2010

Ownership Structure, Financial Structure and R&D Investment: Evidence from Korean Firms

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by

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Submitted to Lee Kong Chian School of Business in partial fulfillment of the requirements for the Degree of Master of Science in Management

Supervisor: Prof Young Rok CHOI

Singapore Management University

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Abstract

Understanding factors that can enhance a firm's innovativeness is of critical concern in management research. Prior studies in strategy and financial economics have advanced our understanding of how resource allocation into innovation is shaped in a firm, mainly from the perspectives of ownership and financial structures. However, the extant literature is incomplete, because it treats ownership and financial structures as separate determinants, even though theoretical arguments and empirical evidences suggest that they are interdependent. This study investigates the determinants of firm's R&D investments by bridging ownership and financial structures. Ownerships held by inside and external owners are considered for ownership structure, while financial slack and leverage ratio are considered for financial structures.

Exploiting simultaneous equation modeling technique and data sample of Korean firms, I found the direct and indirect effects of different types of ownership on R&D investments. Different from previous studies, this paper showed that financial factors such as financial slack and leverage ratio that were used to be considered as determinants of R&D investments are just mediators through which ownership structure affects firm's strategic decision indirectly.

Contents

Acknowledgement

I highly appreciate my supervisor Prof. Young Rok CHOI, who patiently motivates me to conceive and finish the thesis. This thesis owes much to his thoughtful and helpful comments. This paper would not have been possible without his guidance and inspiration. I want to thank the Lee Kong Chian School of Business for giving me this opportunity to study at Singapore and to do the research work.

Also, my gratitude is devoted to Prof. Kenneth HUANG Guang-Lih and Prof. Burkhard SCHRAGE. Thanks for having reading a draft of this thesis and having made their precious comments and suggestions. As for the left errors, the responsibility for the text rests completely upon the author. My classmates from the Department of Management support me in my research work. I want to thank them for all their help, support and valuable hints. I would like to express my gratitude to everyone who directly or indirectly offered his or her help to this thesis.

I cannot end without thanking my family, on whose constant encouragement and love I have relied throughout my life. My deepest appreciation goes to them, namely my parents and my two sisters.

CHAPTER 1 INTRODUCTION

The importance of R&D investment has received increasing attentions from policy-makers and researchers in the fields of economics and strategic management, since a lot of empirical evidence have showed that investment in R&D has a significant positive effect on economic growth. The proponents of new growth theory such as Romer (1990), Lucas (1988) all realized the contribution of R&D activities in pushing economic growth. In the OECD report written by Guellec and Van-Pottelsberghe (2001), they found that one percent increase in R&D stock would contribute 0.13 percent increase in the growth of multi-factor productivity. These studies emphasized the importance of R&D investments in contributing to country's economic growth and enhancing comprehensive national power from the macro level.

As the importance of R&D stock to a country, appropriate expenditure on R&D investments is also essential for firm's survival and growth, especially for firms in R&D-intensive industry. This paper tries to investigate the determinants of R&D investments from micro level, namely from firm's specific characteristics. As Franko (1989) pointed out, firms especially in technologically industries rely on R&D investments to guarantee firm's viability and generate sustained competitive advantages. However, firms differ in committing their resources to R&D investments even after controlling for the industry, firm size and performance (Ettlie, 1998; Mosakowski, 1993). Rumelt *et al*. (1994) claimed that the presence of heterogeneity in R&D expenditures on the firm-level is still the fundamental research in the area of strategic management, because understanding the differences in firm's R&D investments may help us explain the existence of

heterogeneity in other dimensions, for example, firm performance and absorptive capability.

Reviewing the literature, we can find two research streams on the determinants of R&D investments. The first stream concerns about the influence of ownership structure, which is mainly based on agency theory. For example, Lee and O'Neill (2003) investigated the different effects of ownership concentration on firm's R&D intensity in US and Japanese contexts. The second research line focuses on the role financial structures such as financial slack and debt conditions. Researches done in this stream are mainly based on behavioral search theory, pecking order theory, signaling, and agency theory. For instance, Long and Ravenscraf (1993) studied the impact of leverage ratio on R&D intensity for firms undergoing a leveraged buyout. However, most of previous studies treated ownership and financial structures as separate determinants, even though theoretical arguments and empirical evidence suggest that they are interdependent.

Therefore, the extant literature ignores the potential interplay of ownership structures and financial structures in decisions where R&D investments are determined. I argue that this void may lead to a serious limitation in understanding firms' R&D investments, because the current division of the literature may give incomplete understanding of what are the relationships between the antecedents of R&D investments (due to missing some relationship between ownership structures and financial structures such as mediation relationships) and what are the consequences of the relationships between those antecedents on R&D investments (such as over-investments etc.). Therefore, identifying the direct and indirect effects of the salient factors of R&D

investments in a simultaneous model will help us to reveal new insights on the relationship as well as avoid any false attribution of causality between those structure factors and R&D investments.

The aim of this paper is to provide a systematic view on the determinants of R&D investments on firm level, which has important implications in explaining firm's superior performance and competitive advantages. Therefore, the main research questions of this paper are: What are the determinants of R&D investments? What are the influences of controlling owners and institutional owners in emerging markets? Are financial structures such as financial slack and leverage ratio mediating factors in affecting R&D investments?

This paper contributes to the literature as follows: 1) it extends our understanding of how ownership structure shapes strategic decisions such as R&D investments in emerging markets. Since La Porta *et al.* (1999) and Claessons *et al.* (2000)'s finding that there is little separation between control and ownership in emerging markets all around the world, many studies have been done to discern the role of controlling owners. However, whether these controlling owners are long-term oriented and promote R&D investments are still not clear. What's more, the drastic debate regarding the effect of institutional investors on firms' R&D investments are most based on US governance mechanism. I argue that different governance mechanisms and environment such as legal protection may change their orientations. This paper enriches our understanding of their roles in emerging markets. 2) It fills the literature void by bridging the relationships between ownership structure and financial structure, which was neglected by previous researchers. Kim *et al.* (2008) argued that ownership structure has moderating effect on

the relationship between financial slack and R&D investments. However, this paper views financial structures such as financial slack and leverage ratio as mediating factors. And my empirical study showed support for this perspective. 3) It verifies some conventional wisdom such as the role of leverage ratio on R&D investments in Korean context.

The rest of this paper is structured as follows. In Chapter 2, I reviewed the literature regarding the roles of ownership structure such as controlling ownership and institutional ownership and financial structures such as financial slack and leverage ratio in determining firm's R&D investments, and reviewed the potential links between ownership structure and financial structure. In Chapter 3, I proposed the main hypotheses about the relationship between the antecedents of R&D investments and their influences on R&D investments. In Chapter 4, I did the empirical test and presented the results. Finally, I concluded with implications and pointed out the directions for future research.

CHAPTER 2 LITERATURE REVIEW

Since this paper aims to investigate the relationships between the antecedents of R&D investments and their impacts on R&D investments, in the following parts I will review the literature regarding these constructs such as R&D investments, ownership structure and their relationships. First, some aspects of R&D investments such as its importance, characteristics, determinants and its contribution to firm's value are introduced in detail. According to the literature, there are two main determinants of R&D investments that are wildly identified by previous scholars, namely ownership structure and financial structure. Thus, previous studies about ownership structure and financial structure are reviewed respectively. Finally, this paper provides a short summary of this literature review part.

2.1 R&D investments

R&D is the abbreviation of research and development. R&D activity refers to "creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications" (OECD, 2008), includes fundamental research, applied research and development test. The scale of R&D activities or R&D intensity constitutes an important criterion to measure the scientific and technological strength or core competency of a country. Similarly, the scale of R&D activities untaken by a firm represents its value and competitiveness. Almost all famous international companies view R&D activities as the blood of a firm and invest lots of resources in R&D activities. In

the following paragraphs, this paper will talk about the importance of R&D investments, the characteristics of R&D investments, determinants and its contribution to firm's value.

2.1.1 The importance of R&D investments

The importance of R&D has received increasing attentions from policy-makers and researchers in the fields of economics and strategic management, since a lot of empirical evidences have showed that investment in R&D has a significant positive effect on economic growth (Bettina and Nigel, 2008). From the macro level, the proponents of new growth theory such as Romer (1990), Lucas (1988) all realized the contribution of R&D activities in pushing economic growth. In the OECD report written by Guellec and Van-Pottelsberghe (2001), they found that one percent increase in R&D stock would contribute 0.13 percent increase in the growth of multi-factor productivity. From the micro level, firm faces more competitions as the economies globalized. The appropriate expenditure spends on R&D activities is very important for firm's survival and growth, especially for the technology intensive industry such as IT industry (Chan *et al*., 1990). These R&D activities are mainly the sources of innovativeness and help firm generate sustained competitive advantages (Aboody and Lev, 2000; Franko, 1989; Hall, 1998). However, firms differ in committing their resources to R&D investments even after controlling for the industry, firm size and performance (Ettlie, 1998; Mosakowski, 1993).

Since strategy literature shifted away from industry structure and towards firm heterogeneity, theories such as resource-based view are developed to explain firm heterogeneity. Rumelt *et al*. (1994) claimed that the presence of heterogeneity in R&D expenditures on the firm-level is still the fundamental research in the area of strategic

management, because understanding the differences in firm's R&D investments may help us explain the existence of heterogeneity in other dimensions, for example, firm performance and core capability.

2.1.2 The characteristics of R&D investments

R&D investment is one kind of special investments that its result is usually unknown. Mezghanni (2009) concluded that R&D investment has the following three characteristics: *high asset specificity*, *long investment horizon* and *high failure rate*. *High asset specificity* means that the outputs of R&D activities are specialized and can only be fully deployed in its only firm (Williamson, 1988). If such kind of asset is transferred to another firm, it will lose value to some extent. In order to get innovative technologies in some area, firms need to input a lot of human and financial resources continuously, which means *long investment horizon*. *High failure rate* refers to the high uncertainty of R&D activities, means that the expenditure in R&D investments may not get any return or may get some return only after many years. Because of these characteristics of R&D activities, financing for them is different from other kind of investments (Bah and Dumontier, 2001; Singh and Faircloth, 2005).

2.1.3 R&D investments and firm value

It is commonly shared by the literature that R&D investments are crucial to the technology intensive firms and ensure their sustainability and competitiveness (Mezghanni, 2009). Hence, it is expected that R&D investments should help improve firm performance. Early empirical studies investigated the relationship between R&D investments and firm value with two approaches. First approach studied the market

reaction about announcements of changes in R&D spending. For example, Jarrell *et al*. (1985) reported a positive impact of announcements that firms were starting new R&D projects; Woolridge (1988) studied the market response to the announcements of long-term investments including R&D projects, and got the same conclusion with Jarrell *et al*. (1985).

The other approach investigated the relationship between R&D investments and firm value. Ben-Zion (1984) found that R&D intensity has a positive effect on firm's market value. Using a panel of British manufacturing firms, Blundell *et al*. (1999) reported a robust and positive relationship between the headcounts of innovation and market value. Connolly and Hirschey (1984) found the positive effect of R&D investments on Tobin's Q. Using a sample of Australian firms, Chan *et al*. (2007) found that higher R&D intensity is associated with better firm value regardless of the accounting methods used. Above abundant of empirical studies confirmed our conventional wisdom that it is worth investing in R&D activities.

2.1.4 The determinants of R&D investments

According to the upper-echelons perspective, firms' actions are reflections of their top management teams (Hambrick and Mason, 1984). Therefore, decisions about the magnitude and allocation of R&D investments are at the discretion of top management team. Thus, the amount of expenditure on R&D activities depends on managers' risk aversion and preferences. Exploiting the resource-based view, it is obvious that the resources a firm possesses will determine the type of strategies it will take. What's more, managers' decisions and behavior are monitored by various types of shareholders (Jensen

and Meckling, 1976). Hence, while shareholders may affect firms' R&D investment decisions through monitoring managers, resources such as internal finance constraint firms from investing more in R&D activities.

