경제학박사학위논문

Financially Distressed Firms in the Korean Manufacturing Sectors:

Bank Loan, Innovations, and Reorganization

한국 제조업의 부도위험 기업에 관한 연구:

은행대출, 기술혁신, 구조조정

2014년 2월

서울대학교 대학원

경제학부 경제학 전공

김 민 정

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이 논문을 경제학박사 학위논문으로 제출함.

2014년 2월

서울대학교 대학원
경제학부 경제학 전공
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Abstract

Financially Distressed Firms in the Korean Manufacturing Sectors:

Bank Loan, Innovations, and Reorganization

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This research investigates the effectiveness of rescue given to financially distressed firms through looking at the cases of Korean manufacturing companies in the three following ways. The first study uses data from the 1980's until 2010 to observe how bank behaviors have changed in giving additional loans to financially distressed firms. The second and third research analyzes the effect of rescue provided to financially distressed firms on firm performance. More specifically, the second research examines whether a financially distressed firm, if it possesses potential for growth and is motivated to pursue long term growth, achieves technological innovation if additional bank loans are provided. In the cases that long term investments are required for the technological innovation, financial difficulties may occur due to temporary liquidity problems until profitability is secured. Therefore, this research studies companies that were in such

situations to assess whether additional financial aid to such companies has a significant positive effect on the realization of the technological innovation. The third research focuses on evaluating the effectiveness of rescue for financially distressed companies by investigating the validity of workout programs. More specifically, it evaluates whether the workout program, the autonomous restructuring agreement between financially distressed firms and its creditors, successfully keeps the firm from going bankrupt. While the second research focuses on the internal characteristics of companies, the third research looks at the institutional arrangement to analyze the validity of its function to rescue financially distressed firms.

This research has found the following three main results. First, we found that South Korean banks had been giving additional loans to troubled firms before and during a decade after the Seoul Olympics of 1988. However, no additional lending to financially distressed firms was observed after the Asian Financial Crisis of 1997. Especially after the Global Financial Crisis of 2008, banks proved not to provide additional loans to companies if they encountered risks of bankruptcy. Such results imply that banks' screening process has been functioning properly after the Asian Financial Crisis of 1997.

Second, a positive correlation between additional loans to financially distressed firms and technological innovation was shown using the data after the year of 2000. More specifically, the more competitive the market conditions were and the higher the performance-based bonus was, the more likely were technological innovation. In general, financially distressed firms fail to innovate their technologies because of liquidity constraints and because they need to avoid further risks. However, amongst those financially distressed, appropriate motives to pursue growth such as being placed in competitive market conditions or given performance-based bonus are likely to increase the probability of innovations. Such results bear

significant implications in that it has been presented that the positive firm characteristics play crucial roles in mitigating the negative effect of bank loans to distressed firms on technological innovation.

Third, the analysis on the efficacy of the workout system, which was introduced in 1998, found that firms which underwent debt to equity swap experienced improved corporate performance after the completion of workout program. In particular, it has been observed that the banks' decision to swap debt to equity is made contemplating the future growth potential that the company possesses. In other words, it has been found that if potential for growth is recognized within companies undergoing workout, main creditor banks decide to swap debt to equity. Workout firms adjusting its debt structure through debt to equity swap meets the intention of swapping debt to equity, and thus it is found to yield a positive long term corporate performance. Such results imply that the banks' screening system for growth potential amongst workout firms functions effectively.

Keywords: Financially Distressed Firms, Bank Loan, Innovation, Workout, Debt to Equity Swap, Dynamic Panel Model

Student Number: 2008-30802

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I. Introduction

1. Motivation

Since the early 1960s, the Korean government encouraged firms, especially big business groups, to invest in large-scale projects with the guarantee of easy access to capital. Such policy provided firms with financial subsidies or bank loans, sometimes to financially distressed firms partially with a view to avoiding massive unemployment and financial instability. As a result, a high debt/equity ratio, which had been more than 300% for most years, lasted from the early 1970s up to the financial crisis in 1997. Although this policy was believed to contribute to rapid economic development, Korean firms with a high debt/equity ratio were not able to yield high profitability. Hence, non-performing loans increased, which severely weakened financial institutions. These caused financial crisis in 1997.

The provision of additional credits to financially distressed firms is risky for the banking sector because it might increase non-performing loans. Why do banks lend additional credits to financially distressed firms? A number of economists suggest that government intervention or care for profit of banks allows financially distressed firms to get a loan. For instance, Kornai (1979) explains that a paternalistic relationship between the government and enterprises provide an aid to an insolvent firms. In addition to favoritism, the government support financial distressed firms in order to

secure votes. For instance, if a large firm goes bankrupt, its unpaid bills lead creditors to bankruptcy as well. These economic spillover effects induce government to extend more credits or invest more capitals in troubled enterprises (Shleifer and Vishny, 1994; Kornai et al, 2003). On the other hand, Dewatripont and Maskin(1995) set up a theoretical model and explain that creditors estimate the value of liquidation and refinance unhealthy firms in order to recoup their past investment. In the same point of view, Peek and Rosengren (2005) claim that troubled banks have an incentive to allocate credit to severely impaired borrowers in order to avoid the realization of losses on their own balance sheet. In addition, a bank gives additional loans to troubled firms when it estimates firm's financial distress as a temporary problem. In such a case, the bank anticipates that future profits of the firm will cover its current losses (Hoshi et al., 1991).

In terms of the effect of bank loan to financially distressed firms, most of previous studies have emphasized on the hazardous effects on the financial system. In particular, they looked at the inefficiency of investment which caused the financial crisis in Asian countries (Krugman, 1998; Huang and Xu, 1999; Bai and Wang, 1999; Peek and Rosengren, 2005). Meanwhile, some of studies explain the negative effect on the corporate performance of distressed firms which receive additional loans. For instance, Chiu and Joh (2004) find that the ex-post debt payment ability of financially distressed firms is lower than that of non-distressed firms. However, they focus on the overall effects. That is, they exclude the probability of positive effects when we consider the heterogeneity of each firm. Meanwhile, when the phenomenon of bank loan to troubled firm is associated with soft budget constraint, which is attributed to the dynamic commitment problem, moral hazard problem arises, and thus result in inefficient business performance.

However, the provision of additional funds to the troubled firms cannot occur continuously, which is related to dynamic commitment problems, if the system to filter truly nonproductive firm is advanced.

Previous studies may give the impression that bank loan to the distressed firms is bad. But if this were true, why the phenomenon of the bailout the insolvent firms occurs consistently? How can we explain the rapid economic growth in Korean economy which is induced by government intervention? Indeed, government intervened to encourage risk-taking, since risk-taking behavior is beneficial for promote growth (Bai and Wang, 1999). In addition, as Von Thadden (1995) argued, commitment not to refinance a troubled firm is optimal screening device for creditors, but it can induce short-termism on the part of good entrepreneurs. That is, giving additional funds to a troubled but potential profitable firm can be necessary in order to induce such firm to pursue long-term growth. In other word, there can be positive effect of bank loan to financially distressed firms as considering the heterogeneity of each company. In particular, we can expect that the consequence of additional loan to troubled firm can be positive as the system, for instance monitoring system and screening system, is advanced. Consequently, we need to keep positive aspect of bank loan to distressed firms in mind in terms of firm's behavior. In this study, we attempt to look at whether the financially distressed firm shows better corporate performance after receiving an aid.

2. Objectives

Potential profitable firms, which currently suffer from financial distress, can make good performance with the help of additional credits. In particular, a firm which conducts R&D activities might undergo a liquidity problem temporarily until such activities lead to higher profitability than before. Bank loan to this kind of firm can be justified. In addition, institution to rescue an insolvent firm, for instance workout program, can encourage firms under financial distress to make better corporate performance. If the program to revive the insolvent firms is well-organized, then a firm under this system should improve its business performance after finishing reorganization. In this research, we attempt to look the importance of firm characteristic as well as institution in order to make it worthy to give a hand to the troubled firms. More specifically, we investigate whether a troubled firm, which has good internal characteristic such as pursuing long-term growth, shows better corporate performance by using additional aid. In addition, we study the effectiveness of the reorganization program which has been implemented in Korean economy since 1998. Since this program gives a hand to troubled firms by filtering truly nonproductive firms among insolvent enterprises, we can expect that a troubled firm under this program shows better corporate performance after completion of the reorganization.

This study scrutinizes the financially distressed firms in the Korean manufacturing sectors in terms of three issues. First, we investigate whether bank loan to troubled firms exist or not. On the basis of Korean manufacturing firm level data from 1980 to 2010, this study analyzes the trend of lending to unhealthy company with a focus on economic boom and crisis. It is beneficial to look at the tendency of bank loan to troubled firm on the basis of Korean economy which encompasses dynamics of economic cycles. Alexeev and Kim (2008) find that financially distressed firms in

Korea were easy to borrow additional money before financial crisis in 1997, but it becomes hard after 1997. However, they did not consider the early 1980s which represent the process of economic development in Korea. Moreover, they fail to consider the firm characteristic which might affect to borrow bank loan. That is, this paper has studied conglomerate firms, small to middle sized firms, and exporting companies to observe the banks' loaning practices to the respective groups when financially distressed. By analyzing long term panel data of the period starting from 1980 until 2010 observations will be made to explain the dynamics of how the banks' loaning practices to financially distressed firms. By comparing their practices to conglomerate firms and small to middle sized firms, it can be verified whether the notion 'too big to fail' had prevailed near the period of the Asian Financial crisis. Such studies have great implications in that one can observe how banks have evolved in their methods of screening for growth and turnaround potential amongst financially distressed firms.

Second, this research examines the effect of bank loan on technological innovation in firms under financial distress. Based on the data after 1997, we attempt to look at whether bank loan to financially distressed firms is associated with their technological innovation. In terms of the corporate performance for the firms which are given additional credits, economists assess that capital used in the corporate sector was, on average, wasted on unprofitable projects. From 1960 to 1997, the average rate of return on the equity of Korean firm was lower than the prevailing interest rates for loans (Kwon and Shepherd, 2001). Chiu and Joh (2004) also find that the ex-post debt payment ability of financially distressed firms is lower than that of non-distressed firms. Those studies, however, use only the data prior to the financial crisis in 1997, and thus are not able to examine the

development of the Korean financial system after 1997. Moreover, they fail to consider firm characteristics which might affect corporate performance.

After the Asian Financial Crisis, and especially after 2000, banks allowed for additional loans more to small and medium sized companies rather than conglomerate firms, mainly due to government policies supporting the small to medium sized companies. The first research has utilized a long term panel data of a time period starting from 1980 until 2010 to reveal that before 2000, banks allowed loans mainly to conglomerates. But after 2000, loans were mainly given to small and medium sized firms. The second research has analyzed data of after 2000, and 90% of the data utilized for the analysis those of small and middle sized companies. Therefore, the second research allows for an observation which verifies the efficiency of the additional loans provided to small and middle sized companies and financially distressed firms after the Asian Financial crisis.

Third, this research investigates the efficiency of the workout system, which is an agreement between creditors and the financially distressed firm to reorganize the company, in order to evaluate the effectiveness of a social system that functions to help companies facing bankruptcy overcome its crisis. The efficiency of the workout system can be proved if companies with high potentials for future growth and profitability, despite being financially distressed, are well discerned and are walked through workout to achieve improved performances. Therefore, the ability of the creditor banks to identify potential among financially struggling firms is crucial in ensuring the efficiency of the workout system. This paper pays attention to such functions of the creditor banks, and has analyzed the banks' decision making

process for debt-equity swap. More specifically, it has noted on debt-equity swap as the most important method of debt restructuring to check on the banks' functionality for discerning companies worthy of workout. Debt-equity swap is a proactive debt restructuring method in which creditors swap their bonds into equity of the respective company. Therefore, debt-equity swap is likely to be decided upon if one can anticipate lucrative future growth of the concerning firm. If banks function well in identifying such companies, it only makes sense if those successful in receiving a debt-equity swap perform well after workout.

To sum up, this research examines a series of studies on financially distressed firm focusing in the cases of South Korean manufacturing companies. First it observes the changes in loaning practices of banks to financially distressed firms by analyzing a set of long term panel data dating from 1980 to 2010. It pays special attention to the changes in behaviors by scrutinizing the development of their loaning practices to conglomerates, small to medium sized firms, and exporting companies throughout time. This research is interesting in that it has analyzed the dynamics of how the screening process of banks towards financially distressed firm has evolved respectively according to the different types of companies and their distinct characteristics. The second and third research focuses on verifying the effectiveness of corporate rescue for financially distressed companies. More specifically, the second research takes note on factors internal to companies to analyze their effects, and the third research review the efficiency of workout, a social system which rescues financially distressed companies. Second, this study finds that bank loan to the troubled firm can be justified under conditions that firm has good internal and external characteristics, such as pursuing long-run growth. We consider bonus per workers and

competitive environment as the motivation to pursue long-run growth. This result supports that giving bank loan to the firm under short-term financial distress is necessary, especially for the firm conducting R&D activities. On the basis of third research, we find that creditor banks decide for a debt-equity swap if potential for future growth can be anticipated. Also workout firms that underwent debt-equity swap during reorganization experienced improved performances in the long term after termination of workout. This research verifies that in order for corporate rescue to be effective, the company must be in good internal and external conditions. Furthermore, it verifies the importance of the rescue systems functioning well to screen for companies with potential for growth and profit amongst those financially distressed. This research has meaningful implications in that it underlines the following; achieving improved performance through rescue of financially distressed companies requires both internal competitiveness of the company itself, and the good functioning of an advanced and well-structured rescue system.

3. Structure

This study is organized as follows. In Chapter 1, we describe the background and motivation behind the study on financially distressed firms in the Korean manufacturing sector. In spite of convincing arguments against of helping troubled firm with additional loan, financially distressed firms have been often rescued by bank loan or reorganization program. Therefore, it is necessary to study why this phenomenon consistently occurs, and whether these helps are effective in improving corporate performance.

In Chapter 2, we study the features of bank loan to financially distressed firm. Using long-term panel data from 1980 to 2010, we look at how the aspect of bank loan to troubled firms changes. In Chapters 3- 4, we analyze the corporate performance of troubled firms which are given a help to survive. In more detail, Chapter 3 shows that firm's good internal and external characteristics, which induce long-termism, lead a troubled firm with additional bank loan to achieve better corporate performance, particularly technological innovations. Chapter 4 shows that a troubled firm improves its performance under the accurate institutions to revive insolvent firms. In Chapter 5, we present the conclusion of this research.

II. Bank Loan to Financially Distressed Firms

1. Introduction

Financial institutions provide credit to troubled firms for various reasons. A number of researchers show that firms facing bankruptcy get bank loans either through the bank's own decision or as a result of government intervention. Governments encourage banks to provide credit to financially distressed firms as part of industrial policy implementation. In the case of the Korean economy, the government promoted big business groups to implement an export-led growth strategy since the early 1960's. During the process of implementing such strategies, strong ties between the government and big business were formed. Kornai(1979) explains that this paternalistic relationship between the government and enterprises helped insolvent firms receive financial aid. In addition to favoritism, the Korean government supported financially distressed firms as a means of securing its votes. For instance, if a large firm went bankrupt, its creditors would face bankruptcy due to the unpaid bills. Worries of such economic spillover effect induced governments to extend more credit, and invest more capital in troubled enterprises. Meanwhile, banks independently chose to give additional credit to financially distressed firms regardless of political intervention. Peek and Rosengren (2005) argue that troubled banks have an incentive to allocate credit to severely impaired borrowers in order to avoid the realization of losses on their own balance sheets. On the other hand, banks give additional loans to troubled firms when it considers the firm's financial distress as only a temporary problem. In this case, banks anticipate

that the firm's future profits would cover its current losses (Hoshi et al., 1991).

This study examines whether Korean manufacturing firms, which are in poor financial conditions, are able to receive additional bank loans or not. More specifically, it attempts to look at the diverse aspects of bank loans given to financially distressed firm in different economic backdrops. Before and after the Seoul Olympic Game in 1988, the Korean economy experienced rapid economic development. During economic boom periods, financial institutions were optimistic of the future, and thereby were likely to give loans to financially distressed firms. In addition, the screening device to filter out vulnerable firms malfunctioned in such early stages of financial development. On the other hand, the Korean economy suffered twice from economic crises; first the East Asian financial crisis in 1997, and secondly the global financial crisis in 2008. During the economic crises, it might have been hard for banks to provide additional loans to insolvent firms. In this study, we scrutinize the characteristics of bank loans given to financially distressed firms. It bases its analysis on Korean manufacturing firm level data collected for the period between 1980 and 2010. In addition to the taking contrasting economic conditions (i.e. economic boom and crisis) into consideration, this study also takes into account the firms' inherent characteristics which might affect borrowing.

Analyzing the Korean manufacturing firm level data collected for the period between 1980 and 2010, this study looks at lending trends concerning financially unhealthy companies categorizing the cases according to their economic setting of whether the time was an economic boom or crisis period. It is meaningful to analyze how such lending

tendencies change throughout the dynamics of the economic cycles. Alexeev and Kim (2008) found that it was easy for financially distressed firms in Korea to borrow additional money before the financial crisis in 1997, but it becomes harder after 1997. However, they did not consider the early 1980's which a period that represents economic development in Korea. Moreover, they fail to consider the firms characteristics that affect borrowing. This paper categorizes firms into conglomerate firms, small to middle sized firms, and exporting companies to observe the banks' loaning practices to the respective groups when financially distressed. By analyzing long term panel data of the period starting from 1980 until 2010, observations will be made to explain the dynamics of the banks' loaning practices to financially distressed firms. By comparing their practices towards conglomerate firms and SMEs (small and medium-sized enterprises), it can be verified whether it was easier for 'too big to fail' firms to receive loans near the period of the Asian Financial crisis. Such studies have great implications in that one can observe how banks have evolved in their methods of screening for growth and turnaround potential amongst financially distressed firms.

This paper is organized as follows. The next section introduces previous studies regarding the reasons why troubled firms receive additional credits. Section 3 describes our model and data. Section 4 presents empirical evidence on the association between bank loans and financially distressed firms. In this section, we examine whether a firm under financial distress can easily receive bank loans or not. Furthermore, this study also investigates how lending trends change throughout the dynamics of economic cycles as well as the firms' inherent characteristics. The last section contains concluding remarks.

2. Literature Review

A number of economists pointed out that governments intervene in the corporate sector, be it directly or indirectly. Bai & Wang(1999), for instance, explain that governments have growth, export, and development strategies resting upon the growth of particular industries or businesses. Therefore, governments provide aid to financially unhealthy firms in order to ensure the success of such industrial policies. In the case of the Korean economy during 1984-1988, many debt-ridden firms in the overseas construction, shipping, textile, machinery and lumber industries became insolvent, and the Korean government intervened in firms in these industries and in banks. The Korean government provided credit to troubled firms through special loans with interest rates of 3% to 6%, while the general bank loan rates were about 12%. The government also induced the banks to write off bad debts, extend debt maturity, and replace existing debt with longer-term debt at a lower rate (Kwon and Shepherd, 2001).[1] In such processes, the government favored large firms and the perception that the government helps large firms through difficult times has been formed. Kornai(1979), who pioneered the study of soft budget constraint problem, explained that paternalistic relationship between the government and enterprises helped insolvent firms receive financial aid. More specifically, a firm in poor financial conditions was provided resources to cover losses if this firm had strong personal connections with powerful government leaders. In addition to favoritism, the government supported financially distressed firms as a means to secure

[1] Yoo (1997) argued that Korean government shifted to liberal pro-competition polies in the 1980s, but the strong tradition of regulatory industrial policy still remained.

votes. For instance, if a large firm went bankrupt, its creditors would face bankruptcy due to the unpaid bills. Worries of such economic spillover effect induced governments to extend more credit, and invest more capital in troubled enterprises (Shleifer and Vishny, 1994; Kornai et al, 2003).

