence affects the firm's allocation of tangible assets and the cash policy. The common advantage of examining industry level attributes is that the industry structure is less vulnerable to the endogeneity problem that plagues many financial studies with only firm level variables.

The thesis starts with the entrepreneur's decision on whether to go public or stay private. Investment sentiment, invariably introduced by external capital, affects the manager's business strategy, which in turn affects the IPO decision.

Once going public, firms control the accountability of the stakeholders by considering a set of interrelated governance mechanisms, including incentives, board independence and competition. At last, the thesis goes beyond the internal capital and stock market, and looks at the role of general financial dependence in the allocation of tangible assets and cash assets. Overall, all the three chapters take the view that the real and financial variables, all the governance mechanisms work in a combination rather than in isolation. In light of this perspective, the thesis attempts to deepen our understanding on corporate finance decisions and corporate governance designs.

Chapter 2 Go Public or Stay Private: a Catering Theory¹

2.1 Introduction

The decision on whether to go public is important for private firms. Since managers weigh benefits and costs of the operational and financing decisions simultaneously, these two types of decisions are likely to be intertwined. On the one hand, going public provides an alternative channel to raise capital; on the other hand, this capital does not come without strings attached. Previous theoretical literature offers a long list of potential factors that concern managers, such as informational asymmetry (Chemmanur and Fulghieri, 1999), control (Zingales, 1995), liquidity (Bolton and Von Thadden, 1998), and so on. This chapter adds a new one. The primary motivation here is to investigate the possibility that catering-to-market motive, which results in deviations from the optimal actions, deters managers from entering the stock market.

Private ownership allows greater flexibility in corporate governance. According to the survey of CFOs by Brau and Fawcett (2006), "CFOs identify the desire to maintain decision-making control as the primary reason for staying private." While decision-making control can be realized in various contexts, we are particularly interested in the growth-margins trade-off emphasized in Aghion and Stein (2008) (henceforth AS). In different phases of development, firms lean toward different strategy orientations. They can pursue a full-growth strategy and focus on increasing the sales, or go for a cost-cutting strategy to strengthen the margins. Given the limited time and resources, firms have to carefully allocate efforts between the two business strategies. In our model, managers of private firms choose the optimal effort level to maximize the fundamental value, and thus they take the ex-ante first best actions in expectation based on the available information.

In contrast, going public not only gives away a fraction of the expected future profit but also exposes the firm's management to investor sentiment. We take the

¹ This chapter has been presented at Singapore Economic Review Conference 2011.

stand that the causality between market conjecture and the actually chosen strategy runs in both directions. If the market prefers one specific dimension to assess the firm performance, the manager may stand up to the expectation by following the fashionable strategy. Conversely, observing firms in the active pursuit of certain strategy leads investors to weigh more heavily on the metric that evaluates the performance of the intended strategy.

The baseline model assumes that investors have bounded rationality. Bounded rationality in this context suggests that to predict the future profit, investors concentrate on only one dimension of performance measurement. They run a univariate regression on either the growth or margins metric depending on their perception of the firm's strategy. Our main finding is that managers' willingness to take the first best action depends on the relative importance of strategic decisions and external shocks on future profitability. If the strategic decision plays a bigger role than the exogenous shock on the future profit, the manager can launch IPO to raise capital and yet IPO provides incentives to deviate from the first best action. Actually once the firms go public, managers are tempted to cater to the market perception by selecting a strategy in favor of investors instead of the best strategy perceived by managers themselves. Aware of this temptation, managers choose to stay private in the first place. If managers determine to swim against the tide, the cost comes in the form that they have to issue more equity to raise the same amount of capital because investors underprice the chosen strategy. If the influence of the strategic decision is smaller than or equal to that of the exogenous shock, then a large proportion of the firm performance is determined by the exogenous shock, and the manager will never choose IPO because of experiencing severe underpricing.

We also develop a model assuming that investors are fully rational for generality. Full rationality means that investors forecast the future profit of the firm by running a bivariate regression on both the observed growth and margins. We intend to compare how different views of investors will affect the result. Full rationality alleviates the problem but inefficiency is not entirely eliminated. If the managerial decision has a bigger impact on the future profit, in a world of rational investors, the range of the market condition that induces managers to deviate from the first best action still exists but narrows. The manager can issue less equity to

raise the same amount of capital as a price for not following the market, and thus the benefits of external financing dries up slower for managers going against the best strategy perceived by investors.

An immediate implication is that overpricing is not necessarily a blessing. The pecking order theory suggests that external funds are less desirable because informational asymmetry between the manager and investors leads to undervaluation of the traded stocks. We argue that the external funds can be undesirable even in the case of overvaluation on condition that short-run overpricing comes at the expense of abandoning the efficient strategic choice.

Apart from most previous literature stressing the connection between the level of stock prices and real activities (Tobin, 1969), our description of strategic decisions in a public firm inherits AS's focus on sensitivity of stock prices to observable real variables such as sales and profit margins. Depending on the market conjecture, the investment and sales growth can deviate from the first best case in both directions. For example, the public firm is subject to excessive investment and sales growth to buck the market expectation if the market puts a greater emphasis on the growth-related measurement. Alternatively, if the market attributes a larger role to costs and margins in the valuation, then investment and sales growth in the public firm are beneath the efficient level. This effect points to volatility, the second moment, of real variables. To weigh costs and benefits of external financing, the manager would take this volatility concern into consideration.

Throughout our model, two elements contribute to the disparity between the conjectured strategy by the market and the actual strategy. First, the effort allocation between growth and margins strategies is not observable to investors, which leaves room for the maneuver to maximize the manager's self-interests at the expense of efficient strategic choices. The unobservable effort renders our model generally in line with information asymmetry argument. Second, we posit that besides unobservable efforts, investors may disagree with the manager regarding the strategic decisions. The idea that there exists disagreement between investors and the manager on corporate operations is not a new one. Kurz (1994a, 1994b) proposes economic agents can form different beliefs consistent with rationality. The assumption of heterogeneous prior beliefs is used in many models,

such as Allen and Gale (1999), Boot et al. (2006, 2008), and Steen (2004). In our model, differing opinions arise only between investors and the manager. Although we consider and compare two types of investors—boundedly rational and fully rational, in each separate case, investors develop homogeneous beliefs on the firm's growth prospects and future profitability. In other words, we do not directly address the complications of heterogeneous beliefs among investors.

The reminder of the chapter is organized as follows. In section 2.2, we lay out the baseline model resting on the assumption of investors with bounded rationality. In section 2.3, we introduce the assumption of fully rational investors and then compare the results of these two models. Section 2.4 outlines the implications and gives concluding remark.

2.2 Baseline Model

2.2.1 Information Structure and Technology

The baseline model rests on the assumption of boundedly rational investors. The firm operates for two periods. In the first period, the manager is endowed with one unit of effort e and determines the allocation of efforts between two business strategies. He can devote all the effort to either the growth strategy by focusing on increasing the sale volume or the margins strategy by concentrating on improving the profit per unit sale. The effort, however, is only observable to the manager, which naturally leads to the possibility of the moral hazard problem. Furthermore, the realized managerial ability is unknown to both the manager and investors. Ability, denoted by a , follows a normal distribution with mean A and variance v^a . Following AS, the sales and margins are specified as follows

$$s_1 = aeq + \varepsilon^s \quad (2.1)$$

$$m_1 = a(1 - e) + \varepsilon^m \quad (2.2)$$

where q denotes the market size in the first period and is exogenously determined. ε^s is the random shock to sales and follows the normal distribution with zero mean and variance v^s . Similarly, ε^m is the random shock to margins and follows the normal distribution with zero mean and variance v^m . The random shocks to sales

and margins are independent of each other. They are also independent of managerial ability. With the one unit effort, if the manager pursues all-growth (all-margins) strategy, we have $e = 1$ ($e = 0$).

The first period profit π_1 is the sum of the sales and margins. Mathematically, the profit is the product of sales revenue and profit margins. However, the present model specifies that the profit function is the sum of sales and profit margins. These variables can be interpreted as the log forms as they are additive not multiplicative. The profit function specifies

$$\pi_1 = s_1 + m_1 \quad (2.3)$$

The second period profit π_2 depends on the past decision as well as realized shocks. We assume that the strategic component, $aeq + a(1 - e)$, and the shock component, $\varepsilon^s + \varepsilon^m$, enter the second period in a different way.

$$\pi_2 = \lambda[aeq + a(1 - e)] + \rho(\varepsilon^s + \varepsilon^m) \quad (2.4)$$

where λ and ρ are both persistence measures and fall within the neighborhood of (0,1).

This specification has several important implications. First, the first item, $\lambda[aeq + a(1 - e)]$, is subject to the strategic choice of the manager. Although the information of realized ability is unavailable to both the market and the manager, the first item guarantees that the second period profit is at least partially in the control of the manager. The strategic component is to capture the idea that efficient strategic decisions from the past leave the firm with desirable legacy. If the manager makes a wrong decision to boost stock prices in the short run, the blunder may backfire in the future. Second, since the effort is unobservable to the market, it allows the manager and investors to have different expectations of the strategic component. Third, it is crucial that we distinguish the influences from the strategic component and the shock component. The intuition behind is simple. Although the efficient strategic decisions and favorable random shocks are both rewarding, the exactly same shock will not necessarily reoccur in the future. In fact, it turns out that $\lambda > \rho$ is equivalent to assume that the firm is given a positive price by investors even when managers do not follow the fashionable strategy favored by

the market investors. The baseline model assumes that the profit in the manager's control exerts a bigger impact on the future profit than the external shock ($\lambda > \rho$).

At the beginning, the manager's role is close to an entrepreneur in order to avoid complications of the contracting problem between the initial investors and the manager. If the risk-neutral manager maintains the private ownership, the utility function is linear in the current profit and the discounted future profit in expectation. The manager maximizes his utility as follows

$$\max_e E[U] = E(\pi_1 + \delta\pi_2) \quad (2.5)$$

where δ is the discount factor.

Instead, if the manager decides to go public by selling α shares of ownership, the expected utility includes the current profit, the expected price of the sold shares and the present value of the future profit. The manager maximizes his utility as follows

$$\max_{e,\alpha} E[U] = E[\pi_1 + \alpha P + (1 - \alpha)\delta\pi_2] \quad (2.6)$$

Despite the same notation in AS, α here has a different interpretation. In AS, α is the probability that the manager will experience the liquidity shock and thus is exogenously determined. In our model, α is defined as the fractional ownership the manager has to sell in exchange for external capital and thus is a choice variable. In addition, since α in AS is not subject to judgment of the manager, whatever action the manager takes in the first period has no consequence on the future profit. For this reason, the second period profit is excluded from the expected utility function. Nevertheless, in our setting, the bigger α is, the greater proportion of the future profit is transferred to new investors. α reflects the trade-off that the manager faces. Consequently, the second future profit has to be taken into consideration and to be kept in the expected utility function.

The sequence of events is as follows. At the beginning of period one, the manager makes an operational decision to select either the growth or margins strategy. At the end of the period one, the sales and margins components come to light. With private information on the effort e , the manager decides whether to go

public by selling α fractional ownership to raise one unit capital². Based on realized observations of sales and margins, investors price the firm's stocks by forecasting the future profit in line with market conjecture of the strategic orientation. Alternatively, if the manger decides to stay private, the manger simply maximizes the fundamental value of the firm in expectation given the available information. At the period two, the second period profit is realized. Since the manager makes the strategic choice at the beginning of the game, his expectation of the future potential public pricing entertains his belief on the future market conjecture. The timeline in Figure 2.1 captures the timing of the game.

Figure 2.1: The Sequence of Events

Our model considers only the one-period decision, which can be conveniently interpreted to proxy long-run effects. One may argue that since mispricing is unlikely to persist in the long-run, the extent to which our model can generate realistic empirical predication is quite limited. Nevertheless, we argue that empirically mispricing is significant enough to warrant the concern addressed by our model. Da et al. (2012) find that firms with relatively high valuation, high historical sales growth rate but low gross margins in the three years after the IPO wave, underperform their industry IPO wave peers by 0.92 % per month for the subsequent four years. Their finding suggests that investors significantly overprice the growth stocks of firms in early stage of life cycles with perceived growth opportunities.

² In our model, the firm only has two choices, either to stay status quo in private ownership or to become a public firm. Thus selling shares privately is not considered in the choice set as the focus of the model is on the negative effects of the stock market. We acknowledge this limitation in our model and thank the anonymous examiner for pointing it out.

2.2.2 Private Ownership

Immune from market sentiment, the manager of a private firm maximize the expected utility, which is in complete alignment with the firm's fundamental value³. The manager solves the optimization problem as

$$\max_e E(\pi_1 + \delta\pi_2) = (1 + \delta\lambda)[Aeq + A(1 - e)] \quad (2.7)$$

The optimal decision rule is as follows: (1) the manager should select the all-growth strategy ($e = 1$) if the market size q is larger than one. The expected utility is $E[U|e = 1] = (1 + \delta\lambda)Aeq$; (2) the manager should select the all-margins strategy ($e = 0$) if the market size is smaller than one. The expected utility is then $E[U|e = 0] = (1 + \delta\lambda)A$; (3) if the market size is equal to one, the choice of the business strategy orientation is irrelevant, and the manager will be indifferent between the two strategies and obtain the expected utility $E[U] = (1 + \delta\lambda)Aq = (1 + \delta\lambda)A$. Intuitively, the manager should devote more efforts on increasing the sales if the market demand is substantial, and vice versa. The upshot is that the manager will switch the strategy as soon as the market size exceeds or falls below the watershed demand $q = 1$.

2.2.3 Public Ownership

Market Pricing by Investors with Bounded Rationality and the Choice of α

The baseline model assumes that investors are only boundedly rational. They use only one dimension of performance measures, growth or margins, to evaluate the firm's future prospect. The importance of this assumption is built on the following two blocks.

The first block is limits of arbitrage. The Efficient Markets Hypothesis (EMH) suggests that in an efficient market, actual prices reflect fundamental values. Defenders of EMH argue that if irrational investors cause the price to deviate from

³ From the perspective of shareholders, holdings of a given firm's stock shares represent the claims to the stream of cash flows generated by the firm. Therefore, more precisely, the value of the firm is the sum of discounted cash flows. In financial accounting, cash flow is defined as the net income (namely, the profit) adjusted for depreciation/amortization, changed in working capital and capital expenditure. However, finance theories commonly ignore this accounting technicality and assume that the firm value can be represented by the sum of present value of profits. We follow this conventional assumption in the literature. Thank one anonymous examiner for pointing it out.

fundamental value, rational investors will snap up the arbitrage opportunity and quickly undo any mispricing. However, the behavioral finance literature argues that even if not all the investors are boundedly rational, it is not always the case that rational investors will rapidly step in to exploit the arbitrage. When mispricing occurs, strategies designed to correct mispricing can be risky and costly. The previous literature discusses many causes that limit the arbitrage, including fundamental risk, noise trader risk (De Long et al., 1990; Shleifer and Vishny, 1997), implementation costs (D'Avolio, 2002) and restrictions on short-selling (See Barberis and Thaler (2003) for a comprehensive review on behavioral finance).

The second block draws on psychology. Investors can exhibit specific bias deviating full rationality. The psychology literature has accumulated considerable evidence that the limited information processing capability leads people to simplify even the basic kind of the forecasting task. The real world presents us an overwhelming amount of the relevant information to forecast the future. With information overload and limited attention, people tend to simplify the forecasting task by concentrating on only a subset of available data. More importantly, people act as if the simplified model represents the reality. Tversky and Kahneman (1973) provide ample evidence that people overweigh information easily available in memories, such as salient or vivid information.

In finance, previous literature has attempted to embody this more realistic assumption. As a notable example, Hong et al. (2007) study the asset pricing implications of the environment where agents take a simple univariate model as an accurate description of the multivariate complex reality. Instead of engaging in model averaging, agents conduct model selection between two univariate models. This switch between two simple models is termed as the paradigm shift. Sharing the same spirit, we provide the assumption that investors pick up only one variable to fulfill the task of forecasting. Specifically, they will only look at one dimension of the past performance, growth or margins, depending on the prevalent market conjecture. They will run a univariate regression of the future profit on observed growth or margins. The estimates of coefficients are unbiased and the forecast is obtained through minimizing the variance of forecast errors.

Note that our definition of bounded rationality strictly applies to how investors estimate the stock price. After all, it takes considerable cognitive efforts as well as monetary costs to collect all the information and make a thorough analysis. If these costs and efforts are taken into account, the definition of bounded rationality here can be consistent with rationality in a more general sense.

Suppose that the market perceives that the firm is engaged in growth strategy ($e^* = 1$). Conditional on the observed sales s_1 and the market size q , the price of the stock is

$$P = E(\delta\pi_2|s_1, m_1, e^* = 1) = \delta[\lambda Aq + \beta^{sg}(s_1 - Aq)] \quad (2.8)$$

where $\beta^{sg} = cov(\pi_2, s_1|e^* = 1)/var(s_1|e^* = 1) = (\lambda v^a q^2 + \rho v^s)/(v^a q^2 + v^s)$.⁴

In the same vein, if the firm is perceived to pursue the margins strategy ($e^* = 0$), conditional on the observed margins m_1 , the stock's price is

$$P = E(\delta\pi_2|s_1, m_1, e^* = 0) = \delta[\lambda A + \beta^{mg}(m_1 - A)] \quad (2.9)$$

where $\beta^{mm} = cov(\pi_2, m_1|e^* = 0)/var(m_1|e^* = 0) = (\lambda v^a + \rho v^m)/(v^a + v^s)$.

To determine the quantity of α shares sold to the market, the manager consider the following question: to raise one dollar from the stock market, what is the minimum α shares of the firm's present value that the manager has to give up? This is the individual rationality constraint. Specifically, we

$$\alpha E[P|s_1, m_1, e^*] \geq 1 \quad (2.10)$$

To solve the strategic choice later, we assume that this constraint is indeed binding by setting $\alpha = 1/E[P|s_1, m_1, e^*]$. This specification suggests that the intended amount of the raised capital is exogenously determined by the available profitable projects and is actually normalized to one. The firm is indifferent between internal and external financing as long as the amount of money raised is

⁴ Throughout this chapter, we follow AS's notations of the upper scripts of β . On the first digit, s indicates the sales component and m indicates the margins component. On the second digit, g indicates the market conjecture of growth strategy and m indicates the market conjecture of the margins strategy. For example, β^{sg} is the coefficient of the external shock on the sales component when the market conjecture is the growth strategy.

the same for the given cost. In other words, we assume away other potential incentives of IPO other than raising capital, such as risk diversification and increased liquidity in the public shares as suggested by the previous literature. In addition, an implied assumption here is that the firm is not severely financially constrained. The financial condition of the firm is at least good enough to enable itself to raise the unit capital internally. The firm can turn to the stock market as an alternative funding source because the firm can take advantage of the external funds, not because it has to.

Rational Expectation Equilibria

Now we can construct the sufficient conditions for the rational expectation equilibria in which the business strategy perceived by the market is identical to the actual strategy adopted by the manager. For the private ownership, the dividing point $q = 1$ is crucial for the switch of strategies in the optimal decision rule. As soon as the market size passes one, the manager switches from the margins strategy to the growth strategy and vice versa. It is only when the market size is exactly equal to one that the manager will be indifferent between two business strategies. However, public ownership, as we will demonstrate later, yields a larger range that allows multiple equilibria in which both growth and margins strategies are incentive compatible.

Since the manager has to make operational and financing decisions before the investors price the firm, he has to infer the expected price at the starting point of the game. Therefore every item in the utility function is calculated in expectation.

All Growth Equilibrium

Suppose first that the firm follows the market conjecture $e^* = 1$ by setting $e = 1$, then the expected sales, the current profit, and the expected margins are respectively

$$E(s_1|e = 1) = E(\pi_1|e = 1) = Aq; E(m_1|e = 1) = 0 \quad (2.11)$$

Substitute into the pricing rule discussed in the previous subsection and calculate the expectation as

$$E[P] = E[E(\delta\pi_2|e^* = 1)|e = 1] = \delta A\lambda q \quad (2.12)$$

Given the expected price, to raise one unit of capital, the manager sells α^{ge} shares to the market⁵

$$\alpha^{ge} = \frac{1}{E[P]} = \frac{1}{\delta A \lambda q} \quad (2.13)$$

Note that in the rational equilibrium, the market has the same prediction of the future profit as the manager. The manager then has the expected utility

$$E[U|e^* = e = 1] = (1 + \delta A) \lambda q \quad (2.14)$$

If the manager goes against the market conjecture and seeks the margins strategy ($e = 0$) instead, then the expected sales, the expected margins, and the first-period profit are respectively

$$E(s_1|e = 0) = Aeq = 0; E(m_1|e = 0) = E(\pi_1|e = 0) = A \quad (2.15)$$

The manager would expect that the market pricing becomes

$$E[P] = E[E(\delta \pi_2|e^* = 1)|e = 0] = \delta A(\lambda q - \beta^{sg} q) \quad (2.16)$$

The individual rationality constraint suggests that the manager sells α^{gd} shares to the market

$$\alpha^{gd} = \frac{1}{E[P]} = 1/\delta A(\lambda q - \beta^{sg} q) \quad (2.17)$$

α^{gd} is by definition strictly positive and no greater than one, implying that $E[P] = \delta A(\lambda q - \beta^{sg} q) \geq 1$ has to hold to ensure manager's willingness to go public. Additionally, the manager has a different prediction of the discounted future profit

$$\delta E(\pi_2|e = 0) = \delta \lambda A \quad (2.18)$$

The expected utility is

⁵ Throughout the chapter, for the upper scripts of α , we use g to indicate the market conjecture of the growth strategy, m to indicate the market conjecture of the margins strategy, e to indicate the rational expectation equilibrium where the market conjecture is the same as the actual strategy, and d to indicate that the manager's action deviates from the market conjecture. For example, α^{ge} denotes the shares that the manager sells to the market when both the market conjecture and manager's decision are the growth strategy.

$$E[U|e^* = 1, e = 0] = A + \alpha^{gd} \delta A (\lambda q - \beta^{sg} q) + (1 - \alpha^{gd}) \delta \lambda A \quad (2.19)$$

The incentive compatible constraint suggests that the manager would devote all the effort to the growth strategy ($e = 1$) if

$$E[U|e^* = 1, e = 1] \geq E[U|e^* = 1, e = 0] \quad (2.20)$$

Equivalently, we have

$$q \geq 1 - \frac{\alpha^{gd} \delta \beta^{sg} q}{1 + (1 - \alpha^{gd}) \delta \lambda} \quad (2.21)$$

For a sufficiently large market size q , the manager will play the growth strategy in accord with the market conjecture. Denote the cutoff value that renders this constraint binding by q^- . Thus q^- solves

$$q^- = 1 - \frac{\alpha^{gd} \delta \beta^{sg} q^-}{1 + (1 - \alpha^{gd}) \delta \lambda} \quad (2.22)$$

All Margins Equilibrium

Similarly, we can solve the sufficient conditions for the all-margins equilibrium. Suppose that the market forms the conjecture that the firm pursues the margins strategy ($e^* = 0$). If the firm indeed follows the margins strategy, then the expected sales, the expected margins and the current profit are

$$E(s_1|e = 0) = Aeq = 0; E(m_1|e = 0) = E(\pi_1|e = 0) = A \quad (2.23)$$

Substitute into the pricing rule under the margins conjecture and calculate the price expected by the manager

$$E[P] = E[E(\delta \pi_2|e^* = 0)|e = 0] = \delta \lambda A \quad (2.24)$$

It follows that equity issuance and expected utility are

$$\alpha^{me} = \frac{1}{E[P]} = \frac{1}{\delta \lambda A} \quad (2.25)$$

$$E[U|e^* = 0, e = 0] = (1 + \delta \lambda) A \quad (2.26)$$

Conversely, if the manager deviates from the perceived strategy by setting $e = 1$, then the expected sales, the current profit, the expected margins, the expected stock price and fractional ownership sold to raise capital are respectively

$$E(s_1|e = 1) = E(\pi_1|e = 1) = Aq; E(m_1|e = 1) = 0 \quad (2.27)$$

$$E[P] = E[E(\delta\pi_2|e^* = 0)|e = 1] = \delta A(\lambda - \beta^{mm}) \quad (2.28)$$

$$\alpha^{md} = \frac{1}{E[P]} = \frac{1}{\delta A(\lambda - \beta^{mm})} \quad (2.29)$$

For a reasonable choice of $\alpha^{md} \in (0,1]$, the condition $E[P] = \delta A(\lambda - \beta^{mm}) \geq 1$ should be satisfied. Because of discrepancy between the perceived strategy and the actual strategy, the manager will have a different estimate of discounted future profit and obtain the expected utility respectively as

$$\delta E(\pi_2|e = 1) = \delta \lambda Aq \quad (2.30)$$

$$E[U|e^* = 0, e = 1] = Aq + \alpha^{md} \delta A(\lambda - \beta^{mm}) + (1 - \alpha^{md}) \delta \lambda Aq \quad (2.31)$$

The incentive compatible constraint ensures that the manager will choose the margins strategy ($e = 0$) if

$$E[U|e^* = 0, e = 0] \geq E[U|e^* = 0, e = 1] \quad (2.32)$$

Equivalently,

$$q \leq 1 + \frac{\alpha^{md} \delta \beta^{mm}}{1 + (1 - \alpha^{md}) \delta \lambda} \quad (2.33)$$

Denote by q^+ the cutoff value that satisfies the condition above with equality and thus q^+ solves

$$q^+ = 1 + \frac{\alpha^{md} \delta \beta^{mm}}{1 + (1 - \alpha^{md}) \delta \lambda} \quad (2.34)$$

Now we pull together all the previous calculations in both equilibria. First we find the necessary condition for the firm to be positively priced.

Lemma 1 *A necessary condition for the firms to go public is that the managerial decision is no less important than external shock on future profit ($\lambda > \rho$).*

Proof: See Appendix for details.

To understand the penalty of refusing to cater to the fashion, we compare the choices of α shares needed to raise the same amount of capital.

Lemma 2 *Assume that investors have bounded rationality. Under either growth or margins market conjecture, the manager will issue more equity to raise the same unit of capital if he goes against the market.*

Proof: Compare the two pairs of alpha choices in growth and margins equilibria respectively as in equation (2.13) and (2.17), (2.25) and (2.29). It follows that $\alpha^{ge} < \alpha^{gd}$ and $\alpha^{me} < \alpha^{md}$.

For positive α^{gd} and α^{md} , we have $q^- < 1 < q^+$. The previous analysis is summarized in Proposition 1.