Based on above logic, we can divide literature about the determinants of R&D investments into two streams. The first stream focuses on the role financial structures such as financial slack and debt conditions. Researches done in this stream are mainly based on behavioral search theory, pecking order theory, signaling, and agency theory. The second stream concentrates on the influence of ownership structure. Because different types of owners have different preferences, investment horizons and monitoring power (Hoskisson *et al*., 2002), they may have different influences on firm's strategic decisions such R&D investments. Researches that have been done in this stream mostly draw on agency theory. This paper will review the determinants of R&D investments according to these two streams.

2.2 Ownership structure

As Williamson (1963) suggested, ownership structure is the basis of corporate governance. Abundant studies have been done on the effects of ownership structure on firm performance, capital structure, innovation and diversification strategy and other aspects. Thus, the research studying about the effects of ownership structure on R&D investments becomes one main area. Since controlling ownership and institutional ownership are of most significance in ownership structure, especially in emerging markets, the following sections are going to review the literature on the roles of institutional investors and controlling owners.

2.2.1 Controlling owner

Different from developed countries such as US and UK where shareholder protection is good, publicly listed firms in most countries are usually characterized with concentrated ownership structure and controlled by a single and large shareholder (Claessens *et al*., 2000; La Porta *et al*., 1999; Faccio *et al*., 2002). Previous studies name this kind of shareholder as controlling owner or controlling shareholder. These controlling owners are usually the founders of firms or their family members. According to the data of Classens *et al*. (2000), more than two thirds of controlling shareholders in Asian countries are family owners. In firms with controlling owners, there are little separation between control and ownership. These controlling owners generally own more control rights than cash flow rights through a pyramidal structure, cross-share holdings and issuing multi-class shares (Cronqvist and Nilsson, 2003; Yeh, 2005). Reviewing the literature on the role of controlling shareholder, we can find two opposite perspectives, namely agency perspective and stewardship perspective.

Agency perspective

According to the early work of agency theory, Jensen and Meckling (1976) argued that the interest conflicts between owners and managers are minimized in family firms. However, they also noted that family owners have the incentive to expropriate from minority shareholders. Later researchers developed this view as *principle-principle conflict perspective* (PP). This expropriation can happen because controlling shareholder can not only control how to run his firm, but also determine how to distribute firm's profits (Classens and Fan, 2003). As long as they don't have 100% ownership, they may

consume lots of perquisites before distribute profits to other shareholders. La Porta *et al.* (2000) emphasized that expropriation from minority shareholders are more likely to happen in countries where there is limited investor protection. They also listed the forms of expropriations such as asset stripping, resource transferring and ownership dilution. Thus, while controlling shareholders largely reduce the agency cost of managers, whether their presences are good for firms depends on their expropriation behaviors.

Based on PP perspective, researchers have done lots of studies hoping to find the evidence of expropriation (Joh, 2003; Shleifer and Vishny, 1997; Wiwattanakantang, 2001; Yeh, 2005). Using data from Korean firms during 1993-1997, Joh (2003) found that controlling shareholders' expropriation happens when their ownership is lower. His study indicates the negative effect of control-ownership disparity. He also found "the tunneling" behavior, which is one way of expropriation among affiliates of large business groups. Exploiting the data from Taiwan listed firms, Yeh (2005) got the same conclusion as Joh (2003) that the corporate value is lower when the gap between control rights and cash flow rights is larger. Wiwattanakantang (2001) reported the positive relationship between firm value and family ownership for Thailand firms where family owners usually don't adopt pyramidal structures. Above empirical studies seem to confirm the expropriation behavior of controlling owners.

Stewardship perspective

While agency theory assumes that man is self-interested, stewardship theory argues that owners and managers are motivated by high order needs such as growth, achievement and self-actualization, and they promote pro-organizational and

collectivistic behaviors (Davis *et al*., 1997). Since family owners' fortune and reputation are closely tied to their businesses, they have deep emotional investment and psychological attached to their firms (Bubolz, 2001). Burkart *et al*. (2003) and Casson (1999) claimed that family owners generally want to pass their firms to next generations. Anderson and Reeb (2003) identified that strategic investments in family firms are long-term oriented. Le Breton-Miller and Miller (2006) and David and Laurie (2008) suggested that family firms tend to have long-term orientation in other activities, say, maintaining long run relationships with debt holders and suppliers. All these points seem to support Miller and Le Breton-Miller's (2006) argument that stewardship attitude is more likely to breed in family business.

Since most controlling shareholders are family owners, there are several studies trying to discern whether controlling owners are stewards (Eddleston and Kellermanns, 2007; Miller *et al*., 2008; Zahra *et al*., 2008). Miller *et al*. (2008) reported totally support for stewardship perspective. For instance, they found long-term orientation in strategic investments, firm's reputation and relationships with employees and customers in family firms. Using data from 248 family firms in food processing industry, Zahra *et al*. (2008) found that stewardship-oriented organizational culture is conducive to strategic flexibility and positively moderate the relationship between family commitment and strategic flexibility. Eddleston and Kellermanns (2007) by utilizing stewardship theory argued that altruism in family firm is conducive to breed a participative strategy process in which firms are more likely to improve performance.

2.2.2 Institutional investors

Institutional investors are specialized financial institutions which consist of pension funds, insurance companies, mutual funds (Davis and Steil, 2001). They are playing more and more important role in the global stock markets as their assets increases (Hansen and Hill, 1991). These investors usually hold diversified portfolios and provide a better trade-off of risk and return than individual investors. Previous scholars (see David *et al*., 2001; Hoskisson *et al*., 2002) classified institutional investors into two categories: short-term oriented and long-term oriented. Pension funds and insurance companies are identified as long-term investors, since they are both instruments for long-term saving and their goals are to get long-term returns (Fortune, 1993). Gilson and Kraakman (1991) suggested that pension funds emphasize indexing and usually have an investment horizon for about 10 years. However, mutual funds and other professional investment funds are more interested in short-term return, since short-term return is the most important indicator showing whether their management teams are competent. Individual investors generally choose professional investment funds according to their short-term returns. What's more, these professional investment fund managers have the incentive to compete in the short-term return, since their compensation is market-based (Khorana, 1996).

As different types of institutional investors have different investment horizons and focuses, there monitoring powers and influences on invested firms are different (Douma *et al*, 2006). For pension funds, they are active in monitoring firms and care for firms' long-term developments (Fortune, 1993). While for mutual funds, they trade frequently and vote by feet when firm's performance is poor (Froot *et al*., 1992). Based on their

different monitoring power and trading behavior, there have been a lot of studies done regarding their influences on firm performance and strategic decisions.

2.2.3 Ownership structure and R&D investments

Previous studies mainly use agency theory to investigate the influences of ownership structure on R&D investments. Agency problem happens because of interests' conflict and information asymmetry between owners and managers (Fama and Jensen, 1983; Eisenhardt, 1989). Thus, previous researchers link R&D investments with ownership structure in terms of incentive misalignment and information asymmetry (Lee and O'Neill, 2003).

Incentive misalignment: Abundant of studies pointed out that top management teams tend to be reluctant in investing in R&D (e.g., Froot *et al.*, 1992; Stein, 1988; Jensen and Meckling, 1976), which is named as "*managerial myopic*" behavior. One thing to support this argument is that R&D investment involves high risk and high failure rate. While outside shareholders can diversify risk by holding diversified portfolios, managers cannot and bear high risk since their job safety and compensation are related to firms' performance in their contract's periods (Hoskisson *et al*., 1993; Kor, 2006; Laverty, 1996). So managers tend to build empires and invest more in marketing and acquisition activities to get firm's good short-term performance (Kor, 2006). The other thing is that managers usually get pressures from stockholders who are interested in short-term financial return (Froot *et al.*, 1992). These stockholders may sell their stock when they see the bad quarterly or annually reports (Froot *et al.*, 1992; Lee and O'Neill, 2003). If many investors have the same opinion toward the announcement of these reports, namely

to sell the stocks, then the firms' value will decrease. What's more, as Laverty (1996) argued that the professional investment institutions evaluate the value of a firm emphasizing less on the intangible assets which are the results of R&D investments. Thus, in order to get good pay and secure their jobs, managers wouldn't like to take the risk of investing on the long-run. Therefore, because of the misaligned incentives, *managerial opportunism* has been identified as one obstacle for R&D investments by many researchers.

Information asymmetry: *Information asymmetry* between owners and managers would lead to the inappropriate evaluation of R&D investments (Laverty, 1996; Lee and O'Neill, 2003), which is identified as another obstacle of R&D investments. One reason for existence of information asymmetry is that outsider stockholders have costs to collect information on firm's strategic actions (Jensen and Meckling, 1976). For the other, the nature of information on R&D investments put some obstacles for outsiders to get to know them (Myers, 1984). The information publication on the R&D projects would put the firm at a competitive disadvantage if this information provides crucial signal to its competitors (Bhattacharya and Ritter, 1983). Thus, Lee and O'Neill (2003) argued that frequent communication between managers and investors can help alleviate the latter ones' pressure.

2.2.4 Empirical evidence

Lots of empirical studies have been contributed to study the relationship between ownership and R&D investments using above two explanations (i.e. *managerial myopic* and *information asymmetry*). Most of these studies focus on the effect of institutional

ownership. In the 1980s, as the level of institutional ownership of public firms increases, researchers began to worry about its effect on long-term investment such R&D projects (Graves, 1988). Researchers such as Drucker (1986), Mitroff (1987) and Scherer (1984) held the view that institutional investors are short-term oriented which lead to their myopic investment strategy. However, the first empirical study done on this issue by Jarrell and Lehn (1985) indicated the opposite.

The debate regarding the role of institutional investors didn't stop at their work, but led to more empirical studies. For example, using firm data in the computer industry, Graves (1988) found that increased institutional investor ownership decreases R&D investments; Baysinger *et al*. (1991) reported the positive effect for 176 Fortune 500 firms; longitudinal study conducted by Hansen and Hill (1991) also indicate the positive effect. For the above contrary conclusions, Hoskisson *et al*. (2002) provided one persuasive argument that different types of institutional investors have different investment horizons. Therefore, empirical studies using datasets composed by different weights of types of institutional investors might lead to different conclusions.

Regarding the effect of controlling ownership on long-term investment, empirical studies are sparse and most of them were done in recent years. Using panel data of U.S. family and non-family firms and exploiting Bayesian approach, Block and Thams (2008) didn't find evidence that family firms are more long-term oriented. However, Kim *et al*. (2008) reported that controlling owners promote R&D investments for Korean firms. Therefore, more empirical studies need to be done to discern the role of controlling owners on R&D investments.

2.3 Financial structure

According to resource-based view, the resources a firm possesses decide its strategy. Financial factors such as financial slack and debt condition have been considered as important resources in determining firm's R&D investments. While organizational researchers, such as Cyert, March and Bourgeois, emphasized the important role of slack resources in promoting firm's experimentation and innovation activities, financial researcher, such as Myers, Majluf and Williamson, argued that debt condition has enormous effect on financing R&D projects. The literature on financial slack, leverage ratio and their relationships with R&D investments is reviewed in following paragraphs.

2.3.1 Financial slack and R&D investments

Slack resources

The concept "slack" has been the focus of organizational literature for a long time since Cyert and March's (1963) work, and it was usually treated as independent variable to explain organizational behavior (Bourgeois, 1981). Since different scholars captured different aspects and functions of slack resources, there have been many definitions of organizational slack (cf. Child, 1972; Cyert and March, 1963; Litschert and Bonham, 1978). Bourgeosi (1981) suggested a definition by paraphrasing March's work which was adopted by most researchers as follows:

> Organizational slack is that cushion of actual or potential resources which allows an organization to adapt successfully to internal pressures for adjustment or to external pressures for change in policy, as well as to initiate changes in strategy with respect to the external environment.