Dewatripont and Maskin(1995), meanwhile, set up a theoretical model and explained that creditors estimate the value of liquidation and refinance unhealthy firms in order to recoup their past investment. Even though investors or creditors have no intention of refinancing *ex-ante*, they could decide to invest more in a poor project as their initial funding becomes a sunk cost. In addition, Peek and Rosengren (2005) explained that troubled banks have an incentive to allocate credit to severely impaired borrowers in order to avoid the realization of losses on their own balance sheet. Analyzing data collected from manufacturing firms and banks in Japan, it is shown that banks face perverse incentives to provide additional credit to the weakest firms, and that such practices lead to misallocation of credit in Japan. Consequently, this leads to a policy of banks "ever-greening" loans.[2] On the other hand, banks give additional loans to troubled firms when it judges that the firm's financial distress is only a temporary problem. Hoshi et al.(1991) explained that banks can have insider information due to a close historical relationship with a firm, and can assess the distressed firms' future profits. Using this insider information, banks are likely to extend extra loans, and thus recover both its initial and extra loans from the firm's forthcoming profit.

[2] "Ever-greening" loan means in case that a bank extends additional credit to a troubled firm to enable the firm to make interest payments on outstanding loans in order to avoid or delay bankruptcy.

3. Model and Data

3.1. The Model

This paper studies the relationship between bank loans and financially distressed firms. The main research question is to find out whether banks give additional loans to firms that are likely to go bankrupt. Furthermore, this study analyzes what help financially distressed firms receive additional bank loans. In order to scrutinize this relationship, this study considers the firms' inherent characteristics as well as the economic backdrops such as economic boom and crisis. In addition, we look at how the firm characteristics affect lending to distressed firms.

The association between bank loans and financially distressed firms is demonstrated as the following Eq.(2.1). Three different firm characteristics are interconnected with the probability of insolvency, which is measured by Altman's Z-score. Therefore, we can figure out whether firm characteristics make it easy to access bank loans despite financial difficulties. These outcomes are denoted as coefficients δ_{1j}. The coefficients, φ_{1s} indicate the effect of economic conditions on bank loans to a low credit rated firm.

$$Loan_{i,t} = \alpha + \beta lowz_{i,t} + \left(\gamma + \sum_{j=1}^{3} \delta_{1j} Firm\ Ch._{i,j,t} + \sum_{s=1}^{4} \varphi_{1s} Econ.\ Cond._{i,s,t} \right) \times lowz_{i,t-1} + \sum_{j=1}^{3} \delta_{2j} Firm\ Ch._{i,j,t} + \sum_{s=1}^{4} \varphi_{2s} Econ.\ Cond._{i,s,t} + \Gamma X + \epsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{Eq}(2.1)$$

Further study were performed to review the relationships between bank lending to financially troubled firms and the characteristics of the firms, while also taking into account the economic conditions. The relationship are demonstrated as the following Eq(2.2). Through Eq(2.2), we can compare which firm characteristics facilitate or hamper bank loans to financially weak firms in different economic situations. These results are denoted as the coefficients δ_{1j}. The coefficients β_s indicate how easy or difficult it is for firms with financial difficulties to receive a bank loan under economic boom or crisis. Such results are not independent of the firm characteristics.

$$Loan\ to\ Weak\ Firm_{i,t} = \alpha + \sum_{s=1}^{4} \left(\beta_s + \sum_{j=1}^{3} \delta_{1j} Firm\ Ch._{i,j,t} \right) \times Econ.\ Cond._{i,s,t} + \sum_{j=1}^{3} \delta_{2j} Firm\ Ch._{i,j,t} + \Gamma X + \epsilon_{i,t} \quad \ldots\ldots\ldots\ldots\ldots Eq(2.2)$$

Based on these two models, we can figure out whether a firm under financial distress is likely to get a bank loan and how economic conditions as well as firm characteristics change the aspects of bank loans given to troubled firms.

3.2. Data Descriptions

The data for this research is collected from about 8,500 Korean manufacturing firms from 1980 to 2010. The database, called KIS-Value data, managed by National Information and Credit Evaluation (NICE) Inc., is used because of its pool of abundant corporate financial information. Since 1980, KIS-Value data provides corporate and financial information on external audit corporations and firms listed on the Korea Stock Exchange (KSE). Therefore, we conducted a panel data analysis.

KIS-Value data is useful in that it provides financial data for companies after 1980, but has the limitation that it is not an exhaustive data pool. It does not hold any information on firms which are bankrupt at the point of data collection. Therefore, an analysis using such a data set will generate an attrition bias. In order to complement such problems, this research has separately compiled data for firms that went through workout or legal reorganization that eventually were delisted or bankrupt. Approximately 4.3% of the 8,500 total samples studied were such delisted or bankrupt firms. Figure 2.1 illustrates the changes in the number of total companies from 1980 to 2010, and the changes in the number of companies that were delisted or were bankrupt during the same period. It looks as

though the number of bankruptcies increased as time passed, but what has not been taken into consideration is that the total number of firms under operation had also increased. Figure 2.2 reviews the number of bankruptcies as a proportion of the number of entire companies. Figure 2.2 illustrates a trend that is in contrast to what is shown in Figure2.1. The ratio of bankrupt companies in total companies was highest in the early 1980's. It is observable that the ratio is gradually decreasing since mid-1980s' until 2010. Such trend implies that information on the omitted firms are better reflected if it is further past, and that in recent data the portion of such information is low. The portion of such information does not soar in a certain period of time, and the descending trend is not dramatic. This illustrates that omitted information is random.

Figure 2.1 Number of Firms (1980~ 2010): Total and Discontinued Firms

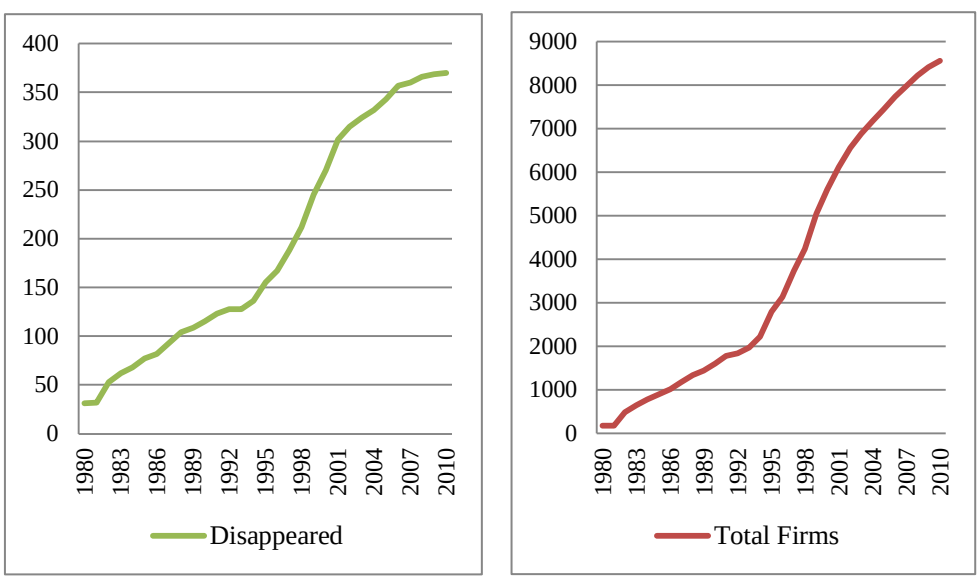
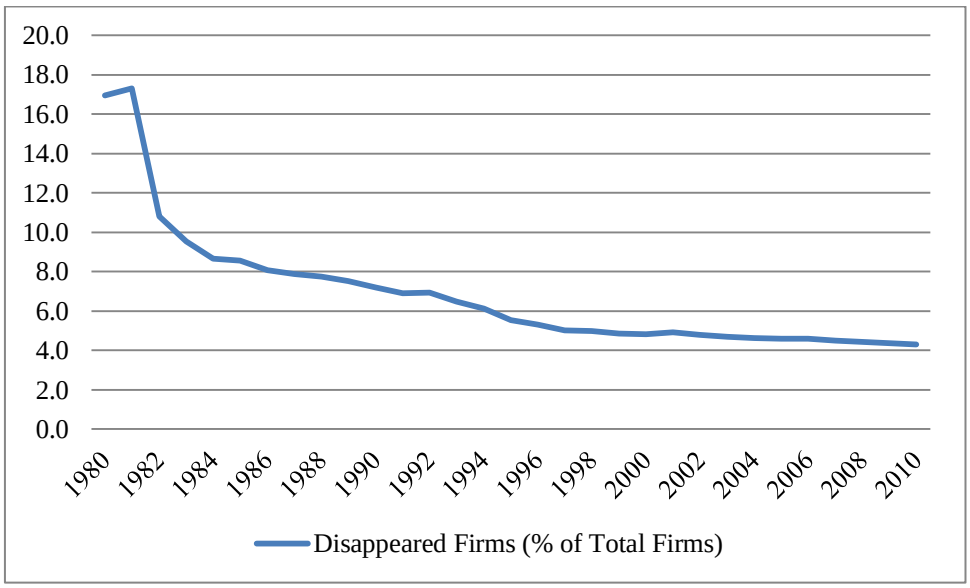


Figure 2.2 Percentage of Discontinued Firms: From 1980 to 2010



Based on such data, this study has performed an empirical analysis by taking into consideration the dynamic experiences of the Korean economy which encompasses rapid economic development as well as two periods of economic crisis. Before and after the Seoul Olympic Games in 1988, the Korean economy had been experiencing rapid growth. On the contrary, the Korean economy suffered from two economic crisis; the East Asian financial crisis in 1997, and the global financial crisis which was caused by the Lehman matter in 2008. In this section, we describe the variables which are included in the estimation.

3.2.1. Financially Distressed Firms

This study understands a financially distressed firm on the basis of Altman's Z-score, which is a corporate credit score structure. A low value of z-score, assessed by Altman's formula, indicates high probability of bankruptcy. Altman (1968) is the pioneer in the study of modern analytical techniques for estimation of the likelihood of borrower's default.[3] More specifically, Altman developed a discriminant function, which is used to predict the probability that a firm will go into bankruptcy within two years. Altman's z-score, calculated from the discriminant function, gives criteria to distinguish whether firms are likely to default or not. Altman found that "all firms having z-score of greater than 2.99 clearly fall into the 'non-bankrupt' sector, while those firms having z-scores below 1.81 will go bankrupt." In short, the lower the z-score, the higher the probability of default. The discriminant function of Altman's z-score is as follows;

$$\mathrm{Z} = 1.2 \times \frac{Working\ Capital}{Total\ Assets} + 1.4 \times \frac{Retained\ Earnings}{Total\ Assets} + 3.3 \times \frac{EBIT}{Total\ Assets}$$

$$+0.6 \times \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Debt} + 0.999 \times \frac{Sales}{Total\ Assets} \qquad \ldots Eq(2.3)$$

Based on the above formula, we define that the firm is likely to be

[3] Altman's z-score was developed based on a sample of 33 U.S. manufacturing firms defaulting between 1946 and 1965 and a paired and appropriately stratified random sample of 33 firms that were still in existence in 1966.

insolvent if its z-score is below 1.81. In order to evaluate the suitability of using z-score for Korean manufacturing firms, this study compares Altman's z-score with the credit rating structure of KIS-Value.[4] About 65.6% of firms of which z-score is below 1.81 are evaluated as 'low' or 'poor' grade from KIS-Value. Table 2.1 shows the distribution of firms with low z-score values in accordance with another source of credit evaluation, namely, the KIS-Value.

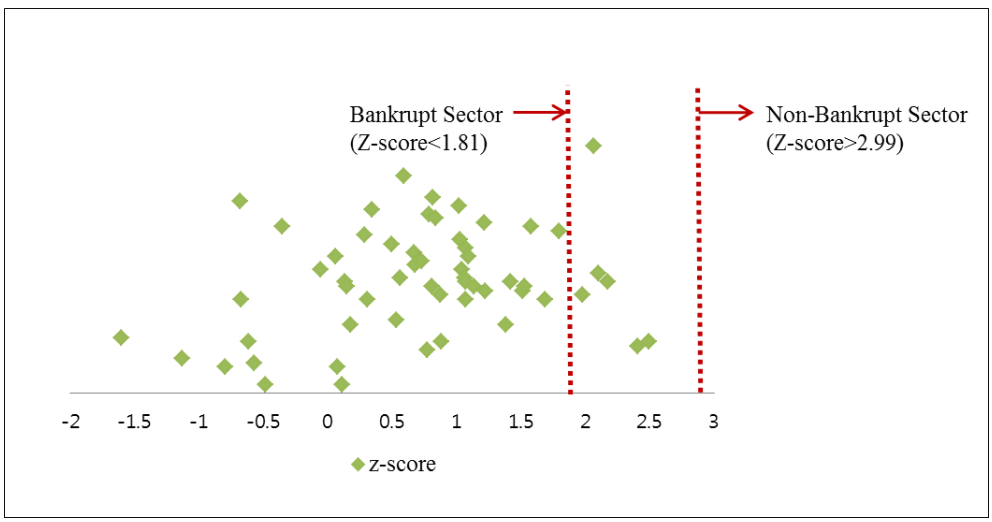
Table 2.1 Comparison of Firms with Low Z-Score Values and Credit Rating based on KIS-Value

Altman z-score<1.81		KIS-Value			Moody's	S&P
	1 (0.0%)	Superlative	1	Extremely Strong	Aaa	AAA
	94 (0.29%)	Superior	2	Very Strong	Aa1, Aa2	AA+, AA
	241 (0.83%)		3	Strong	Aa3	AA-
	676 (2.32%)	Intermediate	4	Good	A1, A2	A+, A
	2,664 (9.15%)		5	Adequate	A3	A-
34.45%	6,362 (21.85%)		6	Less Vulnerable	Baa1, Baa2	BBB+, BBB
	7,440 (25.56%)	Low	7	More Vulnerable	Baa3	BBB-
	6,714 (23.06%)	Poor	8	Currently Vulnerable	Ba, B, Caa	B, CC, CCC
	3,402 (11.69%)		9	Currently Highly Vulnerable	Ca	C
65.55%	1,529 (5.25%)		10	Extremely Vulnerable	C	D

[4] Since 2000, KIS-Value evaluates the credit rating of each firm. However, the data for this study encompasses long period from 1980 to 2010, thus we use Altman's z-score.

Furthermore, in order to review whether Altman's z-score correctly reflects the possibility of bankruptcy in the cases of Korean manufacturing companies, this research has studied into the z-scores of workout firms. If Altman's z-score appropriately reflects Korean cases, workout firms, which have experienced restructuring and threats of bankruptcy, should have low z-scores. Figure 2.3 is a scatter plot that illustrates the z-scores of firms who are threatened of bankruptcy and is about to file for the workout program. About 89.7% of the 58 companies who were selected for the workout program between 1998 and 2010 have z-scores lower than 1.81. Therefore, firms that went through restructuring through workout programs displayed to have had low credit ratings in the previous year. Such implies that Altman's z-score is a suitable metric in predicting the risk of bankruptcy in Korean manufacturing companies.

Figure 2.3 Scatter Plot of Z-score among Workout Firms



3.2.2. Bank Loan to Financially Distressed Firms

The main research question in this study is whether banks give additional loans to insolvent firms. In order to scrutinize the relationship between bank loans and financially distressed firms, two research questions are investigated. The first question is whether firms are able to receive additional bank loans despite risks of insolvency. For this research, the dependent variable in Eq.(2.1) represents the change in the amount of short-term liabilities (i.e. loans with maturity of up to 1 year) of firm *i* in year *t* divided by the firm's average assets for year *t*.[5] Therefore, the dependent variable is continuous, and the positive value indicates that the firm gets additional loans from its bank. The second research question is to figure out what make banks give additional loans to the financially distressed firms. Therefore, the dependent variable, the binary variable in the Eq.(2.2), indicates whether a firm gets a loan despite risks of insolvency. More specifically, the dependent variable shows value 1, if the first dependent variable has positive value (i.e. firm gets additional loans) and the probability of the firm's bankruptcy in the previous year is fairly high. The last term is measured by Altman's z-score which is explained in detail in the previous section 3.2.1.

Figure 2.4 shows the dynamic changes of the proportion of the firms which received additional bank loans despite risks of insolvency. From 1980 to 2010, the Korean economy experienced rapid economic growths as well

[5] In an absence of questionnaire which asks a firm gets loans or not, many studies use short-term liabilities which represent bank debt (Alexxev and Kim, 2008).

as collapses of due to financial crises. We can see that there was a substantial increase of lending for financially distressed firms after the Seoul Olympic Game in 1988. On the contrary, after the East Asian financial crisis, the proportion of bank-loan-received insolvent firm declines in half of what it used to be in three years; from 26.0% in 1997 to 12.9% in 1999. This graph suggests that the tendency of giving a loan to a financially weak firm is affected by the economic situations such as economic boom or crisis.

Figure 2.6 differentiates from Figure 2.5 in that the data is categorized according to whether the firm is a conglomerate or small and medium-sized enterprises (SMEs). For example, in 1997, 26% of financially distressed firms received financial aid from the bank, and the ratio of conglomerate and SMEs among those firms are respectively 8.9% and 17.0%. Figure 2.5 illustrates the distribution of financially distressed firms who received additional loans from the banks, and further categorizes this information according to whether the aided firm was a conglomerate or SMEs. Through Figure2.5, it is recognizable that banks were giving less loans to conglomerates, especially after the Asian Financial Crisis, when the proportion of loans to conglomerates were low as to be in between 2.8% and 3.2%. However, the difference in the number of conglomerate firms and SMEs in operation needs to be taken into account. Thus, a stricter analysis is required; one that reviews the number of conglomerates who received additional loans over total number of conglomerates, and the number of SMEs that received additional loans over total number of SMEs. Figure 2.6 exhibits the proportions.

Figure 2.6 presents the trends in the proportions of financially distressed firms who received bank loans to total number of firms in

operation comparing big business groups with small and medium-sized enterprises (SMEs). From 1980 to 2010, the trend of large firms is similar to that of SMEs. What Figure2.6 shows is that the proportion of SMEs who received bank loans is larger than the proportion of large firms that did since 2003. This phenomenon may reflect the movement of government policy from giving priority to big business groups to favoring SMEs in recent years. In addition, we can expect that the characteristics of each firm in accordance to current economic policies may help them receive bank loans despite troublesome financial circumstances.