Proposition 1: *Suppose that the manager decides to go public and external financing is enough to support a strategy against the market conjecture. There exist two cutoff values q^- and q^+ such that (i) $q^- < 1 < q^+$; (ii) if the market size falls below the lower bound q^- , the only equilibrium is that the manager will play the margins strategy ($e = 0$); (iii) if the market size exceeds the upper bound q^+ , the unique equilibrium is that the manager will play the growth strategy ($e = 1$); (iv) if the market size satisfies $q^- < 1 < q^+$, there exists two equilibria, for one of which the manager plays the growth strategy, and for another of which the manager chooses the margins strategy.*

Finally, we compare the decisions rules for public firms and private firms as shown in the Figure 2.2. For private firms, the firm has a dividing point where the market size $q = 1$. The manager will choose the growth strategy as long as $q > 1$ and switch to the margins strategy as long as $q < 1$. He is indifferent between the two strategies if $q = 1$. For public firms, the growth strategy is preferred if $q > q^-$ and the margins strategy is preferred if $q < q^+$. The overlap of the decision rule between $[q^-, q^+]$ indicates the existence of multiple equilibria.

Figure 2.2 Decision Rules in Private Ownership and Public Ownership

Private Ownership

Public Ownership

2.2.4 Backward Induction: Go public or Stay Private

Back to the decision of going public or staying private, we first sketch the game tree based on the previous analysis. The manager makes both the operational and financing decisions at the beginning of the first period according to the expectation of market pricing and the future profit.

If the market size q is larger than the upper bound q^+ , the manager will always pursue the all-growth strategy regardless of the ownership. The expected utility is equal to $(1 + \delta\lambda)Aq$ in both cases echoing the assumption that the firm is indifferent between internal and external financing as long as the unit capital is successfully raised. Similarly, if the market size shrinks beneath q^- , the manager will always go for the all-margins strategy regardless of the ownership structure.

The complication arises when the market size fall within the two incentive compatible constraints $[q^-, q^+]$. Within this range, it is incentive compatible for the manager to choose either the growth or margins strategy depending on the prevalent market conjecture. If the market conjecture coincides with the efficient strategic choice, then the manager's choice and expected utility would be the same as in the case of private ownership. Nevertheless, if the market conjecture disagrees with the efficient strategic choice, then the manager will deviate from the

first best action in order to please investors. Specifically, he could be tempted to choose the all-growth strategy ($e = 1$) when the market size $q \in [q^-, 1]$ where the efficient strategic decision is supposedly the all-margins strategy. The corresponding expected utility is $(1 + \delta\lambda)Aq$, which is smaller than the expected utility $(1 + \delta\lambda)A$ that he would have obtained if he chose to stay private and freely selected the margins strategy. Alternatively, he could be tempted to aim at the all-margins strategy ($e = 0$) when the market size $q \in [1, q^+]$ where the efficient corporate strategy is the all-growth strategy. The manager will get the commensurate expected utility of $(1 + \delta\lambda)A$, which is smaller than the expected utility $(1 + \delta\lambda)Aq$ that he would have obtained if he chose to stay private and selected the growth strategy in the first place. This choice combination of public ownership and catering-to-market corporate strategy leads to lower expected utility than what the manager would otherwise obtain with private ownership. For this reason, back to the initial decision knot, within the range of market size $[q^-, q^+]$, the manager would stay private in the first place to avoid going down the other undesirable road if he expects that the market conjecture disagrees with his strategic decision.

Figure 2.3: Game Tree

Now we can summarize the backward induction analysis in Proposition 2.

Proposition 2: *Suppose that the manager decides to go public and external financing is enough to support a strategy against the market conjecture. There exist two cutoff values q^- and q^+ such that (i) $q^- < 1 < q^+$. ; (ii) if the market size falls below the lower bound q^- , the manager will choose the margins strategy and will be indifferent between the external capital and the internal capital. (iii) if the market size exceeds the upper bound q^+ , the manager will choose the growth strategy ($e = 1$) and he will be indifferent between the external capital and the internal capital. (iv) if the market size satisfies $q^- < q < q^+$, the manager will always choose the strategy favored by the market. If the manager expects that the market agrees with the manager's intended strategy, the manager will be indifferent between the external capital and internal capital. Nevertheless, if the manager expects that the market disagrees with the manager's intended strategy, the manager will be better off to choose to stay private in the first place to avoid the subsequent temptation to cater to the market.*

2.3 A Tale of Two Cities: Bounded Rationality & Full Rationality

This section intends to compare the model's predictions under different assumptions on investors. The baseline model assumes that investors are boundedly rational at the forecasting task. At the end of first period, they will focus on only one measure of the operating performance to evaluate the firm. In this section, we assume that investors extract information from both the sales and margins components and forecast the future profit based on observations of both dimensions. Suppose that the market perceives that the firm is engaged in the growth strategy ($e^* = 1$). Conditional on the observed sales s_1 and margins m_1 , Bayesian updating rule yields the stock price

$$P = E(\delta\pi_2|s_1, m_1, e^* = 1) = \delta[\lambda Aq + \beta^{sg}(s_1 - Aq) + \beta^{mg}m_1] \quad (2.35)$$

where $\beta^{sg} = \text{cov}(\pi_2, s_1|e^* = 1)/\text{var}(s_1|e^* = 1) = (\lambda v^a q^2 + \rho v^s)/(v^a q^2 + v^s)$ and $\beta^{mg} = \text{cov}(\pi_2, m_1|e^* = 1)/\text{var}(m_1|e^* = 1) = \rho v^m/v^m = \rho$.

If the manager goes against the market, the binding individual rationality constraint suggests that the manager sells α^{gd} shares to the market

$$\alpha^{gd} = \frac{1}{E[P]} = 1/\delta A(\lambda q - \beta^{sg} q + \beta^{mg}) \quad (2.36)$$

Going through the same argument, we can get the similar cutoff values that support the incentive compatible constraint. In the all-growth equilibrium, the lower bound q^- is

$$q^- = 1 + \frac{\alpha^{gd} \delta (\beta^{sg} q^- - \beta^{mg})}{1 + (1 - \alpha^{gd}) \delta \lambda} \quad (2.37)$$

The lower bound of the market size q^- is closer to the turning point of $q = 1$ than that in the baseline model (2.22).

Similarly, we work through the calculation for the all-margins equilibrium. In the same vein, if the firm is perceived to pursue the margins strategy ($e^* = 0$), conditional on the observed sales s_1 and margins m_1 , Bayesian updating rule leads to the stock price as

$$P = E(\delta \pi_2 | s_1, m_1, e^* = 0) = \delta [\lambda A + \beta^{sm} s_1 + \beta^{mm} (m_1 - A)] \quad (2.38)$$

where $\beta^{sm} = \text{cov}(\pi_2, s_1 | e^* = 0) / \text{var}(s_1 | e^* = 0) = \rho v^s / v^s$ and $\beta^{mm} = \text{cov}(\pi_2, m_1 | e^* = 0) / \text{var}(m_1 | e^* = 0) = (\lambda v^a + \rho v^m) / (v^a + v^m)$.

If the manager deviates from the market conjecture, then the expected pricing and α fractional ownership sold to the market are

$$E[P] = E[E(\delta \pi_2 | e^* = 0) | e = 1] = \delta A(\lambda + \beta^{sm} q - \beta^{mm}) \quad (2.39)$$

$$\alpha^{md} = 1/E[P] = 1/\delta A(\lambda + \beta^{sm} q - \beta^{mm}) \quad (2.40)$$

The upper bound of market demand q^+ that maintains the incentive compatible constraint is

$$q^+ = 1 + \frac{\alpha^{md} \delta (\beta^{mm} - \beta^{sm} q^+)}{1 + (1 - \alpha^{md}) \delta \lambda} \quad (2.41)$$

Clearly, the upper bound of the market size q^+ is smaller than that in the baseline model (2.34). Now we have worked out all the information in need to compare how different types of investors will affect the final results.

Lemma 3 *Assume that investors are fully rational. If the past decisions affect the future profit by the same degree to historical external shock, the manager will always take the first best action in corporate strategy since $q^- = 1 = q^+$.*

Proof: See Appendix for details.

Lemma 4 *The ranges that induce managers to deviate from the efficient actions are larger with boundedly rational investors than fully rational investors in both the growth and margins equilibria.*

Proof: Compare expressions in equations (2.22) and (2.37), (2.34) and (2.41).

The range of the market size that induces manager to deviate from the first best actions narrows. The manager now has a smaller motivation to cater to the market. This result makes intuitive sense. In the full rationality model, investors rely more heavily on the metric that evaluates the conjectured strategy. They put a greater emphasis on the growth component if the market conjecture is the growth strategy and accentuate the margins component if the market conjecture is the margins strategy. Nevertheless, they also take into account the less important performance measure. In comparison, investors with bounded rationality completely ignore the unfavorable dimension. In this sense, the bounded rationality model can be considered as one extreme case of the fully rational model. As the interplay between public firms and investors leads to inefficient strategic choices in the full rationality model, this effect is only more pronounced in the bounded rationality model.

Lemma 5 *Assume that investors are fully rational. Under the growth or margins conjecture, the manager will issue less equity if he decides to go against the market. However, the equity issuance is larger with boundedly rational investors than with fully rational investors.*

Proof: Compare equations (2.17), (2.29), (2.36) and (2.40).

The first half of the lemma 5 is similar to the baseline model. Since the market underprices the intended strategy, the reasonable reaction is to issue less equity. Additionally, for the same deviation from market conjecture, the choice of α is

smaller with fully rational investors. This result suggests that to deal with fully rational investors, going against the market conjecture incurs a smaller cost for the manager since he can issue less equity to raise the same unit capital.

2.4 Implications and Conclusion

Now we list several implications from our model as follows.

The central prediction is that potential disagreement on the business strategy between managers and investors would discourage managers from going public. The argument goes as follows. Within a certain range of the market conditions, the manager in a public firm will give in to investor sentiment by selecting the fashionable strategy instead of the efficient strategy in case of conflicts. Aware of this temptation, the manager will choose to stay private if he perceives the potential disagreement.

It follows that firms that have greater difficulty of communicating the intended strategy to public investors are less likely to go public since these firms are more likely to encounter disagreement. For example, perhaps communication of the intended business strategy to investors requires specific technical knowledge.

A secondary predication is that the going public decision is determined by the relative importance of the strategic decision and the external shock. This is a rather intuitive result. In our model, the necessary condition to go public is that the influence of the corporate decision outweighs the influence of the exogenous shock. Otherwise the firm will always stay private.

A third prediction is that the catering-to-market concern is more pronounced with boundedly rational investors. If we accept the view that institutional investors are more sophisticated and rational than individual investors, then the predictions above should be more significant for public stocks held by mostly individual investors. A finding along this line would be another piece of evidence to our theory. To our knowledge, there has been no empirical evidence that directly speaks to the third prediction. It can be the potential future research.

Our model can also offer some sights into the leveraged buyouts (LBOs). Most theories on the going public decision are reversible. Basically the manager weighs costs and benefits of two economic forces driving the trade-off. If one economic force outweighs the other factor, a growing number of firms go public. If this is true, the opposite should also apply: if the economic force is outweighed by the other factor, more firms opt out of the public market. In our setting, if the catering-to-market distortion is large enough, more firms would go private. This kind of finding would be indirect evidence to our theory.

In contrast to the considerable theoretical studies on the going public decision, the empirical work is relatively falling behind, primarily because private firms are not required to disclose financial information and it is harder to collect detailed data on private firms. Despite difficulty on the data collection, there have been several important empirical studies that directly speak to the going public decision. Notable examples include Lerner (1994), Pagano et al. (1998), Fischer (2000) and Helwege and Packer (2003). More recently, Chemmanur et al. (2010) provide the first large sample study of the going public decision of U.S. firms. Their sample covers all the public and private manufacturing firms in U.S. and thus is ideal to examine the relationship between firm's ex-ante characteristics and the going public decision. Therefore an ideal data set for our purpose should also include the entire universe of private and public firms in the given industry.

To sum up, we model the manager/entrepreneur's choice of whether to go public or stay private combined with the business strategy selection between growth and margins. The basic message is that the concern of excess volatility in real variables due to the desire to cater to investor's demand may deter the manager from taking advantage of external financing. The baseline analysis rests on the assumption of boundedly rational investors, and we show that full rationality cannot completely remove the inefficiency introduced by external financing. This mechanism is in line with premise that stock market exerts a destabilizing impact on real activities beyond non-fundamental sentiment.

References

- Aghion, P., and J. C. Stein. 2008. Growth versus Margins: Destabilizing Consequences of Giving the Stock Market What It Wants. *The Journal of Finance* 63 (3):1025-1058.
- Allen, F., and D. Gale. 1999. Diversity of Opinion and Financing of New Technologies. *Journal of Financial Intermediation* 8 (1–2):68-89.
- Barberis, N., and R. Thaler. 2003. Chapter 18 A survey of behavioral finance. In *Handbook of the Economics of Finance*, edited by M. H. G.M. Constantinides and R. M. Stulz: Elsevier, 1053-1128.
- Bolton, P., and E.-L. Von Thadden. 1998. Blocks, Liquidity, and Corporate Control. *The Journal of Finance* 53 (1):1-25.
- Boot, A. W. A., R. Gopalan, and A. V. Thakor. 2006. The Entrepreneur's Choice between Private and Public Ownership. *The Journal of Finance* 61 (2):803-836.
- . 2008. Market Liquidity, Investor Participation, and Managerial Autonomy: Why Do Firms Go Private? *The Journal of Finance* 63 (4):2013-2059.
- Brau, J. C., and S. E. Fawcett. 2006. Initial Public Offerings: An Analysis of Theory and Practice. *The Journal of Finance* 61 (1):399-436.
- Chemmanur, T., and P. Fulghieri. 1999. A theory of the going-public decision. *Review of Financial Studies* 12 (2):249-279.
- Chemmanur, T. J., S. He, and D. K. Nandy. 2010. The Going-Public Decision and the Product Market. *Review of Financial Studies* 23 (5):1855-1908.
- D'Avolio, G. 2002. The market for borrowing stock. *Journal of Financial Economics* 66 (2–3):271-306.
- Da, Z., R. Jagannathan, and J. Shen. 2012. Building Castles in the Air: Evidence from Industry IPO Waves. *National Bureau of Economic Research Working Paper Series* No. 18555.
- De Long, J. B., A. Shleifer, L. H. Summers, and R. J. Waldmann. 1990. Noise Trader Risk in Financial Markets. *Journal of Political Economy* 98 (4):703-738.
- Fischer, C. 2000. Why do companies go public? Empirical evidence from Germany's Neuer Market.
- Helwege, J., and F. Packer. 2003. The Decision to Go Public: Evidence from Mandatory SEC Filings of Private Firms
- Hong, H., J. C. Stein, and J. Yu. 2007. Simple Forecasts and Paradigm Shifts. *The Journal of Finance* 62 (3):1207-1242.

- Kurz, M. 1994a. On rational belief equilibria. *Economic Theory* 4 (6):859-876.
- . 1994b. On the Structure and Diversity of Rational Beliefs. *Economic Theory* 4 (6):877-900.
- Lerner, J. 1994. Venture capitalists and the decision to go public. *Journal of Financial Economics* 35 (3):293-316.
- Pagano, M., F. Panetta, Zingales, and Luigi. 1998. Why Do Companies Go Public? An Empirical Analysis. *The Journal of Finance* 53 (1):27-64.
- Shleifer, A., and R. W. Vishny. 1997. The Limits of Arbitrage. *The Journal of Finance* 52 (1):35-55.
- Steen, E. V. d. 2004. Rational Overoptimism (and Other Biases). *American Economic Review* 94 (4):1141-1151.
- Tobin, J. 1969. A General Equilibrium Approach To Monetary Theory. *Journal of Money, Credit and Banking* 1 (1):15-29.
- Tversky, A., and D. Kahneman. 1973. Availability: A heuristic for judging frequency and probability. *Cognitive Psychology* 5 (2):207-232.
- Zingales, L. 1995. Insider Ownership and the Decision to Go Public. *The Review of Economic Studies* 62 (3):425-448.

Appendix

Proof of Lemma 1: For investors with bounded rationality, a necessary condition for the firms to go public is that the past managerial decision is no less important than realized external shock on future profit. It suffices to prove that the constraint that the firm is positively priced is equivalent to the condition $\lambda > \rho$.

As we have derived in the main text, under the market conjecture of growth strategy ($e^* = 1$), if the manager goes against the conjecture and the firm manages to get a positive price,

$$E[P] = E[E(\delta\pi_2|e^* = 1)|e = 0] = \delta A(\lambda q - \beta^{sg} q) \quad (2.16)$$

It is equivalent to

$$\begin{aligned} \lambda - \beta^{sg} &= \lambda - \frac{\lambda v^a q^2 + \rho v^s}{v^a q^2 + v^s} \\ &= \frac{(\lambda - \rho)v^s}{v^a q^2 + v^s} > 0 \end{aligned} \quad (2.42)$$

Under the market conjecture of the margins strategy ($e^* = 0$), if the manager goes against the conjecture and the firm manages to get a positive price,

$$E[P] = E[E(\delta\pi_2|e^* = 0)|e = 1] = \delta A(\lambda - \beta^{mm}) \quad (2.28)$$

It is equivalent to

$$\begin{aligned} \lambda - \beta^{mm} &= \lambda - \frac{\lambda v^a + \rho v^m}{v^a + v^m} \\ &= \frac{(\lambda - \rho)v^m}{v^a + v^m} > 0 \end{aligned} \quad (2.43)$$

Proof of Lemma 3: Assume that investors are fully rational. If the past decisions affect the future profit by the same degree as the external shock, the manager will always take the first best action in corporate strategy since $q^- = 1 = q^+$.

If $\lambda - \rho = 0$, then $\beta^{sg} = \beta^{mg} = \beta^{sm} = \beta^{mm} = \lambda = \rho$. Under the market conjecture of the all growth strategy ($e^* = 1$), the shares sold to the market if the manager deviates from the perceived strategy becomes

$$\alpha^{gd} = \frac{1}{E[P]} = \frac{1}{\delta A(\lambda q - \beta^{sg} q + \beta^{mg})} = \frac{1}{\delta A \lambda} \quad (2.44)$$

It can be easily verified that $q^- = 1$ solves the following equation

$$q^- = 1 + \frac{\alpha^{gd} \delta (\beta^{sg} q - \beta^{mg})}{1 + (1 - \alpha^{gd}) \delta \lambda} \quad (2.45)$$

Similarly, under the market conjecture of the margins strategy ($e^* = 1$), the shares sold to the market if the manager deviates from the perceived strategy become

$$\alpha^{md} = \frac{1}{\delta A(\lambda + \beta^{sm} q - \beta^{mm})} = \frac{1}{\delta \lambda A q} \quad (2.46)$$

The upper bound of market demand q^+ that maintains the incentive compatible constraint is

$$\begin{aligned} q^+ &= 1 + \frac{\alpha^{md} \delta (\beta^{mm} - \beta^{sm} q)}{1 + (1 - \alpha^{md}) \delta \lambda} \\ &= 1 + \frac{\alpha^{md} \delta \lambda (1 - q)}{1 + (1 - \alpha^{md}) \delta \lambda} \end{aligned} \quad (2.47)$$

It can be easily verified that $q^+ = 1$ is the solution. This is the degenerate case for the selection of the business strategy.

Chapter 3 Board Structure, Product Market Competition and Incentive Compensation⁶

3.1 Introduction

The separation between ownership and control in modern corporations leads to divergence of interests between owners and managers. Firms are simultaneously subject to many governance mechanisms which affect conflicts of interests between owners and managers. It is thus important to understand the interactions between these different mechanisms. This chapter considers three governance mechanisms, namely, board independence, product market competition and managerial incentives.

It is neither a casual nor random pick that we choose these three mechanisms. The board structure and product market competition serve as monitoring devices that provide a disciplinary 'stick' to managers to ensure that they serve the best interests of owners. The former is an internal monitoring device while the latter is an external monitoring device. Incentive compensation, in contrast, provides a 'carrot' to align the incentive of managers with that of owners. Each with a distinct perspective, the combination of these three mechanisms altogether gives a nuanced picture of the corporate governance structure.

We begin our investigation by offering empirical evidence supporting the argument that incentives and board independence are substitutes for each other. Then we add a third governance mechanism, product market competition, into consideration. Economists have long presumed that product market competition mitigates managerial slack. Yet the relationship between competition and incentives is rather ambiguous. Previous theories have no consensus with regards to whether this relationship should be positive or negative (i.e., Hart, 1983; Scharfstein, 1988; Schmidt, 1997).

With regards to the exact role of product market competition on managerial incentives, a number of studies have pointed out that competition acts as a disciplinary mechanism on managers. It has been argued that competition provides better performance evaluation information (Hart, 1983; Nalebuff and Stiglitz, 1983), leads to

⁶ This chapter has been presented at the Econometric Society Australasian Meeting 2012 and the 41st Australian Conference of Economists 2012.

higher takeover threat (Kole and Lehn, 1997; 1999), and introduces greater risk of liquidation (Schmidt, 1997). However, the disciplinary hypothesis is ambiguous on the sign between competition and incentives. Another strand of literature emphasizes the role of competition in encouraging more delegation of authority to managers. For example, competition results in higher priority for immediacy and specific knowledge (Christie et al., 2003). The provision of high-powered incentives is attributed to the importance of giving CEO greater discretion and the complicated management task in competitive industries. The delegation hypothesis predicts a positive relationship between competition and incentives.

To better evaluate the effect of competition on incentives, we exploit exogenous variations in the board structure following the passage of Sarbanes-Oxley Act of 2002 (SOX). Enacted in the year 2002, SOX enhanced standards for all U.S. public firms' boards and management. In the same year, NYSE and NASDAQ also announced the new listing standards on board independence, which required that the board should have (1) a majority of independent board members, and (2) the fully independent auditing, compensation, and nominating committee.

Suppose that product market competition affects incentives, and that the strengthened board independence leads to a more intense monitoring. If competition matters at all, the exogenous change in the board structure would have a different impact on managerial incentives in non-competitive industries from those in competitive industries.

More importantly, the disciplinary hypothesis and the delegation hypothesis yield the opposite predictions on the link between board independence and incentives conditional on the competition intensity. If competition mainly plays the disciplinary role, the decrease in incentives in the post-SOX period would be bigger in competitive industries than in noncompetitive industries since they are more likely to be affected. On the contrary, assuming that competition calls for higher-powered incentive contracts primarily because it encourages delegating more authority to CEOs, this link is likely to be unaffected by the SOX enactment as the necessity of delegation is a largely technological specification uncorrelated with the SOX act. Competition may partially offset the downward pressure on the provision of incentive contracts. The decline in incentives should be smaller in competitive industries than in noncompetitive industries.

To overcome the endogeneity problem of the board structure, we employ the difference-in-difference-in-difference (DDD) approach to test whether the impact of SOX on managerial incentives is associated to product market competition. Particularly, some firms were forced to change their board structure to meet new listing requirements, and they are thus considered to be affected by the enactment of SOX. However, some other firms had already met the requirement even prior to the enactment of SOX. These firms are considered to be unaffected by the passage of SOX. Guo and Masulis (2011) point out that a direct DDD regression may give rise to a selection bias since firms that chose to meet the board independence requirement before the passage of SOX were significantly different from those that chose not to do so. To address this concern, we therefore employ the propensity score analysis to obtain a matched sample to tackle the self-selection problem.

Our results show that, first, there is an overall decrease in pay-to-performance sensitivity attributed to the SOX compliance with the majority independence rule. Secondly, after compliance, the incentives of the treatment firms experience a bigger drop in competitive industries than in less competitive industries. This evidence lends favorable support to the disciplinary hypothesis. These results are robust if we include only non-NASDAQ firms to rule out the possibility that the burst of Internet bubbles may confound our empirical analysis. Yet we do not find any significant influence of the compensation committee on the incentive compensation after controlling for the overall board independence. Finally, we find some evidence that firms that were forced to change their board structure have greater improvement in accounting performance in the less competitive industries. This finding is consistent with the hypothesis that competition serves as an effective disciplinary mechanism and managerial slack is more severe in less competitive industries.

The scrutiny of these three governance mechanisms has several important implications. First, it encourages us to revisit previous studies that have examined the different mechanisms separately and put them together in an integrated framework. Second, it contributes to the heated debate on the consequences and efficiency of SOX, the far-reaching act in corporate governance. It presents inputs to regulators for a comprehensive evaluation of the SOX act. Third, it broadens the policy mix to enhance corporate governance. For example, deregulation and antitrust laws can be associated

with governance designs or public policy efforts to improve corporate governance can place a greater emphasis on noncompetitive industries.

An advantage of our approach is that we provide a cleaner test of interactions between different corporate governance mechanisms by exploiting the exogenous change in the board structure to mitigate the endogeneity problem that has plagued many corporate governance studies. In addition, product market competition, an industry level attribute, provide a better setting than firm level characteristics to test firms' optimal governance choice at the given external environment. It makes reasonable sense to assume that firms' decisions of the governance policy rely on industry attributes, but the reverse is very unlikely. The direction of causality of industry attributes imposing an effect on firm choices is unambiguous.

Our contribution is not to quantify the economic consequences of SOX act per se. Rather, we attempt to show that exogenous variation in the board structure has a different effect on competitive and non-competitive industries. The emphasis falls on the interaction between different mechanisms. Moreover, we clarify and provide empirical evidence on the disciplinary role of competition.

The rest of the chapter is organized as follows. Section 3.2 reviews the relevant literature and develops the hypothesis. Section 3.3 describes the data and the main empirical methodology. Section 3.4 describes the propensity score analysis. Section 3.5 reports the empirical results. Section 3.6 includes the robustness checks on non-NASDAQ firms and the evidence of improvement in accounting performance. Section 3.7 concludes.

3.2 Research Question & Hypothesis Development

3.2.1 Pairwise Interactions

Competition and Incentives

The first pair of governance mechanisms in question is competition and incentives. A strand of literature builds on the observation that competition generates additional information to better assess the actions of the managers. Hart (1983) develops a hidden information model in which information of a common shock in production cost can be transmitted by the market price. He finds that competition

mitigates managerial slack. However, this result crucially depends on the assumptions that the manager is infinitely risk averse and is required to satisfy a single profit target. Scharfstein (1988) shows that the result can be reversed under a different assumption of the manager's utility function. If the marginal utility of income is strictly positive, then a single profit target is not necessarily optimal. In fact, competition may exacerbate the managerial slack problem. Hermalin (1992) illustrate that there is no definitive relationship between competition on managerial incentives from the information perspective.