As he suggested, it is important to operationalize slack in terms of measurable items to facilitate empirical study. Based on his work, Bourgeois and Singh (1983) classified slack into three categories: available slack, recoverable and potential slack. Sharfman *et al*. (1988) simplified their classification and identified slack resources from high discretion (e.g. cash, marketable securities) to low discretion (e.g. inventory, labor and low flexibility machine capacity). This paper is going to investigate the role of financial slack, which is one kind of high-discretion slack, including cash and receivables (Greve, 2003; George, 2005; Kim *et al*., 2008).

Regarding to the functions of slack, there have been two contrary views. Proponents of slack such as Cyert and March (1963), Bourgeois (1981), Singh (1986) argued that slack resources allow firms to engage in experimentation and innovation activities. According to the economic equilibrium theory, there should be no slack in the equilibrium point. Thus, opponents of slack viewed it as phenomenon of inefficiency and argued that slack breeds the sense of complacency in organization and diminish incentives to innovate (Nohria and Gulati, 1996). Agency theorists such as Jensen and Meckling (1976), Triantis (2000) suggested that slack allows managers to pursue their own interests and promotes undisciplined R&D projects.

Slack and innovation

According to the perspective from Cyert and March (1963) and their following proponents, it is definitely the case that slack promotes R&D activities. Several empirical studies have showed supports for it. Using the questionnaires data of 64 large U.S. and

Canadian firms and exploiting structure model equation, Singh (1986) reported that both absorbed and unabsorbed slack have a positive relationship with risk taking projects. Zajac *et al*. (1991) studied the factors that might enhance innovation in internal corporate joint venture, and found that organizational slack is positively related to innovativeness.

However, organizational economists and agency theorists claim that slack is kind of unnecessary cost and is not conducive to innovation. Thus, this view predicts negative relationship between slack and R&D investments. Nohria and Gulati (1996) reconciled above contradictive views by arguing that there is an inverse U-shaped relationship between slack and innovation, which was also supported by their empirical test. Kim *et al*. (2008) provided further evidence for Korean firms that the relationship between slack and R&D investments is curvilinear. Therefore, these studies showed that certain amount of slack resources is needed for innovation while too much slack indicates wastes of resources.

2.3.2 Capital structure and R&D investments

Since Modigliani and Miller (1958) advanced the classic proposition about the capital structure 'irrelevance', the theory of capital structure started. Various theories such as pecking order theory, information asymmetry perspective, transaction cost theory and agency theory were developed to investigate organizational factors' influences on capital structure. On the other hand, capital structure is an important factor affecting the whole organization, from performance to strategic decisions. While researchers in the area of strategy mainly emphasized that the kind of strategy (innovation strategy or diversification strategy) a firm pursues affects capital structure, most financial

researchers claimed that capital structure decides strategy. In the following paragraphs, this paper first reviews the literature about the traditional explanations of capital structure, then the causal relationship between capital structure and R&D investments, and finally the empirical evidence.

Traditional explanation of capital structure

Modigliani and Miller (1958) stated: "in the absence of taxes, bankruptcy costs, and asymmetric information, and in an efficient market, the value of a firm is unaffected by how that firm is financed", which means that a firm's financial structure is irrelevant to its investment decision. This famous conclusion violated conventional wisdom at that time and ignited interest in the study of capital structure. However, the real world is not that frictionless. Several years later, Modigliani and Miller (1963) corrected their model by relaxing the assumption of a tax-free world and got the conclusion that the value of a firm is positively related to leverage ratio, which is because of the tax benefits of interest payments.

While Modigliani and Miller (1963) showed the tax benefits of debt financing, other researchers found the costs of it. We can find two kinds of costs of debt financing from the literature. First, Jensen and Meckling (1976) pointed out that there're agency costs of debt. In their model, owner-manager of a firm first issues debt, and then decides what investments to take. In the modern corporation, owner-manager has limited liability, thus moral hazard problem happens. The equity holders have incentives to pursue riskier investment projects, since the downside risk of the investment decisions are borne by the bondholders. Realizing this problem, the bondholders will probably demand protection

via monitoring and bonding mechanisms, or demand a premium, which increases the costs of debt financing. Second, financial distress is another cost of debt financing. When a firm cannot meet its debt obligations, it causes the firm to lose value going through bankruptcy (Andrade and Kaplan, 1998). Jensen (1986) corrected the conclusion that there are agency costs associated with debt financing, and argued that it also has some benefits. Realizing that managers are self-interested and may invest in unproductive projects, he noted that debt financing increased the leverage ratio and deceased the amount of free cash flow that managers have discretion over, thus reduce the total agency costs within a firm.

Another different perspective on capital structure is Myers and Majluf's (1984) pecking order theory. Their model showed that internal finance is most preferred because of information asymmetry and capital market imperfection. When internal finance is not sufficient, the firm will issue debt first and then equity.

The links between capital structure and R&D investments

After the classic work of Modigliani and Miller (1958), various theories were developed to study the puzzle of capital structure. These theories include pecking order theory, transaction cost theory, information asymmetry perspective. Although some of them indicate the influences of characteristics of R&D investments on the choice of financing, others study the effect of leverage ratio on R&D investments. However, these theories seem to predict the same relationship between leverage ratio and R&D intensity. Each of these theories is reviewed in the following paragraphs respectively:

Information asymmetries: As argued previously, regarding the investments on R&D activities, while the information asymmetry problem exists between managers and shareholders, it also exists between managers and debtholders because of the confidentiality nature of R&D projects (Bhattacharya and Ritter, 1983). As Jensen and Meckling (1976) pointed out, after R&D projects are financed, moral hazard problems may happen. Because of the limited liability, shareholders have the incentive to invest in riskier projects. Realizing this problem and the difficulty to monitor their behavior, debtholders usually demand high premium on their finance. Bah and Dumontier (2001) argued that his high premium makes equity financing more attractive than debt financing. Thus, if firms pursing innovation strategy finance R&D projects using equity, the leverage ratio should be maintained at a low level.

Transaction cost theory: Williamson (1988) suggested that debt financing is preferred to equity when the transaction cost of negotiation is low. He argued that the transaction cost is positively related to asset-specificity. For example, when a firm's asset-specificity is lower, it can be easily redeployed and sold to other firm. Thus, it transaction cost is lower when debtholders execute the option of asset sales and liquidation. But when a firm's asset cannot be easily sold to another firm (high asset specificity), the cost of transferring these assets are high (Long and Ravenscraft, 1993). It is well known that R&D investments are highly specialized that have low redeployability. Therefore, the implication from Williamson's theory is similar to the perspective of information asymmetry.

Leverage as bonding device: Similar to above transaction cost perspective, assets generated by R&D investments are not only highly specialized, but also worth low value when severs as collateral guarantee (Long and Malitz, 1985). Without sufficient collateral guarantee, debt provides are unlikely to lend money to these firms. Thus, a firm invests too much in R&D activities cannot support high leverage ratio. On the other hand, as Mishra and McConaughy (1999) suggested, high leverage ratio indicating the high default of risk increases difficulty in funding for R&D projects. Therefore, a firm with a high leverage ratio is less likely to be financed. Above two points predict the negative relationship between leverage ratio and R&D intensity.

Myopic cash flow generation: Peyer and Shivdasani (2001) suggested that debtholders prefer firms to follow stable strategies that can generate cash flow in short-term, rather than investing in risky R&D projects. When a firm's leverage is higher, they will force managers focusing on generating cash flow to pay the interest of their debts. Free cash flow is very important in …Thus, reduced free cash flow makes the firm's current R&D projects uncontinuous or invests less for future projects. Whited (1992) supported for this view by arguing that higher leveraged firms face greater financial constraints. More financial constraint makes firm more difficult in getting finance for R&D activities. Hence, higher leverage ratio prevents firm pursuing innovation strategy and decreases the expenditure in R&D projects.

Empirical evidence

Most empirical studies have confirmed above prediction that leverage ratio is negatively associated with R&D intensity. Using a sample of 971 COMPUSTAT firms,

Baysinger and Hoskisson (1989) found strong significant negative relationship between the long-term leverage ratio and R&D intensity. Bhagat and Welch (1995) reported a negative relation between debt levels and R&D expenses. By comparing a sample of R&D intensive firms to a sample of non-R&D ones for firms in the UK, US, Japan and Europe, Bah and Dumontier (2001) found the former ones exhibit significantly lower leverage ratio and dividend payout ratio, but longer debt maturity and higher cash levels. Using a sample of large US manufacturing corporations, Singh and Faircloth (2005) found a strong negatively relationship between leverage ratio and the level of R&D expenditure that firms undertake. Jordan *et al.* (1998) found that innovation-based strategy is associated with the lowest level of debt, while cost-leadership based strategy had the highest leverage ratio. O'Brien (2003) got the same conclusion that innovation-based strategy is associated with the lower level of debt.

However, above empirical studies were done based on the contexts of developed countries. Empirical studies regarding the relationship between capital structure and R&D investments in emerging markets are sparse. Different institutional background and governance mechanisms in emerging markets may change above conclusion that is derived from developed countries.

2.4 Ownership structure and financial structure

2.4.1 Ownership structure and financial slack

Investigating the influence of ownership structure on firm's strategic decisions, performance and other aspects has been the main research area in the domain of corporate

governance. However, according to my literature review, rare research has been done on the direct relationship between ownership structure and financial slack. Most studies have contributed to study the relationships between ownership structure and financial policies such as dividend policy using agency theory. Since retained earnings are the main source of financial slack, we may find some implicit relationships between ownership structure and financial slack in the financial economics and strategy literatures.

The link between ownership structure and financial policy is recognized in many early works such as Williamson (1964) and Jensen (1986). Based on their recognition, later scholars have done lots of studies on the relationship between managerial ownership and dividend policy (for example, Rozeff, 1982; Jensen *et al*., 1992; Eckbo and Verma, 1994). Until 1990s, researchers began to realize the role of institutional investors in affecting firm's financial policy (for example, Chaganti and Damanpour, 1991; Bathala *et al*., 1994). As the recent increasing interests in the domain of family business, researchers in this area start to investigate the relationship between family ownership and dividend policy (for example, Faccio *et al*, 2001; Hu *et al*. 2007).

In the eyes of agency theorists, ownership structure and dividend policy are all governance mechanisms that can be used to align the interests between managers and owners. For example, Jensen and Meckling (1976) suggested that increasing managerial ownership can help mitigate the interest conflicts between managers and owners; Rozeff (1982) and Easterbrook (1984) claimed that increasing dividends payout reduces the cash at the discretion of managers and forces them to get additional funds from external capital market, which in turn will monitor their behavior. Hence, managerial ownership and

dividends have the same function in reducing agency cost. Exploiting their substitution effects, Crutchley and Hansen (1989) found the negative relationship between managerial ownership and dividend payout ratio. Using simultaneous equation, Jensen *et al*. (1992) got the same relationship.

Regarding the role of institutional investors on dividend policy, previous studies are mainly based on tax-based theory and agency theory. From tax-based perspective, it is well known that institutional investors have tax benefits. Thus, institutional investors are likely to demand more dividend payout ratio. From agency perspective, Jensen (1986) points out that managers tend to retain cash under their control and pay less dividends. In order to reduce agency cost, institutional investors may force managers to pay more dividends (Short *et al*., 2002). Therefore, above two perspectives all predict the positive relationship between institutional ownership and dividend ratio. However, Grinstein and Michaely (2005) claimed that there is selection procedure in which institutional investors choose invested firms. Empirical researches on this line also produced mixed results. Short *et al*. (2002) found the positive relationship between institutional ownership and dividend policy using UK panel data; using data of public U.S. firms, Grinstein and Michaely (2005) didn't find any relationship between them; Kouki and Guizani (2009) found significant negative relationship for Tunisian firms. For above inconsistency, I would think the context matters on one hand. On the other hand, as Hoskisson *et al*. (2002) pointed out, institutional investors are heterogeneous and have different investment horizons. Hence, long-term oriented institutional investors may not demand too much dividends on the short run while short-oriented ones probably will do.