Figure 2.4 Proportion of Financially Distressed Firms which Received Bank Loans: between 1980-2010

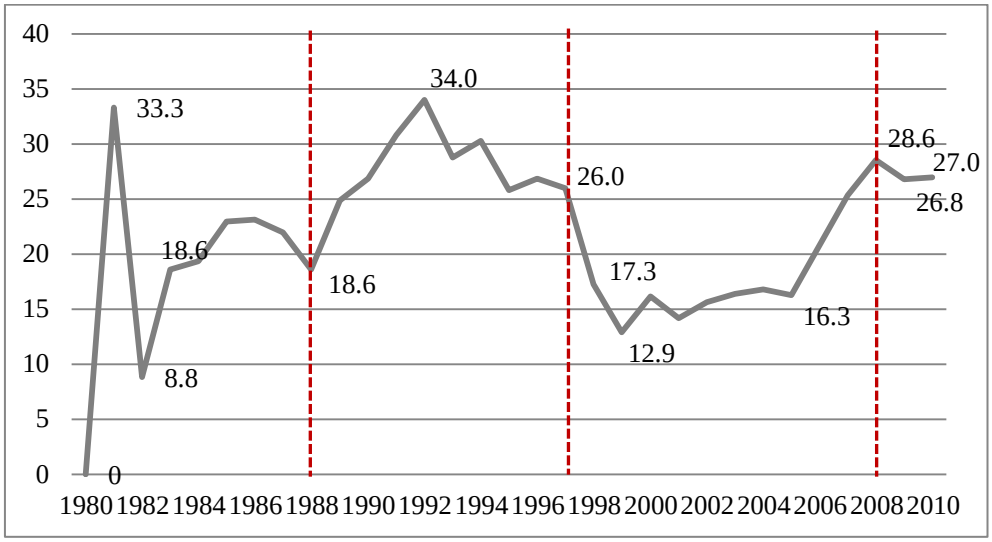


Figure 2.5 Comparison between Financially Distressed Large Firms & SMEs which Received Bank Loans

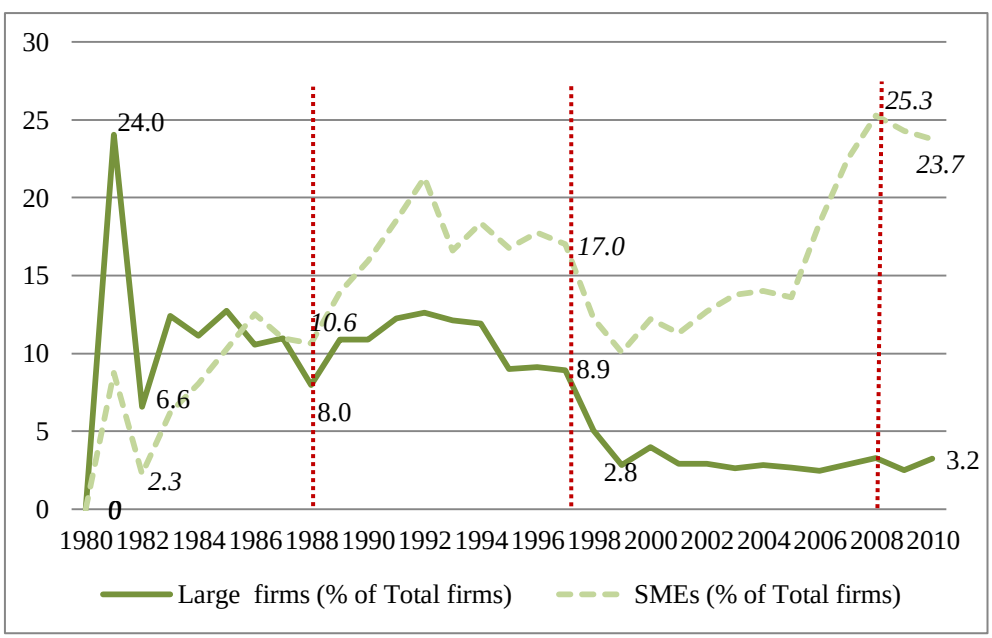
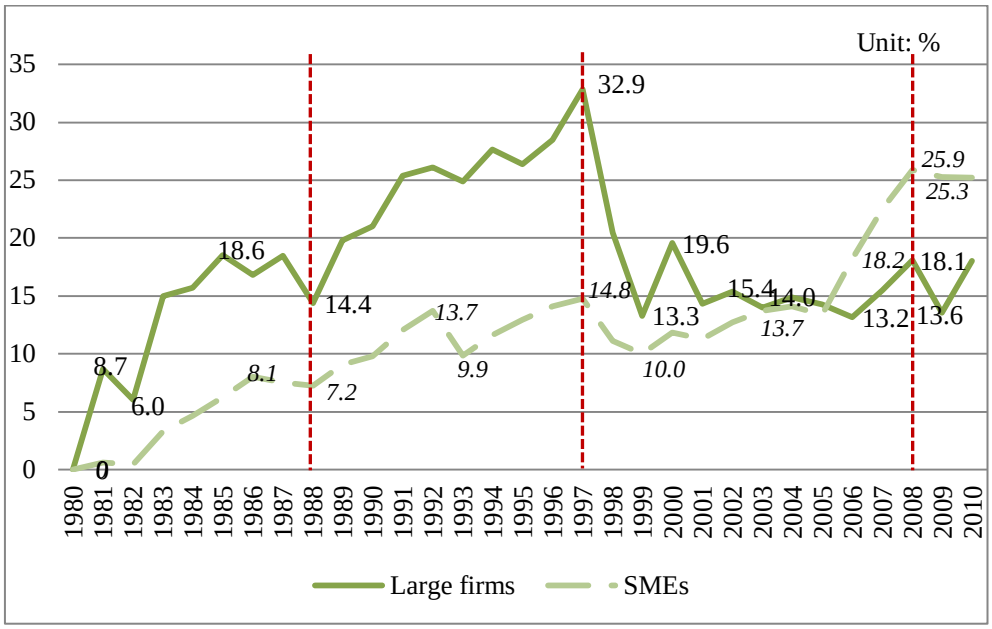


Figure 2.6 Comparison between Financially Distressed Large Firms & SMEs which Received Bank Loans as a Proportion to Total Firms of Respective Type in Operation



3.2.3. Explanatory Variables

This study expects that inherent firm characteristics as well as economic conditions help financially distressed firms to access additional bank loans. As various firm characteristics, we consider three variables: big business groups, small and medium-sized enterprises (SMEs), and export-oriented enterprises. Each variable represents a characteristic of the firm. In order to differentiate large firms from SME, we categorize the size of all manufacturing firms into three; large firm, mid-sized firm, small and medium-sized firm. According to the *Article 2* in the *Framework Act on the Small and Medium-Sized Enterprises*, SMEs is defined as a firm of which

total workers are under 300 or total equity is less than 8 billion won. On the other hand, big business groups are defined as a firm of which total sales of affiliates are more than 5 trillion won. Finally, mid-sized firms do not belong to large firms nor to SMEs. For the third firm characteristic, export-oriented enterprises, is defined as a firm of which total amount of export is more than 5 million dollars.[6]

In addition to various firm characteristics, we also examine whether the aspects of bank loan to financially distressed firms evolve according to the different economic situations (i.e. economic boom or after crisis). More specifically, four different economic conditions are considered in this paper; pre-Olympic period (1980-1987), post-Olympic period (1988-1996), post-East Asian financial crisis (1997-1999), post-global financial crisis (2008-2010). Before and after the Seoul Olympic Game in 1988, the Korean economy had experienced rapid economic development. On the contrary, Korean economy suffered from economic crisis twice. Based on the dynamic experience of Korean economy, this study investigates how contrasting economic conditions affect bank loans to financially distressed firms.

As controlled variables, collateral and firm sizes are considered in this estimation. Collateral is measured by the ratio of tangible assets over the total liability. We can expect that banks are less likely to give additional loans to financially distressed firms if the firm has sufficient collateral to liquidate. In addition, the number of workers is included to control firm size.

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[6] According to the program, called '*500 program to promote export enterprises*', *the Small and Medium Business Administration* support early stage of export firm, of which total amount of export is less than one million dollar, to promote export-oriented firm of which total amount of export is more than five million dollar.

In order to control heterogeneity of industry as well as time effect, we consider 24 categories of industrial sectors and time dummies from 1980 to 2010.[7]

4. Empirical Analysis

4.1. Dynamics of Bank Loan from 1980 to 2010

In this section, we examine whether banks give additional loans to the financially distressed firms and how lending practices evolved in the Korean economy from 1980 to 2010. In analyzing the panel data, this study has controlled for unobservable heterogeneity through the fixed effect model. Meanwhile, debt amount increases if loans, which is a dependent variable, increase, thus affecting credit score and collateral, which are explanatory variables. Therefore this research uses the system GMM estimation to control for endogeneity problems caused by the reverse causality problem (Wooldrigdge, 2002). That is, the results from three different estimations, namely pooled OLS, fixed effect and system GMM estimations are presented. Thus, it would control not only heterogeneity problems but also reverse causality problems. Table 2.2-2.4 present various specifications as firm characteristics and economic conditions are included sequentially. More specifically, Table 2.2 and Table 2.3 consider firm characteristics and contrast economic conditions respectively. Table 2.4 includes both firm characteristics and economic status all together.

[7] According to the Korean standard industrial classification (KSIC), Korean manufacturing firms are classified by 24 sectors.

Table 2.2 illustrates that a firm that showed high probability of bankruptcy in the previous year had difficulty in receiving a bank loan. This result is demonstrated in both Table 2.3 and Table 2.4. Moreover, results were consistent when three different estimation methods were used; namely the OLS, fixed effect, and system GMM. When we looked at the characteristics of the firm which facilitate bank loans for financially distressed firms, as Table 2.2 shows, being a big business group had a positive impact on receiving a bank loan at 10% level of significance through the fixed effect estimation. However, the results through the system GMM estimation, which controls the reverse causality problem, show that the positive correlation between being a financially distressed big business group and the bank loans proved not to be significant. On the contrary, results from the system GMM model tells that small and medium-sized firms and export-oriented firms have negative and significant association with bank loans if they are in trouble with insolvency.

The results, reported in the 3rd and 4th row of Table 2.3, indicate that a firm under financial distress is positively and significantly related to bank loans from 1980 to 1996. That is, before and after the Seoul Olympic Games in 1988, so in the period of economic boom, banks gave additional loans to firms even though the probabilities of firms' bankruptcy were fairly high. Interestingly, however, there is no significant or even negative relationship between financially distressed firms and bank loan in the period of economic crisis. Such results illustrate a change in the screening process of banks after 1997. An example of such is the reduction of lending practices to insolvent firms.

In order to give robust results, both firm characteristics and

economic conditions are considered and the related empirical results are shown in Table 2.4. To sum up, this paper finds that banks are less likely to give additional loans if there was a dangerous signal of insolvency in the previous year. Through looking at the how firm characteristics affect lending practices, it was found that large firms under financial problems have better access to additional bank loans. However this relationship was no longer significant when controlled for reverse causality through estimations using the system GMM methods. On the other hand, results from system GMM estimation show that export-oriented firms experience difficulty in accessing bank loans if this firm is likely to be bankrupt. These results indicate the features of lending practices in the period between 1980 and 2010. When we consider diverse economic conditions, bank loans to financially distressed firms are demonstrated in an economic boom, whereas this feature does not appear in the period of economic crisis.

Table 2.2 Dynamics of Bank Loans Depending on Firm Characteristics: Large Firms, SMEs, and Export-Oriented Firms

	Pooled OLS (1)	Fixed Effect (2)	System GMM (3)
$Lowz_t$	0.057***	0.053***	0.031***
	(47.788)	(39.785)	(2.834)
$Lowz_{t-1}$	-0.045***	-0.045***	0.016
	(-14.689)	(-12.707)	(1.318)
$Lowz_{t-1}$*Large	0.009	0.015*	-0.068
	(1.241)	(1.767)	(-0.628)
$Lowz_{t-1}$*SMEs	-0.003	-0.004	-0.087***
	(-1.120)	(-1.248)	(-5.385)
$Lowz_{t-1}$*Export	-0.007**	-0.005	-0.086***
	(-2.413)	(-1.377)	(-2.589)
Large	-0.003	-0.008	-0.000
	(-0.600)	(-0.953)	(-0.000)
SMEs	0.003	0.006**	0.057***
	(1.589)	(2.004)	(3.509)
Export	0.001	0.003	0.070***
	(0.372)	(1.061)	(3.584)
Collateral	-0.017***	-0.018***	-0.008
	(-19.885)	(-14.304)	(-1.199)
Workers	-0.004***	0.007***	-0.004
	(-6.313)	(6.087)	(-0.819)
Industry dummy	Yes		
Time dummy	Yes	Yes	Yes
Observations	77,923	77,923	77,923
Number of kisid		7,844	7,844
R-squared	0.048	0.045	
F-test		[0.000]***	
Wald test			[0.000]***
Hansen test			[0.134]
AR(2) test			[0.955]

Note: Dependent variable is change in the amount of short-term liabilities over average assets. *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively. T-5 period of lagged dependent variable, and year dummies are used for instrument variables in system GMM estimation.

Table 2.3 Dynamics of Bank Loans Depending on Economic Conditions: Economic Boom vs. Economic Crisis

	Pooled OLS	Fixed Effect	System GMM
	(1)	(2)	(3)
$Lowz_t$	0.057***	0.052***	0.041*
	(47.721)	(39.229)	(1.893)
$Lowz_{t-1}$	-0.051***	-0.050***	-0.069***
	(-32.632)	(-28.919)	(-3.563)
$Lowz_{t-1}$*Pre-Olympic	0.013***	0.017***	0.043**
(1980-1987)	(2.716)	(3.428)	(2.202)
$Lowz_{t-1}$*Post-Olympic	0.015***	0.017***	0.033**
(1988-1996)	(5.791)	(5.669)	(2.368)
$Lowz_{t-1}$*Post-Fin.Crisis1	-0.004	-0.003	0.003
(1997-1999)	(-1.269)	(-0.984)	(0.185)
$Lowz_{t-1}$* Post-Fin.Crisis2	0.000	-0.007***	-0.016
(2008-2010)	(0.009)	(-2.976)	(-1.288)
Pre-Olympic	-0.015	-0.019	0.000
	(-1.292)	(-1.578)	(0.034)
Post-Olympic	-0.009*	-0.008	0.009
	(-1.916)	(-1.583)	(1.098)
Post-Fin.Crisis1	-0.034***	-0.026***	-0.011
	(-9.150)	(-6.829)	(-1.128)
Post-Fin.Crisis2	0.019***	0.010***	0.000
	(6.217)	(3.322)	(0.011)
Collateral	-0.017***	-0.018***	0.001
	(-19.921)	(-14.496)	(0.155)
Workers	-0.005***	0.007***	-0.005
	(-10.703)	(5.695)	(-1.232)
Industry dummy	Yes		
Time dummy	Yes	Yes	Yes
Observations	77,923	77,923	77,923
Number of kisid		7,844	7,844
R-squared	0.049	0.046	
F-test		[0.000]***	
Wald test			[0.000]***
Hansen test			[0.125]
AR(2) test			[0.182]

Note: Dependent variable is change in the amount of short-term liabilities over average assets. *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively. T-5 period of lagged dependent variable, and year dummies are used for instrument variables in system GMM estimation.

Table 2.4 Dynamics of Bank Loans Depending on Firm Characteristics and Economic Conditions

	Pooled OLS (1)	Fixed Effect (2)	System GMM (3)
$Lowz_t$	0.057***	0.052***	0.043***
	(47.711)	(39.171)	(7.938)
$Lowz_{t-1}$	-0.049***	-0.048***	-0.038***
	(-15.055)	(-12.822)	(-4.193)
$Lowz_{t-1}$*Large	0.012	0.018**	0.085
	(1.585)	(2.116)	(0.914)
$Lowz_{t-1}$*SMEs	-0.001	-0.002	-0.016
	(-0.332)	(-0.688)	(-1.213)
$Lowz_{t-1}$*Export	-0.008**	-0.005	-0.109***
	(-2.497)	(-1.369)	(-5.562)
$Lowz_{t-1}$*Pre-Olympic	0.013***	0.018***	0.052***
(1980-1987)	(2.760)	(3.497)	(3.030)
$Lowz_{t-1}$*Post-Olympic	0.015***	0.017***	0.046***
(1988-1996)	(5.875)	(5.683)	(5.801)
$Lowz_{t-1}$*Post-Fin.Crisis1	-0.004	-0.003	0.010
(1997-1999)	(-1.198)	(-0.939)	(1.094)
$Lowz_{t-1}$* Post-Fin.Crisis2	-0.000	-0.008***	-0.013**
(2008-2010)	(-0.071)	(-3.025)	(-2.110)
Large	-0.005	-0.008	-0.046
	(-0.844)	(-1.011)	(-0.663)
SMEs	0.002	0.005*	-0.041***
	(1.019)	(1.895)	(-4.585)
Export	0.001	0.002	0.051***
	(0.423)	(0.855)	(2.839)
Pre-Olympic	-0.017	-0.021*	0.007
	(-1.431)	(-1.671)	(0.684)
Post-Olympic	-0.010**	-0.008*	0.008
	(-2.080)	(-1.738)	(1.391)
Post-Fin.Crisis1	-0.034***	-0.026***	-0.014**
	(-9.186)	(-6.853)	(-2.485)
Post-Fin.Crisis2	0.019***	0.011***	-0.003
	(6.209)	(3.389)	(-0.629)
Collateral	-0.017***	-0.018***	0.005
	(-19.887)	(-14.473)	(0.784)
Workers	-0.004***	0.007***	-0.020***
	(-6.445)	(5.881)	(-6.620)
Industry dummy	Yes		
Time dummy	Yes	Yes	Yes
Observations	77,923	77,923	77,923
R-squared	0.049	0.046	
Number of kisid		7,844	7,844
F-test		[0.000]***	
Wald test			[0.000]***
Hansen test			[0.108]

AR(2) test			[0.397]

Note: Dependent variable is change in the amount of short-term liabilities over average assets. *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively. T-5 period of lagged dependent variable, and year dummies are used for instrument variables in system GMM estimation.

4.2. Dynamics of Bank Loan to Financially Distressed Firms from 1980 to 2010

In order to scrutinize how banks' lending practices to financially distressed firms evolve from 1980 to 2010, this study considers firm characteristics as being jointed with diverse economic conditions. We expect that firm's characteristics have different effects on bank loans to finically distressed firms according to different economic circumstances. In consideration of binary panel model, various estimations, namely pooled probit, pooled logit, random effect probit, and fixed effect logit estimation, are implemented in this study.

The results, reported in the 6th-17th row of Table 2.5, indicate how the probability of receiving a bank loan for large firms, SMEs, or export firms under financial distress, change according to different economic conditions. In the case of large firms, this study finds that being a big business group is positively and significantly associated with receiving a bank loan between 1988 and 1996. This result suggests that a policy to encourage economic growth based on big business groups. This policy was applied in the early stages of economic development in the 1980's, helping large firm to receive bank loans despite their high probabilities of going

bankrupt.[8] However, such trends are not observed after the East Asia Financial Crisis in 1997. This suggests that after the Asian Financial Crisis, banks tended to restrain from lending money to financially distressed big business groups merely based on the notion that big businesses were 'too big to fail.'

Interestingly, in case of SMEs, the probability of financially distressed firms receiving a bank loan differs before and after the 2000's. We can see that being a financially distressed SME is negatively associated with the ability to receive bank loans before 2000s, particularly during the pre-Olympic period (i.e. 1980~1987) and post-East Asian financial crisis (i.e. 1997~1999). On the other hand, after the global financial crisis (i.e. 2008~2010), being a financially weak SME has a positive effect on receiving a bank loan at 1% level of significance. That is, SMEs with financial problems are less and more likely to receive bank loans in different time periods, although in both periods the Korean economy suffered from grave economic crises. Such results may be reflecting the recent government economic policy to promote SMEs. Figure 2.6, shows that the proportion of financially distressed SMEs who were able to receive bank loans among total SMEs in operation is larger than the proportion of large firms that were given loans since 2003. This provides supportive evidence for the empirical result.