Another strand of literature contends that competition affects the marginal value of managerial efforts by altering the marginal benefit of reducing cost (e.g., Hermalin, 1992; Schmidt, 1997). An increase in competition affects incentives in two ways. First, the more elastic demand function increases the marginal benefit of reducing costs and makes it more attractive to steal business from rivals. This is the business stealing effect. Second, there is the scale effect. As the rivals charge lower prices to gain market share, the firm's expected profit decreases and the extra effort of further cost reduction is unjustified. The net outcome of these two effects is unclear. More recently, Raith (2003) shows when the market structure is endogenously determined by free entry and exit, stronger managerial incentives occur only when competition leads to higher firm-level output in equilibrium. In the case of an increase in product substitutability or the growth in market size, each surviving firm produces more, and thus the firm will provide stronger managerial incentives. In contrast, if the increased competition comes from a fall in entry cost, each surviving firm would produce less output, and thus firms would provide weaker incentives.

Competition may also affect managerial incentives by increasing the likelihood of liquidation. Schmidt (1997) shows that the increased competition leads to the greater threat of forced liquidation so that managers have to spend more efforts to avoid the disutility of liquidation. However, since competition also reduces profits and affects value of cost reduction, it affects the marginal benefit of inducing a higher level of effort in an ambiguous way. Overall, the sign between competition and managerial incentives is not definite.

Finally, competition may affect the marginal value of efforts because it leads to a more complicated information environment. Under competition pressure, firms need to cut the cost or improve the quality to keep ahead of rival firms (Kole and Lehn, 1997;

Baggs and De Bettignies, 2007). Competition leads to a more complicated environment for firms to make strategic moves. It also accentuates the importance of speedy decision-making and specific knowledge (Chirstie et al., 2003), since delay in knowledge transfer results in great loss. Prendergast (2002) argues that as the environment becomes more complex, firms' monitoring ability decreases, and the required skills in management lead the firm to give the CEO greater discretion. If competition increases the difficulty of decision-making, the firm will have to delegate greater power to managers to encourage the efficient forward-looking decisions in a complex environment and turn to other mechanisms including incentives to discourage the manager's extraction of private benefits at the expense of shareholders.

Empirically, Karuna (2007) provides evidence that greater product substitutability, bigger market size and lower entry costs are positively related to incentives. By exploiting two deregulation episodes during the 1990s, Cuñat and Guadalupe (2009a) find that the performance-pay sensitivity increases after deregulation in the U.S. banking and financial sectors. Cuñat and Guadalupe (2009b) find that increased foreign competition due to reductions in trade barriers and the globalization of economy activity leads to greater pay-to-performance sensitivity. Yet overall, the empirical literature that directly speaks on the relation between pay-to-performance and competition is relatively thin.

In sum, previous studies are inconclusive on the relationship between product market competition and managerial incentives.

Board Independence and Incentives

The second pair of control mechanisms is board independence and CEO incentives. We assume that board independence is a good indicator of board monitoring.⁷ Insufficient board monitoring may fail to prevent managers' value-

⁷ The conventional independence of the board might be a poor proxy of board effectiveness. Hwang and Kim (2009) show that CEO level pay is not significantly different in the presence of conventionally independent board but it significantly decreases when a socially independent board is present. Masulis et al. (2012) show that only the proportion of independent directors with industry experience is positively related with firm performance. If the implied assumption is believed to be invalid, the empirical analysis in this chapter would be weakened. However, we hold that board independence is a valid measure of board effectiveness based on anecdotal experience and the fact that many academic studies demonstrate the monitoring effectiveness of board independence (Weisbach, 1988; Byrd and Hickman, 1992; Brickley et al., 1994; Cotter et al., 1997; Duchin et al., 2010).

destroying actions, but board monitoring comes at a significant cost. Hermalin and Weisbach (2003) suggest that board composition is endogenously structured for competing objectives. A board optimized to monitor the top management may destroy the firm value by making poor decisions on investment projects. For example, while independent directors may better fulfil the responsibility of contracting with executives, inside directors are likely at a better position to provide input into project selection and investment decisions. Many theoretical studies show that effectiveness of independent directors in advising and monitoring depends on the information environment (Hermalin and Weisbach 1998; Raheja, 2005; Adams and Ferreira, 2007; Harris and Raviv, 2008). Duchin et al. (2010) provide evidence that the independent directors are less effective in advising and monitoring when the outsider's cost of acquiring information about the firm is high. Therefore, at the face of competing objectives, intense monitoring is not necessarily optimal if disciplining top management sacrifices other responsibilities of the board. Indeed, Faleye et al. (2011) show that monitoring quality improves in the presence of a majority of independent directors. However, the more intensive monitoring leads to weaker strategic advising and greater managerial myopia.

In the same vein, although Jensen and Meckling (1976) illustrate that CEO incentive pays can mitigate agency conflicts by linking managers' wealth to firm performance, the provision of incentive compensation also incurs a significant cost. First, the managerial power hypothesis suggests that the CEO has a good deal of control over the board including contracting his own compensation scheme (Bebchuk et al., 2002; Bebchuk and Fried, 2006). Consistent with the managerial power hypothesis, the incentive pay would depend on variables under the manager's control. Any form of incentive compensation based on observable outcomes, such as earnings and stock prices, entails the danger that CEOs may manipulate the observable performance measures. Aboody and Kasznik (2000) find that firms manipulate disclosure of information around CEO option awards. Many studies document the positive relationship between CEO equity incentives and earnings manipulation (i.e., Cheng and Warfield, 2005; Bergstresser and Philippon, 2006; Burns and Kedia, 2006). Second, by linking the managers' wealth portfolios to firm performance, incentive pays expose the managers to the firm-specific risk. Assuming that managers are risk-averse, they would require a higher risk premium to compensate this exposure to firm-

specific risk in a less diversified portfolio (Zajac and Westphal, 1994; Core and Guay, 2010). Third, the structure of compensation package also affects the managers' investment decisions as they attempt to decrease firm risk. The previous studies show that equity incentives are related to diversifying acquisition, hedging activities and reluctance to invest in R&D (e.g., Tufano, 1996; Guay 1999; Rajgopal and Shevlin, 2002; Coles et al., 2006).

Obviously, if the board of directors can observe the firms' growth opportunities and assess the managers' actions at zero cost, no incentive pays would be necessary. Since both board monitoring and incentive compensation incur the significant cost, firms need to weigh the monitoring cost and the agency cost in the design of the optimal governance policy. Previous theories have not reached consensus particularly on the relationship between board monitoring and incentives. Hölmstrom (1979) suggest that monitoring increases observability of the agent's actions and thus reduces the demand for a high-powered incentive contract. Monitoring and incentive pays are substitutes for each other. Cai et al. (2007) suggest that as monitoring cost increases with information asymmetry, firms with greater asymmetric information use less intensive board monitoring but resort to market discipline and CEO incentive compensation. In stark contrast, Milgrom and Roberts (1992) posit that monitoring improves the precision of the performance measures that are used to assess managers' actions. Thus the pay is more sensitive to performance as the monitoring gets more intense. Almazan and Suarez (2003) suggest that in weak boards, the severance pay protects shareholders from the CEO's tendency to resist excessively his own replacement and thus reduces the demand for incentive pays.

It is ultimately an empirical question whether board monitoring and CEO incentives are complements or substitutes. The past empirical studies have mixed evidence. Weisbach (1988) shows that board independence and insider ownership are substitutes. Fahlenbrach (2009) find that firms with weaker governance have higher pay-to-performance sensitivity. Yet Mehran (1995) and Milliron (2000) find that board independence and managerial incentives are complementary mechanisms. Herman and Weisbach (2003) and Adams et al. (2010) summarize a number of studies on the board composition and emphasize that board is endogenously structured. This is probably one important reason for the mixed evidence. To mitigate the endogeneity problem, some recent studies exploit regulatory changes in corporate governance to

allow for a cleaner identification. For example, Cohen et al. (2007) find that pay-to-performance sensitivity on average significantly decreases after strengthened board independence because of SOX enactment.

3.2.2 Discipline or Delegation

Among all the theories on competition, we underscore two lines of arguments. The first line of argument suggests that competition serves as a disciplinary mechanism to guard against the manager's harmful behaviors, from shirking to fraud. This can be done by a variety of channels. Competition may provide more information to better evaluate the manager's performance (Hart, 1983; Nalebuff and Stiglitz, 1983), increase takeover threat (Kole and Lehn, 1997; 1999), and raise the likelihood of liquidation (Schmidt, 1997). When competition acts as a disciplinary mechanism, it weakens the need of intensive board monitoring.

Another line of argument suggests that competition generates the need to delegate more authority to CEOs. Under competition pressure, the necessity of delegation results from the complicated strategic decisions (Kole and Lehn, 1997; Baggs and Bettignies, 2007), or the importance of speed decision making and specific knowledge (Chirstie et al., 2003). In accompany with more delegation, the firms may provide stronger incentives to align the interests of the managers to shareholders.

If competition mainly acts as the disciplinary role, all else equal, the decrease in incentives in the post-SOX period should be bigger in competitive industries since these firms previously resorted to market competition discipline and are more likely to be forced to change the board structure in order to comply with SOX. Alternatively, assume that competition mainly operates by delegating CEO more authority and thus calls for higher-powered incentive contracts. The association is likely to be unaffected by SOX enactment because factors that contribute to delegation including the complicated environment and specific knowledge are exogenous to the legal regulations. Competition may partially dampen the downward pressure in provision of incentive contracts. The decline in incentives should be smaller in competitive industries than noncompetitive industries.

After briefly reviewing the previous studies, we sum up the predictions from the discipline hypothesis and the delegation hypothesis.

- (1) For the pairwise relationship between incentives and competition, the discipline hypothesis is ambiguous about the sign between the two variables and the delegation hypothesis suggests that the two variables should be positively related.
- (2) For the relationship between incentives and board independence conditional on competition intensity, the discipline hypothesis predicts that the decrease in incentives due to SOX should be bigger for firms in competitive industries than firms in less competitive industries. Yet the delegation hypothesis predicts exactly the opposite.

3.3 Empirical Strategy

3.3.1 Pairwise Interactions

The first pairwise relationship in question is between CEO incentives and competition. We measure competition in three dimensions: concentration, product substitutability and entry cost. The regression takes the form of

$$PPS_{ikt} = \beta_1 Competition_{kt} + \gamma' X_{ikt} + \alpha_i + \alpha_t + \varepsilon_{ikt} \quad (3.1)$$

where i denotes firms, k denotes industries, t denotes time. PPS_{ikt} is the pay-to-performance sensitivity (PPS) of firm i in the industry k at year t . $Competition_{kt}$ denotes the competition measure in the industry k in year t . X_{ikt} refers to vector of control variables. α_i and α_t are firm fixed effects and year dummies respectively. ε_{ikt} is the error term.

To test the relationship between CEO incentives and board independence, we first include only the firm-level variables and then control for the industry attributes. The board dependence is captured by a dummy variable which is equal to one if the majority of board members are independent directors and is equal to zero otherwise. To control for other aspects of the board structure, we also include the size of board, the CEO's dual role as the chairman to measure the board's strength. In addition to the industry attributes captured by competition measures, we control the industry-wide shock by adding the median return on assets (ROA) within the given industry group defined by Fama-French 48 industry classifications. We conduct the following regression:

$$PPS_{ikt} = \beta_1 Independence_{ikt} + \beta_2 Competition_{kt} + \gamma' X_{ikt} + \alpha_i + \alpha_t + \varepsilon_{ikt} \quad (3.2)$$

where i indexes firms, k indexes industries, t indexes time. PPS_{ikt} is the pay-to-performance sensitivity (PPS) of firm i in the industry k at year t . $Independence_{ikt}$ denotes firm i 's board independence status in year t . $Competition_{kt}$ denotes the competition measure in the industry k at year t . X_{ikt} refers to the vector of control variables. α_i and α_t are firm fixed effects and year dummies respectively. ε_{ikt} is the error term.

The sign of β_1 is negative if incentives and board independence are substitutes for each other and it is positive if incentives and board independence are complements. We also carry out the tests that include only competition measures as independent variables among other control variables for comparison.

3.3.2 Average Treatment Effect

Furthermore, we are interested to investigate whether the average treatment effect of forced SOX compliance brings down the incentives. Although SOX and the new listing rules apply to all public firms, a large fraction of public firms had been in compliance with the rules before the enactment of the regulations and thus can be considered as unaffected by the new rules. The rest of the public firms nevertheless were forced to change their board structure. Therefore, we define the treatment group as noncompliant firms with the given listing rule in the fiscal year 2001. The control group is defined as firms compliant with the given listing rule in the year 2001. We conduct the following regression:

$$PPS_{ikt} = \beta_1 Treat_i + \beta_2 Post_{it} + \beta_3 (Treat_i * Post_{it}) + \beta_4 Indus_{kt} + \gamma' X_{ikt} + \alpha_t + \varepsilon_{ikt} \quad (3.3)$$

where i indexes firms, k indexes industries, t indexes time. PPS_{ikt} is the pay-to-performance sensitivity (PPS) of firm i in the industry k at year t . $Treat_i$ is an indicator variable which is equal to one if the firm did not have the majority of independent directors on board in the year 2001 and is equal to zero otherwise. It is time-invariant and is uniquely assigned to the given firm. $Post_{it}$ indicates whether the firm i is in post-SOX period. For the treatment firms, $Post_{it}$ is a dummy variable that

switches on to one since the actual time of compliance with the majority independence rule. Thus for a given treatment firm, the occurrence of a change in $Post_{it}$ varies from the year 2002 to 2005. For example, if a treatment firm strengthened board independence to comply with the majority independence rule in the year 2004, $Post_{it}$ for this firm is equal to zero before the year 2004 and switches on to one since 2004. For the control firms, $Post_{it}$ is equal to zero prior to the year 2003 and switches on to one since the year 2003. α_t is the set of year dummy variables. X_{ikt} refers to the vector of control variables. ε_{ikt} is the error term.

To interpret the coefficients, β_1 embodies information of the average effect of compliance status on PPS. β_2 controls for the potential confounding effects of the time trend. The slope dummy β_3 shows whether the relationship between PPS and compliance of majority independence rule changes over time.

3.3.3 The Three-way Interaction

Difference-in-Difference-in-Difference (DDD)

After measuring the average treatment effect of SOX enactment, we examine whether the relationship between incentive and board independence is conditional on competition intensity. The counterfactual here is what the difference of incentives between competitive and noncompetitive industries would be in the absence of the new listing rules. We consider the two new listing rules: the majority independence rule and the independent compensation committee rule.

More specifically, we conduct the direct DDD estimate as

$$\begin{aligned}
 y_{ijkt} = & \beta_1 Treat_{ij} + \beta_2 Post_{ijt} + \beta_3 HHI_{kt} + \beta_4 (Treat_{ij} * Post_{ijt}) \\
 & + \beta_5 (Treat_{ij} * HHI_{kt}) + \beta_6 (HHI_{kt} * Post_{ijt}) \\
 & + \beta_7 (Treat_{ij} * Post_{ijt} * HHI_{kt}) + \gamma' X_{ikt} + \alpha_t + \varepsilon_{ikt}
 \end{aligned} \tag{3.4}$$

where i indexes firms, j indexes treatment with respect to the specific independence requirement of SOX ($j = 1$ for the majority independence rule and $j = 2$ for the fully independent compensation committee rule), k indexes industries, t indexes time. y_{ijkt} is the dependent variable of interest (managerial incentive in the baseline regression or accounting performance in additional tests). $Treat_{ij}$ is a dummy variable which is equal to one if the firm was in compliance with independence rule j in year 2001 and is

equal to zero otherwise. HHI_{kt} is the measure of industrial competition for the industry k in year t . As explained in the next subsection, the main measure of competition is the concentration ratio Herfindahl-Hirschman Index. As concentration ratio increases, the competition intensity declines. $Post_{ijt}$ indicates whether the firm i is in post-SOX period in terms of independence rule j . For the treatment firms, $Post_{ijt}$ is a dummy variable that switches on to one since the actual time of compliance with the independence rule j . Thus for a given treatment firm, the occurrence of a change in $Post_{ijt}$ varies from the year 2002 to 2005. For the control firms, $Post_{ijt}$ is equal to zero prior to the year 2003 and switches on to one since 2003. X_{ikt} is the vector of control variables, α_t is the set of year dummy variables, and ε_{ikt} is the error term.

Here the independent variable $Post_{ijt}$ is used to capture the time trend⁸. By taking the difference of the change in treatment firms and the change in control firms, we have $\beta_4 + \beta_7 HHI_{kt}$ to show the overall difference in managerial incentive between the treatment group and the control group after taking out the time trend.

The most important coefficient, β_7 , evaluates the third difference, which is the change in incentives after the firm enters the post-SOX period conditional on competition intensity. We expect the coefficient β_7 to be statistically significant as supportive evidence of competition's importance as a governance control mechanism. Considering that HHI_{kt} is decreasing in competition intensity, a positive sign of β_7 suggests that PPS decrease is smaller in the noncompetitive industries than competitive industries after SOX compliance, consistent with the discipline hypothesis; on the contrary, a negative sign of β_7 lends favorable support to the delegation hypothesis.

In the regression (3.4), we isolate the treatment effect of one independence rule and ignore the potential confounding effects of other rules. This is mainly to illustrate the basic empirical strategy and can easily control for the confounding effects of other listing rules by adding more treatment indicators similar to the regression (3.4).

First we run this regression on the full sample. Second, to mitigate the self-selection problem, we perform the propensity score matching to improve comparability between treatment firms and control firms, and then run the same regression using the matched sample.

⁸ The average effect is calculated as $[E(y_{ijkt}|Treat_{ij} = 1, Post_{ijt} = 1) - E(y_{ijkt}|Treat_{ij} = 1, Post_{ijt} = 0)] - [E(y_{ijkt}|Treat_{ij} = 0, Post_{ijt} = 1) - E(y_{ijkt}|Treat_{ij} = 0, Post_{ijt} = 0)]$

Propensity Score Matching

The difference-in-difference-in-difference (DDD) approach makes an important assumption that firms in the treatment group have no systematic differences to those in the control group other than a common trend. In other words, after taking into account of the common trend, firms should be randomly assigned to the treatment group or the control group. This assumption is likely to be violated in our study since prior theories and empirical studies have suggested that the board structure is endogenous. It follows that treatment firms may be significantly different from control firms along many dimensions, leading to the threat of the selection bias. This is indeed the case, as verified in the next section.

To overcome the selection bias problem, we construct a new sample by the propensity score matching. Rosenbaum and Rubin (1983) define propensity score as the conditional probability of assignment to a treatment given a vector of observed covariates. By using a single propensity score, it helps solve the problem of failure in matching based on multiple covariates. It also allows flexible post-matching regression specifications.

In the present chapter, we use the nearest neighbor matching within a predefined caliper⁹. It begins with randomly ordering of the treated and non-treated firms. We then choose the first treatment firm i and identify a firm j as a match for i , if the absolute distance of propensity score between the two is the smallest among all pairs of treatment firm i and all other firm j and this absolute distance falls into a predetermined caliper.

3.4 Data and Methodology

3.4.1 Full Sample

Our executive compensation data comes from the Execucomp database, which covers the detailed compensation information of firms that currently or historically belong to the S&P 1500 index. The board data is from the RiskMetrics Governance

⁹ The existing literature has not reached the consensus on the selection of the matching algorithms. It is not clear that which matching algorithm, for example, the k-th nearest neighbor matching, kernel matching, or spline matching, is more preferable for finance and accounting studies. In this chapter, we use the nearest neighbor matching with a predefined caliper, which is also used in several previous studies including Guo and Masulis (2011). And we try out different values of predefined calipers but the results are similar.

and Directors databases (formerly called IRRC, or Investor Responsibility Research Center), which contains directors' information of S&P 1500 firms. The accounting information is extracted from Compustat and the stock return is from Center for Research in Security Prices (CRSP).

Our sample spans from the year 1996 to 2006. It starts at year 1996 when the earliest board data is available. We restrict the sample up to the year 2006 primarily because issuance of the accounting rule FAS123R in 2006 significantly change the reporting format of executive compensation information, rendering the data in Execucomp database before 2006 not directly comparable to that after 2006. To be included in our sample, the firm has to be incorporated and located in the United States. It needs to have the complete observations on CEO compensation, board structure, accounting information and stock performance. We exclude the financial industries (SIC 6000-6999) and the heavily regulated utility firms (SIC 4900-4999). To make sure that the result is not driven by firms entering or exiting the sample, we require the firms to survive from the fiscal year 2001 to 2004. Overall, the full sample includes 7,504 firm-year observations. It spans 42 out of the Fama-French 48 industry groups. All dollar terms are adjusted for inflation to the base year 2000.

We use the board structure in the fiscal year 2001 to identify whether firms are affected by the new listing rules. NYSE and NASDAQ set the compliance deadline for firms with non-classified boards at first annual meeting after January 15, 2004 or October 31, 2004 whichever is earlier. For firms with classified board, the deadline is the second annual meeting after January 15, 2004 or December 31, 2005 whichever is earlier. Yet many firms started to change the board structure before the actual deadlines with anticipation of new rules. Chhaochharia and Grinstein (2009) document that the largest increase of firms with majority independent board actually occurs between 2002 and 2003 and thus use the board structure in the year 2002 as the base year to determine whether a firm is affected by new rules. Guo and Masulis (2011) argue that board structure in year 2001 represents the most recent board membership decisions unaffected by anticipation of new listing rules since early adopters in year 2002 are likely led by passage of SOX and new listing rule proposals. We follow Guo and Masulis (2011)'s suggestion and choose the year 2001 to identify the treatment group.

Figure 3.1 and Figure 3.2 describe the trend in the board structure from 1996 to 2006. Year 2002 and 2003 witness the largest increase in the percentage of firms in terms of independence rules. It is worth noting that it does not reach the full compliance in year 2005 in Figure 3.1. Chhaochharia and Grinstein (2009) point out that the RiskMetrics definition of independent directors is more demanding than that of NYSE and NASDAQ listing rules. For example, NYSE and NASDAQ allow the independent directors to maintain insignificant business relationship with the firm while RiskMetrics does not. NYSE and NASDAQ also classify former employees as independent if the employment has been terminated at least three years ago while RiskMetrics identifies such directors as linked directors. We also reclassify former employee as independent directors if their employment has ended at least three years ago and they do not have any other business or family association to top management. It is worth noting that our definition of independence is still stricter than the exchange listing rules even after adjustment. This is probably the main reason why a very small fraction of firms fail to comply with SOX independence rules even after the deadline.¹⁰

[INSERT FIGURE 3.1 AND FIGURE 3.2 HERE]

We define the treatment group as the noncompliant with the given listing rule in fiscal year 2001. Table 3.1 compares the firm characteristics between treatment firms and control firms in the full sample. The t-test statistic shows that treatment firms are significantly different from control firms along many dimensions. In terms of corporate governance, the treatment firms on average have lower G-index (fewer shareholder rights provisions), smaller boards, and smaller likelihood of CEO-Chairman duality than control firms. Treatment firms also tend to have longer-tenured CEOs, smaller market capitalization, greater sale growth and greater stock risk measured by annualized stock return standard deviation.

[INSERT TABLE 3.1 HERE]

3.4.2 Matched Sample

As shown in Table 3.1, treatment firms are systematically different from control firms. It provides justifications for the use of the propensity score matching. The objective at this stage is to make treatment firms and control firms as much alike as

¹⁰ In the year 2006, firms that were not in compliance with the majority independence rule and the fully independent compensation committee rule account for respectively 0.46% and 15% of all firms at the same year in the full sample.

possible in terms of estimated propensity scores. The prior literature does not give clear preference to logit or probit regressions to estimate the propensity score, and we use a logit model to predict the treatment membership with all the observations in the full sample up to 2001. The set of covariates covers shareholder rights, the board structure, CEO traits and firm characteristics.

Table 3.2 reports the estimates of the logit regression to predict treatment membership. Most estimates of coefficients are statistically significant, indicating that they have predictive power to treatment group membership. Several coefficients, such as the board size, are included in spite of statistical insignificance because we believe that they capture an important aspect of corporate governance.

[INSERT TABLE 3. 2 HERE]

Figure 3.3 to Figure 3.6 illustrate the distribution of the propensity score and the common support before and after matching for the treatment membership of the majority independence rule and the independent compensation committee rule respectively. From the figures, the distribution of propensity score before matching is slightly more even in treatment membership of majority independence than that of independent compensation committee at the low propensity score. Suppose that our logit estimate fairly captures the overt selection bias of treatment firms, and then these figures imply that the selection bias has different sizes across independence listing standards. Note that a small number of observations are off support after matching. This is probably because we use all available data in the pre-SOX period to identify the treatment membership in the year 2001 and then extend those firms' time series observations. It follows that some firm's observations may be off support before 2001 yet turn out to be on support in the year 2001 in estimating the propensity score. We keep these observations in our matched sample.

[INSERT FIGURE 3.3 to FIGURE 3.6 HERE]

With a predetermined caliper of 0.10, we construct the matched sample with respect to the listing rules¹¹. For the requirement of majority independent board, we find matched firms in year 2001, among which are treatment firms and are corresponding control firms. We then extend the time series data to these firms to get a final sample of 1,823 firm-year observations. It spans 34 out of the Fama-French 48

¹¹ The results are similar if we choose the smaller caliper 0.01.

industry groups. Then we do the same to match along the fully independent compensation committee rule. The matched sample for the compensation committee rule include 2,526 firm-year observations and spans 35 out of the Fama-French 48 industry groups.

3.4.3 Variable Measurement

Managerial Incentives

Our main dependent variable is managerial incentive. The equity compensation, inclusive of all existing holdings of stock and options, provides the vastly majority of managerial incentives and dominates other forms of compensation, such as salary or bonus.

Our first measure of incentive is the dollar-to-percentage measure. It is defined as the dollar change in the CEO's stock and option portfolio for a 1% change in stock price. It is calculated by the "one-year approximation" method outlined in Core and Guay (2002). The second measure of incentive is the dollar-to-dollar measure, Jensen-Murphy statistic (Jensen and Murphy, 1990). It is defined as the dollar change in the CEO's stock and option portfolio for 1 dollar change in the firm value. These two measures are the most commonly used empirical proxies of incentives in prior empirical studies. The dollar-to-percentage measure is preferred when the marginal product of CEO decisions is a function of the size of the firm (Baker and Hall, 2004). The dollar-to-dollar measure is appropriate when the impact of the CEO's actions does not vary with the size of the firm, such as overpaying for an acquisition. Both the measures capture different aspects of sensitivity of CEOs' wealth portfolio to firm performance and thus should be examined independently. In all regressions, we take the log of the incentives as they are extremely skewed. The incentive measures are winsorized to 1% in both tails and are adjusted for inflation to the base year 2000.

Board Structure

RiskMetrics contains detailed information of directors on board. Particularly, it classifies the board members into three categories: independent, linked and employed. The SOX requires public firms to have a majority of independent board directors, the fully independent compensation committee, the fully independent auditing committee and the fully independent nominating committee. As Chhaochharia and Grinstein (2009) point out, the independence definition in RiskMetrics is stricter than exchange

requirement. We follow their advice to reclassify former employees who have left the firm at least for three years with no other links as independent directors. In this chapter, we consider only the status of majority independence and compensation committee independence.