Controlling owners are criticized by researchers such as La Porta *et al*. (2000) and Faccio *et al*. (2002) on their expropriation behavior from minority shareholders. They are claimed to pay lower dividend ratio (Faccio *et al*., 2002). Hu *et al*. (2007) supported this argument, and found that family firms pay lower dividend than nonfamily firms. However, direct empirical evidence on the relationship between controlling ownership and dividend ratio is really sparse.

2.4.2 Ownership structure and capital structure

Earlier studies on the relationship between ownership structure and capital structure concern about the role of managerial ownership. Amihud and Lev (1981) argued that professional managers have undiversified employment risk and tend to reduce it by ensuring the viability of their firms. Since high leverage ratio increases the probability of financial stress, Friend and Long (1988) claimed that decreasing the debt holdings can reduce managers' employment risk. Thus, based on managers' self-interest behavior, it might be the case that they hold the debt level below the optimal level (Brailsford *et al*., 2002).

As managerial ownership helps align the interests between managers and shareholders, its effect on capital structure has drawn amount of studies (see Brailsford *et al*., 2002; Crutchley and Hansen, 1989; Jensen *et al*., 1992). Incentive alignment will prompt manager to behave on the behalf of shareholders (Morck *et al*., 1988). Thus, increasing managerial ownership will increase debt holding. However, as their ownership increases to a point, McConnell and Servaes (1990) argued that entrench effect will dominate and results in managerial opportunism. Therefore, above logic suggests an

inverted U-shaped relationship between managerial ownership and leverage ratio. Brailsford *et al.* (2002) found support for this argument while most of earlier studies such Crutchley and Hansen (1989) and Jensen *et al*. (1992) found a negative relationship.

From the agency perspective, most of governance mechanisms are designed to constraint managerial opportunism. The role of institutional investors is identified as a way to increasing shareholders' monitoring power (Friend and Lang, 1998). Thus, when managers pursue a strategy that the debt level is below optimal, institutional investors may have influence in countering their decision. Therefore, this perspective predicts the positive relationship between leverage ratio and institutional ownership. Brailsford *et al*. (2002) supported for this perspective. However, an alternative view leads the opposite conclusion. Jensen's (1986) cash flow theory indicates that debt is a way to reduce agency cost, since interest payment of debt reduces managers' control over firm's cash flow. Thus, debt policy has been viewed as internal governance mechanism by agency theorists in restricting managers' self-interest pursuing behavior where institutional investors play the same function (Grossman and Hart, 1980). According this view, debt policy and the role of institutional investors can be substituted by each other. Hence, a negative relationship is expected between them, which is also supported by Bathala *et al*. (1994)'s empirical study.

As the resurgence in the area of family business, several studies have contributed to investigate the capital structure in family firms (King and Santor, 2008; Mishra and McConaughy, 1999). As similar to managers, controlling owners hold undiversified stakes in their firms. Thus, they care for firm's viability and long-term development

(Anderson and Reeb, 2003; Anderson *et al*., 2003; Villalonga and Amit, 2006). On the other hand, family owners fear losing control over their firm (Mishra and McConaughy, 1999). In addition, Burkart *et al*. (2003) argued that family owners suffer far more lose than just their assets when going bankruptcy. Hence, family owners have much more incentive than any types of shareholders in maintaining control and ensuring firms' survival (Mishra and McConaughy, 1999). Therefore, King and Santor (2008) and Mishra and McConaughy (1999) argued that family firms tend to be more risk aversion and maintain lower level of debt ratio than nonfamily firms. Their empirical studies showed supports for this view.

2.5 Summary

By reviewing the literature, I found two main determinants of R&D investments, namely ownership structure and financial structure. However, according to my knowledge, the literature on the determinants of R&D investments is incomplete, since these two research streams treat ownership structure and financial structures as separate factors, even though there are some arguments and empirical evidences showing these two are interdependent. For example, ownership structure affects firm's financial policy and capital structure. Therefore, the extant literature ignores the potential interplay of ownership structures and financial structures in decisions where R&D investments are determined, which may lead to false attribution of causality between those factors and R&D investments.

CHAPTER 3 THEORY AND HYPOTHESES

3.1 Ownership structure and R&D investments

3.1.1 Controlling ownership and R&D investments

Controlling owners in Korean firms are usually founders and founders' relatives, they often present on the board of directors or top management teams (Kim *et al*., 2008). As such, controlling owners often have great influence on their firms' strategic decisions. While agency problems may be severe in professional manager-managed firms, managerial opportunism is largely restricted in firms with controlling owners, since managers are under effective monitoring or controlling owners may be managers themselves. Therefore, according to the upper-echelons perspective, in Korean context, we can conclude that firms' R&D investment decisions, to a large extent, depend on controlling owners' intentions.

Reviewing the literature, I have found two conflicting voices about the role of controlling owner, namely PP perspective and stewardship perspective. And most of previous studies that done using above two perspectives generally tried to investigate the relationship between controlling ownership and firm performance. It is obvious as Le Breton-Miller and Miller (2006) suggested that expropriation behavior is detrimental to firm performance while stewards can help improve firm performance. While these two conflicting views may predict the opposites regarding the influences of controlling ownership on performance, I argue that they don't have conflicts in predicting the relationship between controlling ownership and R&D intensity.

Controlling owners can be psychologically tied to their firms (Le Breton-Miller and Miller, 2006) and want to pass firms to their heirs (Burkart *et al*.,2003; Casson, 1999). They can also be long-term oriented in making strategic decisions (Anderson and Reeb, 2003), and maintain long run relationships with employees and suppliers (Le Breton-Miller and Miller, 2006; David and Laurie, 2008). At the same time, they may pay little dividend ratio and expropriate from minority shareholders (La Porta *et al*., 1999; Young *et al*., 2008). But as long as controlling owners care for firm's viability and long-term development (Anderson and Reeb, 2003; Villalonga and Amit, 2006) and realize that R&D investments can help firm generate competitive capabilities (Franko, 1989), they would like to invest more in R&D activities.

Previous studies investigated the influences of ownership structure on R&D investments mainly using perspectives derived from agency theory, namely *managerial myopic* and *information asymmetry*. Exploiting these perspectives also suggests a positive relationship between controlling ownership and R&D intensity. For the *managerial myopic* problem, no matter the firm is owner-managed or not, managers pursuing self-interest behavior should be largely restricted as controlling ownership increases, because the benefits of monitoring increase. According to Lee and O'Neill (2003), increased ownership would increase owners' incentive to collect information about R&D projects, which leads to their appropriation valuation on these projects. What's more, controlling owners usually grow with their firms and are very familiar with the businesses and projects. Thus, they will evaluate R&D activities appropriately. Therefore, in the firms with controlling owners, the problems of *managerial myopic* and *information asymmetry* which impede managers from investing in R&D projects don't exist anymore.

Therefore, both stewardship theory and agency theory predict the positive relationship between controlling ownership and R&D intensity.

H1: *Controlling ownership is positively associated with R&D intensity*.

3.1.2 Institutional ownership and R&D investments

Foreign institutional ownership in emerging markets is mostly owned by institutional investors from U.S. and European countries (Choe *et al*., 1999). As the economies globalized and liberalized, these investors hold more and more diversified percentages of stock portfolios in emerging markets to reduce systematic risk. According to the statistics published in *Business Week* (2006), foreign ownership has increased to 42% of public Korean firms in terms of capitalization in year 2006. Although the aggregate ownership is large, their ownerships are usually dispersed as long as their goals are to diversify risk. Korean laws also don't allow foreign investor to hold a large proportion of shares in one company (Jung and Kwon, 2002). Another characteristic of foreign institutional investors is that they trade frequently (David *et al*., 2006), since most of foreign investors are professional investment companies who tend to have short-term horizons and need to shuffle their portfolios. These characteristics and their orientation make them behave like Korean domestic financial institutional investors (Choe *et al*., 1999; Kim *et al*., 2008). Thus, in the following paragraphs, I will use the term "institutional investors" refer to foreign institutional investors and domestic financial institutional investors.

For the role of institutional investors, most prior studies have showed the positive relationship between institutional ownership and R&D investments (Hansen and Hill,

1991; Hill and Snell, 1988). For these studies, their argument is that increased ownership reduce *information asymmetry* problem, which lead to their appropriate evaluation on firms' innovation activities. Hoskisson *et al*. (2002) provided more detailed analysis of institutional investors. They argued that different types of institutional investors have different strategy orientation. Since these studies are all done in U.S. context, the focus is on the conflicting preferences between institutional investors and managers concerning about R&D projects, where there is an agent context according to Lee and O'Neill (2003) and the latter ones are supposed to prefer short-term investments.

However, the case is different in Korea where the conflicting preferences are between institutional investors and controlling owners. While the latter ones are usually strategic investors who prefer R&D investments, I argue that some conditions make institutional investors more likely to be short-term oriented compare to the U.S. context. First, weak laws on shareholder protection don't guarantee investors' return (La Porta *et al*., 2000). Second, most of foreign investors are investment companies and less of them are pension funds. In addition, according to Hoskisson *et al*. (2002), foreign institutional investors tend not to be interested in R&D investments.

While prior studies that support the positive relationship between institutional ownership and R&D investments assuming that institutional investors have pressures on managers in U.S., I argue they may not have influence on controlling owners in Korea. David *et al*. (2001) found that ownership alone is not sufficient to firms' R&D investments decisions. And they argue that only engaging in activism such as initiation of shareholder proposals, negotiations with managers and the launching of proxy contests

can have effect on managers' decision. However, in Korean, institutional investors are not allowed to exercise voting rights based on the "*shadow voting*" rule before the 1997 financial crisis (Hong and Lee, 1998). Although this restriction was removed after the crisis and other corporate governance reforms implemented in Korea, the power and influence of institutional investors is still not as strong as theirs in US (Solomon *et al*., 2002). Therefore, I get the following hypothesis:

H2: *Institutional ownership is not associated with R&D intensity*.

3.2 The mediating effects of financial structures

3.2.1 Financial slack and R&D investments

Although existing literature indicated two contrary views on the role of financial slack on innovation, namely promoting innovation and wastes of resources, I would think they have the same implication on the relationship between financial slack and R&D investments. First, proponents of slack all agreed that more slack resources allow firms to take more experimentation and engage in more R&D activities (Bourgeois, 1981; Cyert and March, 1963). Second, opponents of slack emphasized that too much slack resources are the indicator of inefficiency and allow managers to pursue their own interests, for example, engaging in excessive diversification and investing more in unproductive R&D projects (Jensen and Meckling, 1976). Thus, opponents of slack resources acknowledge that more resources will lead to more R&D activities but may not lead to more innovation. Innovation is the result of R&D investments, but not all R&D investments would lead to

innovation. As Holmstrom (1989) pointed out, innovation requires both strong managerial incentives and careful monitoring.

As long as this paper concerns about the determinants of R&D investments, these above two views all support the argument that more financial slack would lead to more R&D investments where the opponent view claimed that these R&D investments may not be transformed to innovation.

3.2.2 Leverage ratio and R&D investments

According to pecking order theory, because of *information asymmetry* problem, internal finance is first preferred, then debt and equity is ranked at the bottom among this three. However, the characteristics of R&D activities make *information asymmetry* problem severer and debt financing more inappropriate than equity (Bah and Dumontier, 2001). So firms who want to invest in R&D projects have to finance internally or through equity. Hence, firms pursuing innovativeness should exhibit lower leverage ratio. *Transaction cost theory* tells us that transaction cost is positively related to asset-specificity (Williamson, 1988). R&D investment is considered to be highly specialized and the results of it such as patents are not easily deployed by other firms, which makes R&D assets as poor collateral. Thus, R&D investments cannot support a high level of debt (Long and Malitz, 1995).

Above theories all investigate the effects of R&D investments on capital structure. However, capital structure also influences R&D investments in turn. Higher debt ratio increases the probability of bankruptcy and the difficulty in financing for R&D projects (Mishra and McConaughy, 1999). Whited (1992) supported this view by arguing that

higher leveraged firms face greater financial constraints. Therefore, increased leverage ratio is associated with less R&D investments. No matter how R&D investments affects capital structure and how leverage ratio influences R&D investments, above perspectives all predict the negative relationship between the two.