This study also finds that export-oriented firms under financial distress easily accessed bank loans from 1988 to 1999, and that they had

[8] Korean government helped heavy and chemical industries and favored large companies in the early stage of economic development.

trouble borrowing during the global financial crisis. As were the results from SMEs, export firms show different features when compared between the period of East Asian financial crisis and that of global financial crisis. Such contrasting results would be caused by different government policies. More specifically, after East Asian financial crisis, the Korean government makes an effort to enlarge export levels as the means to recover its economy. On the other hand, the Korean government emphasizes to strengthen domestic demand rather than overseas export right after the global financial crisis in 2008. Even though 1997 and 2008 is similar in that they both were financial crises, the difference in the government policies of the two periods bred contrasting lending trends to financially distressed firms.

Table 2.5 Dynamics of Bank Loan to Financially Distressed Firms

VARIABLES	Pooled Probit (1)	Pooled Logit (2)	RE Probit (3)	FE Logit (4)
Pre-Olympic	-5.252	-16.594	-6.627	-21.411
(19890-1987)	(-0.037)	(-0.034)	(-0.005)	(-0.005)
Post-Olympic	-0.109**	-0.174**	-0.069	-0.150
(1988-1996)	(-2.169)	(-2.033)	(-1.206)	(-1.484)
Post-Fin.Crisis1	-0.298***	-0.528***	-0.311***	-0.574***
(1997-1999)	(-4.828)	(-4.943)	(-4.557)	(-4.793)
Post-Fin.Crisis2	-0.050	-0.100	-0.026	-0.011
(2008-2010)	(-1.017)	(-1.170)	(-0.469)	(-0.116)
Large*Pre-Olympic	-0.835	-1.429	-0.784	-1.119
	(-1.463)	(-1.331)	(-1.320)	(-1.038)
Large*Post-Olympic	0.357***	0.578***	0.538***	0.925***
	(3.457)	(3.355)	(4.511)	(4.479)
Large*Post-Fin.Crisis1	0.011	0.012	0.085	0.158
	(0.084)	(0.051)	(0.574)	(0.629)
Large*Post-Fin.Crisis2	0.100	0.191	0.053	0.021
	(1.061)	(1.163)	(0.510)	(0.115)
SMEs*Pre-Olympic	-0.198***	-0.361***	-0.181**	-0.289**
	(-3.134)	(-3.349)	(-2.490)	(-2.279)
SMEs*Post-Olympic	0.025	0.034	-0.020	-0.044
	(0.592)	(0.465)	(-0.410)	(-0.503)
SMEs*Post-Fin.Crisis1	-0.142**	-0.251***	-0.165***	-0.245**
	(-2.508)	(-2.577)	(-2.626)	(-2.220)
SMEs*Post-Fin.Crisis2	0.257***	0.440***	0.291***	0.466***
	(5.574)	(5.477)	(5.647)	(5.081)
Export*Pre-Olympic	0.087	0.159	0.062	0.071
	(1.134)	(1.213)	(0.727)	(0.476)
Export*Post-Olympic	0.231***	0.398***	0.173***	0.241***
	(5.253)	(5.338)	(3.394)	(2.685)
Export*Post-Fin.Crisi1	0.243***	0.431***	0.233***	0.379***
	(4.306)	(4.434)	(3.710)	(3.433)
Export*Post-Fin.Crisis2	-0.283***	-0.478***	-0.297***	-0.451***
	(-6.210)	(-5.976)	(-5.873)	(-5.010)
Large	0.075	0.112	-0.019	-0.335**
	(1.264)	(1.091)	(-0.244)	(-2.213)
SMEs	0.212***	0.364***	0.211***	0.387***
	(7.349)	(7.239)	(5.931)	(5.804)
Export	-0.135***	-0.237***	-0.170***	-0.303***
	(-4.965)	(-4.975)	(-4.980)	(-4.680)
Collateral	-0.159***	-0.275***	-0.225***	-0.617***
	(-14.472)	(-14.338)	(-14.842)	(-18.547)
Workers	0.133***	0.226***	0.144***	0.285***
	(22.627)	(22.216)	(16.988)	(13.596)
Industry dummy	Yes	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes	Yes
Observations	94,530	94,530	94,530	73,562

Number of kisid			8,074	5,513

Note: Dependent variable is binary variable which indicate bank loan to troubled firm. *z* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively.

5. Conclusion

This study analyzes the relationship between bank loans and financially distressed firms by using Korean manufacturing firm level data which covers a long period; from 1980 to 2010. The main research questions are whether financially distressed firms are able to receive additional credits and how banks' lending practices change according to diverse firm characteristics and economic conditions. Since the early 1960s, the Korean economy experienced rapid economic developments. In additions, it also suffered from economic crises twice. Therefore, it is beneficial to look at the trends of bank lending to financially distressed firms through looking at the Korean economy as it encompasses the dynamics of economic cycles. This study considers four different economic conditions; pre-Olympic period (1980-1987), post-Olympic period (1988-1996), post-East Asian financial crisis (1997-1999), post-global financial crisis (2008-2010). In addition, we consider the heterogeneity of firms, which affect the probability of receiving a bank loan. More specifically, large firms, small and medium-sized enterprises (SMEs), and export-oriented firms are considered as firm characteristics.

Main findings from this study can be summarized as follows. First, a firm under financial distress in the Korean manufacturing sectors can easily

receive bank loans during a period of economic boom. However, this phenomenon is not observed, and not even in the opposite way after economic crises. That is, financially distressed firms have difficulty in borrowing additional credits after economic crises. These results indicate that economic cycles such as economic boom and crisis can affect the lending of banks to unhealthy firms. Furthermore, it can be understood that the banks' screening process for suitable borrowers has been functioning properly since 1997.

Second, big business groups in poor financial conditions receive additional credit after the Seoul Olympic game in 1988. This result is consistent with experiences of the Korean economy, in which many debt-ridden firms in the heavy industries were bailed out by the government intervention through banks. However, lending practices that used to be common for financially distressed big businesses could no longer be found after 1997. More specifically, after the Asian Financial Crisis, banks stopped lending money to financially distressed big business groups merely based on the notion that big businesses are 'too big to fail.'

Third, the provision of bank loans to SMEs with financial distress differs before and after the 2000's. Interestingly, SMEs with financial problems are less likely to receive bank loans after financial crisis in 1997, while these firms are more likely to receive additional funds after the crisis in 2008. Such results may be reflecting the recent government economic policy to promote SMEs.

Fourth, export-oriented firms with financial distress could easily to borrow money after the economic crisis in 1997. However this tendency

evolves in the opposite way after the economic crisis in 2008. In spite of the same economic condition, both being an economic crisis, the results contrast each other. This might be because of the different economic policy dealt with each crisis. More specifically, after financial crisis in 1997, the Korean government made an effort to enlarge export level in order to revitalize its economy. Meanwhile, after the economic crisis in 2008, the Korean government emphasizes to strengthen domestic demand. To sum up, this research finds that the provision of bank loans to financially troubled firms is affected by firm characteristics as well as economic cycles.

Appendix

Appendix 2.1 Description of Regression Variables

	Variable	Description
Dependent variable	Loan	Change in the amount of short-term liabilities divided by assets
	Loan to Financially Distressed Firms	Low z at (t-1) and additional loan at (t) *(binary)*
Financially Distressed Firm	Low z	Altman's z-score which below 1.81 *(binary)*
Firm Characteristics	Large Firm	Total sales of affiliates are more than 5 trillion won *(binary)*
	SMEs	Total workers are under 300 or total equity is less than 8 billion won *(binary)*
	Export-Oriented Firms	Total amount of export is more than 5 million dollar *(binary)*
Economic Conditions	Pre-Olympic	From 1980 to 1987 *(binary)*
	Post-Olympic	From 1988 to 1996 *(binary)*
	Post-Financial Crisis 1	From 1997 to 1999 *(binary)*
	Post-Financial Crisis 2	From 2008 to 2010 *(binary)*
Control	Collateral	Ratio of tangible assets over the total liability
	Worker	Number of workers *(log form)*
	Industry	Industry dummy of 24 categories
	Year	Year dummy: 1980-2010

Appendix 2.2 Descriptive Statistics of Regression Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Loan	93,882	0.022	0.945	-286.394	5.196
Loan to FDFs	93,882	0.236	0.425	0	1
Low z	81,809	0.477	0.499	0	1
Large Firm	93,882	0.015	0.123	0	1
SMEs	93,882	0.860	0.347	0	1
Export-Oriented Firms	93,882	0.113	0.317	0	1
Pre-Olympic	93,882	0.040	0.196	0	1
Post-Olympic	93,882	0.151	0.358	0	1
Post-Financial Crisis 1	93,882	0.107	0.309	0	1
Post-Financial Crisis 2	93,882	0.224	0.417	0	1
Collateral	93,882	0.666	0.525	0.000	38.773
Worker	88,109	4.627	1.183	0	11.621

Appendix 2.3 Correlation of the Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	1.00											
(2)	0.29	1.00										
(3)	-0.1	0.64	1.00									
(4)	-0.0	0.01	0.02	1.00								
(5)	0.03	0.03	0.02	-0.3	1.00							
(6)	-0.0	-0.0	-0.1	0.18	-0.5	1.00						
(7)	0.00	0.00	-0.0	-0.0	-0.1	0.02	1.00					
(8)	0.01	0.05	0.03	0.00	-0.1	0.07	-0.1	1.00				
(9)	-0.1	-0.0	0.05	-0.0	-0.0	0.02	-0.1	-0.2	1.00			
(10)	0.02	0.04	0.04	0.01	0.06	-0.1	-0.1	-0.3	-0.2	1.00		
(11)	-0.1	-0.0	-0.0	0.02	-0.1	0.05	-0.1	-0.11	-0.1	0.06	1.00	
(12)	-0.0	0.00	-0.0	0.25	-0.7	0.46	0.23	0.27	0.00	-0.2	0.01	1.00

Note: (1) loan, (2) loan to financially distressed firm, (3) low z score, (4) large firm, (5) SMEs, (6) export-oriented firms, (7) pre-Olympic (8) post-Olympic (9) Post-financial crisis 1, (10) Post-financial crisis 2, (11) collateral, (12) worker

III. Bank Loan and Technological Innovations of Financially Distressed Firms

1. Introduction

Non-performing loans deteriorate the financial soundness of the banking sector, and lead to bankruptcy of firms as well as the financial institutions in worst cases. A number of economists explain that the financial crisis in Asian countries in the 1990s resulted from such huge non-performing loans (Huang and Xu, 1999; Bai and Wang 1999, Kornai et al., 2003). In spite of the hazardous outcome of non-performing loans, banks have been allocating credit to financially unhealthy borrowers for several reasons. Dewatripont and Maskin (1995) explained that creditors estimate the value of liquidation and refinance financially distressed firms in order to recoup their past investment. Peek and Rosengren (2005) also explained that perverse incentives make banks to provide additional loan to the troubled firms. More specifically, troubled banks have an incentive to allocate credit to severely impaired borrowers in order to avoid the realization of losses on their own balance sheet. On the other hand, banks give additional loans to financially distressed firms, if firms are likely to earn sufficient future profits to repay their loans. Hoshi et al. (1991) demonstrated that banks provide additional credit if they perceive the risks and financial distress of a firm as only a temporary problem. In that case, the bank anticipates that future profits of the distressed firms are likely to cover its current losses.

In terms of the effect of bank loans to financially distressed firms, most of the previous studies have emphasized on their hazardous effects of the financial system. In particular, they looked at the inefficiency of investment which caused the financial crisis in Asian countries (Krugman, 1998; Huang and Xu, 1999; Bai and Wang, 1999; Kornai et al., 2003; Peek and Rosengren, 2005). They pointed out that financial aid to unhealthy firms boosts the propensity to invest excessively on risky projects, because such behaviors apparently reduce the investors' risk. Consequently, this overinvestment in risky projects leads to excessive economic expansion. Bai and Wang (1999), for instance, used a theoretical model to illustrate that the government insurance program against business risks induced all rational investors to restructure their portfolios by investing more in risky projects and less in safer projects. Consequently, financial aid to distressed firms results in inefficient resource allocation, which is associated with high volatility as well as high average growth. To sum up, with respect to R&D spending, bank loans to financially distressed firms induce firms to invest more in risky projects than what is socially optimal. Meanwhile, some studies explain the negative effect of distressed firms receiving loans on the corporate performance. Chiu and Joh (2004), for instance, show that the *ex-post* debt payment ability of financially distressed firms is lower than non-distressed firms. They used return on assets at time t+2 as future corporate performance and verified that ROA of distressed firm is lower than that of sound firm by -5%. However, they focus on the overall effects. That is, they did not consider the probability of positive effects which is likely to arise from heterogeneity of each firm that has good factors internally or externally.

In terms of R&D activities, huge investments are required. Moreover, the performance of R&D activities, that is technological innovation, takes a

long time to achieve. In other words, technological innovation requires huge investments. Furthermore, since one cannot be certain of R&D performance, technological innovation impedes profitability and thus increases the risk of bankruptcy before profits are actually realized. (Czarnitzki and Kraft, 2004; Kim, 2008). Czarnitzki and Kraft(2004), for example, verified that innovative firms achieve better ratings, whilst too many innovative activities reduce the credit rating because of the unreached profitability. This result indicates that there is a U-shape relationship between R&D activities and the risk of default. In other words, a firm which conducts R&D activities might undergo temporary financial difficulties until technological innovation is accomplished and yields profit realization. Meanwhile, some studies show that technological innovation helps to overcome economic recessions (Mensch, 1979; Fillppetti and Archibugi, 2011). For instance, Filippetti and Archibugi, (2011) verified that competences and quality of human resources, the specialization in the high-technology sector, along with the development of the credit system, seem to be the structural factors which are able to mitigate the effects of the economic downturn on innovation investments of firms across Europe. Therefore, we need to keep in mind positive aspects of bank loans to troubled firms in terms of the firms' R&D activities.

This study attempts to observe the distressed firm's behavior towards R&D activities by comparing those firms that received bank loans and without loans. These relationships are scrutinized in two respects; one is firm characteristics and another is industrial characteristics. In terms of the characteristics inherent to the firm, we tested whether bank loans to financially distressed firms lead the firm to achieve innovation if motivations were assigned to the firm. In order to ensure that are made for

innovation, motivations for long-run growth pursuits are required. Therefore, if appropriate incentives are given, financially distressed firms may utilize additional bank loans and achieve technological innovation. On the contrary, financially distressed firms which fail to receive additional credit are likely to give up R&D activities. Consequently, appropriate motivations for long run growth pursuit are likely to induce the firm's long-termism. On the contrary, financially distressed firms without bank loans are likely to pursue short-termism, since it tends to be passive in risk-taking. In this study, we look for both beneficial effects and hazardous effects of bank loans to financially distressed firms on R&D performance while also taking into account the firm's inherent characteristics. Furthermore, this paper observes whether the impact of bank loans to troubled firm on R&D performance varies depending on the industrial environment which the firm belongs to. We consider various industrial sectors, depending on its characteristics such as capital intensity or pace of product replacement. The paper attempts to identify the industrial sector which gives grounds for technological innovation for firms under financial distress.

This research aims to improve the existing literature in the three following respects. First, this study focuses on the distressed firm's behavior on R&D activities and gives empirical evidence on the relationship between bank loans and innovation. Most of previous studies investigate the effect of bank loans to financially distressed firms in relation to the banking systems or the overall economy. This paper suggests that bank loans to troubled firms can play a beneficial role to firm's R&D performance. Second, this study reveals which motivations yield firm under financial distress to conduct better R&D performance. Previous studies find that additional credit to unhealthy borrowers is inefficient. However, they did not consider

the firms' inherent characteristics which induce innovation. That is, this study may mitigate the statement that bank loans to financially distressed firms have hazardous effects by decomposing the characteristics in firms identifying which are good and which are bad. Third, this research aims to identify whether bank loans to troubled firms yield positive or negative effects on R&D achievement, depending on the type of industries to which the firm belongs. The positive effects can suggest a mechanism of how bank loans to unhealthy firms drive technological development in certain industrial sectors.

This paper is organized as follows. The next section describes our model and data. Section 3 presents empirical evidence on the association between bank loans and diverse R&D performances for financially distressed firms. More specifically, the effect of bank loans to financially distressed firms on technological innovation is analyzed in sub-section 3.1. Sub-section 3.2 identifies the magnitude of the effect of bank loan to financially distressed firms on innovation, classifying the positive and negative effects. Sub-section 3.3 verifies the robustness of the results by analyzing innovation through taking into consideration both product and process innovations. Sub section 3.4 analyzes relationship between bank loans and technological innovation of financially distressed firms by looking at diverse industry sectors. The last section contains concluding remarks.

2. Model and Data

2.1 The Model

In order to scrutinize the relationship between bank loan to distressed firm and R&D performance, this study considers heterogeneity of a firm characteristics as well as different uncertainty of R&D projects. The main research question is whether additional credit can induce a firm in poor financial condition to innovate or not. More specifically, this paper examines that a troubled firm which gets additional fund is encouraged to achieve technological innovations if it has an incentive to make an effort. We also consider the effect of financial distressed firms which fail to get additional bank loans. Therefore, the effect of bank loan to financially distressed firm on innovation can be compared with the troubled firm that fails to get additional bank loans. In addition, we allow two types of innovation as dependent variables, in accordance with the degree of technological innovation. By extension, we test which industrial sectors provide a ground for technological innovation for a firm under financial distress. Industrial sectors can be classified depending on their capital intensity. For instance, the steel industry has high capital intensity, while the clothing industry has low capital intensity. On the other hand, manufacturing firms can be categorized depending on the pace of product obsolescence. For example, the chemical industry replaces its main product slowly, while rapid product replacement occurs in the IT industry. By taking both capital intensity and the pace of product substitution into consideration, we sort industrial sectors into four categories; low capital intensity and slow product replacement (LS hereafter), low capital intensity and rapid product replacement (LR hereafter), high capital intensity and slow product replacement (HS hereafter), and high capital intensity and rapid product replacement (HR hereafter).