Industrial Competition

The level of concentration is the most widely used measure of competition. More recent theoretical studies, for instance, Raith (2003), suggest that competition comes in several dimensions. Other determinants, such as product substitutability, entry cost and market size, capture different aspects of competition intensity. It follows that the sole use of concentration level as a competition measure can be misleading.

We take the concentration as the main measure of competition in the three-way interaction term and control for product substitutability and entry cost. The concentration ratio is given by Herfindahl–Hirschman Index (HHI henceforth). HHI is defined as the sum of the squared market shares for a given industry group. The higher level of HHI signals stronger concentration. HHI is exactly equal to one in the monopolistic industry and approaches to zero in the perfectly competitive industry. Our baseline calculation is based on Fama-French 48 industry classification. Fama-French 48 industry classification is a reassignment of SIC 4-digit codes. We use Fama-French 48 industry classification to ensure that there is a reasonable number of firm-year observations in each industry-year as many industry-year observations classified by SIC 4-digit code have only one or a couple of firm-year observations.

Product substitutability is also an important measure of competition. The industrial organization literature have employed the price-cost margin, namely, the negative reciprocal of price elasticity of demand (e.g., Carlton and Perloff, 1994; Demsetz, 1996; Besanko et al., 2000; Nevo, 2001). As the industry approaches perfect competition, the price gets closer to the marginal cost. Thus the low price-cost margin indicates high levels of product substitutability. It is computed as sales divided by operating costs based on Fama-French 48 industry classification.

The third industry attribute is the entry cost. Following Karuna (2007), we define entry cost as minimal investment cost incurred by each new entrant firm to a given industry. It is calculated as the weighted average gross value of the cost of property, plant and equipment weighted by each firm's market share in that industry. All the

three competition measures are computed with all domestic firm observations available in Compustat excluding financial and utility industries.

Table 3.3 presents the summary statistics for both the full sample and matched sample.

[INSERT TABLE 3.3 HERE]

3.5 Empirical Results

This section presents the main empirical results. First we show the pairwise regressions between CEO incentives and competition, and between incentives and board independence. Then we go on to evaluate the average treatment effect of compliance with the SOX's majority independence rule. Finally, we present the evidence that the link between incentives and board independence is conditional on competition intensity.

3.5.1 Pairwise Relations

The premise of this chapter is that market competition, board independence and CEO incentives are all interconnected. Facing the external industrial environment, firms weigh agency costs and monitoring costs to determine the optimal governance structure of multiple internal governance devices. Therefore, we first establish that the different mechanisms indeed interact with each other.

Table 3.4 presents the results on the pairwise interactions. Panel A shows the regression results of incentives on competition measures. We employ two measures of pay-to-performance sensitivity. The log form of dollar-to-percentage measure is denoted by $\ln PPS$ and the log form of the dollar-to-dollar measure, Jensen-Murphy Statistic, is denoted by $\ln JM$ hereinafter. More details on the data construction can be found in the Appendix. Column (1), (2), (5) and (6) show the average impact of the concentration measure HHI on incentives. The rest of the columns differentiate the highest and lowest tercile of HHI to capture more nuanced details. HHI is a general description of the market power. Product substitutability is a function of production technology and consumer preferences, which could have an important impact on competition strategies and the monitoring cost. And entry cost is associated with barrier to entry and firms' market power. On the surface, the three competition measures seem insignificant.

Then we take a detailed look at the HHI, its impact is statistically significant at conventional level in the high end of concentration density as shown in Column (3), (4), (7) and (8). While firms in competitive industries (the lowest HHI tercile) have no significantly different incentives, firms in less competitive industries (the highest tercile) have significantly higher incentives. In other words, incentives and competition are negatively related but mainly in concentrated industries. If we include HHI dummies as the only competition measures, the increases in PPS and JM are respectively 10.1% and 7.3% as the firm goes from the less concentrated industry to concentrated industry. If we control for the product substitutability and entry cost, PPS and JM increase by 10.8% and 8.5% respectively as the firm goes from the less concentrated industry to the concentrated industry. As concentration is decreasing in competition intensity, this result suggests the negative relationship on average between competition and incentives. Considering that the delegation hypothesis suggests a positive relationship between competition and incentives, and the discipline hypothesis is consistent with both the positive and negative relationships between the two variables, this result can be interpreted as a piece of supportive evidence for the discipline hypothesis.

For all regressions, the control variable industry median return on assets does not seem to have any significant effect on the incentives. This statistical insignificance may suggest that industry-wide shock has little impact on the provision of incentives. The market-to-book ratio is positively significant at 1% across all specifications. A large market-to-book ratio may signal investors' expectation of high growth potential. It may also imply greater information asymmetry and thus may imply the presence of a more severe agency problem. In panel A, as market-to-book ratio increases by one, PPS approximately increases by 12% and JM increases by 5%. The market cap proxies the size of the firm. A larger firm suggests that the firm is less likely to become a takeover target and is more likely to have greater agency problem. The result shows that as the market capitalization increases by 1%, PPS increases by roughly 5.6%, but the relationship between JM and market cap is insignificant. In addition, incentives are significantly decreasing in stock risk and increasing in the tenure. There is some evidence that PPS is increasing in sale growth and decreasing in R&D expense, but no similar effect is found in JM.

Panel B examines the association between incentives and board structure. If the majority of board members are independent, the incentive will significantly decrease by 10.7% in PPS and by 11% in JM at the significance level of 1%. The negative relationship between board independence and incentives suggests that the two mechanisms are substitutes for each other. The magnitudes of substitution are close in our estimate no matter which incentive measure we use. In addition to board independence, the board size and CEO-Chairman duality also embody the information of the board's power. The growing size of the board is frequently linked to a more severe agency problem due to coordination/communication problems, such as Lipton and Lorsch (1992) and Jensen (1993). Intuitively, CEOs are more influential on the board's decision if they also serve the chairman on board. In Column (1) and (2), as the board recruits an additional member, JM drops by 2.44%. If the CEO also assumes the title of Chairman, JM decreases by 6.2%. Yet a similar effect is not found in PPS. Column (3) and (4) in Panel B include the whole set of independent variables from the first two columns. The estimates are quite close to the first two columns and the competition measures are statistically insignificant. Overall, if the CEO has a bigger bargaining power on the board, the pay-to-performance sensitivity is higher.

[INSERT TABLE 3.4 HERE]

3.5.2 Average Treatment Effect

Table 3.5 evaluates the average effect of majority independence rule. Column (1) and (2) use all the data up to year 2006. Column (3) and (4) use a subsample of the data up to year 2001 when firms could freely choose board structure without anticipation of SOX. In all four specifications, the majority board independence significantly reduces incentives. In general, treatment firms have significantly higher incentives. Since they tend to have smaller board bargaining power, this finding is consistent with results presented in the previous subsection 3.5.1. In the pre-SOX period, the treatment firms in the full sample have on average 53.7% higher PPS than control firms and 51.4% higher JM than control firms at significance level of 5%. In the subsample, PPS and JM are both 54.3% and 51.6% higher in treatment firms than in control firms. The interaction term is supposed to capture the time trend. For control firms, Post-SOX period exhibits a growing time trend in the pay-to-performance sensitivity as shown by the positive sign of $Post_1$. For the treatment firms, entering the Post-SOX reduces the incentives shown by the negative sign on the interaction term. In

the post-SOX period, treatment firms still have on average higher pay-to-performance sensitivity than control firms but the difference narrows to 32.2% for PPS and 30.7% for JM.

[INSERT TABLE 3.5 HERE]

In all regressions, the estimates of control variables are consistent across different specifications. The log of total assets, another proxy of the firm size, is negatively related with Jensen-Murphy statistic consistent with prior studies (e.g. Gibbons and Murphy, 1992; Hall and Liebman, 1998; Baker and Hall, 2004). Yet the sign reverses if the dependent variable is lnPPS. It suggests that the firm size has an ambiguous role on the incentives. In the full sample, HHI is significantly negative in PPS and JM, which suggests that more intensive competition leads to higher-powered incentive contracts. We will further investigate the role of competition in the next section. Collectively, this section provides strong evidence that competition, board independence and incentives are connected with each other.

3.5.3 Three-way Interaction on Competition

This section examines whether the link between incentives and board independence is conditional on competition intensity. The same regressions are executed in both the full sample and the matched sample. The full sample regression uses all the firm-year observations described in the data section. The matched sample is obtained by the propensity score matching in an attempt to remove the overt bias in the firm's self-selection of the board structure. In other words, in the matched sample, treatment firms and control firms should be independent in being forced to change board structure conditional on the set of firm characteristics that we have considered.

The SOX and subsequent exchange listing rules request mandatory compliance in all the public firms, thus this setting is slightly different from the conventional experimental setting. In a traditional experimental design, all the subjects in the control group receive no treatment throughout the experiment and all the subjects in the treatment group will receive a treatment during the experiment. In our setting, the treatment firms certainly have a close resemblance to those in the conventional experiments. They are forced to change board structure prior to the deadline. At a certain point of time, the treatment firms receive the treatment of having to change board structure. Nevertheless, the unaffected firms, considered as the control group in

our setting, are technically in compliance of rules throughout the quasi-experimental setting. Despite the subtle difference, the interpretation in the three-way interaction coefficient is similar to the conventional DDD estimate.

In addition, HHI is in fact a continuous measure of concentration. It is exactly equal to one in the monopolistic industry and approaches to zero in the perfectly competitive industry. For an intuitive illustration, consider HHI as a dummy variable that switches on to one in a monopolistic industry and drops to zero in perfect competition.

After we run the three-way interaction specified in regression (3.4), the treatment effects on the monopolistic industry and perfectly competitive industry are computed respectively as

$$\begin{aligned} \Delta 1 = & [E(Y_{T=1,P=1,HHI=1}) - E(Y_{T=1,P=0,HHI=1})] \\ & - [E(Y_{T=0,P=1,HHI=1}) - E(Y_{T=0,P=0,HHI=1})] \end{aligned} \quad (3.5)$$

$$\begin{aligned} \Delta 2 = & [E(Y_{T=1,P=1,HHI=0}) - E(Y_{T=1,P=0,HHI=0})] \\ & - [E(Y_{T=0,P=1,HHI=0}) - E(Y_{T=0,P=0,HHI=0})] \end{aligned} \quad (3.6)$$

where T is short for the variable $Treat_{ij}$, P short for $Post_{ijt}$, and HHI short for HHI_{kt} .

The third difference is calculated as

$$\Delta 3 = \Delta 1 - \Delta 2 = \beta_7 \quad (3.7)$$

Therefore, β_7 captures the difference in the group difference between treatment firms and control firms as they move from the monopolistic industry to the perfectly competitive industry. Table 3.6 presents the three-way interaction regression results. The third difference of our interest is increasing in HHI. In the full sample, as the treatment firms turn from the perfectly competitive industry to the monopolistic industry, both measures of incentives nearly quadruples. All the coefficient estimates are statistically significant at 5%. At a first glance, it seems enormously large. Nevertheless, two reasons stand that the impact of competition should be smaller on average firms from a more realistic perspective. First, competition intensity of a given industry seldom goes from the one extreme of monopoly to the other extreme of

perfect competition. Second, HHI in our sample is generally small because it is based on the large grouping of Fama-French 48 industry classification. The mean and median in the full sample are respectively 0.083 and 0.056. It can be stated in another way. As the concentration measure HHI increases by one standard deviation (0.084), the treatment firms that were forced to change the board structure will increase more by 34.1% for PPS and by 31% in JM than control firms. The estimates are close in the matched sample in which we net out the self-selection problem.

[INSERT TABLE 3.6 HERE]

Table 3.7 shows the results on the independent compensation committee rule. We are interested to see if the additional independence requirement on the compensation committee plays a role. A simple answer is that we find no evidence for its significance. Not only the three-way interactions on the compensation independence rule are insignificant in all specifications, all the other variables that are supposed to capture the treatment of compensation committee independence are insignificant. In contrast, the treatment of majority independence is statistically significant at 5% or 1%. This is probably because the fully independent compensation adds only an insignificant increment on top of the majority independence rule. Another possibility is that the close timing of mandatory compliance of the two rules might result in a confounding effect.

[INSERT TABLE 3.7 HERE]

3.6 Additional Tests

This section provides more tests to evaluate the consequences of the SOX enactment on public firms. First, as the close timing between the introduction of SOX and burst of the Internet bubble may confound our finding, we exclude all the public firms traded on the NASDAQ exchange (Compustat item `exchcd=3`) for robustness check. Second, we examine whether the firms exhibit different accounting performance across industries with varying competition intensity subsequent to the SOX enactment.

3.6.1 Non-NASDAQ Firms

The introduction of SOX in year 2002 coincided with the collapse of Internet bubble. This confounding event may have contaminated the tests in the previous

section and cast doubt on the validity of the results. After all, the treatment firms are disproportionately populated with younger firms of stronger growth, which are suspiciously high technology firms. We address this concern by taking out all the NASDAQ firms in the full sample. Then based on the non-NASDAQ full sample, we again perform a propensity score matching to get a new matched sample. Overall, the non-NASDAQ full sample contains 5,413 firm-year observations and the new matched sample contains 1,142 observations. Table 3.8 provides the results on the non-NASDAQ samples.

[INSERT TABLE 3.8 HERE]

The uneven effect of SOX across industries of different competitiveness remains robust after we exclude NASDAQ firms. In fact, the impact is even more pronounced. The coefficients of the three-way interaction terms are larger in the non-NASDAQ samples comparing to the main results in the previous section. Within the non-NASDAQ samples, the three-way interaction terms are statistically significant at 5% in the full sample and 1% in the matched sample. For each pay-to-performance sensitivity measure, the estimates in the matched samples are larger than the full samples. More specifically, as HHI increases by one standard deviation (0.095)¹², PPS increases more by 42.5% for the treatment firms than the control firms in the full sample and by 55.8% in the matched sample, and JM increases more by 45.1% for the treatment firms than control firms in the full sample and by 56.8% in the matched sample respectively. These results yield strong support to our findings in the previous section.

3.6.2 Accounting Performance

This subsection examines whether the SOX's impact on accounting performance is uneven across different industries. Giroud and Mueller (2010) exploit the business combination laws passed between 1985 and 1991 which imposed a moratorium on business transactions especially on mergers and asset sales. This moratorium is generally considered to make hostile takeovers more difficult and thus it increases the opportunity for managerial slack. They document a significant decrease in operating performance after business combination laws were passed, and find that this decrease is larger in non-competitive industries. In the spirit of Giroud and Mueller (2010), this

¹² The standard deviation is computed in the new non-NASDAQ full sample.

subsection examines whether SOX exerts a different impact on competitive and noncompetitive industries in terms of the accounting performance.

The measure of accounting performance is return on assets (ROA). For control variables, we include all the three competition measures, the industry median ROA to capture the exogenous industry attribute. We also include the firm level characteristics including stock risk, market-to-book ratio, total assets and book leverage. Table 9 presents the empirical results.

[INSERT TABLE 3.9 HERE]

In Table 3.9, Column (1) and (2) show the results of the three-way interactions on HHI index in the full sample and matched sample respectively. We find no significant impact on ROA conditional on market competition in the full sample. Nevertheless, for the matched sample in which the overt selection bias is removed, the treatment effect of the forced change in the board structure is significantly increasing in concentration. As HHI increases by one standard deviation (0.084), the ROA in treatment firms on average increases more than control firms by 0.016. Although ROA is positively related with the entry cost in the full sample, all the other competition measures seem to account for little of variations in ROA. The included firm level control variables all contribute to variations in ROA. More specifically, ROA is significantly increasing in industry median ROA, market-to-book ratio, and is decreasing in stock risk, total assets and book leverage.

3.7 Concluding Remarks

The unified theme in this chapter is that different governance control mechanisms are connected with each other. It is important to understand the subtle links between the control mechanisms. First we examine the pairwise relations between incentive and market competition, and between incentives and board independence. Then we exploit the exogenous legal change of SOX to investigate whether the forcedly changed board structure results in a different impact on noncompetitive industries and competitive industries. Since firms that were compliant with SOX without any expectation are significantly different from those that were non-compliant, we perform the propensity score matching to mitigate the self-selection problem. Indeed, we find the SOX's impact on treatment firms is positively related to degree of concentration. This result

remains robust if we exclude all the NASDAQ firms. We interpret these findings as strong support on the disciplinary role of market competition. Additionally, we find some evidence of such differentials in accounting performance ROA.

References

- Aboody, D., and R. Kasznik. 2000. CEO stock option awards and the timing of corporate voluntary disclosures. *Journal of Accounting and Economics* 29 (1):73-100.
- Adams, R. B., and D. Ferreira. 2007. A Theory of Friendly Boards. *The Journal of Finance* 62 (1):217-250.
- Adams, R. B., B. E. Hermalin, and M. S. Weisbach. 2010. The role of boards of directors in corporate governance: A conceptual framework and survey. *Journal of Economic Literature* 48 (1):58-107.
- Almazan, A., and J. Suarez. 2003. Entrenchment and severance pay in optimal governance structures. *The Journal of Finance* 58 (2):519-548.
- Baggs, J., and J.-E. De Bettignies. 2007. Product Market Competition and Agency Costs. *Journal of Industrial Economics* 55 (2):289-323.
- Baker, G. P., and B. J. Hall. 2009. CEO Incentives and Firm Size. *Journal of Labor Economics* 22 (4):767-798.
- Bebchuk, L. A., and J. M. Fried. 2006. *Pay without performance: The unfulfilled promise of executive compensation*: Harvard University Press.
- Bebchuk, L. A., J. M. Fried, and D. I. Walker. 2002. Managerial Power and Rent Extraction in the Design of Executive Compensation. *The University of Chicago Law Review*:751-846.
- Bergstresser, D., and T. Philippon. 2006. CEO incentives and earnings management. *Journal of Financial Economics* 80 (3):511-529.
- Besanko, D., D. Dranove, M. Shanley, and S. Schaefer. 2009. *Economics of strategy*: Wiley.
- Brickley, J. A., J. L. Coles, and R. L. Terry. 1994. Outside directors and the adoption of poison pills. *Journal of Financial Economics* 35 (3):371-390.
- Burns, N., and S. Kedia. 2006. The impact of performance-based compensation on misreporting. *Journal of Financial Economics* 79 (1):35-67.
- Byrd, J. W., and K. A. Hickman. 1992. Do outside directors monitor managers?: Evidence from tender offer bids. *Journal of Financial Economics* 32 (2):195-221.
- Cai, J., Y. Qian, and Y. Liu. 2009. Information asymmetry and corporate governance. *Drexel College of Business Research Paper* (2008-02).
- Carlton, D. W., and J. M. Perloff. 1994. *Modern Industrial Organization*, 2005: Boston: Addison Wesley.

- Cheng, Q., and T. D. Warfield. 2005. Equity incentives and earnings management. *The Accounting Review* 80 (2):441-476.
- Chhaochharia, V., and Y. Grinstein. 2009. CEO Compensation and Board Structure. *The Journal of Finance* 64 (1):231-261.
- Christie, A. A., M. P. Joye, and R. L. Watts. 2003. Decentralization of the firm: theory and evidence. *Journal of Corporate Finance* 9 (1):3-36.
- Cohen, D. A., A. Dey, and T. Z. Lys. 2007. The Sarbanes Oxley Act of 2002: Implications for Compensation Contracts and Managerial Risk-Taking In *Northwestern University working paper*.
- Coles, J. L., N. D. Daniel, and L. Naveen. 2006. Managerial incentives and risk-taking. *Journal of Financial Economics* 79 (2):431-468.
- Core, J., and W. Guay. 2002. Estimating the value of employee stock option portfolios and their sensitivities to price and volatility. *Journal of Accounting Research* 40 (3):613-630.
- Core, J. E., and W. R. Guay. 2010. Is CEO Pay Too High and Are Incentives Too Low? A Wealth-Based Contracting Framework. *Academy of Management Perspectives* 24 (1):5-19.
- Cotter, J. F., A. Shivdasani, and M. Zenner. 1997. Do independent directors enhance target shareholder wealth during tender offers? *Journal of Financial Economics* 43 (2):195-218.
- Cuñat, V., and M. Guadalupe. 2009a. Executive compensation and competition in the banking and financial sectors. *Journal of Banking & Finance* 33 (3):495-504.
- . 2009b. Globalization and the provision of incentives inside the firm: The effect of foreign competition. *Journal of Labor Economics* 27 (2):179-212.
- Demsetz, H. 1996. *The economics of the business firm: seven critical commentaries*: Cambridge University Press.
- Duchin, R., J. G. Matsusaka, and O. Ozbas. 2010. When are outside directors effective? *Journal of Financial Economics* 96 (2):195-214.
- Fahlenbrach, R. 2009. Shareholder Rights, Boards, and CEO Compensation*. *Review of Finance* 13 (1):81-113.
- Faleye, O., R. Hoitash, and U. Hoitash. 2011. The costs of intense board monitoring. *Journal of Financial Economics* 101 (1):160-181.
- Gibbons, R., and K. J. Murphy. 1992. Optimal Incentive Contracts in the Presence of Career Concerns: Theory and Evidence. *Journal of Political Economy*:468-505.
- Giroud, X., and H. M. Mueller. 2010. Does corporate governance matter in competitive industries? *Journal of Financial Economics* 95 (3):312-331.

- Guay, W. R. 1999. The sensitivity of CEO wealth to equity risk: an analysis of the magnitude and determinants. *Journal of Financial Economics* 53 (1):43-71.
- Guo, L., and R. Masulis. 2012. Board structure and monitoring: New evidence from CEO turnover. *Available at SSRN 2021468*.
- Hall, B. J., and J. B. Liebman. 1998. Are CEOs really paid like bureaucrats? *The Quarterly Journal of Economics* 113 (3):653-691.
- Hallman, G., J. C. Hartzell, and C. Parsons. 2005. Carrots and sticks: The threat of dismissal and incentive compensation. *University of Texas at Austin working paper*.
- Harris, M., and A. Raviv. 2008. A Theory of Board Control and Size. *Review of Financial Studies* 21 (4):1797-1832.
- Hart, O. D. 1983. The market mechanism as an incentive scheme. *The Bell Journal of Economics*:366-382.
- Hermalin, B. E. 1992. The effects of competition on executive behavior. *The RAND Journal of Economics*:350-365.
- Hermalin, B. E., and M. S. Weisbach. 1998. Endogenously Chosen Boards of Directors and Their Monitoring of the CEO. *The American Economic Review* 88 (1):96-118.
- Hermalin, B. E., and M. S. Weisbach. 2003. Boards of directors as an endogenously determined institution: a survey of the economic literature. *Economic Policy Review* (Apr):7-26.
- Hölmstrom, B. 1979. Moral Hazard and Observability. *The Bell Journal of Economics* 10 (1):74-91.
- Hwang, B.-H., and S. Kim. 2009. It pays to have friends. *Journal of Financial Economics* 93 (1):138-158.
- Jensen, M. C. 1993. The modern industrial revolution, exit, and the failure of internal control systems. *The Journal of Finance* 48 (3):831-880.
- Jensen, M. C., and W. H. Meckling. 1976. Theory of the firm: Managerial behavior, agency costs and ownership structure. *Journal of Financial Economics* 3 (4):305-360.
- Jensen, M. C., and K. J. Murphy. 1990. Performance Pay and Top-Management Incentives. *The Journal of Political Economy* 98 (2):225-264.
- Karuna, C. 2007. Industry product market competition and managerial incentives. *Journal of Accounting and Economics* 43 (2):275-297.
- Kole, S., and K. Lehn. 1997. Deregulation, the evolution of corporate governance structure, and survival. *The American Economic Review* 87 (2):421-425.

- Kole, S. R., and K. M. Lehn. 1999. Deregulation and the adaptation of governance structure: the case of the US airline industry. *Journal of Financial Economics* 52 (1):79-117.
- Lipton, M., and J. W. Lorsch. 1992. A modest proposal for improved corporate governance. *The Business Lawyer*:59-77.
- Masulis, R. W., C. Ruzzier, S. Xiao, and S. Zhao. 2012. Do Independent Directors Matter?
- Mehran, H. 1995. Executive compensation structure, ownership, and firm performance. *Journal of Financial Economics* 38 (2):163-184.
- Milgrom, P. R., and J. Roberts. 1992. *Economics, organization and management*. Vol. 7: Prentice-Hall Englewood Cliffs, NJ.
- Milliron, J. 2000. Board of director incentive alignment and the design of executive compensation contracts. *Available at SSRN 229198*.
- Nalebuff, B. J., and J. E. Stiglitz. 1983. Information, competition, and markets. *The American Economic Review* 73 (2):278-283.
- Nevo, A. 2001. Measuring market power in the ready-to-eat cereal industry. *Econometrica* 69 (2):307-342.
- Prendergast, C. 2002. The Tenuous Trade-off between Risk and Incentives. *Journal of Political Economy* 110 (5):1071-1102.
- Raheja, C. G. 2005. Determinants of Board Size and Composition: A Theory of Corporate Boards. *The Journal of Financial and Quantitative Analysis* 40 (2):283-306.
- Raith, M. 2003. Competition, risk and managerial incentives. *American Economic Review* 93:1425-1436.
- Rajgopal, S., and T. Shevlin. 2002. Empirical evidence on the relation between stock option compensation and risk taking. *Journal of Accounting and Economics* 33 (2):145-171.
- Rosenbaum, P. R., and D. B. Rubin. 1983. The central role of the propensity score in observational studies for causal effects. *Biometrika* 70 (1):41-55.
- Scharfstein, D. 1988. Product-market competition and managerial slack. *The RAND Journal of Economics*:147-155.
- Schmidt, K. M. 1997. Managerial incentives and product market competition. *The Review of Economic Studies* 64 (2):191-213.
- Tufano, P. 1996. Who manages risk? An empirical examination of risk management practices in the gold mining industry. *The Journal of Finance* 51 (4):1097-1137.

Vicente Cuñat, and Maria Guadalupe. 2009. Globalization and the Provision of Incentives inside the Firm: The Effect of Foreign Competition. *Journal of Labor Economics* 27 (2):179-212.

Weisbach, M. S. 1988. Outside directors and CEO turnover. *Journal of Financial Economics* 20 (0):431-460.

Zajac, E. J., and J. D. Westphal. 1994. The costs and benefits of managerial incentives and monitoring in large US corporations: when is more not better? *Strategic Management Journal* 15 (S1):121-142.