3.2.3 The mediating effects of financial slack

Controlling owner

Controlling owners are identified by previous researchers as long-term oriented (Anderson and Reeb, 2003; David and Laurie, 2008), it is unlikely that these firms would pay large amount of dividends (Jensen *et al*., 1992; Hu *et al*., 2007), since more retained earnings can help firm get out of financial distress and grasp growth opportunities (Mishra and McConaughy, 1999). What's more, according to the tax policy, as controlling owners are generally individuals, they will pay higher dividend tax ratio than institutional investors. Thus, controlling owners probably would prefer lower dividend ratio to avoid high tax rate. Hu *et al*. (2007) provided evidence for above argument that family firms tend to have lower dividend payout ratio than nonfamily firms. Lower dividends payout ratio increases firm's financial slack indirectly.

Controlling owners are identified as psychologically tied to their firms and even take them as "children" (Bubolz, 2001). Thus, they have strong incentive to maintain and ensure control over their firms (Mishra and McConaughy, 1999). As issuing equity will dilute their control, study of De Angelo and De Angelo (1985) indicates that controlling owners usually issue non-voting stocks. As the market imperfection and information asymmetry problems make external finance such as equity and debt more expensive

(Jensen and Meckling, 1976; Myers and Majluf, 1984), controlling owners are more likely to rely on internal finance. Internal finance generally comes from firm's retained earnings, which are important part of financial slack. Hence, I predict that controlling owners tend to maintain high level of financial slack.

Institutional investors

From the agency perspective, institutional owners tend to demand more dividends in order to reduce agency costs. However, there is no consistent empirical conclusion about it (see Grinstein and Michaely, 2005; Kouki and Guizani, 2009; Short *et al.*, 2002). Based on the implication from Hoskisson *et al*. (2002) that institutional investors are heterogeneous, I argue that the relationship between dividend payout ratio and institutional ownership depends on the types of top management teams and institutional investors. In the context of Korea, it is clear that the top management teams are usually controlled by family owners to a large extent. As suggested by La Porta *et al.* (2000), they may behave like entrenched managers who will expropriate from minority investors. Thus, their expropriation incentives and poor shareholder protection will force institutional investors demand more dividends. In addition, institutional investors in emerging markets are usually mutual funds and other types of professional investors who are short-term oriented. So these institutional investors focus on the short-term return rather than long-term return. Hence, for the certain environment in Korea, it is likely that institutional ownership is positively related to dividend payout ratio.

The problem is whether institutional investors can affect controlling owners' financial policies or not. Controlling owners may need the presences of institutional

investors on their firms' shareholders list to signal outsider investors that their firms are well run. So they may pay more dividend ratio to please these institutional investors. What if controlling owners don't take this action? I argue that institutional investors can still adjust their portfolios and choose the companies that pay high dividend ratio, since they short-term oriented. Higher dividend ratio decreased financial slack, since more dividends reduce retained earnings. Therefore, this paper predicts that institutional ownership is negatively associated with financial slack.

3.2.4 The mediating effects of leverage ratio

Controlling owner

Existing literature on ownership and capital structure indicates that the level of financial leverage depends on "manager's risk aversion, the costs of monitoring and bankruptcy, the threat of takeovers, and the growth opportunities of the firm" (King and Santor, 2008: 2425). However, these views are developed in developed markets. In the Korean context, the threats of takeover are very seldom. As there is little separation between ownership and management, agency cost of managers is largely restricted. So firm leverage ratio mainly depends on controlling owners' risk aversion, the cost of bankruptcy and growth opportunity.

For their undiversified and large stakes in firms, controlling owners are identified to be more risk averse than professional managers, since they will lose more than just their assets (Burkard *et al*., 2003). As emphasized by Mishra and McConaughy (1999) that family owners have strong desire to maintain control over their firms and care for firm's survival, the cost of losing control and bankruptcy is extremely large. Although

high leverage ratio increases the probability of financial distress, financing through equity causes other problems. First, underdeveloped equity market in Korea makes the cost of equity financing much more expensive. It is wildly recognized that Korea corporate governance is bank-oriented, which makes financing through debt much cheaper. Second, financing through equity diluted controlling owners' control over their firms. It is the case what controlling owners fear most. Therefore, in order to grow their firms and get finance for strategic investments, but not to weaken their controls, they are more likely to finance through debt rather than equity. According to this argument, it is expected that controlling ownership is positively associated with leverage ratio.

Institutional investors

Agency theorists view both outsider ownership concentration and debt financing as monitoring devices. Because of substitution effects between these two, increased institutional ownership makes debt financing less necessary. According to the signaling model, the presence of institutional investor gives minority shareholders confidence and signals that the firm is committed (Wiwattanakantang, 1999). Hence, these two theories predict the negative relationship between leverage ratio and institutional ownership.

Institutional investors' frequently trading behaviors which increase the stock liquidity can help reduce information asymmetry (Brennan and Tamarowshi, 2000), which further reduce the cost of capital. What's more, the presence of institutional investors on shareholder list gives debtors more confidence that that firm is well-managed and has low risk of default. Thus, institutional investors may influence controlling owners' finance decisions (David *et al*., 2006). It is well known that Korean

firms are highly leveraged even after 1997 financial crisis. From the lesson of that crisis, institutional investors may force firms to reduce debt ratio or may tend to choose the firms that present low level of debt to protect their held stake (Grinstein and Michaely, 2005). Therefore, this paper predicts the negative relationship between institutional ownership and leverage ratio.

Based on the above arguments, I get the following relationships between ownership structure, financial structure and R&D investments (refer to **Figure 1** and **Figure 2**):

H3a*: Financial slack mediates the relationship between controlling ownership and R&D intensity, such that financial slack increases the positive effect of controlling ownership on R&D intensity;*

H3b*: Financial slack mediates the relationship between institutional ownership and R&D intensity, such that institutional ownership indirectly negatively affects R&D intensity;*

H4a*: Leverage ratio mediates the relationship between controlling ownership and R&D intensity, such that leverage ratio decreases the positive effect of controlling ownership on R&D intensity;*

H4b*: Leverage ratio mediates the relationship between institutional ownership and R&D intensity, such that institutional ownership indirectly positively affects R&D intensity.*

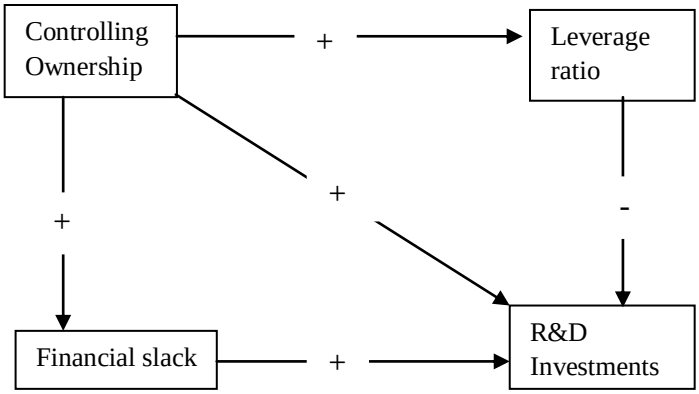

Figure 1. Proposed model of relationships between controlling ownership, leverage ratio, financial slack and R&D investments.

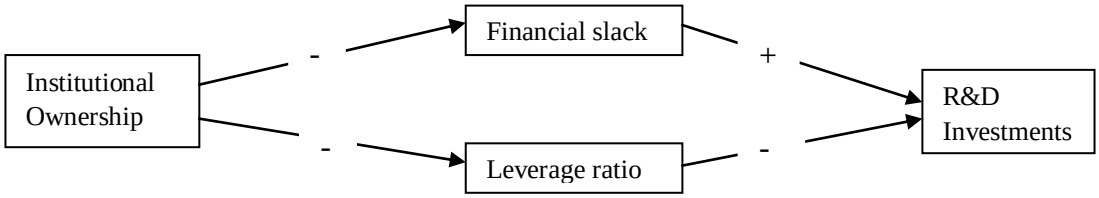

Figure 2. Proposed model of relationships between institutional ownership, leverage ratio, financial slack and R&D investments.

CHAPTER 4 EMPIRICAL STUDY

4.1 Data and measurements

4.1.1 Sample

To test these hypotheses, I used a database developed by the Korea Investor Service, which contains information about company's profiles, ownership structure and financial structure for all Korean publicly listed firms. The data structure is similar to those found in COMPUSTST, and has been used by many previous scholars (see Chang and Hong, 2002; Kim *et al.*, 2008). Since R&D investment is relatively more important for manufacturing industry, I selected companies in this industry during the 1995-2007 periods. After eliminating observations with incomplete information, there were 999 firms and 10518 firm-years left for analysis.

4.1.2 Measurements

Dependent and independent variables

Dependent variable: R&D intensity (*rdint*), was measured by the ratio of expenditure to total sales. This measure has been widely used by previous studies (e.g., Greve, 2003; Lee and O' Neill, 2003; Kim *et al.*, 2008).

Independent variables: (1) Financial slack (*fs*), was measured by the ratio of operation cash flow to total sales. According to Singh (1986), financial slack can be measure by the ratio of quick assets (such as cash and receivables) to total assets or total sales. Operation cash flow consists of these quick assets.

(2) Leverage ratio (*da*), was measured by the ratio of total debt to total assets.

(3) Controlling ownership (*owner_p*), was measured by the percentage of equity shares owned by the person who actually controls the firm and his/her family members and relatives.

(4) Institutional ownership (*inst_p*), was measured by the adding foreign institutional ownership and domestic institutional ownership. Domestic institutional ownership is the total percentage of equity ownership held by domestic institutional investors composed of insurance companies, securities firms, and merchant banks, while foreign institutional ownership is the total percentage of equity ownership held by foreign financial institutions. These variables and their corresponding abbreviations are listed in **table 1**.

Control variables

(1) ROA (*roa*): net income divided by total assets. ROA indicates the profitability of a firm which would influence firm's strategic decisions directly. Many empirical studies, e.g., Lotta Väänänen's (2003), showed support for it. The profitability of a firm is also likely to affect its dividend payout ratio and capital structure (Jensen *et al.*, 1992).

(2) Firm size (*emp*): the total number of employees. Firm size is considered to be a main factor to explain firm-specific heterogeneity. Choi *et al.* (2008) showed the necessity to control it for Korean firms.

(3) Industry R&D intensity (*inddrint*): average of R&D intensity in the each detailed industry. It is reasonable to account for industry effect, since the importance of

R&D investments to the industry of food products and beverages is different to its importance to the industry of rubber and plastics products.

(4) Total assets (*logta*): take the natural log value of total asset. Crutchley and Hansen (1989)'s empirical study showed its influence on dividend payout ratio and capital structure.

(5) Affiliated (*bgmember*): dummy variable, to control for the affiliated effect. Affiliated to a business group is very common in Korean firms. This affiliation would have effect on firm's corporate governance mechanisms and possessed resources (Khanna and Yafeh, 2007).

(6) Export ratio (*exportr*): the ratio of total export to total sales. Choi *et al*. (2008) showed the necessity to control it, because it may be the case that internationally oriented firms tend to invest more in R&D activities, which would enhance their competitiveness in international market.

(7) Growth opportunity (*go*): the increased ratio of total sale. Early studies (e.g., David *et al.,* 2006; Wright *et al.,* 1996) talked about the efficiency of R&D investments by investigating whether these R&D investments are made consistent with growth opportunity. Thus, it can be expected that when growth opportunity appears, firm is more likely to investment in R&D activities. What's more, previous studies (e.g. Jensen *et al*., 1992; Eckbo and Verma, 1994) have showed that growth opportunity affects firm's capital structure and financial slack.

(8) Dividend ratio (*divr*): the percentage of cash dividend amount divided by total assets. Agency theorists view dividend policy as a tool to reduce agency cost, which is similar to the function of debt financing. So dividend ratio might have substitute effect on leverage ratio. As a source of financial slack, dividend ratio is supposed to affect financial slack. All control variables and their corresponding abbreviations are listed in **table 1**.