Associations between bank loan to troubled firm and R&D

performance are demonstrated as the following Eq.(3.1).

$$\sum_{s=1}^{2} Innovation_{i,s} = \alpha_0 + \left(\alpha_1 + \sum_{j=1}^{2} \beta_{1j}\, Motivations_{i,j} \right) \times FDFs\ with\ Loan_i$$

$$+ \left(\alpha_2 + \sum_{j=1}^{2} \beta_{2j}\, Motivations_{i,j} \right) \times FDFs\ without\ Loan_i$$

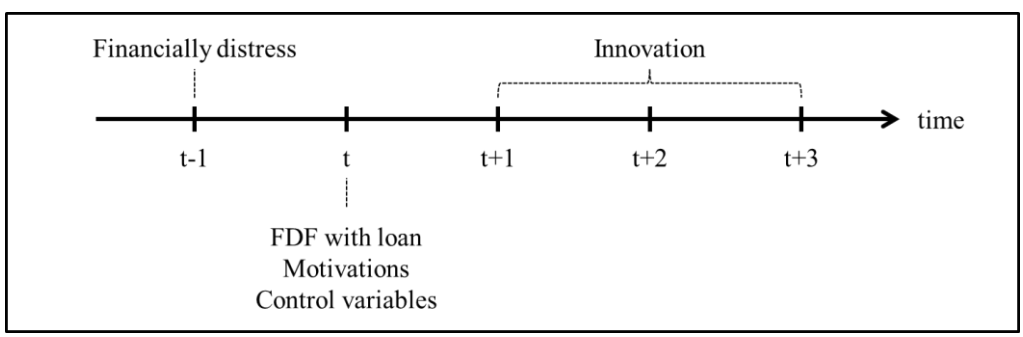
$$+ \sum_{j=1}^{2} \beta_{3j}\, Motivations_{i,j} + \Gamma X + \varepsilon_i \quad \ldots . Eq(3.1)$$

FDFs with Loan and *FDFs without Loan* indicate the financially distressed firms which succeed in or fail to get additional bank loan, respectively. The effects of bank loan to financially distressed firm on innovation can be decomposed into positive effects and negative effects. We allow two motivations as important drivers to pursue long-run growth. One is related to profit motive, and the other is associated with survival motive. Both motivations give incentives to a firm to make an effort. Therefore, a troubled firm with bank loans can achieve technological innovation if profit or survival motive is inherent in the firm. The coefficients β_{1j} indicate beneficial effects of bank loan to distressed firm on innovation, while α_1 shows negative effects of bank loan to troubled company that remain after controlling for positive factors. As a counterpart of bank loan to financially distressed firm, the effects of FDFs without loan on innovation are also

decomposed into positive effect and negative effect, which are denote as β_{2j} and α_2, respectively.

As technological innovations require time to accomplish, there exists a time interval between the explanatory and dependent variables. Furthermore, in order to set whether the financially distressed firms received loans as a variable, information on the firms' credit ratings and banks loans are needed. Such informations also display time differences between themselves. Figure 3.1 briefly illustrates the time interval found between the explanatory and dependent variables. If firms borrow money from banks at point t despite of low credit ratings at point t-1, we call these 'FDFs with loans'. Meanwhile, technological innovation measured by this research includes all accomplishments made within three years, thereby noting all R&D performance between points t+1 and t+3 into as dependent variables. Other controlled variables used information at point t, taking into consideration the time interval with technological innovation.

Figure 3.1 Time Interval between the Explanatory and Dependent Variables



A further study for the relationships between bank loan to unhealthy firm and R&D performance under diverse industrial sectors are demonstrated as the following Eq.(3.2).

$$\sum_{s=1}^{2} Innovation_{i,s} = \sum_{j=1}^{3}\left[\left(\alpha_{1j} + \sum_{q=1}^{2}\beta_{1jq} Motivations_q\right) + \left(\alpha_{2j} + \sum_{q=1}^{2}\beta_{2jq} Motivations_q\right) \times FDFs\ with\ Loan_i + \left(\alpha_{3j} + \sum_{q=1}^{2}\beta_{3jq} Motive_q\right) \times FDFs\ without\ Loan_i\right] \times Industry_{ij} + \Gamma X + \varepsilon_i \quad \ldots\ldots\ldots\ldots Eq(3.2)$$

On the basis of Eq.(3.2), we can compare the favorable industrial sectors for technological innovation under *FDFs with Loan* and *FDFs without Loan*. Furthermore, we can discover whether a financially distressed firm with bank loans achieves innovation in a certain industry if some motivations are assigned to the firm. In particular, even though a troubled company with bank loan rarely conducts R&D activities in some industrial sectors (i.e. $\alpha_{2j} < 0$), we can extract positive effects of this firm in those industrial sectors (i.e. $\beta_{2jq} > 0$).

2.2 Data Descriptions

This study examines empirical analysis on the basis of two data sets. One of the data, Korean Innovation Survey (KIS), is constructed by Science and Technology Policy Institute (STEPI). KIS contains comprehensive information of innovation activities on manufacturing firms over four waves in 2002, 2005, 2007, and 2010. Another database, called KIS-Value data, managed by National Information and Credit Evaluation (NICE) Inc., is used for this study because of its abundant financial information. Since 1980, KIS-Value data provide corporate and financial information on external audit corporations and firms listed on the Korea Stock Exchange (KSE). To make a full use of firm's R&D activities together with its financial status, the KIS-Value data set is merged with the KIS data set. Since 2002, STEPI has surveyed Korean Innovation Survey (KIS) four times, but most firms are only observed once. Therefore we conduct a pooled cross-sectional analysis rather than a panel data analysis.

2.2.1. Technological Innovations

As we consider the degree of R&D performance, this study utilizes two dependent variables. The first dependent variable is a binary one, indicating whether a firm launched new or improved products over the last three years. This variable reflects an occurrence of innovation. However, it contains not only the first product innovation in the market, but also new product launches which are later than its competitors. For the latter, a firm's R&D

performances fall a step behind its rivals, implying low uncertainty R&D activities such as imitation. Therefore, we need to distinguish the higher level of R&D performance from that of the lower level.

The second dependent variable measures the degree of innovation for R&D activities. In order to formulize this variable, we use two questions, obtained from Korean Innovation Survey (KIS). One asks whether product innovation took place prior to its competitors or not. The other inquires whether a firm launched new or improved existing products. Based on these two questions, this paper generates an innovation score index which denotes the degree of technological innovation. Table 3.1 shows how innovation score index was measured. This index is on a scale from 0 (no R&D performance) to 4 (the most innovative R&D performance).

Table 3.1 Innovation Score Index

		The first product innovation in the market (prior to competitors)	
		No	Yes
Product Innovation:	Improved products	1	3
	New products	2	4
	Nothing	0	

The distribution of innovation score index in the sub-sample of large firms or small & medium-sized enterprises (SMEs) is presented in Table 3.2. Large firms achieve R&D performance more than SMEs; 49.76% of firms

among SMEs achieve R&D performance, while 67.32% of large firms succeed in innovation. Interestingly, when we look at the distribution within the cases of success in R&D activities, SMEs accomplish high uncertainty R&D activities (i.e. innovation score is 4) more than large enterprises; the share of those achieving 4 points in innovation among SMEs and large firms are 39.9% and 33.0%, respectively.

Table 3.2 Distribution of Innovation Score

Innovation Score	Small and Medium-Sized Firms	Large Firms
0	1,802 (50.24)	150 (32.68)
1	473 (13.19)	86 (18.74)
2	403 (11.24)	65 (14.16)
3	197 (5.49)	56 (12.20)
4	712 (19.85)	102 (22.22)
Total	3,587 (100)	459 (100)

Note: () denotes percentage

2.2.2. Financially Distressed Firms with Bank Loans and without Bank Loans

In this study, the principal variable is associated with bank loan to financially distressed firms. We measure whether a firm gets additional loans from its bank in spite of financial difficulties, which are assessed by a

low value of Altman's z-score.[9] Altman (1968) is the pioneer in the study of modern analytical techniques for estimation of the likelihood of borrower's default.[10] More specifically, Altman developed a discriminant function, which is used to predict the probability that a firm will go into bankruptcy within two years. Altman's z-score, calculated from the discriminant function, gives criteria to distinguish whether firms are likely to default or not. Altman found that "all firm having z-score of greater than 2.99 clearly fall into the 'non-bankrupt' sector, while those firms having z-score below 1.81 are all bankrupt." In short, the lower the z-score is, the higher the probability of default increases. The discriminant function of Altman's z-score is as follows;

$$\mathrm{Z} = 1.2 \times \frac{Working\ Capital}{Total\ Assets} + 1.4 \times \frac{Retained\ Earnings}{Total\ Assets} + 3.3 \times \frac{EBIT}{Total\ Assets}$$

$$+0.6 \times \frac{Market\ Value\ of\ Equity}{Book\ Value\ of\ Total\ Debt} + 0.999 \times \frac{Sales}{Total\ Assets} \qquad \ldots Eq(3.3)$$

On the basis of the above formula, we define the financially distressed firm with bank loan if it gets additional bank loans even though z-

[9] Alexeev and Kim (2008) demonstrated the existence of SBC before and after the Korean financial crisis by using Altman's z-score.

[10] Altman's z-score was developed based on a sample of 33 U.S. manufacturing firms defaulting between 1946 and 1965 and a paired and appropriately stratified random sample of 33 firms that were still in existence in 1966.

score was below 1.81 in the previous year. On the contrary, the financially distressed firm without bank loan is in case that z-score is below 1.81 and fails to borrow additional fund from its bank in the following year. Both financially distressed firm with bank loan and that without bank loan are binary variables. Since technological innovations require long-term to achieve, the additional funds to accomplish innovation might be necessary more than one year. Therefore, we consider the secondary variables which indicate the experience of providing additional bank loan for two years in a row.

Table 3.3 presents the distribution of financially distressed firms with or without bank loan. When we consider continuous experiences, the share of the financially distressed firm, which gets bank loan, decrease remarkably. If we look at the distribution on a year-on-year basis, the share of FDFs with loan or FDFs without loan does not vary except in 2007. This trend implies that the phenomenon of bank loan to financially distressed firms was prevalent just before the global financial crisis in 2008.

Table 3.3 Distribution of Financially Distressed Firms (FDFs) with or without loan

	2000	2002	2005	2007	Total
FDFs with loan	175 (18.5)	186 (18.2)	109 (17.1)	242 (23.9)	712 (19.7)
FDFs without loan	159 (16.8)	173 (16.9)	116 (18.2)	157 (15.5)	605 (16.7)
FDFs with loan for two years	45 (4.8)	70 (6.8)	49 (7.7)	105 (10.4)	269 (7.4)
FDFs without loan for two years	78 (8.2)	67 (6.5)	42 (6.6)	44 (4.3)	231 (6.4)
Total number of firms	947	1,023	637	1,012	3,619

Note: percentage is in parentheses

2.2.3. Explanatory Variables

This study regards two motivations as drivers to induce beneficial effects of bank loan to troubled firm on innovation. One is related to profit motive, and the other is associated with survival motive. Both motivations may give firms incentives to make an effort although they could anticipate bailouts from a financial distress. In terms of profit motive, we employ a performance-based bonus per workers as an explanatory variable. Meanwhile, the reciprocal of Herfindahl-Hirschman Index (HHI) is applied to explain survival motive. HHI indicates an industrial concentration, therefore U.S. Department of Justice and the Federal Trade Commission use this index as a screening tool to determine whether a proposed horizontal merger is likely to increase anti-trust concerns. We calculate HHI by the summation of the squares of domestic market share within the three-digit industry. Since increases in HHI indicate decreases in competition, this paper uses the reciprocal of HHI. Both bonus and the inverse of HHI are log-transformed in the estimation.

In order to consider industrial differences, this paper classifies industrial sectors into four categories according to the capital intensity and the pace of product substitution; low capital intensity and slow product replacement (LS), low capital intensity and rapid product replacement (LR), high capital intensity and slow product replacement (HS), and high capital intensity and rapid product replacement (HR). For instance, the chemical industry or the steel industry belongs to ‘high capital intensity and slow product replacement (HS)’ industrial sector. Meanwhile, the IT industry or

the precision instrument industry fits in 'low capital intensity and rapid product replacement (LR)' industrial sector. Table 3.4 presents the distribution of four industrial sectors, and Table 3.5 shows the distribution of industrial sectors depending on different budget constraints.

Table 3.4 Distribution of Manufacturing Industrial Sectors

		Pace of Product Replacement					
		Slow			Rapid		
Capital Intensity	Low	*classification*	*Freq.*	*%*	*classification*	*Freq.*	*%*
		- Pharmaceuticals, Medicinal Chemicals and Botanical Products	180	16.1	- Tanning and Dressing of Leather , Manufacture of Luggage and Footwear	51	4.2
		- Other Machinery and Equipment	413	37.0	- Wearing Apparel, Clothing Accessories and Fur Articles	96	7.8
		- Furniture	43	3.9	- Rubber and Plastic Products	234	19.0
		- Motor Vehicles, Trailers and Semitrailers	480	43.0	- Electronic Components, Computer, Radio, Television and Communication Equipment and Apparatuses	427	34.7
					- Medical, Precision and Optical Instruments, Watches and Clocks	136	11.1
					- Electrical Equipment	244	19.8
					- Other Manufacturing	42	3.4
		Total	1,116	100	Total	1,230	100
	High	*classification*	*Freq.*	*%*	*classification*	*Freq.*	*%*
		- Beverages	42	3	- Food Products	180	59.8
		- Wood and of Products of Wood and Cork ; Except Furniture	37	2.6	- Textiles, Except Apparel	121	40.2

		- Pulp, Paper and Paper Prod.	101	7.2			
		- Printing and Reproduction of Recorded Media	48	3.4	-		
		- Coke, Hard-Coal and Lignite Fuel Briquettes and Refined Petroleum Products	37	2.6			
		- Chemicals and Chemical Products Except Pharmaceuticals and Medicinal Chemicals	314	22.4			
		- Other Non-metallic Mineral Products	182	13.0			
		- Basic Metal Products	288	20.6			
		- Fabricated Metal Products, Except Machinery and Furniture	240	17.2			
		- Other Transport Equipment	110	7.9			
		Total	1,399	100	Total	301	100

Note: Industrial classification is based on Korean Standard Industrial Classification (KSIC)

Table 3.5 Distribution of Industrial Sectors: FDFs with loan, FDFs without loan, and Healthy Firms

		Pace of Product Replacement					
		Slow			Rapid		
Capital Intensity	Low		*Freq.*	*%*		*Freq.*	*%*
		FDFs w/ loan	231	22.9	FDFs w/ loan	219	20.6
		FDFs w/o loan	146	14.5	FDFs w/o loan	122	11.5
		Healthy firm	632	62.6	Healthy firm	724	68.0
	High		*Freq.*	*%*		*Freq.*	*%*
		FDFs w/ loan	291	23.0	FDFs w/ loan	74	34.4
		FDFs w/o loan	207	16.3	FDFs w/o loan	63	29.3
		Healthy firm	769	60.7	Healthy firm	141	65.6

According to the Schumpeterian tradition, we control size effects on

innovation equation. Large firms have more internal finance and easier to access to external finance. They are more likely to engage in risky projects and benefit from economies of scale (Schumpeter, 1942; Raymond et al., 2010). This paper includes two explanatory variables to control size effects. One is measured by the number of workers. The other is domestic market share which is defined as the ratio of sales of a firm over the total sales of the three-digit industry to which it belongs. In addition, two R&D variables associated with R&D capacity, are included. One is R&D expenditure, and another is R&D human capital. R&D spending is log-transformed in this estimation, and we define R&D human capital as the ratio of the number of researchers in R&D over the total number of employees. We expect that the likelihood of technological innovation increases when a firm invests more on R&D capital. This study also controls industry and time effects as well as firm's age, which might represent its learning process.

3. Empirical Analysis

3.1. Effect of Bank Loan to Financially Distressed Firms on Technological Innovations

This section empirically analyzes the relationship between bank loan to financially distressed firms and R&D performance. According to diverse uncertainties of R&D projects, we employ two dependent variables which are associated with innovation. The first dependent variable is related to product innovation, which takes the value 1 if a firm launched new or improved existing products and 0 otherwise. The second dependent variable

indicates innovation score, which is on a scale from 0 to 4. This score reflects the degree of technological innovation depending on the project's risk. In short, a higher innovation score is associated with more innovative R&D performances. Therefore, we apply probit estimation for the first dependent variable, while ordered-probit estimation is conducted for the second one.

By extension, we consider the continuous experience of providing additional bank loan. Collective experience of getting bank loan takes the value 1 if a firm under financial distress gets bank loan for two consecutive years and 0 otherwise. Similarly, continuous experience of FDFs without loan, which is binary, indicates that the firm under financial distress fails to get additional loans for two years. The empirical results of the association between loan to financially distressed firm and technological innovation is presented in Table 3.6; the 2nd and 4th column are related to FDF with loan, which is measured by one-time experience, while 3rd and 5th column are associated with two times of funding experiences.

Controlling for other determinants of innovation, this paper proves that FDFs with loan itself has a negative and significant effect on R&D performance. However, when performance-based bonus is interacted with bank loan to financially distressed firm, this interacted term shows a positive association with innovation. This implies that profit motives induce the firm to bring out innovation, in case that the firm which conducts R&D activities suffers from financial difficulties. This beneficial effect of FDFs with loan is consistent with both product innovation model and innovation score model. These results imply that a troubled firm with bank loan focuses on not just launching products, which include imitation, but also conducting

high risk projects, if it has an incentive to make an effort.

When the variable of FDF with loan is measured by using collective experience, we can find more interesting results. For the firm under financial distress but getting bank loan, interestingly, competition influences positively and significantly on both product innovation and innovation score. Intensive competitive market gives a motivation for survival, but it also gives a chance for preoccupying the market. Therefore, the troubled firm, in the competitive environment with loans, is more likely to engage in risky project, which in turn grants high returns. To sum up, both profit and survival motives can drive more significant R&D performance, when the distressed firm gets additional funds. These results suggest that distressed firms with loans could pursue long-termism when it has incentives to make an effort. Meanwhile, this study finds that financially distressed firms with loan, itself, is negatively associated with innovation when we extract beneficial effects from the total effect.

For a trouble firm which fails to get bank loan, bonus has a significant and positive effect on product innovation as well as innovation score model. In contrast, there is no significant relationship between competition and innovation. These empirical findings imply that intensive competition as a survival motive makes a manager who fails to get bank loan and suffers from financial distress to focus on short-termism, because he is unwilling to take business risks. To sum up, this paper finds that profit motive, rather than survival motive, has much to do with more innovative R&D performance in terms of FDFs without loan.

The results, reported in Table 3.6, indicate that size, measured by the

number of employees, is positively and significantly associated with R&D performance. This result supports the Schumpeterian tradition. Meanwhile, R&D capacities, which are comprised of R&D expenditure and R&D human capital, influence positively and significantly on technological product innovation.

Table 3.6 The Effect of Bank Loan to Financially Distressed Firm on Innovation[11]

	Product Innovation Model		*Innovation Score Model*	
	(1)	(2)	(3)	(4)
FDFs with loan	-4.042** (0.01)	-6.407** (0.02)	-3.685** (0.01)	-5.155** (0.04)
× Bonus	0.304*** (0.00)	0.517** (0.011)	0.295***(0.002)	0.460** (0.01)
× Competition	0.079 (0.348)	0.215* (0.076)	0.093 (0.207)	0.253** (0.01)
FDFs w/o loan	0.254 (0.874)	-2.713 (0.312)	1.299 (0.320)	-2.977 (0.227)
× Bonus	0.015 (0.882)	0.288* (0.089)	-0.043 (0.602)	0.278* (0.071)
× Competition	0.088 (0.353)	0.230 (0.120)	0.114 (0.163)	0.168 (0.180)
Bonus	-0.019 (0.729)	0.014 (0.749)	0.009 (0.833)	0.018 (0.618)
Competition	-0.038 (0.620)	-0.046 (0.525)	-0.123* (0.055)	-0.130** (0.03)
Workers	0.208*** (0.00)	0.201*** (0.00)	0.148*** (0.00)	0.146***(0.00)
Market power	0.027 (0.232)	0.027 (0.231)	0.027* (0.094)	0.026 (0.106)
R&D expenditure	0.066*** (0.00)	0.068*** (0.00)	0.076*** (0.00)	0.077***(0.00)
R&D human cap.	0.024*** (0.00)	0.024*** (0.00)	0.011*** (0.00)	0.010***(0.00)
Age	0.001 (0.760)	0.000 (0.930)	-0.002 (0.617)	-0.003 (0.497)
Industry dummy	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Observations	1,241	1,241	1,241	1,241
LR test	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Pseudo R^2	0.115	0.118	0.0455	0.0460

Note: Model (1) and (3) reflect just a single experience of borrowing additional loans, while model (2) and (4) reflect repeated experience of getting bank loans. P-values are in parentheses and in brackets. The superscripts *, **, and *** following the *p*-values represent a 10%, 5%, and less than 1% significant level, respectively.