Appendix: Data Definition

SOX Treatment

Treat ₁	An indicator variable that switches on to one if the firm satisfied the requirement of the majority independence rule in the year 2001.
Post ₁	For firms in the treatment group of the majority independence rule, Post ₁ is equal to one since the actual compliance of the majority independence rule and is equal to zero otherwise. For control firms, Post ₁ is equal to one since the year 2003 and is equal to zero otherwise.
Treat ₂	An indicator variable that switches on to one if the firm satisfied the requirement of fully independent compensation committee in the year 2001.
Post ₂	For firms in the treatment group of the compensation independence rule, Post ₂ is equal to one since the actual compliance of the compensation independence rule and is equal to zero otherwise. For control firms, Post ₂ is equal to one since 2003 and is equal to zero otherwise.

CEO Incentives and Characteristics

Age	Age of the CEO.
Age Squared	Squared age of the CEO.
CEO-Chairman	A dummy variable that switches on to one if the CEO assumes the title of Chairman on board.
JM	Jensen-Murphy statistic. Jensen-Murphy statistic (Jensen and Murphy, 1990) is the dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. It is winsorized to 1% in both tails and adjusted for inflation to year 2000.
lnJM	Log of Jensen-Murphy statistic (JM).
lnPPS	Log of pay-to-performance sensitivity (PPS).
ln(Tenure)	Log of 1+ years in office of the CEO.
PPS	Pay-to-performance sensitivity. The pay-to-performance sensitivity is the dollar change (in millions) in the CEO's stock and option portfolio for a 1% change in stock price. It is calculated by the "one-year approximation" method outlined in Core and Guay(2002). It is winsorized to 1% in both tails and adjusted for inflation to the base year 2000.

Firm Characteristics

Board Size	The number of the directors on board.
Book Leverage	The sum of long-term debt and debt in current liability scaled by total assets.
Classified Board	A dummy variable that switches on to one for the classified board.

Dual Class	A dummy variable that switches on to one if the firm has more than one class of common shares.
G-Index	The Gomper, Ishi and Metricks (2003) index. It is calculated by counting the number of anti-takeover provisions of the firm.
Insider-Linked Voting	The percentage of votes held by insider and linked (gray) directors as defined by RiskMetrics
ln(No.of Shareholders)	Log of the number of common shareholders.
ln(Total Assets)	Log of total assets.
Majority Indp	A dummy variable that switches on to one if the majority of directors on board are independent.
ln(Market Cap)	Log of market capitalization of the firm.
Non-emp. Block	An indicator variable for the presence of non-employee block holders on board where a block holder is defined as anyone holding more than 1% of the total voting power.
R&D	Research and development expenditure scaled by assets.
Ratio of Indp Dir	The ratio of the number of independent directors over the number of all directors on board.
ROA	Return on assets. It is calculated as operating income before depreciation over total assets.
Sale Growth	Log of the current year's sales over the previous year's sales.
Stock Risk	Annualized standard deviation of stock returns with reinvested dividend with at least 120 trading days for the year.
Market-to-Book	The ratio of the market value of equity item minus the book value of equity plus the book value of assets to the book value of assets.

Industry Attributes

HHI	Herfindahl–Hirschman Index (HHI henceforth). HHI is defined as the sum of the squared market shares for a given industry group based on Fama-French 48 industry groups classification.
HHI_Low	A dummy variable that switches on to one if the industry falls into the lowest tercile of HHI index. It is equal to zero otherwise.
HHI_High	A dummy variable that switches on to one if the industry falls into the highest tercile of HHI index. It is equal to zero otherwise.
Industry Median ROA	The median return on assets in a given industry group assigned by Fama-French 48 industry classifications.
ln(Entry Cost)	Log of the entry cost in a given industry. Entry cost is calculated as the weighted average gross value of the cost of property, plant and equipment weighted by each firm's market share in that industry. It is based on Fama-French 48 industry group classifications.
ProdSub	The ratio of the industry's total sales over the industry's operating cost. The operating costs include cost of goods sold, selling, general, and administrative expense, and depreciation, depletion, and amortization. It is based on Fama-French 48 industry group classifications.

Table 3.1 The Comparison of Treatment Firms and Control Firms in Fiscal Year 2001

This table compares the means of governance, firm characteristics and CEO merits between treatment and control firms in the fiscal year 2001. It consists of 720 domestic firms with complete board information on RiskMetrics 2001 and that have survived from year 2001 through 2004 on ExecuComp database. The treatments are defined by new listing rules on majority independence (column 1-3), compensation committee independence (column 4-6), All variables definitions are provided in Appendix. Column (3) and (6) give p-values of t-tests for sample mean differences of the treatment and control groups.

	Majority Independence			Independent Compensation Committee		
	(1)Treatment	(2)Control	(3)P-value	(4)Treatment	(5)Control	(6)P-value
ln(Total Assets)	7.034	7.481	0.002	7.434	7.394	0.749
Market-to-Book	2.049	2.170	0.377	2.112	2.161	0.688
Sale Growth	0.041	0.013	0.459	0.018	0.018	0.991
Book Leverage	0.138	0.154	0.215	0.155	0.150	0.681
ln(Market Cap)	14.363	14.800	0.006	14.772	14.710	0.658
Stock Risk	0.521	0.502	0.332	0.504	0.505	0.931
G-Index	8.298	9.456	0.000	8.832	9.391	0.014
Ratio of Indp Dir	0.406	0.744	0.000	0.557	0.726	0.000
Board Size	8.815	9.300	0.045	9.399	9.159	0.264
Classified Board	0.524	0.609	0.080	0.561	0.605	0.300
Dual Class	0.161	0.101	0.051	0.133	0.104	0.295
CEO-Chairman	0.581	0.658	0.103	0.566	0.669	0.014
Insider Linked Voting	12.827	2.703	0.000	6.306	3.858	0.036
Nonemp. block	0.460	0.300	0.001	0.445	0.291	0.000
ln(No of Shareholders)	0.962	1.813	0.000	1.362	1.762	0.010
Tenure	11.992	7.485	0.000	9.671	7.815	0.009
Age	56.992	55.253	0.021	56.064	55.391	0.314
N	124	596		173	547	

Figure 3.1: The Board Structure from Year 1996 to 2006

This figure shows the percentage of firms in our full sample with a majority of independent directors, with fully independent auditing committees, with full independent compensation committees and with fully independent nominating committees from year 1996 to 2006¹³.

Figure 3.2: The Ratio of Independent Directors on Board

This figure shows the mean ratio of independent directors on board from year 1996 to 2006 for the full sample, for the treatment firm of the majority independence rule and for the control firms unaffected by the majority independence rule.

¹³The database WRDS reports a jump in the number of committee members (from 1,089 to 4,295) from the year 1997 to 1998. This irregularity seems to appear only to independent directors. For our purpose, we exclude the committee membership data before 1998 for all the analysis.

Table 3.2: Logit Estimates for the Propensity Score Matching

This table shows the coefficient estimates of the logit models to predict membership into the treatment groups defined by the new listing rules on majority independence (*Treat₁*) and independent compensation committee (*Treat₂*). This sample includes all the firm-years from 1996 to 2001 in the full sample. All the variables are defined in the Appendix. The numbers in parentheses are standard errors. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable	Treatment ₁	Treatment ₂
G-Index	-0.153*** (0.0246)	0.00984 (0.0238)
Insider Linked Voting	0.0262*** (0.00318)	-0.0128*** (0.00376)
Board Size	0.0218 (0.0253)	0.0163 (0.0246)
Classified Board	0.220* (0.120)	-0.00373 (0.117)
Dual Class	-0.157 (0.158)	-0.0705 (0.159)
Nonemp Block	0.0554 (0.108)	0.405*** (0.108)
ln(No. of Shareholders)	-0.194*** (0.0413)	-0.165*** (0.0406)
Market-to-Book	-0.0416 (0.0316)	-0.0601* (0.0325)
Sale Growth	0.358* (0.200)	0.158 (0.181)
ln(Market Cap)	-0.0602 (0.0500)	0.229*** (0.0499)
Stock Risk	0.372 (0.288)	-0.359 (0.298)
Book Leverage	-0.510 (0.419)	0.713* (0.413)
Age	-0.143*** (0.0478)	-0.0110 (0.0535)
Age Squared	0.00125*** (0.000407)	0.000160 (0.000461)
CEO-Chairman	-0.329*** (0.115)	-0.403*** (0.114)
ln(Tenure)	0.457*** (0.0641)	0.0788 (0.0606)
Ratio of Indp Dir		-5.104*** (0.326)
Constant	3.637** (1.533)	-0.962 (1.644)
N	3529	2710
Pseudo R-squared	0.137	0.141

Figure 3.3: Treatment of the Majority Independence Rule Pre-Matching

This figure shows the propensity score distribution before the matching is performed based on the treatment membership of the majority independence rule.

Figure 3.4: Treatment of the Majority Independence Rule Post-Matching

This figure shows the propensity score distribution after the matching is performed based on the treatment membership of majority independence rule.

**Figure 3.5: Treatment of the Independent Compensation Committee Rule
Pre-Matching**

This figure shows the propensity score distribution before the matching is performed based on the treatment membership of fully independent compensation committee rule.

**Figure 3.6: Treatment of the Independent Compensation Committee Rule
Post-Matching**

This figure shows the propensity score distribution after the matching is performed based on the treatment membership of the fully independent compensation committee rule.

Table 3.3: Summary Statistics

This table reports the summary statistics for the full sample (column 1-3) and the sample matched according to the majority independence rule (column 4-6). The full sample and matched sample include 7,504 and 1,823 firm-year observations respectively. All the variables are defined in the Appendix. Column (1) and (3), column (2) and (4), column (3) and (6) show the mean, median and standard deviation respectively. The measures of incentives are winsorized to 1% in both tails. All dollar terms are adjusted for inflation to year 2000. The sample period is from 1996 to 2006.

Variables	Full Sample			Matched Sample		
	(1)Mean	(2)Median	(3)sd	(4)Mean	(5)Median	(6)sd
PPS	0.948	0.273	2.388	1.165	0.342	2.566
ln(PPS)	-1.241	-1.295	1.482	-1.076	-1.055	1.613
JM	0.227	0.085	0.407	0.374	0.141	0.540
ln(JM)	-2.427	-2.461	1.368	-1.877	-1.953	1.427
HHI	0.083	0.056	0.084	0.081	0.054	0.082
ProdSub	1.044	0.975	0.565	1.081	0.975	0.692
ln(Entry Cost)	8.668	8.875	1.218	8.676	8.955	1.218
Board Size	9.372	9.000	2.414	8.804	8.000	2.416
Ratio of Indp Dir	0.697	0.727	0.164	0.587	0.571	0.184
Classified Board	0.601	1.000	0.490	0.536	1.000	0.499
Dual Class	0.106	0.000	0.308	0.157	0.000	0.364
ln(No. of Shareholders)	1.631	1.588	1.807	1.063	0.917	1.551
Nonemp. Block	0.561	1.000	0.496	0.598	1.000	0.491
Insider Linked Voting	3.916	0.000	12.686	7.647	0.000	16.724
ln(Tenure)	1.767	1.792	0.913	2.006	2.079	0.988
Age	55.944	56.000	7.502	56.648	56.000	8.694
CEO-Chairman	0.635	1.000	0.481	0.541	1.000	0.498
G index	9.326	9.000	2.627	8.451	8.000	2.444
ln(Market Cap)	14.775	14.578	1.522	14.434	14.150	1.411
Book Leverage	0.141	0.115	0.128	0.126	0.086	0.131
ln(Total Assets)	7.464	7.300	1.417	7.063	6.906	1.243
Stock Risk	0.412	0.372	0.181	0.438	0.393	0.184
Market-to-Book	2.168	1.682	1.624	2.179	1.717	1.471
R&D	0.029	0.005	0.048	0.026	0.000	0.045
Sale Growth	0.086	0.077	0.234	0.106	0.093	0.264
ROA	0.156	0.148	0.093	0.161	0.152	0.082
Industry ROA	0.080	0.097	0.064	0.081	0.103	0.064

Table 3.4: Pairwise Relations in the Full Sample

This table presents the regression results of the pairwise relationships between incentives and competition, and between incentives and board independence . It includes all the firm year observations in the full sample from year 1996 to 2006. lnPPS is the log of dollar change in millions in the CEO's stock and option portfolio for a 1% change in stock price. lnJM is the log of dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. HHI denotes Herfindahl–Hirschman Index. HHI_Low is a dummy variable that switches on if the industry falls into the lowest tercile. HHI_High is a dummy variable that switches on if the industry falls into the highest tercile. ProdSub indicates product substitutability, the ratio of sales over operating cost. ln(Entry Cost) denotes the log of entry cost. HHI, ProdSub and ln(Entry Cost) are based on Fama-French 48 industry group classifications. *Majority Indp* is an indicator variable that switches on to one if the firm has a majority of independent directors on board. All the other variables are defined in the Appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Panel A: Incentives and Competition

Dependent Variables	(1)lnPPS	(2)lnJM	(3)lnPPS	(4)lnJM	(5)lnPPS	(6)lnJM	(7)lnPPS	(8)lnJM
HHI	0.368 (0.231)	0.123 (0.219)			0.433 (0.287)	0.194 (0.298)		
HHI_Low			-0.0354 (0.0246)	-0.0284 (0.0243)			-0.0421 (0.0263)	-0.0392 (0.0260)
HHI_High			0.101** (0.0486)	0.0730 (0.0484)			0.108** (0.0514)	0.0846* (0.0514)
ProdSub					-0.0146 (0.0397)	-0.0140 (0.0478)	-0.00956 (0.0323)	-0.0204 (0.0376)
ln(Entry Cost)					-0.0170 (0.0346)	-0.0356 (0.0343)	-0.0328 (0.0358)	-0.0526 (0.0360)
Industry ROA	0.285 (0.386)	-0.209 (0.358)	0.296 (0.386)	-0.207 (0.357)	0.287 (0.393)	-0.214 (0.365)	0.292 (0.394)	-0.211 (0.364)
Market-to-Book	0.118*** (0.0264)	0.0532*** (0.0168)	0.118*** (0.0261)	0.0528*** (0.0167)	0.118*** (0.0264)	0.0529*** (0.0169)	0.117*** (0.0261)	0.0522*** (0.0167)
ln(Market Cap)	0.552*** (0.0365)	-0.0129 (0.0340)	0.554*** (0.0363)	-0.0116 (0.0339)	0.554*** (0.0363)	-0.0106 (0.0338)	0.557*** (0.0362)	-0.00801 (0.0337)
Sale Growth	0.0910** (0.0379)	-0.0218 (0.0274)	0.0889** (0.0375)	-0.0231 (0.0272)	0.0907** (0.0378)	-0.0225 (0.0272)	0.0879** (0.0373)	-0.0247 (0.0269)
Stock Risk	-0.709*** (0.103)	-0.309*** (0.106)	-0.727*** (0.103)	-0.323*** (0.106)	-0.710*** (0.103)	-0.312*** (0.106)	-0.731*** (0.103)	-0.329*** (0.107)
R&D	-0.597* (0.360)	0.481 (0.373)	-0.607* (0.357)	0.474 (0.371)	-0.591* (0.359)	0.493 (0.374)	-0.597* (0.356)	0.489 (0.372)
ln(Tenure)	0.402*** (0.0372)	0.437*** (0.0377)	0.402*** (0.0372)	0.437*** (0.0377)	0.402*** (0.0369)	0.438*** (0.0375)	0.403*** (0.0370)	0.439*** (0.0376)
Constant	-10.25*** (0.500)	-2.808*** (0.471)	-10.26*** (0.500)	-2.820*** (0.471)	-10.11*** (0.601)	-2.531*** (0.575)	-9.999*** (0.594)	-2.405*** (0.573)
N	7504	7504	7504	7504	7504	7504	7504	7504
R-squared	0.407	0.091	0.408	0.092	0.407	0.091	0.409	0.093

Panel B: Incentives and Board

Dependent Variables	(1)lnPPS	(2)lnJM	(3)lnPPS	(4)lnJM
Majority Indp	-0.107*** (0.0384)	-0.110*** (0.0376)	-0.106*** (0.0382)	-0.109*** (0.0373)
Board Size	-0.0119 (0.0100)	-0.0244** (0.00956)	-0.0117 (0.00996)	-0.0243** (0.00952)
CEO-Chairman	0.0428 (0.0351)	0.0620* (0.0353)	0.0417 (0.0349)	0.0612* (0.0351)
HHI			0.389 (0.278)	0.129 (0.286)
ProdSub			-0.00983 (0.0387)	-0.0128 (0.0468)
ln(Entry Cost)			-0.0145 (0.0334)	-0.0328 (0.0325)
Market-to-Book	0.117*** (0.0262)	0.0511*** (0.0165)	0.117*** (0.0262)	0.0508*** (0.0165)
ln(Market Cap)	0.557*** (0.0357)	-0.00445 (0.0331)	0.558*** (0.0355)	-0.00248 (0.0330)
Sale Growth	0.0928** (0.0381)	-0.0259 (0.0272)	0.0931** (0.0382)	-0.0265 (0.0271)
Stock Risk	-0.739*** (0.0996)	-0.329*** (0.103)	-0.740*** (0.0995)	-0.332*** (0.103)
R&D	-0.590* (0.356)	0.515 (0.371)	-0.583 (0.355)	0.527 (0.372)
ln(Tenure)	0.388*** (0.0376)	0.418*** (0.0376)	0.388*** (0.0373)	0.419*** (0.0374)
Constant	-10.07*** (0.501)	-2.637*** (0.467)	-9.974*** (0.592)	-2.388*** (0.556)
N	7504	7504	7504	7504
R-squared	0.409	0.098	0.409	0.098

Table 3.5: Average Treatment Effect of the Majority Independence Rule

This table presents the regression results of average treatment effects of the majority independence rule on treatment firms. Column (1) and (2) include all the firm year observations from year 1996 to 2006. Column (3) and (4) limit the sample up to 2001 when firms had no anticipations of SOX. $\ln\text{PPS}$ is the log of dollar change in millions in the CEO's stock and option portfolio for a 1% change in stock price. $\ln\text{JM}$ is the log of dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. HHI denotes Herfindahl–Hirschman Index. ProdSub indicates product substitutability, the ratio of sales over operating cost. $\ln(\text{Entry Cost})$ denotes the log of entry cost. HHI, ProdSub and $\ln(\text{Entry Cost})$ are based on Fama-French 48 industry group classifications. Treat_1 is an indicator variable that switches on to one if the firm did not have a majority of independent directors on board in year 2001. All the other variables are defined in the appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors clustered at the CEO level. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variables	(1) $\ln\text{PPS}$	(2) $\ln\text{JM}$	(3) $\ln\text{PPS}$	(4) $\ln\text{JM}$
Treat_1	0.537*** (0.0974)	0.514*** (0.0933)	0.543*** (0.110)	0.516*** (0.106)
Post_1	0.194** (0.0868)	0.186** (0.0851)		
$\text{Treat}_1 * \text{Post}_1$	-0.215** (0.0983)	-0.207** (0.0943)		
HHI	-0.668** (0.282)	-0.588** (0.288)	-0.153 (0.333)	-0.207 (0.340)
ProdSub	0.0512 (0.0553)	0.0557 (0.0520)	-0.0281 (0.0533)	-0.00531 (0.0493)
$\ln(\text{Entry Cost})$	-0.0385* (0.0225)	-0.0386* (0.0222)	-0.0706** (0.0305)	-0.0728** (0.0295)
Industry ROA	-0.355 (0.376)	-0.0628 (0.370)	-0.475 (0.510)	-0.0489 (0.493)
Market-to-Book	0.329*** (0.0265)	0.0800*** (0.0181)	0.289*** (0.0297)	0.0773*** (0.0194)
$\ln(\text{Total Assets})$	0.568*** (0.0212)	-0.391*** (0.0225)	0.581*** (0.0292)	-0.383*** (0.0304)
Sale Growth	0.268*** (0.0804)	0.201** (0.0746)	0.383** (0.149)	0.288** (0.134)
Stock Risk	-0.423** (0.156)	-0.0729 (0.150)	0.207 (0.208)	0.378* (0.205)
R&D	1.279** (0.519)	0.148 (0.465)	1.072 (0.680)	-0.191 (0.630)
$\ln(\text{Tenure})$	0.597*** (0.0290)	0.605*** (0.0291)	0.539*** (0.0373)	0.543*** (0.0363)
CEO-Chairman	0.126** (0.0492)	0.122** (0.0469)	0.151** (0.0691)	0.165** (0.0640)
Board Size	-0.0525*** (0.0120)	-0.0583*** (0.0121)	-0.0558*** (0.0157)	-0.0654*** (0.0156)
Constant	-6.664*** (0.274)	-0.143 (0.268)	-6.432*** (0.346)	0.143 (0.335)
N	7504	7504	3517	3517
R-squared	0.551	0.512	0.535	0.481

Table 3.6: Three-way Interaction on HHI for the Majority Independence Rule

This table shows the regressions that evaluate the impact of the majority independence rule on incentives conditional on concentration. The full sample includes all the observations from year 1996 to 2006 (Column 1 and 3). The matched sample includes the firm observations matched by the majority independence rule (Column 2 and 4). $\ln\text{PPS}$ is the log of dollar change in millions in the CEO's stock and option portfolio for a 1% change in stock price. $\ln\text{JM}$ is the log of dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. HHI denotes Herfindahl–Hirschman Index. ProdSub indicates product substitutability, the ratio of sales over operating cost. $\ln(\text{Entry Cost})$ denotes the log of entry cost. HHI, ProdSub and $\ln(\text{Entry Cost})$ are based on Fama-French 48 industry group classifications. Treat_1 is an indicator variable that switches on to one if the firm did not have a majority of independent directors on board in year 2001. All the other variables are defined in the Appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors clustered at the CEO level. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variables	$\ln\text{PPS}$		$\ln\text{JM}$	
	(1)Full	(2)Matched	(3)Full	(4)Matched
Treat_1	0.619*** (0.133)	0.636*** (0.187)	0.635*** (0.127)	0.693*** (0.180)
Post_1	0.260** (0.0908)	0.160 (0.141)	0.242** (0.0884)	0.144 (0.138)
HHI	-0.368 (0.303)	1.065 (1.000)	-0.340 (0.307)	1.432 (0.903)
$\text{Treat}_1 * \text{Post}_1$	-0.543*** (0.148)	-0.324* (0.177)	-0.546*** (0.143)	-0.311* (0.180)
$\text{Treat}_1 * \text{HHI}$	-1.248 (1.050)	-3.021** (1.360)	-1.491 (1.005)	-3.375** (1.291)
$\text{HHI} * \text{Post}_1$	-0.877** (0.345)	-1.004 (0.696)	-0.727** (0.327)	-0.890 (0.707)
$\text{Treat}_1 * \text{Post}_1 * \text{HHI}$	4.065** (1.336)	3.642** (1.514)	4.142** (1.306)	3.431** (1.662)
ProdSub	0.0507 (0.0563)	0.0703 (0.117)	0.0604 (0.0525)	0.0384 (0.104)
$\ln(\text{Entry Cost})$	-0.0393* (0.0226)	0.0161 (0.0526)	-0.0382* (0.0222)	0.0186 (0.0529)
Industry ROA	-0.734** (0.371)	-0.361 (0.911)	-0.142 (0.355)	0.139 (0.868)
$\ln(\text{Total Assets})$	0.570*** (0.0212)	0.600*** (0.0542)	-0.390*** (0.0225)	-0.374*** (0.0545)
Market-to-Book	0.336*** (0.0259)	0.428*** (0.0537)	0.0805*** (0.0178)	0.117** (0.0395)
Sale Growth	0.254** (0.0797)	0.0375 (0.109)	0.199** (0.0746)	0.00938 (0.0996)

Table 3.6 Continues

Dependent Variables	lnPPS	lnJM		
	(1)Full	(2)Matched	(3)Full	(4)Matched
Stock Risk	-0.322** (0.152)	0.0137 (0.362)	-0.0642 (0.146)	0.140 (0.340)
ln(Tenure)	0.596*** (0.0291)	0.657*** (0.0609)	0.604*** (0.0291)	0.663*** (0.0596)
CEO-Chairman	0.126** (0.0493)	0.198* (0.115)	0.125** (0.0467)	0.203* (0.110)
Board Size	-0.0559*** (0.0119)	-0.0586** (0.0260)	-0.0596*** (0.0119)	-0.0593** (0.0251)
Constant	-6.628*** (0.275)	-7.598*** (0.724)	-0.154 (0.268)	-0.878 (0.713)
N	7504	1823	7504	1823
R-squared	0.551	0.555	0.513	0.481

Table 3.7: Three-way Interaction on HHI for the Independent Compensation Committee Rule

This table shows the regressions that evaluate the impact of the fully independent compensation committee rule on incentives conditional on concentration. The full sample includes all the observations from year 1996 to 2006 (Column 1 and 3). The matched sample includes the firm observations matched by the rule of fully independent compensation committee (Column 2 and 4). $\ln\text{PPS}$ is the log of dollar change in millions in the CEO's stock and option portfolio for a 1% change in stock price. $\ln\text{JM}$ is the log of dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. HHI denotes Herfindahl–Hirschman Index. ProdSub indicates product substitutability, the ratio of sales over operating cost. $\ln(\text{Entry Cost})$ denotes the log of entry cost. HHI, ProdSub and $\ln(\text{Entry Cost})$ are based on Fama–French 48 industry group classifications. Treat_1 is an indicator variable that switches on to one if the firm did not have a majority of independent directors on board in year 2001. Treat_2 is an indicator variable that switches on to one if the firm did not have a fully independent compensation committee in year 2001. All the other variables are defined in the Appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors clustered at the CEO level. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variables	$\ln\text{PPS}$		$\ln\text{JM}$	
	(1)Full	(2)Matched	(3)Full	(4)Matched
Treat_2	-0.0486 (0.112)	-0.321* (0.178)	-0.0929 (0.109)	-0.286 (0.176)
Post_2	0.0851 (0.0847)	0.0539 (0.145)	0.0746 (0.0818)	0.0892 (0.143)
HHI	-0.497 (0.322)	-2.176* (1.284)	-0.557* (0.321)	-1.741 (1.346)
$\text{Treat}_2*\text{Post}_2$	-0.0603 (0.130)	-0.0757 (0.185)	-0.0615 (0.124)	-0.118 (0.181)
$\text{Treat}_2*\text{HHI}$	0.162 (0.887)	2.057 (1.557)	0.569 (0.860)	1.936 (1.566)
$\text{HHI}*\text{Post}_2$	-0.644* (0.387)	-0.0320 (1.304)	-0.504 (0.373)	-0.171 (1.328)
$\text{Treat}_2*\text{Post}_2*\text{HHI}$	1.237 (1.188)	0.129 (1.810)	1.321 (1.115)	0.516 (1.805)
Treat_1	0.528*** (0.103)	0.468*** (0.136)	0.528*** (0.0980)	0.476*** (0.133)
Post_1	0.176* (0.102)	0.231 (0.140)	0.168* (0.1000)	0.238* (0.136)
$\text{Treat}_1*\text{Post}_1$	-0.218** (0.108)	-0.180 (0.120)	-0.218** (0.104)	-0.194* (0.115)
ProdSub	0.0488 (0.0559)	-0.00861 (0.0676)	0.0621 (0.0524)	-0.0116 (0.0666)
$\ln(\text{Entry Cost})$	-0.0404* (0.0225)	-0.00314 (0.0453)	-0.0401* (0.0222)	0.000586 (0.0455)
Industry Median ROA	-0.737** (0.372)	-0.374 (0.785)	-0.155 (0.356)	0.0313 (0.752)