Table 1. All variables and their corresponding abbreviations

Variables	Corresponding abbreviations
R&D intensity	rdint
Financial slack	fs
Debt ratio	da
Controlling ownership	owner_p
Institutional ownership	inst_p
ROA	roa
Firm size	emp
Industry R&D intensity	inddrint
Total assets	logta
Affiliated	bgmember
Export ratio	exportr
Growth opportunity	go
Dividend ratio	divr

4.2 Summary statistics and model design

4.2.1 Summary statistics

Table 2 gives out the sample distribution among each year. From this table, we can see that the data sample is an unbalance panel. As more and more firms went public, the number of sample increased in the later years. In the year 1995, the size of Korean stock market is 566, and it increased to 980 in the year 2007.

Table 2. Sample distribution among each year

Year	Freq.	Percent	Cum.
1995	566	5.38	5.38
1996	614	5.84	11.22
1997	645	6.13	17.35
1998	670	6.37	23.72
1999	711	6.76	30.48
2000	763	7.25	37.74
2001	836	7.95	45.68
2002	897	8.53	54.21
2003	938	8.92	63.13
2004	951	9.04	72.17
2005	966	9.18	81.36
2006	981	9.33	90.68
2007	980	9.32	100.00
Total	10,518	100.00	

Figure 3. Firms' R&D intensity on average in the period of 1995-2007

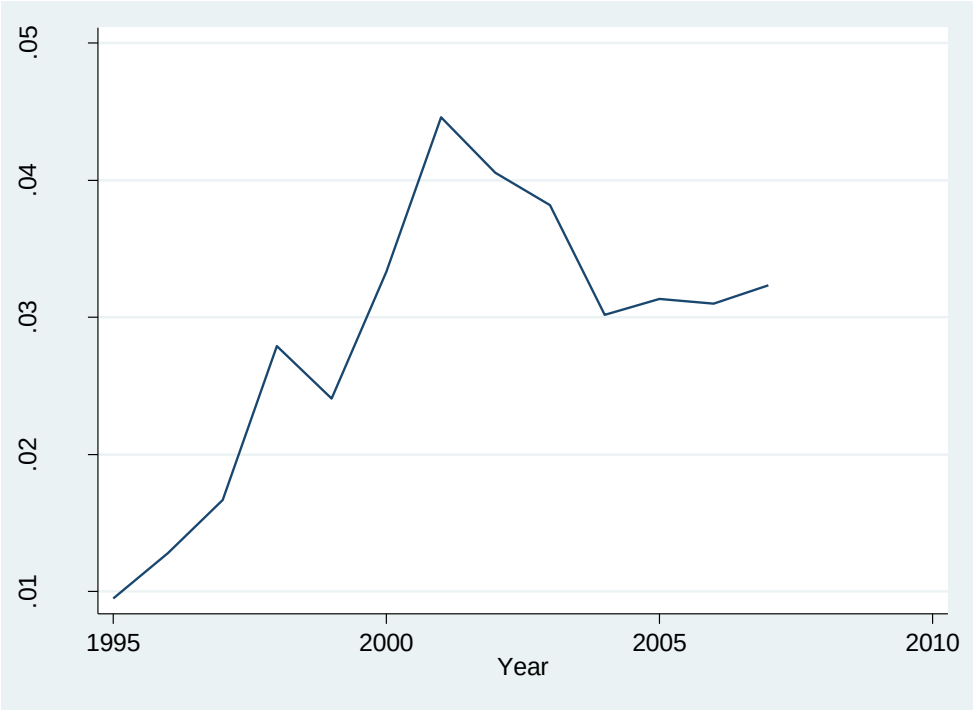

Figure 4. Firms' ROA on average in the period of 1995-2007

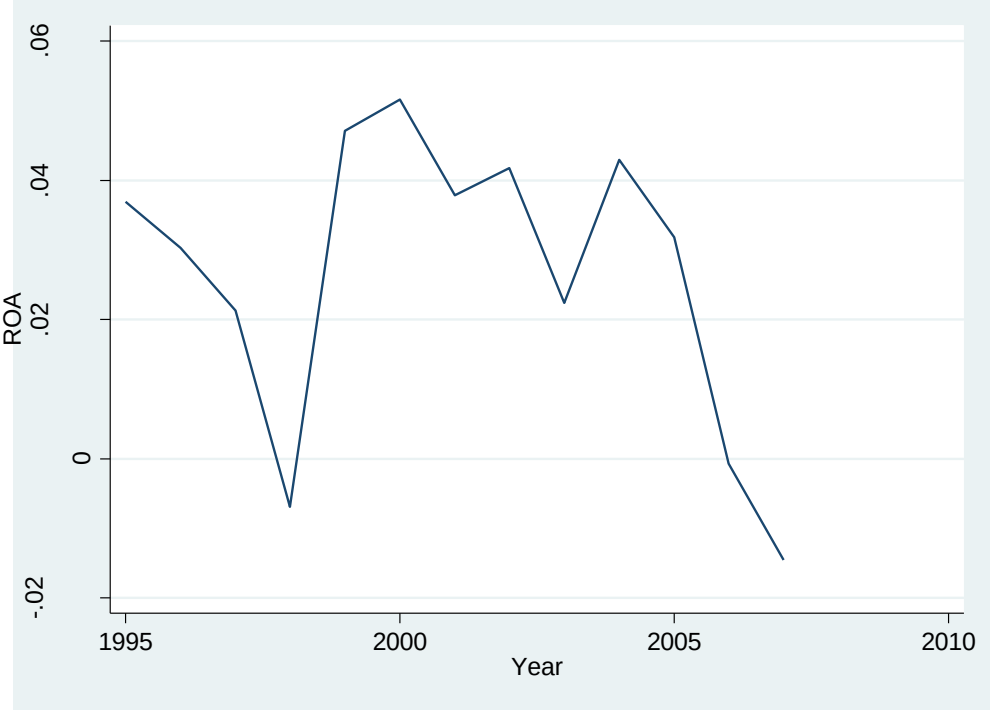

Figure 3 and **Figure 4** give out the trends of firm's R&D intensity and ROA on average in the period of 1995-2007. From **Figure 3**, we can see that R&D intensity firms increased in first several years and decreased after the year 2001. The trend for ROA is much more complicated than the trend for R&D intensity. From **Figure 4**, we can see that there is a deep decrease in the year 1998, and then a sharp increase in the following two years, and the main tread of the remaining years is decreasing. We may explain the first decrease by 1997's financial crisis, after which Korean firms cut down budget to invest in R&D activities. However, we still don't know what caused the complicated change in Korean firms' R&D intensity after the year 2000.

Table 3. Summary statistics for all variables

Variable	Obs	Mean	Std. Dev.	Min	Max
rdint	10518	.0246	.0468	0	.4880
fs	10518	.0424	.1947	-5.438	1.490
da	10518	.4944	.2081	.0110	.9992
owner_p	10518	.2591	.2236	0	1
inst_p	10518	.0563	.1254	0	1
divr	10518	.0076	.0123	0	.2807
roa	10518	.0321	.1461	-.9888	.9731
emp	10518	697.43	3368.7	1	85813
indrdint	10518	.0684	.1496	0	.8863
logta	10518	10.95	1.492	5.198	17.993
bgmember	7765	.1030	.3040	0	1
go	9677	.1266	.3886	-5.337	5.613
exportr	10518	.2885	.3105	0	1

Table 3 is the summary statistics for all variables. From this table, we can see that the numbers of observations for variables *bgmember* and *go* are less that others'. For the former one, it is because there're some missing values in my data; while for the latter one, the value of *go* is missing in the beginning year for a firm, since I take the first year as a base year. The mean value for R&D intensity (*rdint*) is 0.0246 and the maximum value is 0.0468, which indicates the large variance of R&D intensity of Korean firms. It is same case indicated by Lee and O'Neill (2003)'s study. The variance for financial slack (*fs*) is even larger, since the minimum value is -5.438, the maximum is 1.490 while the mean is 0.0424. While many scholars have attributed the causes of 1997's financial crisis to the high leverage ratio of Korean Chaebols, the leverage ratio reduced a lot after Korean government's reform. The mean value of leverage ratio (*da*) is 0.4944. But there are still some firms with high leverage ratio, since the maximum value is 0.9992. The mean value of controlling ownership (*owner_p*) and institutional ownership (*inst_p*) are 0.2591 and 0 .0563.

4.2.2 Model

In order to indentify the direct and indirect effects of ownership structure on R&D investments, this paper builds a simultaneous equation model as follows:

rdint = f (fs, da, exportr, emp, roa, go, bgmember, indrint, owner_p, inst_p) (1)

fs= g (owner_p, inst_p, divr, logta, roa, go) (2)

da= h (owner_p, inst_p, divr, logta, roa, go) (3)

It is usually the case that top management team makes the budget plans and strategic decision at the beginning fiscal year, so the factors this year are likely to influence next year's R&D investments. Thus, the variables in the right side of **equation (1)** were all lagged by one year except the affiliation indicator, *bgmember*. In **equation (2)** and **equation (3)** only ownership variables were lagged by one year, since the ownership effect maybe hysteretic. From above simultaneous equations, we can see that **equation (2)** and **equation (3)** are independent from **equation (1)** while **equation (1)** depends on the other two. Hence, I estimate **equation (2)** and **equation (3)** independently and use two-stage estimation for **equation (1)**. For the estimation of **equation (2)** and **equation (3)**, I exploit the most common method, namely Fixed Effect model. To test whether Fixed Effect model is appropriate, the F statistics and Hausman statistics are reported in the result.

One characteristic of R&D investment is long investment horizon. While one R&D project is ratified and starts to implement, various resources are needed continuously. So it is more likely the case that the expenditure of R&D investments this

year is related to it in the last year. Thus, I add lagged dependent variables as independent variables. For such model setting, it may cause biased estimation while using Ordinary Least Square (OLS). Using the generalized method of moments (GMM) estimation, Arellano and Bond (1991) have shown that the lagged dependent and explanatory variables are valid instruments, under the assumption that the error terms are not serially correlated. The GMM estimator in such a situation achieves asymptotic efficiency. The dynamic panel GMM estimation method has advantageous capacities to deal with unobserved firm-specific heterogeneity, endogeneity problems, and the presence of the unknown heteroscedasticity and autocorrelation in panel data (Arellano 2003). Therefore, I used the generalized method of moments (GMM) estimation and dynamic panel data model – Arellano-Bond regression for **equation (1)** in the second stage. However, the validity of the GMM estimation relies on the validity of the assumption that the error terms are not serially correlated. If the assumption is valid, there should be evidence of significant negative first-order serial correlation in difference residuals and no evidence of second-order serial correlation in the difference residuals (Baltagi 2005). Thus, I test this assumption with an Arellano-Bond test of second-order serial correlation.

4.3 Results

Table 4 is the correlation matrix for all the variables. From this table, we can see that the correlation coefficients between these variables are all not very high, which reduces the probability of multicollinearity problem.

The estimation results of **equation (2)** and **equation (3)** are illustrated in **Table 5**. From the two Hausman statistics and F statistics, we can see that Fixed effect (F.E.)

models are appropriate. From the results in **Table 5**, we can conclude that both controlling ownership and institutional ownership influence financial slack and leverage ratio significantly. Hypothesis 3a predicts that controlling ownership positively affects financial slack. The regression coefficient of controlling ownership (*owner_p*) in **equation (1)** is 0.0306 and is statistically significant, which is consistent with my prediction. Hypothesis 3b predicts that institutional ownership negatively affects financial slack. The regression coefficient of institutional ownership (*inst_p*) in **equation (1)** is negative and statistically significant, which indicates my prediction is correct.

My predictions about the influence of ownership structure on capital structure are that controlling ownership positively affects leverage ratio while institutional ownership negatively affects leverage ratio. However, the estimation results in **equation (2)** don't show support for the effect of controlling ownership on leverage ratio but support for the effect of institutional ownership, since the regress coefficients of controlling ownership (*owner_p*) and institutional ownership (*inst_p*) in **equation (2)** are -0.0308 and -0.0491, and both them are statistically significant.