[11] The results are consistent when we exclude R&D expenditure in the estimation in order to look at the total effect of FDFs with loan to innovation.

3.2. Comparison of the Magnitude of Effects on Innovation between FDFs with loan and FDFs without loan

We can compare the magnitude of beneficial effects and hazardous effects on innovation depending on the different budget constraints. As considering the characteristic of technological innovation which takes long period to achieve, we quantify the magnitude of each effect on the basis of the outcomes in 5th column of Table 3.6. In order to distinguish the impact on high uncertainty projects from that on low uncertainty projects, this paper compares the magnitude of each effect, depending on the various R&D performances. In short, we compare positive effects and negative effects, depending on not only different budget constraints but also diverse degrees of R&D performance.

Table 3.7 presents the marginal effects of FDFs with loan and FDF without loan on innovation. 2nd column of Table 3.7 shows R&D performance of low risky project, that is, in case when a firm gains the lowest score except zero for the innovation score index. One point in the innovation score index denotes that a firm introduces fairly improved, but already launched product in the market by its competitors. Therefore, R&D performance, which takes the value 1 in the innovation score, implies less significant R&D achievement such as imitation. Meanwhile, the highest mark in innovation score index indicates that a firm invents new products which are the first launches in the market. Therefore, the innovation score of 4 implies more significant R&D performance. The related findings are reported in the 3rd column of Table 3.7.

When R&D performances are less significant, there is no beneficial

effect of bank loan on innovation for a firm under financial distress. More specifically, this study finds that association between profit motive and low R&D performance is statistically insignificant when the trouble firm gets additional funds. In addition, we find that bank loan to the troubled firm itself reduces the probability of less significant R&D performance by 17.1%. Meanwhile, R&D performance in low risky project is reduced by 17.5% when a firm fails to get additional loan in a situation of financial distress. Consequently, with respect to less significant R&D project, we can find that the volumes of hazardous impacts are similar whether the distressed firm gets additional bank loan or not. Figure 3.2 briefly shows the impact of bank loan on the less significant R&D performance for a firm under financial distress.

A distinct difference between advantageous effects and harmful effects is observed in more significant R&D performance. The results, reported in 3rd column of Table 3.7, show that both profit motive and survival motive are positively associated with high risky projects, when the financially distressed firm are provided additional funds. More specifically, a troubled firm with loans augments the chance of success in technological innovation by 13.3% since the firm gives performance-based bonus to its workers. In addition, a 1% increase in competition raises the probability of highly innovative R&D performance by 7.3%. However, the bank loan to the distressed firm itself reduces the probability of a very innovative R&D performance by 33.2%. Consequently, this study finds that bank loan to the distressed firm reduces the chance of success in high risk innovation by 12.6%, when we consider both beneficial effects and harmful effects. Meanwhile, a troubled firm which fails to get credits hampers highly innovative R&D performance by 26.5%. Bonuses, however, increase

technological innovation approximately by 8%, despite the troubled firm fails to get additional funds. Therefore, the net effect of FDFs without loan amounts to 18.5%, which discourages more significant R&D accomplishments. Figure 3.3 briefly shows the impact of bank loan on the more significant R&D performance for a firm under financial distress.

Table 3.7 Marginal Effects of Bank Loan to Financially Distressed Firms on Technological Innovation

	$\frac{dPr[Innovation\ Score = 1]}{dX}$	$\frac{dPr[Innovation\ Score = 4]}{dX}$
FDFs w/ loan	-0.171*** (0.015)	-0.332*** (0.069)
× Bonus	0.003 (0.003)	0.133** (0.052)
× Competition	0.001 (0.002)	0.073** (0.030)
FDFs w/o loan	-0.175*** (0.022)	-0.265*** (0.051)
× Bonus	0.002 (0.002)	0.080* (0.045)
× Competition	0.001 (0.001)	0.048 (0.036)
Performance-based bonus	0.000 (0.000)	0.005 (0.010)
Competition in the market	-0.001 (0.001)	-0.038** (0.018)
Workers	0.001 (0.001)	0.042*** (0.014)
Domestic market power	0.000 (0.000)	0.008 (0.005)
R&D expenditure	0.000 (0.000)	0.022*** (0.005)
R&D human capital	0.000 (0.000)	0.003*** (0.001)
Age	-0.000 (0.000)	-0.001 (0.001)

Note: Standard errors are in parentheses. The superscripts *, **, and *** following the p-values represent a 10%, 5%, and less than 1% significant level, respectively.

Figure 3.2 Comparison of the Effects between FDF With Loan and Without Loan on the Less Significant Innovation

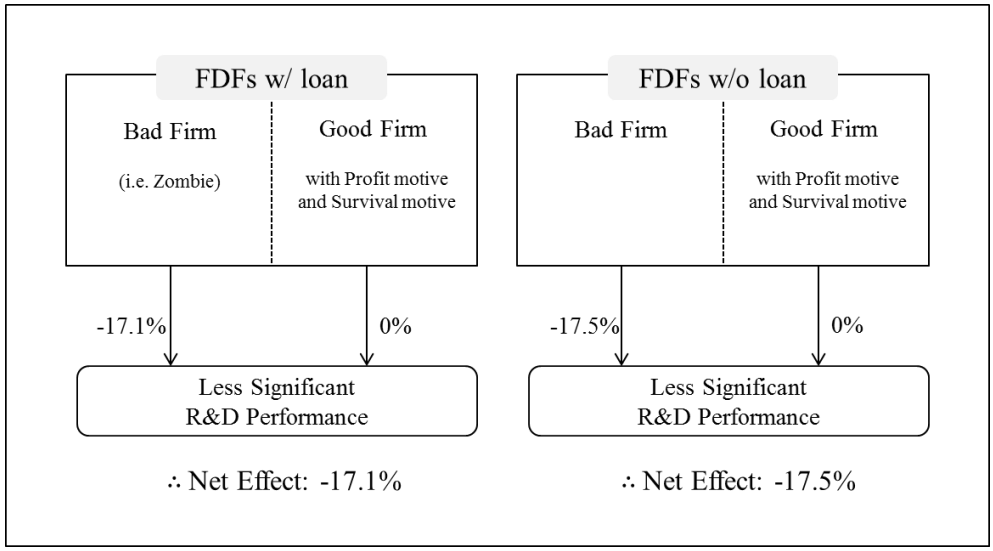
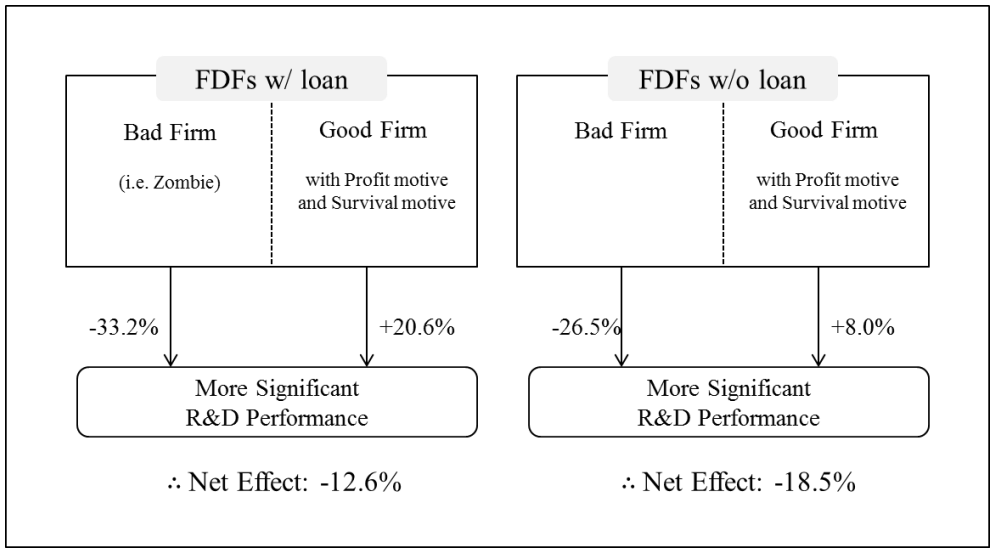


Figure 3.3 Comparison of the Effects between FDFs With Loan and Without Loan on the More Significant Innovation



To sum up, we have two implications from the association between different budget constraints and diverse degrees of innovation. First, the magnitudes of net effects between FDFs with loan and FDFs without loan are comparable in less significant R&D performance. That is, about 17% decrease in low risky project occurs whether the financially distressed firms get additional bank loan or not. This is because there are no beneficial effects on less significant R&D performance. Second, when R&D performance is more significant, the results are somewhat contrary depending on firm's budget constraint. The probability of more significant R&D performance is hampered by 18.5% when the trouble firm fails to get a loan. This result is compared to a 12.6% decrease when the distressed firm gets a loan. This is because the beneficial effect of financially distressed firm, which fails to achieve more credits, is not strong enough for high uncertainty projects. This implies that a troubled firm without additional funds is likely to focus on the short-termism, which is unwilling to engage in high risk project. To sum up, the gap of net effects between FDFs with loan and FDFs without loan widens in cases of more significant R&D accomplishments for two reasons; one is short-termism for a distressed firm which fails to get additional funds and another is enormous advantageous effects for a distressed firm which gets additional bank loan.

3.3. Robustness Check: Product Innovation as well as Process Innovation

Technological innovation largely consists of product innovation and process innovation. Product innovation signifies cases when a new product launched

in the market has influenced the company's revenue significantly. On the other hand, process innovation point to cases when new production procedures, delivery and retailing logistics derive significant production and retailing cost reduction. This study certifies the robustness of its estimates by performing analysis taking into consideration both product and process innovations as dependent variables.

Table 3.8 shows that the relationship between financially distressed firms and innovation scores through the ordered probit estimation. As dependent variable, model (1), (2), (3) use product innovation, process innovation, and product or process innovation, respectively. We found that the empirical results of model (1) and model (3) are comparable. In short, this paper finds that FDFs with loans have a significantly negative effect on R&D performance such as product or process innovation. However, when performance-based bonus or competition is conditioned for the bank loan, a positive association with technological innovation is found. For financially troubled firms which fail to receive bank loans, the results of model (3) are similar with those of model (1). The difference between model (1) and model (3) is that competition influences positively and significantly on technological innovation when innovation is defined as including both product and process innovation.

Model (2), which use process innovation as the dependent variable, shows different results from when innovation is defined as product innovation. If good conditions allow the financially distressed firms that received additional loans to pursue long term growth, product innovation is proven to be accomplished. However, even if financially troubled firms are provided with good internal and external conditions (in other words, profit

and survival motives), additional loans from banks do not significantly affect process innovations. Such results illustrate firms that receive bank loans, though they may have less financial constraints than firms that did not receive loans, may experience heightened risks of bankruptcy because periodical interest payments are increased. Product innovation designates cases in which the previous products are improved or new products are launched, thus bringing about diverse bounds of achievements. On the other hands, process innovation bespeaks of cases in which logistics or retail systems are introduced. Therefore, if financially distressed firms receive loans, the probability of them succeeding in a product innovation is higher than process innovations.

Table 3.8 The Effect of Bank Loan to Financially Distressed Firm on Innovation: Robustness Check

	(1) Product Innovation	(2) Process Innovation	(3) Product or Process Innovation
FDFs with loan	-5.155** (0.048)	-1.621 (0.531)	-4.142* (0.094)
× Bonus	0.460** (0.011)	0.148 (0.409)	0.358** (0.037)
× Competition	0.253** (0.014)	0.106 (0.311)	0.175* (0.082)
FDFs w/o loan	-2.977 (0.227)	-3.559 (0.201)	-3.287 (0.180)
× Bonus	0.278* (0.071)	0.414** (0.020)	0.378** (0.015)
× Competition	0.168 (0.180)	0.399*** (0.003)	0.352*** (0.006)
Bonus	0.018 (0.618)	0.040 (0.298)	0.025 (0.487)
Competition	-0.130** (0.033)	0.019 (0.769)	-0.079 (0.191)
Workers	0.146*** (0.002)	0.205*** (0.000)	0.195*** (0.000)
Market power	0.026 (0.106)	0.031* (0.095)	0.037** (0.023)
R&D expenditure	0.077*** (0.000)	0.018 (0.342)	0.050*** (0.006)
R&D human cap.	0.010*** (0.000)	0.008*** (0.010)	0.011*** (0.000)
Age	-0.003 (0.497)	-0.008** (0.046)	-0.008** (0.033)
Industry dummy	Yes	Yes	Yes
Time dummy	Yes	Yes	Yes
Observations	1,241	1,241	1,241
LR test	[0.000]***	[0.000]***	[0.000]***
Pseudo R^2	0.0460	0.0480	0.0430

Note: Model (1), (2) and (3) reflect repeated experience of borrowing additional loans. p-values are in parentheses and in brackets. The superscripts *, **, and *** following the *p*-values represent a 10%, 5%, and less than 1% significant level, respectively.

3.4. Effect of Bank Loan to Financially Distressed Firms on Technological Innovations, under Diverse Industrial Sectors

In this section, we test which industrial sectors positively or negatively influence a distressed firm with bank loan to induce technological innovation. Based on two criteria, capital intensity and pace of product substitution, manufacturing firms are sorted into four categories; low capital and slow product replacement (LS) industries, low capital and rapid product replacement (LR) industries, high capital and slow product replacement (HS) industries, and high capital and rapid product replacement (HR) industries. In addition, this study consider two motivations, profit motive and survival motive, in order to examine the beneficial effects of bank loan to the troubled firm on innovation. In short, the four industrial sectors and the two motivations to pursue long-run growth are considered in the estimation. The results from probit estimation, related to the product innovation model, are presented in the 2nd and 3rd column of Table 3.9, while the results form ordered-probit estimation, associated with the innovation score model, are presented in the 4th and 5th column of Table 3.9[12].

Controlling for the other determinant of innovation, this paper finds that bank loan to the financially distressed firm impedes product innovation when the firm belongs to low capital intensity industries. In particular, under LR (low capital intensity and rapid product replacement) industries such as the IT or the clothing industry, bank loan to the distressed firm negatively influences more significant R&D performance. The results imply that

[12] 3rd and 5th column of Table 3.9 reflect repeated experience of getting additional credits.

additional bank loan to the financially distressed firm can hamper technological development in the realm of low capital intensity and rapid product replacement industries. However, when we consider both diverse industrial sectors and motivations all together, we find interesting results for the LR industries. Bank loan to the distressed firm itself impedes technological innovation when the firm belongs to LR industries. However, even in these industrial sectors, the beneficial impact of bank loan to the distressed firm appears if a profit motive is given to the firm. In particular, we prove that an incentive to make an effort helps a troubled firm with loans carry out outstanding innovation in the realm of LR industries such as the IT industry. These results may suggest a mechanism how LR industries achieve technological development for a troubled firm with additional funds. Meanwhile, for a firm which suffers from financial distress and fails to get additional funds, the paper finds evidence that survival motive induces a firm, which belongs to LS industries, to achieve technological innovations.

Table 3.9 The Effect of Bank Loan to Financially Distressed Firms on Innovation under Diverse Industrial Sectors

VARIABLES	*Product Innovation Model*		*Innovation Score Model*	
	(1)	(2)	(3)	(4)
LS industry	0.106(0.95)	-0.727(0.587)	-1.867(0.146)	-1.784(0.104)
for FDF w/ loan	-6.3**(0.03)	-4.94(0.246)	-3.539(0.162)	-2.933(0.453)
× Bonus	0.5***(0.01)	0.544*(0.058)	0.342**(0.037)	0.392(0.133)
× Competition	0.180(0.26)	0.577**(0.020)	0.261*(0.059)	0.511**(0.019)
for FDF w/o loan	1.947(0.47)	0.874(0.867)	2.838(0.194)	1.092(0.811)
× Bonus	-0.004(0.98)	0.223(0.481)	-0.097(0.447)	0.109(0.692)
× Competition	0.34*(0.05)	0.678**(0.013)	0.261*(0.085)	0.480**(0.034)
LR industry	-1.30(0.468)	-1.973(0.184)	-1.664(0.248)	-1.779(0.137)
for FDF w/ loan	-6.20*(0.08)	-18.831(0.103)	-6.008**(0.039)	-17.622**(0.03)
× Bonus	0.40*(0.08)	1.270(0.111)	0.361*(0.059)	1.242**(0.027)
× Competition	-0.048(0.82)	-0.015(0.961)	-0.130(0.448)	0.079(0.748)
for FDF w/o loan	2.189(0.61)	-9.469(0.420)	3.292(0.211)	0.532(0.948)
× Bonus	-0.120(0.67)	0.578(0.419)	-0.205(0.218)	-0.076(0.882)
× Competition	0.011(0.96)	-0.204(0.752)	0.008(0.962)	-0.139(0.704)
HS industry	-0.901(0.69)	1.257(0.524)	-1.249(0.521)	-0.250(0.879)
for FDF w/ loan	2.075(0.58)	-1.886(0.763)	0.855(0.795)	1.527(0.775)
× Bonus	-0.182(0.44)	0.049(0.910)	0.116(0.576)	0.035(0.924)
× Competition	-0.094(0.71)	-0.170(0.606)	0.374*(0.085)	0.286(0.310)
for FDF w/o loan	9.64**(0.04)	1.546(0.819)	5.738*(0.087)	-1.114(0.846)
× Bonus	-0.429(0.11)	0.175(0.664)	-0.117(0.567)	0.270(0.433)
× Competition	0.500(0.13)	0.596(0.188)	0.607**(0.029)	0.422(0.304)
LS industry				

× Bonus	-0.018(0.83)	0.021(0.754)	0.034(0.611)	0.030(0.595)
× Competition	-0.129(0.31)	-0.133(0.280)	-0.33***(0.003)	-0.30***(0.004)
LR industry				
× Bonus	0.052(0.63)	0.102(0.224)	0.057(0.495)	0.049(0.454)
× Competition	0.048(0.69)	0.035(0.758)	-0.012(0.910)	-0.055(0.559)
HS industry				
× Bonus	0.043(0.72)	-0.093(0.340)	-0.064(0.529)	-0.084(0.304)
× Competition	-0.006(0.97)	0.016(0.925)	-0.295*(0.072)	-0.185(0.218)
Worker	0.2***(0.00)	0.196***(0.001)	0.143***(0.003)	0.15***(0.002)
Market power	0.04*(0.08)	0.031(0.169)	0.037**(0.027)	0.028*(0.088)
R&D expenditure	0.06***(0.0)	0.064***(0.004)	0.078***(0.000)	0.078***(0.00)
R&D human capital	0.03***(0.0)	0.031***(0.000)	0.011***(0.000)	0.01***(0.001)
Age	0.00(0.943)	0.000(0.955)	-0.002(0.652)	-0.002(0.629)
Industry dummy	Yes	Yes	Yes	Yes
Year dummy	Yes	Yes	Yes	Yes
Observations	1,241	1,241	1,241	1,241
LR test	[0.000]***	[0.000]***	[0.000]***	[0.000]***
Pseudo R^2	0.129	0.130	0.0515	0.0494

Note: Model (1) and (3) reflect just a single experience of borrowing additional loans, while model (2) and (4) reflect repeated experience. LS industry and LR industry denote low capital intensity and slow product replacement, low capital intensity and rapid product replacement, respectively. HS industry indicates high capital intensity and slow product replacement. *P*-values are in parentheses and brackets. The superscripts *, **, and *** following the p-values represent a 10%, 5%, and less than 1% significant level, respectively.