Table 3.7 continues

Dependent Variables	lnPPS		lnJM	
	(1)Full	(2)Matched	(3)Full	(4)Matched
ln(Total Assets)	0.570*** (0.0213)	0.585*** (0.0434)	-0.391*** (0.0226)	-0.377*** (0.0398)
Market-to-Book	0.336*** (0.0259)	0.382*** (0.0414)	0.0805*** (0.0178)	0.0828** (0.0291)
Sale Growth	0.255** (0.0796)	0.532** (0.164)	0.201** (0.0746)	0.488** (0.161)
Stock Risk	-0.321** (0.152)	-0.529* (0.301)	-0.0615 (0.146)	-0.344 (0.290)
ln(Tenure)	0.598*** (0.0293)	0.625*** (0.0512)	0.606*** (0.0293)	0.633*** (0.0504)
CEO-Chairman	0.123** (0.0498)	0.140 (0.0931)	0.122** (0.0474)	0.137 (0.0885)
Board Size	-0.0550*** (0.0119)	-0.0798*** (0.0209)	-0.0587*** (0.0120)	-0.0875*** (0.0201)
Constant	-6.608*** (0.275)	-6.494*** (0.582)	-0.122 (0.268)	0.116 (0.552)
N	7504	2526	7504	2526
R-squared	0.550	0.533	0.513	0.514

Table 3.8: Three-way Interaction on HHI for Non-NASDAQ Firms

This table shows the regressions that evaluate the impact of the majority independence rule on incentives conditional on concentration excluding firms traded on the NASDAQ exchange. The full sample includes all the observations from year 1996 to 2006 (Column 1 and 3). The matched sample includes the firm observations matched by the majority independence rule (Column 2 and 4). $\ln\text{PPS}$ is the log of dollar change in millions in the CEO's stock and option portfolio for a 1% change in stock price. $\ln\text{JM}$ is the log of dollar change in the CEO's stock and option portfolio for 1000 dollars change in the firm value. HHI denotes Herfindahl–Hirschman Index. ProdSub indicates product substitutability, the ratio of sales over operating cost. $\ln(\text{Entry Cost})$ denotes the log of entry cost. HHI, ProdSub and $\ln(\text{Entry Cost})$ are based on Fama-French 48 industry group classifications. Treat_i is an indicator variable that switches on if the firm did not have a majority of independent directors on board in year 2001. All the other variables are defined in the Appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors clustered at CEO level. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variables	$\ln\text{PPS}$		$\ln\text{JM}$	
	(1)Full	(2)Matched	(3)Full	(4)Matched
Treat_i	0.690*** (0.165)	0.422 (0.260)	0.759*** (0.155)	0.508** (0.244)
Post_i	0.255** (0.117)	0.150 (0.200)	0.251** (0.117)	0.121 (0.193)
HHI	-0.311 (0.334)	-0.903 (1.039)	-0.231 (0.320)	-0.609 (1.098)
$\text{Treat}_i * \text{Post}_i$	-0.497** (0.187)	-0.366 (0.228)	-0.548** (0.176)	-0.384* (0.212)
$\text{Treat}_i * \text{HHI}$	-2.093* (1.125)	-2.100 (1.535)	-2.489** (1.086)	-2.672* (1.547)
$\text{HHI} * \text{Post}_i$	-0.733** (0.351)	-1.968*** (0.559)	-0.710** (0.339)	-1.831*** (0.542)
$\text{Treat}_i * \text{Post}_i * \text{HHI}$	4.469** (1.463)	5.877*** (1.179)	4.751** (1.452)	5.976*** (1.274)
ProdSub	0.0706 (0.0669)	0.140 (0.116)	0.0772 (0.0622)	0.108 (0.107)
$\ln(\text{Entry Cost})$	-0.0500* (0.0256)	-0.0229 (0.0644)	-0.0417* (0.0252)	-0.0202 (0.0624)
Industry ROA	-0.240 (0.420)	0.797 (1.349)	0.0495 (0.408)	1.181 (1.270)
$\ln(\text{Total Assets})$	0.558*** (0.0244)	0.707*** (0.0949)	-0.419*** (0.0235)	-0.289** (0.0945)
Market-to-Book	0.377*** (0.0340)	0.351*** (0.0690)	0.0589** (0.0241)	0.0605 (0.0519)
Sale Growth	0.385*** (0.0979)	0.385 (0.267)	0.337*** (0.0961)	0.331 (0.259)
Stock Risk	-0.669** (0.212)	-0.816 (0.599)	-0.383* (0.204)	-0.602 (0.570)
$\ln(\text{Tenure})$	0.587*** (0.0338)	0.650*** (0.0894)	0.595*** (0.0332)	0.654*** (0.0897)

Table 3.8 continues

Dependent Variables	lnPPS		lnJM	
	(1)Full	(2)Matched	(3)Full	(4)Matched
CEO-Chairman	0.0655 (0.0556)	0.111 (0.164)	0.0632 (0.0528)	0.110 (0.157)
Board Size	-0.0485*** (0.0133)	-0.0779** (0.0319)	-0.0491*** (0.0131)	-0.0729** (0.0313)
Constant	-6.567*** (0.312)	-7.231*** (1.071)	0.101 (0.298)	-0.459 (1.005)
N	5413	1142	5413	1142
R-squared	0.532	0.476	0.508	0.373

Table 3.9: ROA and Three-way Interaction on HHI

This table shows the regressions that evaluate the impact of the majority independence rule on ROA conditional on concentration. The full sample includes all the observations from year 1996 to 2006 (Column 1). The matched sample includes the firm observations matched by the majority independence rule (Column 2). ROA*100 is the return on assets multiplied by 100. HHI denotes Herfindahl–Hirschman Index. ProdSub indicates product substitutability, the ratio of sales over operating cost. ln(Entry Cost) denotes the log of entry cost. HHI, ProdSub and ln(Entry Cost) are based on Fama–French 48 industry group classifications. Treat₁ is an indicator variable that switches on to one if the firm did not have a majority of independent directors on board in year 2001. All the other variables are defined in the Appendix. All regressions include year dummy variables. The numbers in parentheses are robust standard errors clustered at the firm level. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variables: ROA*100	(1)Full	(2)Matched
Treat ₁	1.047 (0.874)	0.787 (0.949)
Post ₁	0.651 (0.511)	1.692** (0.788)
HHI	3.187 (6.755)	-0.588 (4.246)
Treat ₁ *Post ₁	-1.133 (0.854)	-2.244** (1.025)
Treat ₁ *HHI	-6.368 (7.967)	2.437 (5.925)
HHI*Post ₁	-0.268 (3.377)	-11.13** (5.079)
Treat ₁ *Post ₁ *HHI	7.789 (7.088)	18.66** (9.294)
ProdSub	0.00393 (0.437)	0.425 (0.482)
ln(Entry Cost)	0.613*** (0.152)	0.244 (0.285)
Industry ROA	21.75*** (3.848)	36.52*** (7.486)
Stock Risk	-17.81*** (1.492)	-10.69*** (2.479)
Market-to-Book	2.547*** (0.387)	2.594*** (0.320)
ln(Total Assets)	-0.553** (0.189)	-0.872** (0.298)
Book Leverage	-10.13*** (2.203)	-10.79*** (2.245)
Constant	15.78*** (1.921)	16.60*** (3.476)
N	7511	1832
R-squared	0.374	0.404

Chapter 4 Cash Holdings, Asset Tangibility and Financial Dependence

4.1 Introduction

In the previous literature, the industry level variables are generally considered as important factors on the financial structure but many researchers routinely construct the industry dummy variables to absorb industry variations and go on to test the relationship between firm characteristics and the financial structure. As MacKay and Phillips (2005) point out, this approach does not inform us how or why industry-specific factors affect firms' financial decisions. We address these questions by quantitatively analyzing how the exogenous industry characteristic is related to firms' financial decisions and the effectiveness of firms' actions to the exogenous industry characteristic. For the industry characteristics, we focus on the technological differences in financial dependence across industries. For the firm-level financial decision, we focus on the corporate cash holdings. For the strategic action, we focus on the effectiveness of tangible assets as a signal of pledgeability.

The recent financial crisis highlights great uncertainties in external financial conditions and the importance of corporate liquidity management. Based on an extensive survey of CFOs during the recent global financial crisis, Campello et al. (2010) show that financial constrained firms planned deeper cuts in technology spending, capital spending and employment, and firms that were unable to borrow externally had to bypass profitable investment opportunities. As the external financial dependence has significant real effects on profitability, it is thus important to gain a deep understanding of the corporate liquidity policy. The past literature has discussed a rich set of possible determinants of the cash holding decision. However, much less attention is directed at examining to what extent the exogenous industry-level characteristics affect the decision to hold cash and to what extent the firms may react to the built-in industry characteristics. This chapter helps fill the gap by examining the role of external financial dependence and the usage of tangible assets to reduce the negative consequences stemming from external financial dependence.

We begin the investigation by examining whether a firm's decision to hold tangible assets helps reduce the holding of cash assets. The negative relationship

between tangible assets and cash assets has been well-documented in previous studies. In our sample, cash holdings and asset tangibility are approximately one-to-one substitute for each other.

Then we examine if the negative relationship is conditional on the industry-level external financial dependence. We construct measures of external financial dependence and external equity financial dependence following Rajan and Zingales (1998)¹⁴. The financial dependence measures are uniquely determined for each industry and are assumed to be invariant over time.

The results show that the external financial dependence indeed has a significant impact on the link between cash assets and tangible assets. The marginal effect of tangible assets on cash assets is significantly negatively related to the external financial dependence. We interpret this result as using tangibility assets to signal pledgeability to outside investors and debt holders is more important for firms operating in industries with high financial dependence than those in industries with low financial dependence, and thus the negative relationship is more pronounced in financially dependent industries.

To gain further insights at the distribution of relationship between cash assets, tangible assets and financial dependence, we classify industries into two subgroups: the high financially dependent industries and the low financially dependent industries. An industry is put in the category of the high (low) financial dependent industries if its financial dependence measure falls into the highest (lowest) two quintiles across all industries. The results are quite consistent with regressions on continuous measures of financial dependence. The negative relationship between tangible assets and cash assets is more pronounced in the high financially dependent industries than in the low financially dependent industries.

Moreover, we examine whether the asset tangibility is an exogenous industry characteristic instead of a choice variable. Particularly, we replace the firm level

¹⁴ We do not directly take their measures because our sample uses the new industry classification NAICS code to identify the industry while Ranjan and Zingales (1998)'s original paper uses the older SIC code. Despite the concordance table that links the NAICS and SIC, they are two completely different industry classification systems. NAICS is not a refinement or reassignment of SIC. It is difficult to transform one system to another by simply performing the one-to-one, one-to-many, and many-to-one matches.

tangibility with the industry level tangibility to run the similar regressions. Nevertheless, we do not find a significant impact of the industry level tangibility.

Finally, as our baseline regression is restricted to a sample of manufacturing firms, we also construct a sample that takes up the all the available public firms' accounting data from Compustat but exclude the firms in utility and financial industries. We are interested to see whether our findings hold up for a broader range of industries. The results in the new sample are quite similar to the sample consisting of manufacturing firms only.

This chapter makes two contributions. First, although it has been documented that tangible assets are negatively related to cash assets (for example, see John (1993)), tangible assets holdings normally appear in the set of control variables. This chapter provides greater details on the role of tangible assets in the corporate cash policy. Second, instead of sweeping the inter-industry variations into the dummy variables, we quantify the interaction of industry external financial dependence and corporate holdings of tangible assets as a way to dampen the negative influences of that financial dependence.

The rest of the chapter is organized as follows. Section 4.2 outlines the literature review and develops the theoretical argument. Section 4.3 describes the data sample, variable construction and empirical strategy specification. Section 4.4 presents the regression results. Section 4.5 gives concluding remarks.

4.2 Research Question & Hypothesis Development

In the world of a perfect frictionless financial market, the cash holding decision is irrelevant. There is no opportunity cost of raising capital to fund profitable projects. And there is no premium of holding cash assets.

However, in the world of the incomplete financial market, the opportunity cost to raise funds is strictly positive. Thus firms have to equate the marginal cost with the marginal benefit of holding an additional dollar of cash assets to achieve the optimal amount of cash holdings. The past literature points to four important motives of corporate cash holdings: the transaction cost motive, the precautionary motive, the agency motive, and the tax motive.

Dating back to Keynes (1936), the transaction cost motive suggests that firms choose to hold cash assets because the transaction cost occurs as the firm converts the cash substitutes to cash assets. The transaction cost arises when a strictly positive cost is associated with firms' actions to liquidate its assets, reduce dividend payments, negotiate financial contracts, and raise capital from the equity market. For example, the cost of asset sales, the cost of hedging instruments, dividends cut and renegotiation, and cash conversion cycles are among the many factors contributing to the transaction cost.

The precautionary motive suggests that firms choose to hold cash assets in order to insure against the adverse shock. In the presence of information asymmetry, the manager has more information than the outside investors. The firms' securities may be seriously underpriced. As the price of raising external capital goes up, the firm would find it prohibitively expensive to raise the outside funds. This financial constraint can be very costly such that the firm has to cut investment and forgo profitable projects. Thus firms will hold cash assets to finance their own activities and investment projects. Consistent with the precautionary motive, Opler et al. (1999) show that the firms with riskier cash flows and poor access to external financing hold more cash. The precautionary motive also suggests that firms will hold more cash if the cost of financial distress is larger, for example, firms with high research and development (R&D) expenses (Opler and Titman, 1994). In addition, corporate cash holdings can be instrumental in R&D strategic competition (Lyandres and Palazzo, 2012). Along the same line of argument, Bates et al. (2009) document the average cash-to-assets ratio for U.S. industrial firms more than doubles from 1980 to 2006 and this dramatic increase in cash holdings is concentrated in industries that experience the greatest increase in idiosyncratic risk.

The agency motive points to the possibility that managers would retain cash to pursue their own objectives at the expense of shareholders. Cash is considered as free cash flow. Managers may hold the excess cash as cash flow management to avoid the discipline of the capital market. The agency cost of managerial discretion is less important when firms have valuable investment opportunities, but it can be costly when firms have inadequate profitable projects and spend the excess cash on poor projects. Jensen (1986) argues that entrenched managers would rather retain cash than increase payouts to shareholders when firms have poor investment opportunities.

Dittmar and Mahrt-Smith (2007) provide evidence that entrenched managers dissipate cash more quickly in ways that reduce operating performance. Harford et al. (2008) show that firms with weaker shareholder rights and low insider ownership have lower cash holdings, and that firms with excess cash tend to increase acquisition.

Finally, the tax motive is also a determinant of holding liquid assets. For example, Foley et al. (2007) show that the U.S. multinational firms that have higher repatriation taxes hold more cash assets and hold these cash assets abroad.

From a general perspective, achieving the optimal amount of cash assets is equivalent to solving a constrained optimization problem. Firms attempt to maximize the payoff and minimize the cost subject to the budget constraint in an uncertain environment. In this context, the transaction cost motive and the tax motive mainly affect the specification of the cost function. The precautionary motive captures the influence of uncertainty, which can be seen as a function of the distribution of risk. These motives are summarized in the optimization argument. The agency motive emphasizes that the constrained optimization problem for the manager may be in conflicts with the optimization problem of the owner. In contrast, this chapter is interested in firms' efforts to relax the binding financial constraints when they make the cash holding decision. It shares the information asymmetry argument for the precautionary motive, but it does not conveniently belong to any motive discussed in the previous literature as the emphasis falls on the specification of the binding constraint in the constrained optimization problem. Particularly, we examine firms' usage of tangible assets to signal pledgeability in order to prevent the potential loss from the agency problem in financial contracting.

Previous finance theories suggest that the presence of contracting frictions and limited enforceability restricts a firm's access to external finance (Hart and Moore, 1994; Holmstrom and Tirole, 1997). To alleviate this restriction, firms may take actions to signal pledgeability to outside investors and debt holders in the incomplete financial market. Particularly, the allocation of tangible assets has captured a lot of attention from researchers. If the relationship between the firm and investors breaks down, tangible assets can be easily shifted to investors. Therefore, from the perspective of creditors, tangible assets are desirable collaterals to back up the loans because they are easier to resell or redeploy in case of bankruptcy. Consistent with this view, Shleifer and Vishny (1992) and Campello and Giambona (2011) find that tangible

assets that are redeployable have high liquidation values and thus sustain high debt capacity. Almeida and Campello (2007) find that investment cash flow sensitivity is increasing in firms' asset tangibility in financially constrained firms.

We consider a firm that has profitable investment projects but has limited access to external capital. To finance the investment projects, the firm can save up available cash assets or issue debts. Of course it does not necessarily suggest that cash assets and debts are perfect substitutes for each other. Indeed, Acharya et al. (2007) show that when hedging needs are high, financially constrained firms prefer higher cash to lower debt. However, assume that cash assets and debts are alternative sources of funds. All else equal, if the cost of raising the debt decreases, for example, because of asset tangibility, raising the debt becomes more attractive. Firms should be more likely to issue debts and in turn rely less on the cash assets. To the extent that presence of tangible assets facilitates borrowing external funds, asset tangibility weakens the need to hold extra cash assets.

A related question arises that what types of firms would rely on more heavily this signaling mechanism. Braun (2003) argues that if financial contractibility is poor, external finance requires higher proportions of, in his term, "hard assets" to send a reassuring message to outside investors. He shows that the more financially dependent the industry is, the more important the asset hardness is for the industry growth performance, and the less sensitive the firm leverage is to asset tangibility. Along the same line of argument, we hypothesize that this signaling mechanism is also more important for firms with high financial dependence on external capital when it comes to the corporate cash holding behavior.

It is worth noting that financial dependence varies across different industries. There is a technological reason that different industries have the varying degree of financial dependence. Industries differ considerably in the initial project scale, the gestation period, requirement of continuing investment and the cash harvest period. For example, the pharmaceutical industry has a larger initial scale than the textile industry and is thus likely to be more dependent on external finance. Rajan and Zingales (1998) first take the view of the built-in financial dependence and develop the industry-level measures. They show that financial dependence is crucial to understand growth of the industry and an important fraction of financial dependence is exogenous to firms' decisions.

More broadly, it is not a radically new idea that the exogenous external financial dependence affects firms' strategic behaviors. Consider the agency problem in the financial contracting. If a firm is vulnerable to financial conditions, the rival firm can take advantage of information asymmetry and ensure that the performance of the vulnerable firm is indeed poor so as to force it to exit the market. Bolton and Scharfstein (1990) show that in the oligopolistic competition setting, it is rational for a firm to take predation strategy to crowd out its rival firm which is in negotiation with debt holders.

After summarizing the most relevant literature, we develop the hypotheses as follows.

As firms can actively choose asset tangibility to signal their pledgeability to outside investors and debtholders, more holdings of tangible assets put firms in a better position to negotiate with investors and debtholders, and the cost of raising external capital is then reduced.

Hypothesis 1: at the firm level, cash holdings and assets tangibility should be negatively related¹⁵.

Consider that the signaling mechanism of allocating tangible assets is more important for firms with greater financial dependence on external capital. Therefore firms in high financial dependent industries should be more sensitive to the relationship between cash holdings and asset tangibility.

Hypothesis 2: the negative relationship between cash holdings and asset tangibility is stronger in high financially dependent industries than in low financially dependent industries.

4.3 Data Construction and Empirical Strategy

4.3.1 Data Sample

To investigate our hypotheses, we construct a sample of U.S. manufacturing firms from Compustat from the fiscal year 1995 to 2009. We first drop the observations with

¹⁵ Note that we only hypothesize the negative relation between cash assets and asset tangibility but do not distinguish the causal directions between these two variables. Cash assets can be used to fund the investment projects. Asset tangibility can also relax the financial constraint by signaling pledgeability. Therefore, greater asset tangibility allows the lower holdings of cash assets. Yet we do not hypothesize whether the decision of cash assets results in or results from asset tangibility.

negative sales or negative total assets. To be included in the sample, we require firms to have sales and total assets greater than one millions dollars. We also require the sale growth of the firm in a given year to be no larger than 200% as extreme sale growth often indicates major corporate events such as mergers and acquisitions. Following the previous studies including MacKay and Phillips (2005) and Almeida and Campello (2007), we drop observations with Tobin's Q larger than ten. Before constructing any industry level measure, firms must have observations for all the dependent and independent variables. Finally, to alleviate the concern that our results may be driven by few influential observations, we require that each industry-year must have at least 5 observations, so that the industry level variables are not fully determined by a couple of firms. All dollar terms are adjusted for inflation to the year 2000 constant dollars.

Then we match the firms' accounting data with the concentration measure Herfindahl–Hirschman Index (henceforth HHI) provided by the U.S. Census. The concentration measure based on Compustat data covers only public firms while the concentration measure reported by the Census covers the both public firms and private firms. Ali et al. (2009) show that the industry concentration measure based on Compustat data is a poor proxy for the actual industry concentration. Thus we use the Census HHI to overcome the potential bias in the concentration measure derived from Compustat. The Census replaced the older Standard Industrial Classification (SIC) system with the new North American Industry Classification System (NAICS) to classify business establishments in the year 1997. Considering that the HHI is reported every five years, following Almeida and Campello (2007), we take the reporting year as the middle year to match the firm accounting data. For example, the Census HHI in year 1997 is matched with Compustat firms' accounting variables from the fiscal year 1995 to fiscal year 1999, the Census HHI in year 2002 is matched to Compustat firms' accounting variables from the fiscal year 2000 to fiscal year 2004, and so on. We use the HHI based on six-digit NAICS code. Overall, the sample includes 172 industries, 2,999 public firms, and 18,234 firm-year observations.

4.3.2 Variable Construction

The Dependent Variable: Cash Holdings

The dependent variable of cash holdings is defined as the cash and short-term investment divided by total assets. Figure 4.1 summarizes the profile of cash-to-assets ratio from the year 1995 to 2009. As in the figure, the annual median of cash-to-assets

ratio exhibits radical changes over time. The line connected by triangles shows the median of cash-to-assets ratio for all firms in manufacturing firms in our sample. And the line connected by circles plots the median of cash-to-assets ratio for all the public firms in a broader coverage of industries that exclude only utilities and financial industries. Despite the difference in the industry coverage, the two lines roughly follow the same time trend. Before the year 2000, the medians of cash-to-assets in both samples fluctuate around 0.1. After the year 2000, they climb up along the upward trend until hitting the peak around the year 2006. After two consecutive declines in the year 2007 and 2008, the cash-to-assets ratio picks up in the year 2009. Consider the timing of recessions during the sample period. The first recession occurred between March 2001 and November 2001. The second recession went through December 2007 to June 2009. It is interesting to note that the 2001 recession does not seem to disrupt the trend of cash-to-assets probably because of its short recession span. Yet the cash holdings indeed took a turn just preceding the 2007-2009 recession. As the recession deepened, the cash holdings declined further before going up again in the year 2009 when the recession was over. Over the sample period, the manufacturing industries always have greater cash-to-assets ratios than the average industries. Their difference roughly remains constant until it suddenly drops in the year 1999. The two ratios diverge thereafter.

[INSERT FIGURE 4.1 HERE]

The External Financial Dependence

Following Rajan and Zingales (1999), we construct the external financial dependence and external equity financial dependence for each industry. Their methodology captures the technological component of the industry need of external finance. The degree of industry external financial dependence is invariant for all the firms within the same industry across the years. This industry level measure is considered to be much less vulnerable to the endogeneity problem and is still widely used in economics and finance studies. The notable examples include Beck and Levine (2002), Franks et al. (2012), and Friedrich et al. (2013).

In the earlier work of Kaplan and Zingales (1997) (KZ thereafter), the degree to which a firm is financially constrained is defined by the difference between its internal and external cost of funds. KZ classify firms into five groups by financially constrained status based on qualitative and quantitative information of company annual

reports. Following KZ, Cleary (1999) also classifies firms according to firm-level financial variables related to financial constraints. Hadlock and Pierce (2010) propose a new measure of financial constraint which casts serious doubt on the validity of KZ's index. They estimate the ordered logit models to predict financial constraints as a function of a set of quantitative factors. Nevertheless, all these measures of financial constraints are essentially firm-level measures, which are vulnerable to the endogeneity problem. In addition, the focus of this chapter is to examine the role of financial dependence, an exogenous industry characteristic, in the relationship between cash holdings and asset tangibility. The Rajan and Zingales (1998)'s measure used in this chapter is more appropriate to serve the purpose.

Now we describe the construction of financial dependence measures. It starts at the firm level. For each firm in a given year, the external financial dependence is defined as capital expenditures minus cash flow from operations divided by capital expenditure. For cash flow statements with format codes 1, 2, or 3, cash flow from operations is defined as the sum of cash flow from operations plus decreases in inventories, decreases in receivables, and increases in payables. For cash flow statement with format code 7, cash flow from operations is defined as the sum of income before extraordinary items, depreciation and amortization (cash flow), deferred taxes (cash flow), equity in net loss/earnings, sale of property, plant and equipment and investment/gain (loss), and other funds from operations. At the firm level, the external equity financial dependence is defined as the ratio of sale of common and preferred stock minus purchase of common and preferred stock over the capital expenditures.

To smooth the temporal fluctuations and to make the financial dependence measures comparable across industries, we need to aggregate them to the industry level. To average out the temporary shocks and reduce the influence of outliers, we first sum all the use of external finance/external equity finance over the sample years and then divide by the sum of capital expenditures over the sample years. Then we take the median for each industry classified by NAICS six-digit code to aggregate the dependence measures across firms. The median provides a more representative summary than the mean as the latter can be easily swamped by big firms. Table 4.1 presents all our estimates of financial dependence measures for each industry.

[INSERT TABLE 4.1 HERE]

Asset Tangibility

Asset tangibility is constructed to capture the expected asset liquidation values. Berger et al. (1996) assemble the information on discontinued operations from a sample of Compustat firms from the year 1984 to 1993. They find that on average, a dollar's book value converts to 72 cents in exit value for receivable, 55 cents for inventories and 54 cents for fixed assets. Borrowing their estimates, we calculate the asset tangibility as

$$\begin{aligned} \text{Tangibility} = & 0.715 * \text{Receivables} + 0.547 * \text{Inventory} \\ & + 0.535 * \text{Fixed Capital} \end{aligned} \quad (4.1)$$

Then we scale the tangibility by the value of the total assets.