To dismantle the direct and indirect effects of ownership structure on R&D investments, I used two-stage estimation method. First, to estimate the direct effect of controlling ownership on R&D investments, I regressed controlling ownership (*owner_p*) on financial slack (*fs*), leverage ratio (*da*) and other variables and got the predicted value of *owner_p*, which is uncorrelated with *fs*, *da*. Then, I substituted the *owner_p* with the predicted value of *owner_p* in **equation (1)**. Repeat the same procedures for institutional ownership (*inst_p*). Finally, I did the Arellano-Bond dynamic panel-data estimation for

equation (1). Hence, in the regression results of Arellano-Bond dynamic panel-data estimation, the coefficient for controlling ownership (*owner_p*) is the direct effect of controlling ownership on R&D investments, while the coefficient for institutional ownership (*inst_p*) is the direct effect of institutional ownership on R&D investments. The two-stage estimation results for the direct and indirect effects of controlling ownership and institutional ownership on R&D investments are presented in **Table 6**.

Hypothesis 1 predicts that controlling ownership is positively associated with R&D intensity. From **Table 6**, we can see that the coefficient of controlling ownership (*owner_p*) is 0.1008 and statistically significant, which means that controlling ownership has direct positive effect on R&D investments. Thus, hypothesis 1 is supported. Hypothesis 2 predicts that institutional ownership has no impact on R&D intensity. The coefficient of institutional ownership (*inst_p*) is -0.0525 but not statistically significant, which means that institutional ownership has no direct negative effect on R&D investments. So hypothesis 2 is also supported.

Hypotheses H3a, H3b, H4a, H4b argue that financial slack and leverage ratio are mediators through which controlling owners and institutional investors influence R&D investments. From **Table 6**, we can see that the coefficients signs for leverage ratio (*da*) and financial slack (*fs*) are negative and positive, and both of them are significant, which are consistent with my predictions that more financial slack will lead to more R&D investments while higher leverage ratio is associated with less R&D investments. Combined with the results presented in **Table 5**, namely controlling ownership is positively associated with financial slack and negatively associated with leverage ratio

while institutional ownership is negatively associated with both financial slack and leverage ratio, we can conclude: (1) financial slack positively mediates the relationship between controlling ownership and R&D intensity; (2) financial slack negatively mediates the relationship between institutional ownership and R&D intensity; (3) leverage ratio positively mediates the relationship between controlling ownership and R&D intensity; (4) leverage ratio positively mediates the relationship between institutional ownership and R&D intensity. Therefore, Hypotheses H3a, H3b, H4b are supported, but hypothesis H4a is not supported.

4.4 Robustness test

To check the robustness of above empirical results, I did the following tests:

(1) Delete observations where R&D intensity is above its mean three standard deviations. After this deletion, repeat the analysis model in **Table 5** and **Table 6**, I found that both controlling ownership and institutional ownership influences financial structures, namely financial slack and leverage ratio, significantly with the same impacts as I got in above empirical studies. I also found that controlling ownership affects R&D intensity directly while institutional ownership has no direct impact on it. Compared to earlier study, the only difference after this deletion is that the prediction "financial slack positively affects R&D intensity" is not supported. Detailed result is presented in **Table 7** and **Table 8** in **Appendix A**.

(2) After the 1997's financial crisis, Korean government has initiated some corporate governance reforms. To control for the effects of these institutional change, I

choose the sample after year 1997. Consistent with earlier study, I got the same relationships between ownership structure, financial structure and R&D investments. Detailed result is presented in **Table 9** and **Table 10** in **Appendix B**.

(3) Use the natural logarithm of total assets to measure firm size. In the primary analysis, I used the number of employees to measure firm size. However, the natural logarithm total assets is an alternative measure of firm size that is wildly used in the areas of finance of strategy. Substitute Ln(totoal assets) for the number of employees and repeat the analysis model in **Table 6**, I found that no differences compared to the results in **Table 6**. Detailed result of this change is presented in **Appendix C**.

(4) Delete some insignificant control variables. From **Table 6**, we can see that the control variables such as firm size (*emp*), ROA and affiliated (*bgmember*) don't have significant influence on R&D intensity. Dropping these control variables, the results found in earlier study still don't change. Detailed result is presented in **Appendix D**.

From above model changes and tests, we can see that the results found in my primary study are not changed, indicating the robustness of these results.

Table 4. Correlation Matrix

	rdint	exportr	indrdint	emp	roa	da	fs	owner_p	inst_p	go	logta	bgmember	divr
rdint	1.000												
exportr	0.005	1.000											
indrdint	0.167	0.098	1.000										
emp	0.013	0.136	-0.006	1.000									
roa	-0.111	0.011	-0.011	0.030	1.000								
da	-0.178	0.028	-0.049	0.070	-0.248	1.000							
fs	-0.094	0.064	-0.017	0.067	0.445	-0.149	1.000						
owner_p	-0.092	-0.032	-0.064	-0.077	0.187	-0.114	0.133	1.000					
inst_p	-0.042	0.052	0.085	0.183	0.095	0.107	0.093	-0.054	1.000				
go	-0.073	0.003	0.023	0.010	0.301	-0.004	0.201	0.046	0.033	1.000			
logta	-0.156	0.196	-0.106	0.491	0.092	0.194	0.142	-0.038	0.298	0.012	1.000		
bgmember	-0.078	0.138	-0.067	0.376	0.029	0.159	0.074	0.024	0.186	0.010	0.622	1.000	
divr	-0.046	0.004	-0.016	0.002	0.314	-0.381	0.232	0.153	0.021	0.132	-0.005	-0.026	1.000

Table 5. Panel Regression Results for equation (2) and equation (3)

	Dependent variable: Financial slack (fs)	**Dependent variable: Leverage ratio (da)**
Independent variables	Coef.	Coef.
Controlling ownership ($owner\_p_{t-1}$)	.0306**	-.0308***
	(.0107)	(.0078)
Institutional ownership ($inst\_p_{t-1}$)	-.0428*	-.0491***
	(.0183)	(.0134)
Dividend ratio ($divr_{t-1}$)	.0860	-1.551***
	(.1982)	(.1451)
Ln(total assets) ($logta_{t-1}$)	.0121**	.0017
	(.0043)	(.0031)
ROA (roa_{t-1})	.3093***	-.1446***
	(.0163)	(.0119)
Growth Opportunity (go_{t-1})	.0222***	.0189***
	(.0052)	(.0038)
_cons	-.1029*	.6566***
	(.0460)	(.0336)
Obs.	8486	8486
Firm	991	991
F Stat.	2.86***	12.21***
Hausman Stat.	254.83***	171.63***
Model	F.E.	F.E.
R-square	0.0823	0.3124

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%;
3. Year dummies are controlled for above models but not reported in this table.

Table 6. Two-Stage estimation and Arellano-Bond dynamic panel-data estimation

	Dependent variable: R&D intensity (rdint)
Independent variables	Coef.
R&D intensity ($rdint_{t-1}$)	.4098***
	(.0254)
R&D intensity ($rdint_{t-2}$)	-.0473**
	(.0152)
Leverage ratio (da_{t-1})	-.0233***
	(.0048)
Financial slack (fs_{t-1})	.0068*
	(.0035)
Export ratio ($exportr_{t-1}$)	-.0061+
	(.0034)
Firm size (emp_{t-1})	-5.27e-07
	(7.10e-07)
ROA (roa_{t-1})	.0008
	(.0043)
Growth Opportunity (go_{t-1})	.0120***
	(.0013)
Affilated (bgmember)	.0021
	(.0065)
Industry R&D intensity ($indrdint_{t-1}$)	-.0072**
	(.0028)
Controlling ownership ($owner\_p_{t-1}$)	.1008**
	(.0390)
Institutional ownership ($inst\_p_{t-1}$)	-.0525
	(.0726)
_cons	.0233***
	(.0064)
Obs.	5740
Firm	901
Wald stat.	436.08***
Sargan Stat.	491.22***
AR(1)	-5.45***
AR(2)	.977

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%.
3. Year dummies are controlled for above models but not reported in this table.

CHAPTER 5 DISCUSSION AND CONCLUSION

5.1 Conclusions

Realizing the importance of R&D investments to firm's survival and growth, this paper investigated the determinants of R&D investments in Korean context. Exploiting simultaneous equation modeling technique, this paper obtained the following conclusions:

(1) Controlling owners have direct impact on firms' strategic decisions, and they promote R&D investments. Apart from this direct effect, controlling owners tend to maintain high level of financial slack and low level of leverage ratio, with both financial factors increase R&D investments;

(2) Institutional investors have no direct impact on R&D investment because of the corporate governance environment where their monitoring power is limited. However, they have influences on financial slack and leverage ratio. Contrary to the effect of controlling ownership, institutional ownership is negatively associated with financial slack and leverage ratio.

5.2 Discussions

While previous studies mainly draw agency theory to investigate the direct relationships between different types of ownership and R&D investments, this paper tried to find the different mechanisms about how different types of ownership influence R&D investments. Mainly based on agency theory, stewardship theory and financial theories such as pecking order theory, this paper predicted that different types of ownership may

not only affect R&D investments directly, but also influence it indirectly through financial structures such as leverage ratio and financial slack.

Exploiting simultaneous equation modeling, my empirical study has showed that controlling ownership has direct positive effect on R&D intensity while institutional ownership has no influence. For the mediation effects, my empirical work showed: financial slack positively mediates the relationship between controlling ownership and R&D intensity but negatively mediates the relationship between institutional ownership and R&D intensity; while leverage ratio both positively mediates the relationship between controlling ownership and R&D intensity and the relationship between institutional ownership and R&D intensity. The whole effects of ownership structure on R&D investments are concluded in **Figure 5** and **Figure 6**.

Consistent with previous studies, this paper found that controlling owners have impact on firms' strategic decisions. As La Porta *et al.* (1999) and Claessons *et al.* (2000) found, there is little separation between control and ownership among firms with controlling owners in developing countries all around the world. Since controlling owners both dominate the boards of directors and top management teams, it is reasonable that they have impact on firm's strategic decisions such as R&D investments. Drawing on agency theory and stewardship theory, this paper predicted that controlling ownership positively affect R&D intensity, which is also supported by the empirical study.

Previous studies that have been done in the context of US showed the positive relationship between institutional ownership and R&D intensity. However, this paper didn't find the direct impact of institutional ownership. The different conclusions in

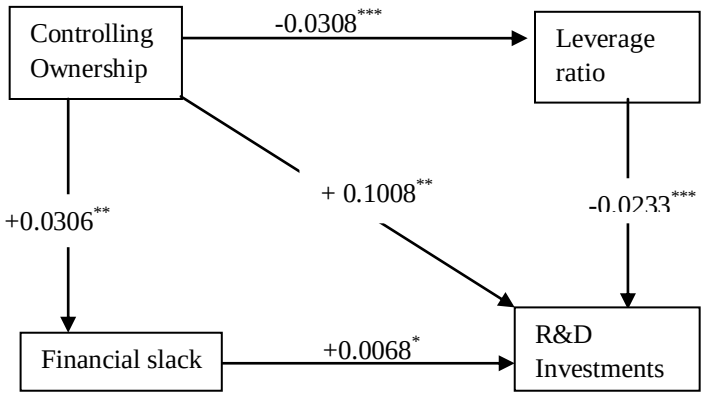

Figure 5. The model indicated by empirical study on the direct and indirect effects of controlling ownership on R&D investments.