4. Conclusion

This study scrutinizes the association between the bank loan to the financially distressed firm and technological innovation. Four waves of pooled-cross section data in 2002, 2005, 2007, and 2010 of Korean manufacturing firms are used in this research. We consider various industrial sectors as well as heterogeneity of the firm's characteristics. In addition, diverse levels of R&D performance are considered in the estimation.

Main findings from this research can be summarized as follows. First, bank loan can induce a financially distressed firm to invent new products. Bank loan to the troubled firm itself has a negative effect on innovation, but we find that beneficial effects are seen if the firm has motivations to pursue long-run growth. In particular, both profit and survival motives induce the distressed firms to achieve more significant R&D performance by using additional funds. In short, the positive impact of bank loan to the distressed firm is more prominent when a firm has highly innovative performance than in case of poorly innovative R&D performance. This implies that a distressed firm with bank loan leads to long-termism if some motivations to exert an effort are given. Second, the gap of net effects between financially distressed firms (FDFs) with loan and FDFs without loan increases as R&D performance is more innovative. When we consider harmful effects and beneficial effects all together, net effects on innovation still appear negative. In terms of less significant R&D performance, the magnitude of net impact of FDFs with loan, which impedes innovation, is not different from that of FDFs without loan. In addition, for a financially distressed firm with loan, the magnitude of net effect on less significant R&D performance is similar with the effect on more significant R&D

performance. However, a hazardous net impact on more significant R&D performance escalates if the firm with financial distress fails to get additional loan. Consequently, with respect to more significant R&D performance, the gap of net impact between FDFs with loan and FDFs without loan shows considerable difference. This is because a troubled firm which fails to get additional loan, in contrast with FDFs with loan, does not have enough incentives to promote outstanding innovation because of high risk. This finding implies that a financially distressed firm which fails to get bank loan could lead to short-termism, while the distressed firm with additional bank loan could induce long-termism. Third, for a financially distressed firm with bank loan, low capital intensity and rapid product replacement (LR) industries are negatively associated with innovation. However, we find that profit motive drives a troubled firm with bank loans to achieve more significant R&D performance, even the firm belongs to LR industries. These results can suggest a mechanism how bank loan to the distressed firm drives technological development in certain industrial sectors such as the IT industry.

Appendix

Appendix 3.1 Description of Regression Variables

	Variable	Description
R&D Performance	Product innovation	Launches new or improved products *(binary)*
	Innovation score	Innovation score index *(scale: 0~4)*
Financially Distressed Firm	FDFs with loan	Low z at (t-1) and additional loan at (t) *(binary)*
	FDFs without loan	Low z at (t-1) but fails to borrow at (t) *(binary)*
	FDFs with loan for 2 years	Experience FDF w/ loan for 2 consecutive years *(binary)*
	FDFs without loan for 2 years	Experience FDF w/o loan for 2 consecutive years *(binary)*
Motivations	Bonus (profit motive)	Performance-based bonus per worker *(log form)*
	Competition (survival motive)	Inverse of HHI *(log form)*
Control	Worker	Number of workers *(log form)*
	Market power	Domestic market share
	R&D spending	R&D expenditures *(log form)*
	R&D human capital	Ratio of no. of researchers over total no. of workers
	Age	Period since the date of the establishment
	Industry	Industry dummy of 24 categories
	Year	Year dummy: 2000, 2002, 2005, 2007

Appendix 3.2 Descriptive Statistics of Regression Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Product innovation	1687	0.5382	0.4987	0	1
Innovation score	1687	1.3094	1.5844	0	4
FDFs w/ loan	1576	0.2005	0.4005	0	1
FDFs w/o loan	1576	0.1707	0.3764	0	1
FDFs w/ loan (2yrs)	1576	0.0698	0.2549	0	1
FDFs w/o loan (2yrs)	1576	0.0558	0.2297	0	1
Bonus	1687	14.6016	1.0168	7.6211	16.9424
Competition	1687	-6.3135	-1.1074	-9.1521	4.4345
Worker	1675	4.6421	0.8845	1.0986	7.4354
Market power	1685	0.9915	2.8754	0.0003	56.3148
R&D spending	1336	18.8930	2.1117	10.6920	23.9306
R&D human capital	1687	7.0979	12.0138	0	132.394
Age	1687	15.2922	10.3250	1	71

Appendix 3.3 Correlation of the Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1)	1.00												
(2)	0.72	1.00											
(3)	-0.1	-0.0	1.00										
(4)	-0.0	-0.0	-0.2	1.00									
(5)	-0.1	-0.0	0.56	-0.1	1.00								
(6)	0.00	0.00	-0.1	0.56	-0.1	1.00							
(7)	0.07	0.04	-0.1	-0.1	-0.0	-0.0	1.00						
(8)	-0.0	-0.1	0.00	0.04	0.01	0.04	0.04	1.00					
(9)	0.10	0.10	0.00	0.07	0.00	0.06	0.22	0.12	1.00				
(10)	0.01	0.05	0.03	0.09	0.00	0.10	0.11	-0.2	0.28	1.00			
(11)	0.20	0.16	-0.0	-0.0	0.00	-0.1	0.01	-0.0	0.28	0.09	1.00		
(12)	0.18	0.12	-0.1	0.01	-0.0	-0.0	-0.1	-0.1	-0.2	-0.0	0.27	1.00	
(13)	0.01	0.00	0.02	0.15	0.00	0.13	0.24	0.07	0.42	0.30	0.03	-0.1	1.00

Note: (1) product innovation, (2) innovation score, (3) FDF with loan, (4) FDFs without loan, (5) FDFs with loan for 2 years, (6) FDFs without loan for 2 years, (7) bonus (8) competition (9) worker, (10) market power, (11) R&D spending, (12) R&D human capital, (13) age

IV. Corporate Performance and Reorganization of Financially Distressed Firms

1. Introduction

The Workout program, whose initial aim was to prevent the wave of bankruptcies subsequently expected of the Asian Financial Crisis, was introduced in 1998. Since then, its function has been to search for firms with high growth and turnaround potentials, and to recuperate their strong financial structures. In that a workout is carried out as an agreement between the firm and its creditors, it is differentiated from a legal corporate restructuring, under which the court takes charge to overlook the process. Early researches studying the performance of workout programs differentiate workout and legal reorganization programs, and focus mainly on comparing and contrasting the effects of the two different programs. For example, Kim and Kim (2000) found that in the case of a workout, the CAR(Cumulative average abnormal return) has a tendency to rise immediately before and after the announcement of its initiation, while a CAR increase coinciding such disclosure tends not to prolong itself, regardless of whether it was a workout or legal reorganization disclosed. Kim and Kim(2000)'s research, however, only sheds light on the effects of announcing the commencement of reorganization, and is ignorant to the outcomes beyond termination of the programs. Therefore, strictly speaking, it fails to offer a thorough understanding of the subject under study. On the other hand, Lee (2004) scrutinizes both points of initiation and termination

of reorganization. He verified that when initiation of reorganization begun, firms which underwent a workout program tended to yield a positive CAR value, while firms which walked through a legal reorganization tended to return negative CAR value. At points of the programs' termination, neither workout nor legal reorganization was significant factors affecting the CAR value. Lee claims that such results suggest skepticism amongst market participants towards turnaround possibilities of firms under reorganization. Furthermore, Chang and Hwang (2008) reviewed the long-term performances of firms that underwent reorganization programs. They found that workout programs yielded highly positive outcomes, whilst performance of legal reorganization programs was rather disappointing. As such, previous works of research recognize that workout programs are more efficient than, if not indifferent to, legal reorganization.

Recently, numerous researches have analyzed factors that affect the performance of workout firms. Some of the factors which were identified to be significant are as follows; debt restructuring, corporate ownership structure, and self-restoration effort of the firm (Chang and Hwang. 2008; Kang. 2004; Park et al. 2011). Amongst researches that reviewed the effects of the factors above, studies focusing on debt-equity swap, a means of debt restructuring, is interesting as contradicting results appear. For example, Park et al. (2002) claim that the lower the BIS ratio of its main creditor bank, and the larger the size of the distressed firm, the more likely was a debt-equity swap. Park et al. (2002) claims such results suggest the notion that 'too big to fail' is still affect banking practices. Lee and Park (2007) were on the same wavelength as Park et al. (2002) in that they also supported the statement that the lower the BIS ratio of the main creditor bank, the more likely a debt-equity swap. But they further found that amongst the firms

who underwent debt equity swaps, firms whose main creditor bank had higher BIS ratios displayed better business performance than those whose creditor bank had lower BIS ratios. Through such discovery, Lee and Park (2007) argues that in the case of financially distressed banks, the decision to swap debt to equity may be arrived as a means to avoid recognizing further loss, not from a judgment that the struggling firm would grow in the future.

Researches of Park et al. (2002), and Lee and Park (2007) have great implications in that they underline the possibility of mal-function in the part of banks in screening out best candidates for debt equity swap among struggling firms. However, their limitation is that they do not take into account how the firms' potential for growth comes into play in the relationship between debt to equity swap and the banks' BIS ratio. To elaborate further, in the case of a bank whose BIS ratio is low, it is attractive to decide on a debt-equity swap as it rids of their insolvent loans, their risky assets. However, despite the possibility that a financially distressed bank chooses debt to equity swap to inflate its BIS ratio, banks will not make the decision if a delisting of the firm is clearly anticipated. On the contrary, if the firm shows strong signs of potential future growth, banks ought to seek returns through stock ownership. Therefore, one needs not only consider the financial health of banks, but also the future growth potentials of the firms when discussing whether banks function well in screening out best candidates for debt equity swap amongst those undergoing workout. Moreover, there are two more drawbacks in the works of Park et al. (2002) and Lee and Park (2007) in their analysis of relationship between debt to equity swap and firm performance. Firstly, effects of disclosing the initiation of workout on stock prices are suitably to measure corporate performance. Strictly speaking, no concrete analysis can be said to have taken place on the

relationship between corporate performance and workout programs. Secondly, only a simple t-test was carried out, while a regression analysis could have been more suitable, as it takes into account possibilities of many other variables that may affect corporate performance. Such drawbacks restrain the credibility of their research results, and lead to contradicting results in analyzing the relationship between debt to equity swap and corporate performance. For example, Kang (2004) and Park et al. (2011) analyze multi-variate regression to show that debt to equity swap positively affect ex-post corporate performance after termination of workout program. However, taking factors in a point of time in the past and relating them to have an effect on a point of time long thereafter is a shortcoming. It does not consider the possible existence of other variables which might occur in between to influence performance. Also, they have flawed by failing to analyze the firms' changing characteristics by time. They manage only to perform a simple cross sectional analysis.

This paper explores the relationship between debt to equity swap and corporate performance while enhancing the credibility of its research results through rigorous analysis procedures, which are improved from preceding methods in three ways. Firstly, it shall consider not only the banks' financial health as the factor yielding to debt to equity swap, but also the growth potential of the distressed firms as another factor. Intangible assets, such as industrial property rights continuously aid in the profitability. Thus this paper focuses on the proportion of intangible assets from total assets as a measure of potential future growth. Secondly, this paper reviews debt to equity swap, self-restoration efforts of the firm, and corporate ownership structure as factors which affect performance of workout firms, and performs both short term and long term analyses in these relationships. In

other words, this paper will make comparing analyses on the various factors that may affect corporate performance due to reorganization. Such analyses will be made in terms of both immediate short term effects, and long-term effects into times beyond termination of the workout program. Thirdly, this paper bases its short and long term analyses on a dynamic panel model to analyze the effects of debt to equity swap on corporate performance. The rationale is that performance in the previous term may influence performance this year. This research will concede to the above three points to review whether banks take into consideration the future growth potential of firms when deciding to swap debt to equity, and further investigate whether debt to equity swaps indeed yield improved corporate performance even after termination of the workout program. Results from such research shall have meaning by revealing whether banks function as they should to screen out the best debt equity swap candidates, those with high growth and profitability potential, among distressed firms under the workout system.

2. Literature Review

The performance of workout, which is a private reorganization program, is evaluated in comparison with the alternative reorganization program overlooked by the court. For instance, Gilson et al. (1990) found that financially distressed firms can more successfully restructure their debt outside of Chapter 11, the legal management method of reorganization. More specifically, 169 financially distressed firms in the USA were researched to find that cumulative stock returns were significantly higher when debt was restructured privately. Schwarz (1993) also explains that a

private workout should pareto dominate a legal bankruptcy, because Chapter 11 is more costly. Hotchkiss (1995) pointed out that a substantial number of firms emerging from Chapter 11 are strongly associated with poor post-bankruptcy performance. Although his study does not compare the performance of private reorganization with that of legal reorganization, he emphasizes the inefficiency of reorganization process through chapter 11.

Since 1998, in which the workout procedure was first introduced to the Korean economy, Korean researchers have also been studying the performance of workout programs in comparison with legal reorganization programs. For example, Kim and Kim (2000) found that cumulative average abnormal return (CAR) significantly increases immediately before and after announcement of reorganization. However, no further increase takes place if time passes after the announcement, regardless of whether the reorganization is managed privately or by court. Therefore, they conclude that the information of reorganization is fully reflected in Korean stock market in advance of the reorganization itself, and that the reorganization itself has no positive effect on the stock price. The drawback of this research is that it analyzes the performance of reorganization only through the effects of announcing of the initiation, rather than the completion of the program. Strictly speaking, the study merely examines the effect that the reorganization news has on stock prices. In order to truly review the effect of reorganization, corporate performance after termination of the program should be scrutinized. Meanwhile, Lee (2004) studied the effect of public announcement of reorganization on CAR, not only at periods of initiation but also at periods of termination of the debt reconstruction. He found that CAR of a firm that went through a workout program yields a positive value, while CAR of a firm that went through legal reorganization turns a negative

value at points of announcement of initiation of reorganization. Therefore, he concludes that the market participants prefer workout to legal processes in terms of reorganization. However, a positive value of CAR is statistically insignificant when completion of reorganization is announced, regardless of whether workout or legal process. With these results, he concludes that the market participants hold skeptical attitudes toward the possibility that firms under reorganization can be revitalized. Chang and Hwang (2008), on the other hand, found that firms in workout programs show over-performance after completion, while firms in the law process display under-performance in long-run stock performance after restructuring.

In the previous studies, workout programs are argued to be more efficient than legal reorganizations. Otherwise, it is argued that there is no difference between the two reorganization methods in efficiency yielding positive post reorganization performance. The main reason of inconsistent results arises from different period when the performance of reorganization is evaluated. Most of the previous studies use stock returns as the measure of performance and analyzes only short-term (i.e. from one day to one month) effects rather than long-term effects. Therefore, the results can be sensitive according to the differently segmented period. Although there is no consensus on the evaluation of legal reorganization in terms of its efficiency in yielding positive post reorganization performance, it is the general view that workout gives better results than legal reorganization.

With regards to the factors that determine a successful workout, debt restructuring, corporate ownership structure, and self-restructuring effort are identified as significant factors. For example, Chang and Hwang (2008) found that higher asset reduction yields a positive effect on CAR two years

after reorganization. In addition, they found that concentrated ownership structures are positively related to long-term performance of workout firms. Their finding supports the convergence of interest hypothesis, which tells that the more large shareholders, the higher corporate value (Herman, 1981; Jensen and Ruback, 1983; Demsetz and Lehn, 1985; Li and Simerly, 1998; Kim at al., 1988; Holderness and Sheehan, 1991). Kang (2004) executes an interesting empirical analysis by introducing the criteria of success and failure for reorganization by taking into account both the perspectives of creditors and debtors. From a creditors' point of view, success of workout means completion of the workout process. On the other hand, post reorganization revitalization is considered as the most important criterion of success from the debtors' perspectives. Speaking in the terms of debtors, exemption of interest rates, one of the major debt restructuring instruments, is positively associated with firm performance. Park et al. (2011) investigates the effects of workout by measuring performance through various variables, such as return on assets (ROA), return on net sales (ROS), and operational cash flows (OCF). They found that the workout program generally gives a positive effect on profitability and cash flows in the long term. In particular, they show that workout firms that implement capital reduction and that have a higher ratio of outside advisors enjoy better performances. Therefore, they suggest that major shareholders and executives, who are responsible for present insolvency, should be restricted from influencing the workout procedures in order to ensure a more effective reorganization. In addition, disposal of assets has a very large effect on the performance of workout firms. This implies that the self-restructuring effort is an essential factor of successful reorganization.

Among various factors that determine post-workout corporate

performance, it is interesting that previous literatures show contrasting views on debt-to-equity swap, an important debt restructuring tool. For instance, James (1995) uses 102 samples of financially distressed firms in the USA from 1981 to 1990 and finds that firms in which banks hold stock have a higher average cash flow than the firms in which banks do not take an equity stake. However, in Korea, there are some contradicting findings. Park et al. (2002), for example, show that banks with lower BIS ratios and higher loan concentrations prefer debt-equity swaps as the means to restructure workout firms. They assert that these results provide an indirect evidence that the too big to fail hypothesis still influences banking practices in the corporate loan market. Lee and Park (2007) is on the same wavelength as Park et al (2002) as they also found that banks are more likely to swap debt to equity especially when the distressed firms are large and when the BIS ratio of the banks is low. They further found that amongst the firms who underwent debt equity swaps, firms whose main creditor bank had higher BIS ratios displayed better business performance than those whose creditor bank had lower BIS ratios. Therefore, they concluded that a principal-agent problem may be in effect. With data of Japanese firms, Peek and Rosengren (2005) demonstrated a similar point of view. They argue that troubled banks have a pervasive incentive to allocate credit to severely impaired borrowers in order to avoid the realization of losses on their own balance sheet.

Both Park et al. (2002) and Lee and Park (2007) argue for the existence of this principal-agent problem. The reason why banks adopt the debt-equity swap is not because the distressed firms possess enough future growth potential, but because these firms have insolvent debt, which are risky assets for banks. However, these studies have three drawbacks in their

arguments.

Firstly, they evaluate the effect of debt-equity swap on performance by measuring performance as the effect of public announcement of workout initiation. In other words, these studies do not offer an explanation on how debt equity swap affect performance after termination of reorganization. Secondly, they investigate the relationship between debt-equity swap and performance by performing a t-test between two groups; data of firms who carried out a debt-equity swap, and data of those who did not. Therefore, various other factors which might determine corporate performance are not controlled for in these models. Finally, these studies use CAR as the measure of performance. It is not safe to use stock performances for such purposes. Stock prices are determined by many factors other than corporate performance. Instead of stock returns, it is desirable to use accounting indices such as return on assets (ROA) , return on equity (ROE), or operating margin (OPM) (Holder-Webb et al., 2005).

Although Park et al. (2002) and Lee and Park (2007) give interesting implications, the three main drawbacks above cast doubt on the reliability of the results. Particularly, in recent studies, there are contradicting findings that debt-equity swap has a positive effect on the post reorganization performance of workout firms. Kang (2004), for instance, shows that debt-equity swap is a relatively effective tool, among other debt restructuring instruments, which leads to successful corporate turnarounds. This result, however, is insignificant in the multi-variate regression analysis. On the other hand, Park et al. (2011) find that the workout program is more effective when its debt to equity swap ratio is high. They argue that such results suggest the need of an intensive debt restructuring for better post-

reorganization performance. However, they take factors at the period of initiation as independent variables and measure their influence on performance of a time period after the programs' completion. Therefore, they fail to take into account the factors which may occur in between, which may also have a significant effect on performance.