Control Variables

There has been a large body of literature on the determinants of cash holdings. We include a rich set of control variables commonly used in these previous studies, such as Opler et al. (1999), Almeida et al. (2004), and Duchin (2010). More specifically, we include the log of total assets to control for the firm size, the standard deviation of earnings for the past five years to control for earning risk, the market-to-book ratio to control for investment opportunities, the number of common shareholders to control for the investor base dispersion, the number of business segments to control for diversification, the R&D expense scaled by the total assets to control for cost of the liquidity shortfall and information asymmetry. The financial distress is measured by the R&D expense scaled by sales. We also measure the age of firm defined by how many years the firm has a valid observation in the Compustat since 1950. The access to public debt market is measured by a dummy variable which switches on to one if the firm has the S&P bond rating. For other firm-level determinants, we also include the net working capital, leverage and the dummy variable that switches on to one if the firm pays out dividend in a given year. To control for the industry-wide shock, we include the median of return on assets for each industry. The Census HHI is used to measure concentration within the six-digit NAICS industry. The definitions of all the variables are listed in greater details in the Appendix.

Table 4.2 presents the summary statistics of the main variables. There are wide variations in the ratio of cash and short-term investment to total assets. The median of

cash-to-assets ratio is 14.6%. The median size of the firm in this sample is 98.531 million dollars adjusted for inflation to year 2000. As the mean of total assets, 1,362.355 million dollars, is significantly larger than the median, the distribution of the firm's size is skewed, thus we take the log transformation of the total assets in all regressions. For the same reason, we also take the log form of the number of common shareholders in the regressions.

[INSERT TABLE 4.2 HERE]

4.4 Empirical Strategy

To explore the impact of the exogenous industry financial dependence, we examine the differential sensitivity between cash holdings and asset tangibility. The baseline regression takes the specification as follows.

$$\begin{aligned} Cash_{ijt} = & \beta_1 Tang_{ijt} + \beta_2 Depen_j + \beta_3 Tang_{ijt} * Depen_j \\ & + \beta'_4 X + \alpha_i + \alpha_t + \varepsilon_{ijt} \end{aligned} \quad (4.2)$$

where the subscripts i, j, t denote the firm i in the industry j at the year t . $Cash_{ijt}$ denotes the cash-to-assets ratio for the firm at the industry j in the given year t . $Tang_{ijt}$ is the firm-level tangibility, $Depen_j$ is the financial dependence measure uniquely determined for each industry, $Tang_{ijt} * Depen_j$ is the interaction between asset tangibility and financial dependence, X is a vector of all the control variables, α_i is the firm fixed effect, α_t is the year dummies, and ε_{ijt} is the error term. As the tangibility and financial dependence are both continuous variables in the baseline specification, the marginal effect of asset tangibility on cash holdings can be expressed as

$$\frac{\partial Cash_{ijt}}{\partial Tang_{ijt}} = \beta_1 + \beta_3 Depen_j \quad (4.3)$$

If the firm can effectively use asset tangibility to signal pledgeability to outsiders, asset tangibility and cash holdings should be negatively related. That is, the overall impact of $\beta_1 + \beta_3 Depen_j$ should be negative. As the negative relationship is more

important in the industries of greater financial dependence, we expect the sign of β_3 to be negative.

To take a closer look at the distribution of the interaction, we run similar regressions with the dummy variables of financial dependence. An industry is classified as high (low) external financial dependence if it falls in the highest (lowest) two quintiles across all the industries. The dummy variable of high dependence for the industry j is denoted $HighDepen_j$. The binary variable that switches on to one for firms of high tangibility is defined similarly and is denoted by $HighTang_{ijt}$. More details are documented in the data definition appendix. All the other variables take the same definition as in the regression (4.3) We specify the regression as follows

$$\begin{aligned} Cash_{ijt} = & \beta_1 HighTang_{ijt} + \beta_2 HighDepen_j \\ & + \beta_3 (HighTang_{ijt} * HighDepen_j) + \beta'_4 X + \alpha_i \\ & + \alpha_t + \varepsilon_{ijt} \end{aligned} \tag{4.4}$$

β_3 captures the differential impact of high asset tangibility on cash holdings between high financially dependent firms and low financially dependent firms. As firms at high financially dependent industries are more sensitive at the relationship between asset tangibility and cash holdings, we expect that the sign of β_3 is negative.

4.5 Empirical Results

In this section, we first test whether firms can effectively use tangible assets to signal pledgeability and whether this mechanism is more important in more financially dependent industries. Then we measure the difference of cash holdings' sensitivity to asset tangibility between high financially dependent industries and low financially dependent industries. Finally, we examine whether asset tangibility affects the cash holdings because it embodies the information of aggregate exogenous industry attributes.

4.5.1 Firm-level Asset Tangibility

Table 4.3 shows the results on the continuous measures of firm-level asset tangibility and industry financial dependence for U.S. manufacturing firms from year 1995 to 2009. For all regressions, we include the year dummies and firm fixed effects.

Column (1) reports the estimates of the relationship between cash-to-assets and firm-level asset tangibility excluding the impact of financial dependence. Column (2) and (3) add the overall industry financial dependence measure. Column (4) and (5) include the dependence on equity financing. The estimates of tangibility are quite close across different specifications. They are statistically significant at 1% ranging from -0.913 to -0.996. The estimates of the interactions are also significant at 1%. As we expect, the signs on the interactions are both negative. More specifically, the estimates shows that as the financial dependence measure increases by one, the marginal effect of tangibility on cash-to-assets pushes down further by 0.074. As the equity dependence measure increases by one, the marginal effect of tangibility on cash-to-assets goes down by 0.152. For both measures, as the financial dependence goes up, the sensitivity of cash holding to tangibility strengthens.

Most of the estimates for control variables are close to each other across specifications and are consistent with other studies on the determinants of cash holdings (i.e., Opler et al., 1999; Bates et al., 2009). The cash-to-assets ratio is significantly decreasing in the firm's size, net working capital scaled by total assets, the number of common shareholders, the number of segments, R&D expense scaled by total assets, and leverage. The cash-to-assets ratio is significantly increasing in the earning risk, market-to-book ratio, cash flow scaled by total assets. The concentration ratio, the bond dummy variable, the dividend dummy and the firm's age are statistically insignificant perhaps their information has been picked up by other control variables.¹⁶

[INSERT TABLE 4.3 HERE]

Table 4.4 presents the alternative binary measures of financial dependence and firm-level asset tangibility. First, we obtain the external financial dependence and the external equity financial dependence for each industry. Then the dummy variable *High Dependence* is equal to one/zero if the given industry falls into the highest/lowest two quintiles of the financial dependence measures; it is set missing if the industry belongs

¹⁶ Recent empirical evidence shows that the payout policy has also increased significantly over time so that firms use a considerable amount of the cash to buy back their own shares (i.e., Skinner (2008)). However, the focus of this chapter is not to provide an explanation to the rapid increase in corporate cash-holding over the last decade but to examine the under-researched relationship between cash holding behavior and asset tangibility conditional on industry financial dependence. Thus, I only use a dummy variable which becomes one if the firm is a dividend-payer and is zero otherwise to control for the payout policy.

to the middle quintiles to sharpen the contrast between high financially dependent industries and low financially dependent industries. Since the quintiles are computed based on a one-to-one mapping between the industry code and financial dependence, and each industry apparently consists of a different number of firms, the number of excluded firms in the middle quintile of the external financial dependence is different from the number of excluded firms in the middle quintile of the equity financial dependence. Overall, it has 10,728 firm-year observations for the regression on external financial dependence and 14,355 firm-year observations for the regression on equity financial dependence. The dummy variable for the firm-level asset tangibility *HighTangibility* is defined as follows: it is equal to one/zero if the firm tangibility in a given year falls into the highest/lowest two quintiles of all the firm-year tangibility observations within the same industry; it is set as missing if it belongs to the middle quintile.

Column (1) and (2) show the estimates for the external financial dependence and the equity financial dependence respectively. Similar to the results on the continuous variables, the estimates on the interaction terms are significantly negative. That is, high tangibility has a bigger impact to reduce cash holdings in more financial dependent industries. High tangibility introduces a further decline of 0.026 in the cash-to-assets ratio in industries of high financial dependence at the significance level of 10%, and it brings about a further drop of 0.076 in the cash-to-assets ratio in industries of high equity financial dependence at the significance level of 1%. The estimates of the control variables are largely consistent with the results of continuous measures of financial dependence and asset tangibility as shown in the Table 4.3.

[INSERT TABLE 4.4 HERE]

4.5.2 Industry-level Asset Tangibility

In the previous subsection, the asset tangibility is considered as a choice variable for the firm. In other words, firms can actively choose the optimal level of asset tangibility. In this section, we test the alternative assumption that asset tangibility includes an important technological component such that it operates mainly via its reflection of the exogenous industry attribute.

Table 4.5 combines the regression specifications in Table 4.3 and Table 4.4 only that it replaces firm tangibility with industry tangibility. The measure of industry

tangibility is constructed similarly to the industry measure of financial dependence. We smooth the temporary fluctuations across the years for each firm and then aggregate to the industry level by taking the median of the NAICS 6-digit industry. The dummy variable for high industry tangibility is equal to one if it belongs to the highest two quintiles across all industries, equal to zero if it belongs to the lowest quintiles across all industries and set missing if it belongs to the middle quintile. Column (1) and (2) report the results with continuous measures, and column (3) and (4) report the results with binary measures. Among the four specifications, only the continuous measure of equity dependence is significant at 5% and the rest are all insignificant. This piece of evidence is consistent with our theoretical argument that asset tangibility is indeed a choice variable of the firm.

[INSERT TABLE 4.5 HERE]

4.6 Tests on a Broader Range of Industries

All the previous results are based on the manufacturing firms. In this section, we compile a sample of firms in a broader range of industries. We collect the accounting data from Compustat on all the U.S. public firms from the year 1984 to 2010 excluding utility industries (with the first three-digit NAICS 221) and financial industries (with the first two-digit NAICS 52)¹⁷.

Then we go through the same data screening process as we do for the manufacturing industries. To be included in the sample, we require that the firm has to have sales and total assets greater than one millions dollars. We drop observations with sale growth larger than 200% or Tobin's Q larger than ten. Before constructing any industry level measure, the firms must have observations for all the dependent and independent variables. We require that each industry-year must have at least 5 observations, so that the industry level variables are not fully determined by a couple of firms. All dollar terms are adjusted for inflation to the year 2000 constant dollars. HHI here is calculated as the sum of the squared market share of the sales. Overall, this bigger sample covers 316 industries, 7,835 firms, and 57,726 firm-year observations.

¹⁷ The initial data collection starts at the year 1980. The computation of the earning risk uses the first four years, so the actual regressions start with the year 1984

Column (1) and (2) report the estimates on continuous measures of tangibility and financial dependence. Column (3) and (4) show the regression results on the binary classification of high tangibility and high financial dependence. The tangibility/dependence dummies are defined the same way as in the previous manufacturing industries. The dummy variable *High Tangibility* is equal to one/zero if the firm tangibility in a given year falls into the highest/lowest two quintiles of all the firm-year observations within the same industry; it is set as missing if it belongs to the middle quintile. The dummy variable *High Dependence* is equal to one/zero if the given industry falls into the highest two quintiles of financial dependence measures; it is set missing if the industry belongs to the middle quintile. Excluding the middle quintile leaves us 35,781 firm-year observations for the financial dependence dummy and 39,098 observations for the equity dependence dummy. Note that only the interaction term in column (3) gives the positive sign, all the other three specifications yield the negative sign significant at 1% or 5%. We take it as generally favorable support to the hypothesis that financial dependence sharpens the relationship between cash holdings and asset tangibility. Most estimates for control variables are similar to the previous section. It is worth noting that whether provided by Census or computed by Compustat data, the concentration ratio HHI appears statistically insignificant in all the regressions.

[INSERT TABLE 4.6 HERE]

4.7 Conclusion

We examine the interaction between cash holding and asset tangibility conditional on the exogenous industry financial dependence among the publicly traded U.S. manufacturing firms from the year 1995 to 2009. Our results show that industry financial dependence exerts an important impact on the corporate cash policy. We also present the evidence that given this exogenous industry attribute, firms can effectively reduce cash holdings by allocating more tangible assets. This behavior is consistent with the information asymmetry argument in the sense that the successfully signaling sends a reassuring message on pledgeability to investors and debt holders. These results remain robust if we extend to a broader range of the U.S. industries. This chapter does not directly address the optimal cash policy or the target of the cash policy, but an immediate implication from our finding is that if such an optimal cash

policy or the target cash policy is relevant, it should be a function of the exogenous industry financial dependence. Finally, we present evidence that industry level asset tangibility variations accounts for little of variations in corporate cash holdings. It is consistent with the hypothesis that asset tangibility is indeed a choice variable of the firm.

References

- Acharya, V. V., H. Almeida, and M. Campello. 2007. Is cash negative debt? A hedging perspective on corporate financial policies. *Journal of Financial Intermediation* 16 (4):515-554.
- Ali, A., S. Klasa, and E. Yeung. 2009. The Limitations of Industry Concentration Measures Constructed with Compustat Data: Implications for Finance Research. *Review of Financial Studies* 22 (10):3839-3871.
- Almeida, H., and M. Campello. 2007. Financial Constraints, Asset Tangibility, and Corporate Investment. *Review of Financial Studies* 20 (5):1429-1460.
- Almeida, H., M. Campello, and M. S. Weisbach. 2004. The Cash Flow Sensitivity of Cash. *The Journal of Finance* 59 (4):1777-1804.
- Bates, T. W., K. M. Kahle, and R. M. Stulz. 2009. Why Do U.S. Firms Hold So Much More Cash than They Used To? *The Journal of Finance* 64 (5):1985-2021.
- Beck, T., and R. Levine. 2002. Industry growth and capital allocation:: does having a market-or bank-based system matter? *Journal of Financial Economics* 64 (2):147-180.
- Berger, P. G., E. Ofek, and I. Swary. 1996. Investor valuation of the abandonment option. *Journal of Financial Economics* 42 (2):257-287.
- Bolton, P., and D. S. Scharfstein. 1990. A Theory of Predation Based on Agency Problems in Financial Contracting. *The American Economic Review* 80 (1):93-106.
- Braun, M. 2003. Financial contractibility and asset hardness. *Working paper, UCLA*.
- Campello, M., and E. Giambona. 2011. Asset tangibility and capital structure, Unpublished working paper, Cornell University and University of Amsterdam.
- Campello, M., J. R. Graham, and C. R. Harvey. 2010. The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics* 97 (3):470-487.
- Cleary, S. 1999. The Relationship between Firm Investment and Financial Status. *The Journal of Finance* 54 (2):673-692.
- Dittmar, A., and J. Mahrt-Smith. 2007. Corporate governance and the value of cash holdings. *Journal of Financial Economics* 83 (3):599-634.
- Duchin, R. 2010. Cash Holdings and Corporate Diversification. *Journal of Finance* 65 (3):955-992.
- Foley, C. F., J. C. Hartzell, S. Titman, and G. Twite. 2007. Why do firms hold so much cash? A tax-based explanation. *Journal of Financial Economics* 86 (3):579-607.

- Franks, J., C. Mayer, P. Volpin, and H. F. Wagner. 2012. The Life Cycle of Family Ownership: International Evidence. *Review of Financial Studies* 25 (6):1675-1712.
- Friedrich, C., I. Schnabel, and J. Zettelmeyer. 2012. Financial integration and growth—Why is Emerging Europe different? *Journal of International Economics*.
- Hadlock, C. J., and J. R. Pierce. 2010. New Evidence on Measuring Financial Constraints: Moving Beyond the KZ Index. *Review of Financial Studies* 23 (5):1909-1940.
- Harford, J., S. A. Mansi, and W. F. Maxwell. 2008. Corporate governance and firm cash holdings in the US. *Journal of Financial Economics* 87 (3):535-555.
- Hart, O., and J. Moore. 1994. A Theory of Debt Based on the Inalienability of Human Capital. *The Quarterly Journal of Economics* 109 (4):841-879.
- Holmstrom, B., and J. Tirole. 1997. Financial Intermediation, Loanable Funds, and the Real Sector. *The Quarterly Journal of Economics* 112 (3):663-691.
- Jensen, M. 1986. Agency cost of free cash flow, corporate finance, and takeovers. *Corporate Finance, and Takeovers. American Economic Review* 76 (2).
- John, T. A. 1993. Accounting Measures of Corporate Liquidity, Leverage, and Costs of Financial Distress. *Financial Management* 22 (3):91-100.
- Kaplan, S. N., and L. Zingales. 1997. Do Investment-Cash Flow Sensitivities Provide Useful Measures of Financing Constraints? *The Quarterly Journal of Economics* 112 (1):169-215.
- Keynes, J. M. 1936. The general theory of interest, employment and money: London: Macmillan.
- Lyandres, E., and B. Palazzo. 2012. Strategic Cash Holdings and R&D Competition: Theory and Evidence. *SSRN eLibrary*.
- MacKay, P., and G. M. Phillips. 2005. How Does Industry Affect Firm Financial Structure? *Review of Financial Studies* 18 (4):1433-1466.
- Opler, T., L. Pinkowitz, R. Stulz, and R. Williamson. 1999. The determinants and implications of corporate cash holdings. *Journal of Financial Economics* 52 (1):3-46.
- Opler, T. C., and S. Titman. 1994. Financial distress and corporate performance. *The Journal of Finance* 49 (3):1015-1040.
- Rajan, R. G., and L. Zingales. 1998. Financial Dependence and Growth. *The American Economic Review* 88 (3):559-586.
- Rampini, A. A., and S. Viswanathan. Forthcoming. Collateral and Capital Structure. *Journal of Financial Economics*.

Santalo, J., and M. Becerra. 2008. Competition from Specialized Firms and the Diversification-Performance Linkage. *The Journal of Finance* 63 (2):851-883.

Shleifer, A., and R. W. Vishny. 1992. Liquidation Values and Debt Capacity: A Market Equilibrium Approach. *The Journal of Finance* 47 (4):1343-1366.

Skinner, D. J. 2008. The evolving relation between earnings, dividends, and stock repurchases. *Journal of Financial Economics* 87 (3):582-609.

Appendix: Data Construction

Firm Level Variables

Age	The number of years that the firm has an observation in Compustat since 1950
Bond Dummy	A dummy variable that is equal to one if the firm has a S&P bond rating and is equal to zero otherwise
Cash	Cash and short term investment scaled by total assets
Cash flow	(Net Income Before Extraordinary Item + Depreciation And Amortization)/Total Assets
Dividend Dummy	A dummy variable that is equal to one if the firm pays out dividend in the fiscal year and is equal to zero otherwise
Distress	R&D expenses scaled by sales.
High Tangibility	It is equal to one if the firm tangibility in a given year falls into the highest two quintiles of all the firm-year tangibility observations within the same industry; it is equal to zero if the firm tangibility in a given year falls into the lowest two quintiles of all the firm-year tangibility observations within the same industry; it is set as missing if it belongs to the middle quintile.
Leverage	(Debt In Current Liabilities And Long Term Debt)/Total Assets
Log (Number of Shareholders)	The log of the number of common shareholders
Log(Total Assets)	Log of total assets
Market-to-book	(Market Value+ Book Value – Book Value Of Equity – Deterred Taxes)/Total Assets
Net working capital	(Current assets – Cash – Current liability)/Total assets
Number of segments	The number of all segments of the firm. It is obtained from Compustat Segment file.
R&D	R&D expenses scaled by total assets. It is equal to zero if the observation is missing.
Risk	The standard deviation of earnings for the past five years. The earning is defined by earnings before interest and taxes over total assets.
Tangibility	It borrows the coefficient estimates from Berger et al. (1996). $(0.715 * \text{Receivables} + 0.547 * \text{Inventory} + 0.535 * \text{Capital}) / \text{total assets}$

Industry Level Variables

Dependence on External Finance	It closely follows the methodology outlined in Rajan and Zingales (1998). For each firm in a given year, the external financial dependence is defined as capital expenditures minus cash flow from operations divided by capital expenditure. For cash flow statements with format codes 1, 2, or 3, cash flow from operations is defined as the sum of cash flow from operations plus decreases in inventories, decreases in receivables, and increases in payables.
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	For cash flow statement with format code 7, cash flow from operations is defined as the sum of income before extraordinary items, depreciation and amortization (cash flow), deferred taxes (cash flow), equity in net loss/earnings, sale of property, plant and equipment and investment/gain (loss), and other funds from operations. First sum all the use of external finance over the years and then divide by the sum of capital expenditures over the years. Then Take the median for each industry classified by NAICS six-digit code.
Dependence on External Equity Finance	It closely follows the methodology outline in Rajan and Zingales (1998). At firm level, it is defined as the ratio of sale of common and preferred stock minus purchase of common and preferred stock over the capital expenditures. First sum all the use of equity finance over the years and then divide by the sum of capital expenditures over the years. Then Take the median for each industry classified by NAICS six-digit code.
HHI	Herfindahl–Hirschman Index. For manufacturing firms, the HHI is provided by U.S. Census at NAICS six-digit code. For the broader range of industries, it is computed as the sum of squared market shares of the sales based on Compustat data.
High Dependence	It is equal to one if the given industry falls into the highest two quintiles of financial dependence measures; it is equal to zero if it falls into the lowest two quintile of financial dependence measures; it is set missing if the industry belongs to the middle quintile to sharpen the contrast between high financially dependent industries and low financially dependent industries.
High Industry Tangibility	The dummy variable for high industry tangibility is equal to one if the it belongs to the highest two quintiles across all industries, equal to zero if it belongs to the lowest quintiles across all industries and set missing if it belongs to the middle quintile.
Industry ROA	The industry median of operating income before depreciation and amortization scaled by total assets
Industry Tangibility	Sum the tangible assets over the years and then divide the sum of total assets over the years to smooth temporary fluctuations. Then take the median of the industry.

Figure 4.1: Median of Cash-to-Assets Ratio from the Year 1995 to 2009

This figure shows the median of cash-to-assets ratio for the U.S. manufacturing public firms and U.S. public firms in all industries excluding the financial and utility industries. The data is extracted from Compustat. The sample period starts from year 1995 to 2009.

Table 4.1: External Financial Dependence and External Equity Financial Dependence Measures

This table presents the estimates of external financial dependence and external equity financial dependence based on the Compustat data for manufacturing industries. Each industry is identified by the six-digit NAICS code. The computation closely follows the method outlined by Rajan and Zingales (1998).

NAICS	Industry	Financial Dependence	Equity Dependence
311340	Nonchocolate confectionery manufacturing	-1.610	0.000
311412	Frozen specialty food manufacturing	1.000	0.000
311421	Fruit and vegetable canning	0.133	0.000
311520	Ice Cream and Frozen Dessert Manufacturing	-0.623	-0.103
311611	Animal (except poultry) slaughtering	0.364	0.000
311612	Meat processed from carcasses	-0.750	0.000
311615	Poultry processing	-0.057	-0.005
311812	Commercial Bakeries	0.069	0.000
311920	Coffee and Tea Manufacturing	-1.580	0.051
311999	All other miscellaneous food manufacturing	0.603	-0.034
312111	Soft drink manufacturing	-0.354	-0.041
312130	Wineries	-0.284	0.092
313210	Broadwoven fabric mills	0.331	-0.003
314110	Petroleum Refineries	0.151	-0.108
315191	Outerwear Knitting Mills	0.106	-0.032
315239	Women's and Girls' Cut and Sew Other Outerwear Manufacturing	1.703	0.114
316211	Rubber and plastics footwear manufacturing	-0.525	-0.247
316213	Men's footwear (except athletic) manufacturing	-0.907	0.000
316214	Women's Footwear (except Athletic) Manufacturing	-1.915	0.041
321113	Sawmills	-0.197	0.000
321991	Manufactured home (mobile home) manufacturing	-1.043	-0.156
321992	Prefabricated wood building manufacturing	-0.355	-0.026
322121	Paper (except newsprint) mills	-0.313	-0.034
322130	Paperboard mills	0.111	-0.008
322222	Coated and laminated paper manufacturing	0.224	-0.255
322291	Sanitary Paper Product Manufacturing	0.563	-0.001
323116	Manifold business forms printing	-1.699	-0.090
323119	Other commercial printing	-0.200	0.000
324110	Petroleum refineries	0.226	-0.038
325188	All other basic inorganic chemical manufacturing	-0.093	-0.052
325199	All other basic organic chemical manufacturing	0.426	-0.231
325211	Plastics material and resin manufacturing	-0.009	-0.066
325320	Pesticide and other agricultural chemical manufacturing	0.641	0.035
325411	Medicinal and botanical manufacturing	1.160	0.894
325412	Pharmaceutical preparation manufacturing	0.734	1.072
325413	In-vitro diagnostic substance manufacturing	1.540	1.840

Table 4.1 continues

NAICS	Industry	Financial Dependence	Equity Dependence
325414	Biological product (except diagnostic) manufacturing	5.622	4.357
325510	Paint and coating manufacturing	-0.886	-0.059
325520	Adhesive Manufacturing	0.902	0.000
325611	Soap and other detergent manufacturing	-0.571	-0.467
325612	Polish and other sanitation good manufacturing	0.300	-0.029
325620	Toilet preparation manufacturing	-1.071	-0.549
325998	All other miscellaneous chemical product and preparation manufacturing	-0.102	-0.323
326113	Nonpackaging plastics film and sheet mfg.	-0.565	-0.285
326199	All other plastics product manufacturing	-0.534	0.001
326299	All other rubber product manufacturing	0.095	-0.002
327310	Cement Manufacturing	-1.375	-0.423
327320	Ready-mix concrete manufacturing	-0.104	-0.003
331111	Iron and steel mills	0.479	0.000
331210	Iron and steel pipe and tube manufacturing from purchased steel	-0.219	0.010
331221	Rolled steel shape manufacturing	-0.791	-0.094
331421	Copper rolling, drawing, and extruding	-0.355	0.448
332211	Cutlery and flatware (except precious) manufacturing	0.380	-0.020
332212	Hand and edge tool manufacturing	-0.580	-0.078
332311	Prefabricated Metal Building and Component Manufacturing	-0.265	0.000
332312	Fabricated structural metal manufacturing	-1.761	0.000
332410	Power Boiler and Heat Exchanger Manufacturing	0.050	-0.120
332420	Metal Tank (Heavy Gauge) Manufacturing	-1.828	0.000
332431	Metal Can Manufacturing	0.540	-0.065
332722	Bolt, nut, screw, rivet, and washer manufacturing	-1.020	-0.025
332812	Metal Coating, Engraving (except Jewelry and Silverware), and Allied Services to Manufacturers	0.030	-0.004
332912	Fluid power valve and hose fitting manufacturing	-1.572	0.046
332991	Ball and roller bearing manufacturing	-0.605	-0.026
332999	All other miscellaneous fabricated metal product manufacturing	-0.150	0.000
333111	Farm machinery and equipment manufacturing	-1.019	-0.005
333120	Construction machinery manufacturing	-1.286	0.010
333132	Oil and gas field machinery and equipment manufacturing	-1.245	0.087
333293	Printing machinery and equipment manufacturing	-0.426	0.000
333295	Semiconductor machinery manufacturing	0.409	0.974
333298	All other industrial machinery manufacturing	-0.155	0.636
333313	Office Machinery Manufacturing	0.694	0.000
333314	Optical instrument and lens manufacturing	-0.419	0.510
333315	Photographic and photocopying equipment manufacturing	0.160	0.266
333319	Other commercial and service industry machinery manufacturing	-0.979	0.000
333411	Air purification equipment manufacturing	-0.948	0.066