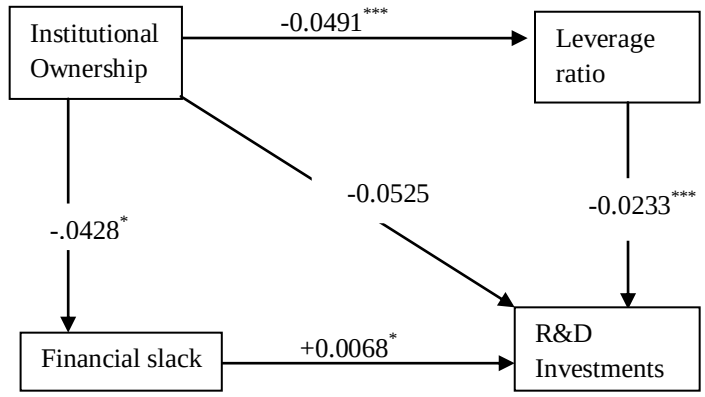

Figure 6. The model indicated by empirical study on the direct and indirect effects of institutional ownership on R&D investments.

different contexts can be explained by different corporate governance mechanisms and law environments. While shareholder protection laws in US and UK require public firms to publish more information and give shareholders more ways to monitor professional managers in these firms, shareholders' rights are limited in emerging markets. For example, in Korea, institutional investors were not allowed to exercise voting rights based on the "*shadow voting*" before 1997. Although there're some improvements after Korean government reform, Solomon *et al.* (2002) argued that the culturally embedded governance system is no easy to change, and doubted that institutional investors still may not play an active role in monitoring. What's more, unlike professional managers, controlling owners don't have job concerns and may not be enslaved to institutional investors. Thus, institutional investors don't have direct influence on R&D investments.

Apart from different owners' direct impact on R&D investments, this paper argued that financial structures such as financial slack and leverage ratio might mediate the relationship between different types of ownership and R&D intensity. For example, since controlling owners have large influence on firms' behavior, it is straightforward that they affect firms' capital structure and financial slack; while institutional investors don't influence R&D investments directly, they may affect firms' dividend policy and capital structure. While controlling owners tend to maintain firms' control and care for long-term development, institutional investors only care for short-term return. Consistent with these perspectives, this paper showed that controlling ownership is positively associated with financial slack and but negatively associated with leverage ratio while institutional ownership is negatively associated with these financial factors.

There have been many empirical studies regarding the influences of these financial factors on R&D investments. Consistent with these studies, this paper found that financial slack positively affects R&D intensity while leverage ratio negatively affects it. Therefore, above findings indicate that financial factors such as financial slack and leverage ratio that were used to be considered as determinants of R&D investments are just mediators through which ownership structure affects firm's strategic decision indirectly.

5.3 Limitations

Above conclusions are reached based on an emerging economy, Korea. So these findings may not be generalized to other contexts. For example, whereas institutional investors are long-term oriented and promote R&D investments in United States (Hansen and Hill, 1991), I found that foreign and domestic institutional investors have no impact in Korea. One explanation for this difference is that controlling owners may not be enslaved to institutional investor' pressures in Korea but professional managers in US will do.

My sample data only covers manufacturing industry, so above conclusions might also not be generalized to other industries. For instance, controlling owners are willing to invest in R&D activities may be only when these R&D activities are essential to their firms' survival and growth. R&D investments is especially important for manufacturing industry, but not for many other industries. So the different characteristics of different industries may influence different types of owners' orientations and preferences.

5.4 Implications

Whereas prior studies treated financial factors such as financial slack and leverage ratio as important determinants of firm's R&D investments, this paper found that they are only some mediators through which ownership structure affects firm's strategy. Consistent with Williamson (1963)'s view that ownership structure is the basis of corporate governance, ownership structure is the ultimate and most important factor that causes firm heterogeneity within an industry.

In Korean context where legal protection of outsider investors is weak and rights of them are limited, to large extent firm's strategic decisions reflect its controlling owners' orientation and preferences. The specific governance environment in Korea endows controlling owners with strong power in determining firms' decisions. This governance setting might have some bad consequences. For example, controlling owners usually initiate projects that are good for themselves, no matter whether these activities would be detrimental to other shareholders; my study showed that they promote R&D investments but whether they overinvest in R&D activities is still not clear. Therefore, this study emphasizes the importance of improving the corporate governance mechanisms and environment in emerging markets, including improving legal protection of outside shareholders and debt holders, developing capital market and takeover market and so on. Only when corporate governance mechanisms and environment give balance the powers among all the stakeholders (i.e. controlling owners, institutional investors, minority shareholders, managers, debtholders) can impel controlling owners make appropriate strategic decisions.

APPENDIX A

Delete observations where R&D intensity is above its mean three standard deviations

Table 7. Panel Regression Results for equation (2) and equation (3)

	Dependent variable: Financial slack (fs)	**Dependent variable: Leverage ratio (da)**
Independent variables	Coef.	Coef.
Controlling ownership ($owner\_p_{t-1}$)	.0208*	-.0310***
	(.0092)	(.0077)
Institutional ownership ($inst\_p_{t-1}$)	-.0311+	-.0474***
	(.0168)	(.0133)
Dividend ratio ($divr_{t-1}$)	.5638***	-1.4668***
	(.1714)	(.1445)
Ln(total assets) ($logta_{t-1}$)	.0140***	.0069*
	(.0019)	(.0033)
ROA (roa_{t-1})	.3849***	-.1477***
	(.0152)	(.0122)
Growth Opportunity (go_{t-1})	.0216***	.0235***
	(.0051)	(.0040)
_cons	-.1315***	.6013***
	(.0216)	(.0348)
Obs.	8237	8237
Firm	982	982
F Stat.	2.60***	12.33***
Hausman Stat.	228.98***	173.91***
Model	F.E.	F.E.
R-square	0.0803	0.3220

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%;
3. Year dummies are controlled for above models but not reported in this table.

Table 8. Two-Stage estimation and Arellano-Bond dynamic panel-data estimation

	Dependent variable: R&D intensity (rdint)
Independent variables	Coef.
R&D intensity ($rdint_{t-1}$)	.1308 (.0878)
R&D intensity ($rdint_{t-2}$)	.0002 (.0017)
Leverage ratio (da_{t-1})	-.0091*** (.0032)
Financial slack (fs_{t-1})	-.0007 (.0027)
Export ratio ($exportr_{t-1}$)	.0008 (.0020)
Firm size (emp_{t-1})	-2.60e-07 (5.20e-07)
ROA (roa_{t-1})	.0006 (.0036)
Growth Opportunity (go_{t-1})	.0015 (.0012)
Affilated (bgmember)	.0012 (.0015)
Industry R&D intensity ($indrdint_{t-1}$)	.0002 (.0017)
Controlling ownership ($owner\_p_{t-1}$)	.0450* (.0178)
Institutional ownership ($inst\_p_{t-1}$)	-.0523 (.0367)
_cons	.0175*** (.0043)
Obs.	5523
Firm	878
Wald stat.	83.97***
Sargan Stat.	463.01***
AR(1)	-3.81***
AR(2)	.287

1. The figures in the parentless are the standard deviations for the coefficients;

2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%.

3. Year dummies are controlled for above models but not reported in this table.

APPENDIX B

Control for the effect of institutional change

Table 9. Panel Regression Results for equation (2) and equation (3)

	Dependent variable: Financial slack (fs)	**Dependent variable: Leverage ratio (da)**
Independent variables	Coef.	Coef.
Controlling ownership ($owner\_p_{t-1}$)	.0429*** (.0122)	-.0283*** (.0085)
Institutional ownership ($inst\_p_{t-1}$)	-.0572** (.0210)	-.0268+ (.0146)
Dividend ratio ($divr_{t-1}$)	-.0202 (.2156)	-1.168*** (.1503)
Ln(total assets) ($logta_{t-1}$)	.0159** (.0051)	.0052 (.0036)
ROA (roa_{t-1})	.2938*** (.0172)	-.1263*** (.0120)
Growth Opportunity (go_{t-1})	.0226*** (.0055)	.0176*** (.0038)
_cons	-.1038+ (.0541)	.4912*** (.0377)
Obs.	7539	7539
Firm	991	991
F Stat.	2.60***	12.50***
Hausman Stat.	47.96***	173.91***
Model	F.E.	F.E.
R-square	0.0824	0.1155

1. The figures in the parentless are the standard deviations for the coefficients;
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%;
3. Year dummies are controlled for above models but not reported in this table.

Table 10. Two-Stage estimation and Arellano-Bond dynamic panel-data estimation

	Dependent variable: R&D intensity (rdint)
Independent variables	Coef.
R&D intensity ($rdint_{t-1}$)	.4928*** (.0301)
R&D intensity ($rdint_{t-2}$)	-.0327+ (.0173)
Leverage ratio (da_{t-1})	-.0270*** (.0055)
Financial slack (fs_{t-1})	.0080* (.0048)
Export ratio ($exportr_{t-1}$)	-.0039 (.0042)
Firm size (emp_{t-1})	-1.26e-06 (9.50e-07)
ROA (roa_{t-1})	-.00002 (.0050)
Growth Opportunity (go_{t-1})	.0135*** (.0016)
Affilated (bgmember)	.0035 (.0091)
Industry R&D intensity ($indrdint_{t-1}$)	-.0134*** (.0037)
Controlling ownership ($owner\_p_{t-1}$)	.1553* (.0659)
Institutional ownership ($inst\_p_{t-1}$)	-.1628 (.1344)
_cons	.0088 (.0068)
Obs.	4659
Firm	900
Wald stat.	385.87***
Sargan Stat.	247.36***
AR(1)	-5.16***
AR(2)	1.14

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%.
3. Year dummies are controlled for above models but not reported in this table.

APPENDIX C

Different measure of firm size

Table 11. Two-Stage estimation and Arellano-Bond dynamic panel-data estimation

	Dependent variable: R&D intensity (rdint)
Independent variables	Coef.
R&D intensity ($rdint_{t-1}$)	.4124*** (.0254)
R&D intensity ($rdint_{t-2}$)	-.0458** (.0153)
Leverage ratio (da_{t-1})	-.0198** (.0067)
Financial slack (fs_{t-1})	.0059+ (.0037)
Export ratio ($exportr_{t-1}$)	-.0060+ (.0034)
Firm size ($logta_{t-1}$)	-.0068 (.0052)
ROA (roa_{t-1})	.0062 (.0068)
Growth Opportunity (go_{t-1})	.0120*** (.0013)
Affilated (bgmember)	.0022 (.0065)
Industry R&D intensity ($indrdint_{t-1}$)	-.0075** (.0028)
Controlling ownership ($owner\_p_{t-1}$)	.1268** (.0451)
Institutional ownership ($inst\_p_{t-1}$)	.0561 (.1013)
_cons	.0807+ (.0436)
Obs.	5740
Firm	901
Wald stat.	438.52***
Sargan Stat.	487.13***
AR(1)	-5.457***
AR(2)	1.00

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%.
3. Year dummies are controlled for above models but not reported in this table.

APPENDIX D

Drop insignificant control variables

Table 12. Two-Stage estimation and Arellano-Bond dynamic panel-data estimation

	Dependent variable: R&D intensity (rdint)
Independent variables	Coef.
R&D intensity ($rdint_{t-1}$)	.3963*** (.0199)
R&D intensity ($rdint_{t-2}$)	-.0182 (.0125)
Leverage ratio (da_{t-1})	-.0267*** (.0038)
Financial slack (fs_{t-1})	.0064* (.0031)
Export ratio ($exportr_{t-1}$)	-.0062* (.0028)
Growth Opportunity (go_{t-1})	.0100*** (.0011)
Industry R&D intensity ($indrdint_{t-1}$)	-.0072** (.0025)
Controlling ownership ($owner\_p_{t-1}$)	.0616* (.0296)
Institutional ownership ($inst\_p_{t-1}$)	-.0101 (.0581)
_cons	.0279 (.0048)
Obs.	7072
Firm	960
Wald stat.	566.19***
Sargan Stat.	458.20***
AR(1)	-6.38***
AR(2)	.854

1. The figures in the parentless are the standard deviations for the coefficients；
2. *** indicates the significance level at 0.1%，** indicates the significance level at 1%，* indicates the significance level at 5%，+ indicates the significance level at 10%.
3. Year dummies are controlled for above models but not reported in this table.

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