Table 4.1 continues

NAICS	Industry	Financial Dependence	Equity Dependence
333415	Air-conditioning and warm air heating equipment and commercial and industrial refrigeration equipment manufacturing	-0.358	-0.161
333911	Pump and pumping equipment manufacturing	-1.543	-0.006
333912	Air and gas compressor manufacturing	0.008	-0.010
333994	Industrial Process Furnace and Oven Manufacturing	-0.141	0.000
333999	All other miscellaneous general purpose machinery manufacturing	-0.775	0.099
334111	Electronic computer manufacturing	1.000	0.539
334112	Computer storage device manufacturing	0.105	0.555
334113	Computer terminal manufacturing	4.879	0.000
334119	Other computer peripheral equipment manufacturing	0.128	0.644
334210	Telephone apparatus manufacturing	-0.234	0.381
334220	Broadcast and wireless communications equip.	0.068	0.547
334290	Other communications equipment manufacturing	-0.251	0.686
334310	Audio and video equipment manufacturing	0.221	0.090
334412	Bare printed circuit board manufacturing	0.172	0.295
334413	Semiconductor and related device manufacturing	-0.090	0.218
334416	Electronic coil, transformer, and other inductor manufacturing	-1.885	0.335
334417	Electronic connector manufacturing	-0.076	0.000
334418	Printed circuit assembly (electronic assembly) manufacturing	0.039	0.481
334419	Other electronic component manufacturing	-0.164	0.207
334510	Electromedical and electrotherapeutic apparatus manufacturing	-0.219	0.862
334511	Search, detection, navigation, guidance, aeronautical, and nautical system and instrument manufacturing	-0.784	0.151
334513	Instruments and related products manufacturing for measuring, displaying, and controlling industrial process variables	-2.763	0.086
334514	Totalizing fluid meter and counting device manufacturing	-0.075	0.784
334515	Instrument manufacturing for measuring and testing electricity and electrical signals	-0.067	0.040
334516	Analytical laboratory instrument manufacturing	-0.283	0.206
334517	Irradiation apparatus manufacturing	-0.971	1.663
334519	Other measuring and controlling device manufacturing	-1.271	0.149
335122	Commercial, industrial, and institutional electric lighting fixture manufacturing	-0.957	0.000
335211	Electric Housewares and Household Fan Manufacturing	-0.073	0.001
335312	Motor and generator manufacturing	-0.579	0.000
335313	Switchgear and switchboard apparatus manufacturing	-0.384	-0.038
335314	Relay and industrial control manufacturing	-0.524	-0.138
335911	Storage battery manufacturing	0.779	0.268
335921	Fiber optic cable manufacturing	0.233	0.163
335931	Current-Carrying Wiring Device Manufacturing	-0.030	0.022

Table 4.1 continues

NAICS	Industry	Financial Dependence	Equity Dependence
335999	All other miscellaneous electrical equipment and component manufacturing	0.329	0.161
336211	Motor vehicle body manufacturing	-0.411	0.001
336212	Truck Trailer Manufacturing	0.201	0.005
336213	Motor home manufacturing	-0.541	-0.205
336312	Gasoline engine and engine parts manufacturing	0.274	0.000
336322	Other motor vehicle electrical and electronic equipment manufacturing	-1.149	0.071
336340	Motor Vehicle Brake System Manufacturing	1.000	0.000
336399	All other motor vehicle parts manufacturing	-0.062	-0.016
336412	Aircraft engine and engine parts manufacturing	-0.436	-0.005
336413	Other aircraft parts and auxiliary equipment manufacturing	-1.188	-0.015
336991	Motorcycle, bicycle, and parts manufacturing	-1.534	0.000
336999	All other transportation equipment manufacturing	-1.121	-0.772
337122	Nonupholstered wood household furniture manufacturing	-1.407	-0.383
337127	Institutional Furniture Manufacturing	-1.434	-0.248
337214	Office furniture (except wood) manufacturing	-0.687	-0.331
339111	Laboratory apparatus and furniture manufacturing	-1.224	0.424
339112	Surgical and medical instrument manufacturing	0.113	0.529
339113	Surgical appliance and supplies manufacturing	-0.742	0.950
339114	Dental equipment and supplies manufacturing	-0.313	0.343
339115	Ophthalmic goods manufacturing	-0.310	0.203
339911	Jewelry (except Costume) Manufacturing	1.000	0.000
339920	Sporting and athletic goods manufacturing	-0.680	-0.040
339931	Doll and stuffed toy manufacturing	-1.906	0.466
339932	Game, toy, and children's vehicle manufacturing	0.603	0.123
339950	Sign manufacturing	0.207	0.217
339999	All other miscellaneous manufacturing	-0.629	-0.008

Table 4.2: Summary Statistics

This table presents the univariate comparison of distributions of firm characteristics of 18,234 firm years from the 1995-2009 sample of U.S.-based publicly traded manufacturing firms from Compustat. Cash-to-assets is defined as cash assets scaled by total assets. The calculation of firm tangibility is based on Berger et al. (1996). Industry Tangibility aggregates the firm tangibility over time and across the firms within the same 6-digit NAICS industry. The construction of financial dependence and equity dependence follows the Rajan and Zingales (1998). Total assets is book value of total assets. No. of Shareholders is the number of common shareholders. NO. of segment counts the sum of segments of the firm. HHI is Herfindahl–Hirschman Index provided by U.S. Census. Age is defined as the number of years a firm has an observation in Compustat since 1950. R&D is the R&D expenses scaled by total assets. Financial distress is R&D expenses scaled by sales. Leverage is short-term and long-term debt scaled by total assets. Cash flow is defined as net income before extraordinary item plus depreciation and amortization, and then divided by total assets. Earning risk is the standard deviation of profit for the past five years. The market-to-book is the book value of assets, less the book value of equity, plus the market value of equity divided by assets. Net working capital is defined as current assets minus cash, minus current liability and then divided by total assets. Dividend dummy is a dummy variable that switches on if the firm pays out dividends. Bond rating dummy is a dummy variable that switches on if the firm has an S&P bond rating.

Variable	Mean	Median	5th Percentile	95th Percentile	Standard Deviation
Cash-to-Assets	0.225	0.146	0.004	0.714	0.230
Firm Tangibility	0.244	0.237	0.048	0.453	0.121
Industry Tangibility	0.152	0.156	0.089	0.223	0.042
Financial Dependence	0.096	-0.076	-1.271	1.540	1.290
Equity Dependence	0.529	0.218	-0.161	1.840	0.877
Total Assets	1362.355	98.531	4.909	4929.090	7230.878
Log(Total Assets)	4.770	4.590	1.591	8.503	2.085
No. of Shareholders	8.306	1.018	0.094	25.170	112.991
Log(No. of Shareholders)	0.175	0.018	-2.364	3.226	1.691
NO. of Segments	1.770	1.000	1.000	4.000	1.242
HHI	651.719	529.900	75.000	1685.100	505.824
Age	19.071	15.000	5.000	47.000	12.799
R&D	0.101	0.055	0.000	0.365	0.154
Financial Distress	0.324	0.058	0.000	1.095	1.789
Leverage	0.211	0.136	0.000	0.625	0.312
Cash Flow	-0.037	0.061	-0.610	0.207	0.340
Earning Risk	0.226	0.132	0.026	0.706	0.328
Market-to-Book Ratio	2.115	1.578	0.745	5.492	1.560
Net Working Capital	0.110	0.131	-0.221	0.437	0.313
Dividend Dummy	0.297	0.000	0.000	1.000	0.457
Bond Rating Dummy	0.172	0.000	0.000	1.000	0.378

Table 4.3: Regressions on Continuous Measures of Tangibility and Financial Dependence

This sample includes 18,234 firm years from the year 1995-2009 of the U.S.-based publicly traded manufacturing firms from Compustat. Cash-to-assets is defined as cash assets scaled by total assets. The calculation of firm tangibility is based on Berger et al. (1996). The construction of financial dependence and equity dependence follows the Rajan and Zingales (1998). Total assets is book value of total assets. Risk is the standard deviation of profit for the past five years. The market-to-book is the book value of assets, less the book value of equity, plus the market value of equity divided by assets. Net working capital is defined as current assets minus cash, minus current liability and then divided by total assets. Cash flow is defined as net income before extraordinary item plus depreciation and amortization, and then divided by total assets. Distress is R&D expenses scaled by sales. NO. of Shareholders is the number of common shareholders. NO. of segment counts the sum of segments of the firm. R&D is the R&D expenses scaled by total assets. Age is defined as the number of years a firm has an observation in Compustat since 1950. Leverage is short-term and long-term debt scaled by total assets. Dividend dummy is a dummy variable that switches on if the firm pays out dividends. Bond rating dummy is a dummy variable that switches on if the firm has an S&P bond rating. HHI is Herfindahl–Hirschman Index provided by U.S. Census. Industry ROA is the median of return on assets in the industry-year. All regressions include year dummies and firm fixed effects. The numbers in parentheses are standard errors robust to heteroskedasticity. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable:	Financial Dependence			Equity Dependence	
Cash-to-Assets	(1)	(2)	(3)	(4)	(5)
Tangibility	-0.996*** (0.0304)	-0.995*** (0.0304)	-0.991*** (0.0304)	-0.996*** (0.0304)	-0.913*** (0.0348)
Financial Dependence		0.0120** (0.00511)	0.0253*** (0.00621)	0.0124 (0.00887)	0.0371*** (0.00949)
Tangibility* Financial Dependence			-0.0744*** (0.0223)		-0.152*** (0.0343)
ln(Total Assets)	-0.0289*** (0.00388)	-0.0289*** (0.00387)	-0.0284*** (0.00390)	-0.0290*** (0.00388)	-0.0288*** (0.00393)
Risk	0.0219** (0.00833)	0.0216** (0.00834)	0.0217** (0.00833)	0.0217** (0.00834)	0.0213** (0.00830)
Market-to-Book	0.0153*** (0.00123)	0.0153*** (0.00123)	0.0154*** (0.00122)	0.0153*** (0.00123)	0.0154*** (0.00121)
Net Working Capital	-0.0194** (0.00772)	-0.0192** (0.00771)	-0.0186** (0.00774)	-0.0193** (0.00772)	-0.0182** (0.00778)
Cash Flow	0.0303*** (0.00579)	0.0302*** (0.00580)	0.0297*** (0.00580)	0.0301*** (0.00579)	0.0300*** (0.00580)
Distress	0.00259 (0.00179)	0.00253 (0.00177)	0.00214 (0.00172)	0.00254 (0.00177)	0.00201 (0.00171)
ln(No. of Shareholders)	-0.00708*** (0.00182)	-0.00713*** (0.00182)	-0.00715*** (0.00183)	-0.00713*** (0.00182)	-0.00699*** (0.00184)
No. of Segments	-0.00491** (0.00176)	-0.00495** (0.00176)	-0.00468** (0.00175)	-0.00490** (0.00176)	-0.00457** (0.00175)
R&D	-0.110*** (0.0222)	-0.110*** (0.0222)	-0.108*** (0.0225)	-0.110*** (0.0222)	-0.106*** (0.0227)

Table 4.3 continues

Dependent Variable: Cash-to-Assets	Financial Dependence			Equity Dependence	
	(1)	(2)	(3)	(4)	(5)
Age	0.000423 (0.000482)	0.000460 (0.000482)	0.000492 (0.000479)	0.000443 (0.000481)	0.000475 (0.000476)
Leverage	-0.0948*** (0.00963)	-0.0946*** (0.00962)	-0.0934*** (0.00973)	-0.0947*** (0.00963)	-0.0927*** (0.00982)
Bond Dummy	-0.00673 (0.00813)	-0.00649 (0.00811)	-0.00673 (0.00814)	-0.00665 (0.00813)	-0.00656 (0.00822)
Dividend Dummy	-0.00362 (0.00467)	-0.00344 (0.00468)	-0.00356 (0.00465)	-0.00346 (0.00468)	-0.00353 (0.00462)
HHI	-0.00000280 (0.00000600)	-0.00000304 (0.00000595)	-0.00000272 (0.00000589)	-0.00000275 (0.00000595)	-0.00000174 (0.00000589)
Industry ROA	0.0536* (0.0299)	0.0719** (0.0297)	0.0727** (0.0296)	0.0655** (0.0297)	0.0597** (0.0296)
Constant	0.609*** (0.0240)	0.606*** (0.0239)	0.598*** (0.0241)	0.602*** (0.0240)	0.580*** (0.0248)
N	18234	18234	18234	18234	18234
R-squared	0.333	0.333	0.335	0.333	0.337
Year Dummy	Yes	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes	Yes

Table 4.4: Regressions on Binary Measures of Tangibility and Financial Dependence

This sample includes the U.S.-based publicly traded manufacturing firms from Compustat from the year 1995-2009. Cash-to-assets is defined as cash assets scaled by total assets. High Tangibility is equal to one/zero if the firm tangibility in a given year falls into the highest/lowest two quintiles of all the firm-year tangibility observations within the same industry and is set as missing if it belongs to the middle quintile. High Dependence is equal to one/zero if the given industry falls into the highest/lowest two quintiles of financial dependence measures and is set missing if the industry belongs to the middle quintile. Total assets is book value of total assets. Risk is the standard deviation of profit for the past five years. The market-to-book is the book value of assets, less the book value of equity, plus the market value of equity divided by assets. Net working capital is defined as current assets minus cash, minus current liability and then divided by total assets. Cash flow is defined as net income before extraordinary item plus depreciation and amortization, and then divided by total assets. Distress is R&D expenses scaled by sales. NO. of Shareholders is the number of common shareholders. NO. of segment counts the sum of segments of the firm. R&D is the R&D expenses scaled by total assets. Age is defined as the number of years a firm has an observation in Compustat since 1950. Leverage is short-term and long-term debt scaled by total assets. Dividend dummy is a dummy variable that switches on if the firm pays out dividends. Bond rating dummy is a dummy variable that switches on if the firm has an S&P bond rating. HHI is Herfindahl–Hirschman Index provided by U.S. Census. Industry ROA is the median of return on assets in the industry-year. All regressions include year dummies and firm fixed effects. The numbers in parentheses are standard errors robust to heteroskedasticity. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable:		
Cash-to-Assets	(1) Financial Dependence	(2) Equity Dependence
High Tangibility	-0.117*** (0.0119)	-0.0836*** (0.00967)
High Dependence	0.0337** (0.0171)	0.0367 (0.0230)
High Dependence*		
High Tangibility	-0.0260* (0.0142)	-0.0763*** (0.0119)
ln(Total Assets)	-0.0120** (0.00535)	-0.0124** (0.00445)
Risk	0.0295** (0.0121)	0.0277** (0.00935)
Market-to-Book	0.0119*** (0.00180)	0.0135*** (0.00148)
Net Working Capital	-0.0820*** (0.0147)	-0.0686*** (0.0104)
Cash Flow	0.0367*** (0.00767)	0.0283*** (0.00687)
Distress	0.00290 (0.00205)	0.00321 (0.00217)
ln(No. of Common Shareholders)	-0.00895*** (0.00237)	-0.00737*** (0.00208)
No. of Segments	-0.00739** (0.00237)	-0.00568** (0.00208)
R&D	-0.122*** (0.0268)	-0.128*** (0.0241)
Age	0.000830 (0.000686)	0.000956 (0.000593)

Table 4.4 continues

Dependent Variable:		
Cash-to-Assets	(1) Financial Dependence	(2) Equity Dependence
Leverage	-0.130*** (0.0150)	-0.120*** (0.0115)
Bond Dummy	-0.0167 (0.0118)	-0.00498 (0.00959)
Dividend Dummy	-0.00394 (0.00620)	-0.00360 (0.00544)
HHI	-0.00000331 (0.00000819)	-0.00000119 (0.00000757)
Industry ROA	0.0232 (0.0400)	-0.00743 (0.0371)
Constant	0.349*** (0.0315)	0.342*** (0.0294)
N	10728	14355
R-squared	0.231	0.230
Year Dummy	Yes	Yes
Firm Fixed Effects	Yes	Yes

Table 4.5: Industry Level Tangibility

This sample includes the U.S.-based publicly traded manufacturing firms from Compustat from the year 1995-2009. Cash-to-assets is defined as cash assets scaled by total assets. Industry Tangibility is the firm tangibility aggregated over time and across firms with the 6-digit NAICS industry. Dependence is the financial dependence measure. High Industry Tangibility is equal to one/zero if it belongs to the highest/lowest two quintiles across all industries and is set missing if it belongs to the middle quintile. High Dependence is equal to one/zero if the given industry falls into the highest/lowest two quintiles of financial dependence measures and is set missing if the industry belongs to the middle quintile. Total assets is book value of total assets. Risk is the standard deviation of profit for the past five years. The market-to-book is the book value of assets, less the book value of equity, plus the market value of equity divided by assets. Net working capital is defined as current assets minus cash, minus current liability and then divided by total assets. Cash flow is defined as net income before extraordinary item plus depreciation and amortization, and then divided by total assets. Distress is R&D expenses scaled by sales. NO. of Shareholders is the number of common shareholders. NO. of segment counts the sum of segments of the firm. R&D is the R&D expenses scaled by total assets. Age is defined as the number of years a firm has an observation in Compustat since 1950. Leverage is short-term and long-term debt scaled by total assets. Dividend dummy is a dummy variable that switches on if the firm pays out dividends. Bond rating dummy is a dummy variable that switches on if the firm has an S&P bond rating. HHI is Herfindahl–Hirschman Index provided by U.S. Census. Industry ROA is the median of return on assets in the industry-year. All regressions include year dummies and firm fixed effects. The numbers in parentheses are standard errors robust to heteroskedasticity. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable:	(1)Financial Dependence	(2)Equity Dependence	(3)Financial Dependence	(4)Equity Dependence
Cash-to-Assets				
Industry Tangibility	0.0408 (0.213)	0.0808 (0.223)		
Dependence	0.0229* (0.0135)	0.0436** (0.0197)		
Industry Tangibility *Dependence	-0.0809 (0.0968)	-0.485** (0.209)		
High Industry Tangibility			-0.00805 (0.0493)	0.00532 (0.0316)
High Dependence			0.0745** (0.0259)	0.000481 (0.0352)
High Industry Tangibility *High Dependence			-0.0631 (0.0463)	-0.0586 (0.0405)
ln(Total Assets)	0.00385 (0.00444)	0.00381 (0.00444)	0.00100 (0.00571)	0.00562 (0.00490)
Risk	0.0411*** (0.00975)	0.0411*** (0.00971)	0.0391** (0.0131)	0.0427*** (0.0102)
Market-to-Book	0.0113*** (0.00143)	0.0113*** (0.00143)	0.0104*** (0.00181)	0.0121*** (0.00152)
Net Working Capital	-0.110*** (0.0132)	-0.110*** (0.0132)	-0.134*** (0.0189)	-0.121*** (0.0157)
Cash Flow	0.0335*** (0.00701)	0.0335*** (0.00699)	0.0416*** (0.00813)	0.0342*** (0.00753)
Distress	0.00461** (0.00223)	0.00460** (0.00223)	0.00415** (0.00209)	0.00456** (0.00222)

Table 4.5 continues

Dependent Variable: Cash-to-Assets	(1)Financial Dependence	(2)Equity Dependence	(3)Financial Dependence	(4)Equity Dependence
ln(No. of Common Shareholders)	-0.00689** (0.00214)	-0.00678** (0.00214)	-0.00758** (0.00271)	-0.00662** (0.00242)
No. of Segments	-0.00470** (0.00198)	-0.00472** (0.00198)	-0.00476* (0.00262)	-0.00474** (0.00232)
R&D	-0.152*** (0.0236)	-0.152*** (0.0236)	-0.136*** (0.0271)	-0.144*** (0.0249)
Age	0.00253*** (0.000559)	0.00253*** (0.000559)	0.00225** (0.000747)	0.00225*** (0.000641)
Leverage	-0.151*** (0.0131)	-0.151*** (0.0131)	-0.168*** (0.0172)	-0.153*** (0.0143)
Bond Dummy	0.000181 (0.00906)	-0.000478 (0.00908)	-0.00824 (0.0122)	0.000179 (0.0105)
Dividend Dummy	-0.000955 (0.00532)	-0.00115 (0.00532)	-0.00106 (0.00690)	-0.00149 (0.00633)
HHI	0.00000117 (0.00000699)	0.00000265 (0.00000698)	-0.00000167 (0.00000832)	-0.00000400 (0.00000824)
Industry ROA	-0.0334 (0.0343)	-0.0419 (0.0340)	-0.0157 (0.0424)	-0.0752* (0.0401)
Constant	0.188*** (0.0396)	0.190*** (0.0432)	0.190*** (0.0375)	0.218*** (0.0387)
N	18234	18234	11493	15129
R-squared	0.116	0.116	0.129	0.116
Year Dummy	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes

Table 4.6: Tests on a Broader Range of Industries

The full sample includes 57,726 firm years from the year 1984-2010 of the U.S.-based publicly traded firms from Compustat. It excludes utility industries and financial industries. Cash-to-assets is defined as cash assets scaled by total assets. Tangibility is based on Berger et al. (1996). The construction of financial dependence and equity dependence follows Rajan and Zingales (1998). High Tangibility is equal to one/zero if the firm tangibility in a given year falls into the highest/lowest two quintiles of all the firm-year tangibility observations within the same industry and is set as missing if it belongs to the middle quintile. High Dependence is equal to one/zero if the given industry falls into the highest/lowest two quintiles of financial dependence measures and is set missing if the industry belongs to the middle quintile. Total assets is book value of total assets. Risk is the standard deviation of profit for the past five years. The market-to-book is the book value of assets, less the book value of equity, plus the market value of equity divided by assets. Net working capital is defined as current assets minus cash, minus current liability and then divided by total assets. Cash flow is defined as net income before extraordinary item plus depreciation and amortization, and then divided by total assets. Distress is R&D expenses scaled by sales. NO. of Shareholders is the number of common shareholders. NO. of segment counts the sum of segments of the firm. R&D is the R&D expenses scaled by total assets. Age is defined as the number of years a firm has an observation in Compustat since 1950. Leverage is short-term and long-term debt scaled by total assets. Dividend dummy is a dummy variable that switches on if the firm pays out dividends. Bond rating dummy is a dummy variable that switches on if the firm has an S&P bond rating. HHI is Herfindahl–Hirschman Index computed with Compustat data. Industry ROA is the median of return on assets in the industry-year. All regressions include year dummies and firm fixed effects. The numbers in parentheses are standard errors robust to heteroskedasticity. *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Dependent Variable: Cash-to-Assets	(1)Financial Dependence	(2)Equity Dependence	(3)Financial Dependence	(4)Equity Dependence
Tangibility	-0.786*** (0.0187)	-0.707*** (0.0206)		
Dependence	0.00637 (0.00661)	0.0385** (0.0120)		
Tangibility* Dependence	-0.0467** (0.0211)	-0.239*** (0.0353)		
High Tangibility			-0.111*** (0.00569)	-0.0656*** (0.00497)
High Dependence			-0.00424 (0.0101)	0.0354** (0.0109)
High Tangibility* High Dependence			0.0210** (0.00712)	-0.0657*** (0.00647)
ln(Total Assets)	-0.0216*** (0.00194)	-0.0221*** (0.00195)	-0.0143*** (0.00244)	-0.0128*** (0.00230)
Risk	0.0212** (0.00686)	0.0211** (0.00682)	0.0248** (0.00887)	0.0328*** (0.00714)
Market-to-Book	0.0160*** (0.000866)	0.0161*** (0.000857)	0.0129*** (0.00119)	0.0134*** (0.00108)
Net Working Capital	-0.0193** (0.00601)	-0.0177** (0.00599)	-0.0674*** (0.00869)	-0.0711*** (0.00737)
Cash Flow	0.0120* (0.00719)	0.0118* (0.00714)	0.0145 (0.00931)	0.0170* (0.00901)
Distress	0.00336* (0.00175)	0.00273 (0.00166)	0.00456** (0.00226)	0.00429* (0.00224)

Table 4.6 continues

Dependent Variable: Cash-to-Assets	(1)Financial Dependence	(2)Equity Dependence	(3)Financial Dependence	(4)Equity Dependence
ln(No. of Shareholders)	-0.00188* (0.00101)	-0.00192* (0.00101)	-0.00195 (0.00137)	-0.00183 (0.00131)
No. of Segments	-0.00280** (0.00108)	-0.00265** (0.00108)	-0.00599*** (0.00144)	-0.00515*** (0.00144)
R&D	-0.109*** (0.0164)	-0.103*** (0.0164)	-0.135*** (0.0190)	-0.131*** (0.0179)
Age	-0.000979*** (0.000221)	-0.000895*** (0.000221)	-0.000511* (0.000307)	-0.000182 (0.000291)
Leverage	-0.107*** (0.00765)	-0.105*** (0.00763)	-0.130*** (0.00996)	-0.131*** (0.00984)
Bond Dummy	-0.00764** (0.00379)	-0.00717* (0.00379)	-0.00636 (0.00479)	-0.00265 (0.00469)
Dividend Dummy	-0.000170 (0.00253)	0.0000186 (0.00252)	-0.00176 (0.00330)	-0.00256 (0.00324)
HHI	-0.00217 (0.00715)	-0.00389 (0.00725)	0.00815 (0.00959)	-0.00328 (0.00938)
Industry ROA	0.0227 (0.0190)	0.0222 (0.0196)	-0.0297 (0.0255)	-0.0293 (0.0241)
Constant	0.503*** (0.0122)	0.488*** (0.0130)	0.346*** (0.0150)	0.320*** (0.0155)
N	57726	57726	35781	39098
R-squared	0.269	0.273	0.169	0.194
Year Dummy	Yes	Yes	Yes	Yes
Firm Fixed Effects	Yes	Yes	Yes	Yes