3. Model and Data

3.1. The Model

This research studies two things in order to analyze the relationship between the debt-equity swap of a workout firm and its corporate performance. First, it analyzes the factors that affect the decision of whether to carry out a debt-equity swap. Second, it analyzes how debt-equity swap affects corporate performance not only in short term, but also in a longer term which stretches until after termination of the workout program.

The following equation (4.1) identifies the factors that affect the decision of whether to carry out debt-equity. The factors affecting the decision whether to do a debt-equity swap are either characteristics of the firms themselves, or related to the creditor banks' screening process of identifying candidates with the best potential for growth. The three factors categorized as characteristics of the firms themselves are debt ratio, size scale of the company, and firm ownership structure. A debt-equity swap is attractive for firms if it has a high debt ratio because it offers to the indebted party, the firm, a reduction in debt load. However, a debt-equity swap

transforms the firm ownership structure and tends to reduce the management power of major shareholders by empowering creditors. Considering such aspects, one can anticipate that the debt ratio of a firm should have a positive relationship with debt-equity swap, while the ownership structure of the firm, or, measures such as the stock ownership proportion of major shareholders should have a negative relationship with debt-equity swap. Moreover, this research will verify the relationship between the size scale of firm and debt-equity swap to check whether the notion 'too big to fail' still influence South Korean banking practices. Meanwhile, this research pays attention to the BIS ratio of major creditor banks and the growth potential of firms in order to analyze how banks screen out companies with potential for growth, and thus good debt-equity swap candidates. The growth potential of firms is measured by the proportion of intangible assets, such as industrial property rights, in total assets.

$$Debt\ Equity\ Swap_{i,t} = \alpha + \sum_{j=1}^{3} \beta_j Firm\ Ch._{i,j,t-1} + \sum_{s=1}^{2} \gamma_s Screening\ Factor_{i,s,t-1} + \Gamma X + \epsilon_{i,t} \quad \ldots\ldots Eq(4.1)$$

The following equations (4.2), (4.3) are used to analyze how debt-equity swap affects corporate performance. Equation (4.2) analyzes the short term effects and the extended equation (4.3) analyzes both short term and long term effects. This research has taken into consideration that the

following factors influence the performance of workout firms; schemes of debt restructuring, the firms' self-restructuring efforts, and ownership structure. This research focuses on the debt equity swap cases in which it is a proactive debt restructuring where the creditors of the financially distressed firm take ownership of the firm's stocks instead of bonds. If future returns are expected, there is incentive for the bank to swap debt with equity. Therefore, if a bank decides on a debt equity swap abiding to the original purpose of its creation, a positive relationship between debt-equity swap and corporate performance ought to be. Meanwhile, this research looks at reduction in non-operating expenses and labor costs per employee as the measures for a firm's self-restructuring efforts. It intends to review whether corporate performance had been improved through reduction in labor and non-operating costs during reorganization. It further aims to verify whether stock ownership proportion of major shareholders aids in yielding improved corporate performance.

$$ROA_{i,t} = \alpha_0 + \alpha_1 ROA_{i,t-1} + \sum_{j=1}^{4} \gamma_j \, Effort_{i,j,t} + \Gamma X + \varepsilon_{i,t} \quad \dots Eq(4.2)$$

$$ROA_{i,t} = \alpha_0 + \alpha_1 ROA_{i,t-1} + \left(\beta_0 + \sum_{s=1}^{4} \beta_s \, Effort_{i,s} \right) \times Period_{i,t} + \sum_{j=1}^{4} \gamma_j \, Effort_{i,j,t} + \Gamma X + \varepsilon_{i,t} \quad \dots\dots Eq(4.3)$$

This research takes into account the above four factors to study whether going through a workout program significantly improves corporate performance in short and long term periods. More specifically, β_s of equation (4.3) represents the long term effect of how efforts during the workout program help performance after the program is terminated. On the other hand, γ_j represents the short term effects. This research, furthermore, takes into consideration that corporate performance in the previous season influences current year performance, and builds a dynamic panel model through which it analyzes the post reorganization performances of workout firms.

3.2. Data Descriptions

This paper studies post reorganization performance of workout firms, especially focusing on the effects of debt-equity swap on performance. Data used for the analysis pertains to South Korean manufacturing companies that went through workout between 1998 and 2010. The financial data of the workout firms were collected from the KIS-Value database run by NICE (National information and Credit Evaluation). Data related to the main creditor banks of the workout firms were gathered from the DART (Data Analysis, Retrieval and Transfer System), a data pool service provided by the Financial Supervisory Service of Korea. More specifically, it has looked into the external audit report written at point of confirmation of workout, and found information on which banks were its main creditors. The BIS ratio of the main creditor banks were collected through FSIS (Financial Statistical Information System), another data pool service provided by the

Financial Supervisory Service of Korea.

This research has utilized three data base pools, namely the KIS-Value, DART, and FSIS, to compile its data; financial data pertaining to the workout firms themselves, identification of who their main creditor banks were, and data on the financial status of the main creditor banks during the period.

3.2.1. Workout Firms

In total, 68 manufacturing companies started a workout program between 1998 and 2010 in Korea. Table 4.1 offers a distribution on those who have fully walked through their workout programs. Forty six firms were able to successfully terminate their workout programs. In percentage, they make up 67.7% of total workout firms, a rather large proportion. Meanwhile, 16 firms, so 23.5% in percentage proportion, started the workout program only to experience failure in negotiations with creditors, or bankruptcy in the middle of the program. Moreover, 6 firms, an 8.8% proportion, are still is under workout.

Table 4.1 Distribution of Workout Firms

Completion	Discontinue	Ongoing	Total
46 (67.7)	16 (23.5)	6 (8.8)	68

Note: () denotes percentage

Table 4.2 illustrates the annual count of firms undergoing workout between 1998 and 2010. One can easily recognize that 68 firms, a 67.7% proportion, had started their workouts immediately after the Asian Financial Crisis, between 1998 and 1999. Meanwhile, one can review the annual count of firms who successfully terminated the workout. For example, 82.8%, 24 among the 29 which started workout in 1998, had successfully finished their programs. However, as is recognizable through table 4.2, amongst workout firms which have started their programs more recently, only 50% of them were able to finish the program. This may be because not enough time has passed since the start of the program for them to be able to finish.

Table 4.2 Distribution of Workout Firms by Year

Initiation year	# of firms	# of firms which successfully finished workout process
1998	29 (42.7)	24 (82.8)
1999	17 (25.0)	11 (64.7)
2000	6 (8.8)	4 (66.6)
2001	1 (1.5)	1 (100.0)
2002	2 (2.9)	2 (100.0)
2005	2 (2.9)	1 (50.0)
2007	2 (2.9)	1 (50.0)
2009	5 (7.4)	1 (20.0)
2010	4 (5.9)	1 (25.0)
Total	68	46 (67.7)

Note: () denotes percentage

On average, a workout program takes 4.5 years to complete successfully. Table 4.3 illustrates the time periods it took for firms to finish their workout programs. From the forty six firms that successfully terminated workout, around 37% continued the program for a time of between 4 years and 6 years.

Table 4.3 Period from Initiation to Completion of Workout Program

Period (year)	# of Firms	%	Mean
1	4	8.7	4.54
2	6	13.0	
3	10	21.7	
4	2	4.4	
5	9	19.6	
6	6	13.0	
7	4	8.7	
8	1	2.2	
9	3	6.5	
11	1	2.2	

3.2.2. Debt-Equity Swap

This research notes debt-equity swap as the major debt restructuring tool for financially distressed companies. It thereby studies which factors determine the decision to carry out a debt-equity swap, and how debt-equity swap influences corporate performance.

Table 4.4 depicts the distribution of companies which carried out a debt-equity swap, and companies who successfully finished their workout

program. Among the 68 workout firms, 25 underwent a debt-equity swap constituting a 36.8% proportion of the total. Among the 25 companies, approximately 68%, so 17 firms successfully completed the workout. However, 7 companies, or 28%, failed its workout despite having done a debt-equity swap. Among companies that failed to receive a debt-equity swap, 9 companies, or 21%, failed its workout. This is a lower percentage of workout failure than when debt-equity swap took place. Such distribution may make one skeptical of the hypothesis that there is a positive relationship between debt-equity swap and successful workout. However, Table 4.4 is merely an approximate distribution. Furthermore, of the companies that did not receive a debt equity swap, 5 firms are currently still undergoing the workout program, making it difficult to come to any conclusions.

Table 4.4 Distribution between Debt-Equity Swap and Workout Process

		Workout Process		
		Completion	Ongoing	Discontinue
Debt-Equity Swap : Yes	25 (36.8)	17 (68)	1 (4)	7 (28)
Debt-Equity Swap : No	43 (63.2)	29 (67)	5 (12)	9 (21)

Note: () denotes percentage

Table 4.5 illustrates the approximate average values of factors that

determine debt-equity swap. More specifically, the average values of debt ratio, size scale of company, proportion of equity ownership in the part of large shareholders, BIS ratio of major creditor banks and the proportion of intangible assets from total assets, etc. are shown calculated separately according to whether or not the firm underwent debt-equity swap. On average, companies that had done a debt-equity swap had a higher debt ratio, than those that did not do a debt-equity swap. In addition, firms that underwent debt-equity swap on average had more employees and more assets than firms that did not undergo debt-equity swap. Through such observations, it can be anticipated that to check whether 'too big to fail' still affects banking practices. Meanwhile, companies that swapped debt to equity had a larger proportion of intangible assets from total assets, and worked with major creditor banks with lower average BIS ratios than companies that did not undergo debt-equity swap. The proportion of intangible assets from total assets in debt-equity swapped firms were 2.07, which is a much larger value than 0.48, the average of the same ratio in firms that did not do a debt-equity swap.

Table 4.5 Mean Value of Various Factors that Determine Debt to Equity Swap

	Debt ratio	Worker	Asset*	Large Share	BIS ratio	Intang. asset**
Yes	5.22	1842	11,339	21.71	12.49	2.07
No	2.25	1041	6,451	14.31	13.06	0.48
Total	3.49	1378	8,497	17.15	12.84	1.09

Note: * indicates one billion won. ** indicates the proportion of intangible assets from total assets.

3.2.3. Explanatory Variables

Two models have been used in order to analyze the effects of the workout program, to grasp the extent to which workout improves post reorganization corporate performances. The first model reviews factors which determine the decision to undergo debt-equity swap, a debt restructuring method used often for financially distressed firms. The second model analyzes the post reorganization performance of workout firms, scrutinizing the functionality of the workout program and the screening process of banks seeking for favorable debt-equity swap candidates with high growth potential. The control variables for the analysis are as follows.

First of all, determining factors of the debt-equity swap decision model are either characteristics of the firms themselves or related to the creditor banks' screening process for debt-equity swap and decision making process. Characteristics of the workout firms themselves which influence the decision to swap debt to equity include debt ratio, size scale of firm, and stock ownership proportions of large shareholders. Debt ratio is the value of proportion of debt over total assets, log transformed. Size scale of firm means total assets per workers. Stock ownership proportions of large shareholders is literally number of stocks owned by large shareholders over total number of stocks. Meanwhile, the debt-equity swap candidate screening and decision process of major creditor banks were understood taking into account the roles played by the banks' financial stability and growth potential of firms. Financial stability of major creditor banks is measured by the BIS ratio (Equity/Risky Assets). Growth potential of firm is measured by the percentage proportion of intangible assets in total assets. Other controlled variables for the debt-equity swap decision model include

age of company, industry dummy, and annual dummy. In addition, this study checks the robustness of our results as considering the period of workout initiation as a control variable.

In model (2), ROA (Return on Assets) was used as the dependent variable in analyzing post reorganization performance of workout firms. Also, as previous season performance influences current year performance, a dynamic panel model considering previous season ROA as independent variable for its analysis. Meanwhile, the following have been considered as factors which have a significant positive influence on improving performance in workout firms; schemes of debt restructuring, the firms' self-restructuring efforts, and ownership structure. Whether debt-equity swap has taken place was the measure for debt restructuring, and the value of 1 was attributed if positive. Reductions in labor and non-operating costs were measured as self-restructuring efforts. Labor cost was calculated as wage cost per employee and was log-transformed. Furthermore, the proportion of non-operating costs in total revenue was reviewed to study whether various cost reduction efforts were made during reorganization. Lastly, the proportion of stock owned by single shareholders was analyzed to investigate how ownership structures affect corporate performance when ownership is concentrated to few individuals.

This research analyzes performance of workout firms not only in short term but also in long term periods. In order to investigate into the long term effects, post reorganization time periods were taken into account. More specifically, in order to observe how the series of actions taken to recuperate a workout firms' financial strength, namely debt-equity swap, reductions in labor and non-operating costs, changes in ownership structure influence

performance after reorganization, these factors were used as cross variables for comparisons between time periods during workout program and time periods post reorganization.

Further controlled variables include debt ratios, growth potential of company, company age, competitive environment levels, and number of employees. Competitive environment levels were measured through the inverse value of the Herfindahl-Hirschman Index (HHI). HHI represents concentration within the industry, and a high HHI value indicates a highly monopolistic industry. The inverse of such index should thus indicate the competitiveness of the industry. Lastly, industrial and annual dummy variables were used in order to control against characteristics specific to industries and certain periods of time.

4. Empirical Analysis

4.1. Determinants of Debt-Equity Swap

Table 4.6 and Table 4.7 illustrate results of what determine the decision to do a debt-equity swap. Table 7 illustrates results when the period of workout initiation is additionally controlled in the estimation. In both models the dependent variable is a binary variable, thus regression analysis was carried out through probit and logit models. In order to avoid the firms' unobservable and time-invariant heterogeneity, analysis was carried out through fixed effect model. In addition, we conduct random effect probit estimation. Having carried out and mapped results from the two separate

analyses allow for a more accurate understanding on whether the determinants of debt to equity swap shows different aspect depending on between estimators or within estimators (Wooldrigdge, 2002).

Two results were found through the random effect estimation. First, when firm size is defined as the number of employees over assets, a positive relationship between firm size and debt equity swap is verified. Therefore, if the number of employees is controlled, the grander the asset size, the more likely are the firms to swap debt to equity. Such results imply that main creditor banks tend to decide upon a debt to equity swap due to worries for serial bankruptcy rather than concerns for the large scale job losses that the bankruptcy of a conglomerate should lead to. Second, it was observed that the lower the BIS ratio of main creditor banks, the more likely was a debt-equity swap, however the negative relationship saw here was statistically insignificant. Meanwhile, this research found a positive relationship between debt to equity swap and the proportion of intangible assets in total assets. More specifically, it has been verified that the higher the proportion of intangible assets such as industrial property rights, thus the higher the growth potential of the struggling company, the higher was there the possibility for debt-equity swap. We found consistent results through an analysis that additionally controlled for the period of the workout process.

Results obtained from the fixed effect model which controlled for heterogeneity of firms can be narrowed in to three aspects. First, unlike the results deduced from the random effect model, no significant result was found between size of firm and debt to equity swap. The random effect model explains between estimators, while the fixed effect model explains within estimators. Considering this, the fact that each of these

methodologies derived a different result is interesting. The result of analysis between estimators, derived through the random effect model, sheds light to how creditor banks are more likely to decide upon firms to swap debt for equity if the firm is relatively sizeable. However, result of analysis within estimator, obtained through the fixed effect model, demonstrates that creditor banks don't decide to swap debt to equity just because a firm's asset size has grown larger than the previous year. Thus, the increase in asset size which has a positive effect on debt to equity swap should be understood in a relative context, in comparison between companies, and not in comparison between the past and current asset size of the same firm. Second, we showed that the higher proportion of stock ownership large shareholders have, the less likely the debt-equity swap. This result implies that shareholders wished to avoid debt equity swap because they did not want to share their management control powers to creditors. Third, this research found the positive correlation between debt to equity swap and the proportion of intangible assets in total assets, as can be observed through random effect estimation. Such are all verified by results shown in Table 4.6 and Table 4.7. These results imply that banks decide on debt-equity swaps despite being financially distressed if sufficient growth potential is found in the workout firm. Such results are interesting in that it suggests that creditor banks are functioning properly in screening out the best candidates for debt equity swap, those with the best potential for growth.

Table 4.6 Determinants of Debt-Equity Swap

	(1) Pooled Probit	(2) Probit, RE	(3) Logit, FE
Debt ratio	-0.189	-0.180	-0.267
	(1.534)	(0.888)	(0.612)
Assets/Worker	0.301**	0.476*	0.611
	(2.506)	(1.912)	(1.096)
Large Share	-0.001	-0.010	-0.037*
	(0.192)	(1.148)	(1.682)
Potential	0.033*	0.103**	0.165**
	(1.658)	(2.400)	(1.976)
BIS ratio	-0.050	-0.033	0.078
	(1.507)	(0.522)	(0.471)
Industry Dummy	Yes	Yes	
Time Dummy	Yes	Yes	Yes
Observations	453	453	238
Number of kisid		67	27

Note: Dependent variable is binary variable which indicate debt-equity swap. *z* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *z* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively.

Table 4.7 Determinants of Debt-Equity Swap: Robustness Check

	(1) Pooled Probit	(2) Probit, RE	(3) Logit, FE
Debt ratio	-0.227*	-0.154	-0.566
	(1.822)	(0.708)	(0.915)
Assets/Workers	0.323***	0.433	0.795
	(2.630)	(1.609)	(0.974)
Large Share	0.000	-0.014	-0.057**
	(0.087)	(1.430)	(2.168)
Period after Workout Initiation	0.121***	-0.211*	-17.025
	(3.010)	(1.682)	(0.008)
Potential	0.052**	0.088*	0.186*
	(2.460)	(1.917)	(1.805)
BIS ratio	-0.044	-0.049	0.057
	(1.285)	(0.696)	(0.314)
Industry Dummy	Yes	Yes	
Time Dummy	Yes	Yes	Yes
Observations	453	453	238
Number of kisid		67	27

Note: Dependent variable is binary variable which indicate debt-equity swap. *z* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *z* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively.

4.2. Effect of Workout Process on Corporate Performance

This paper studied the performances of firms that went through workout in order to verify the functionality of the workout system. For this purpose this research also analyzes the effects of debt-equity swap, and thus notes whether the main creditor banks function properly in screening out the best candidates for debt-equity swap. This paper further analyzes whether self-restructuring efforts such as reductions in labor costs per employee or non-operating costs and ownership restructuring has a significant effect on post

workout performances. In other words, relationships between debt-equity swap, labor costs per employee, non-operating costs, stock ownership structure, and post workout performances was tested. In addition, such relationships were analyzed not only in short term periods, but also in longer terms stretching to post workout time periods.

This research analyzes the dynamic model which deals with the lagged dependent variable, taking into consideration the influence that the corporate performance of the previous year has on the successive year. Moreover, it has additionally analyzed using the static model in order to certify the robustness of the empirical results. Both Table 4.8, related to dynamic model, and Table 4.9, related to static model, show the short term performances of workout firms. While table 4.10(dynamic model) and table 4.11(static model) illustrate the long term corporate performance of workout firms. Data here allows an analysis of whether the measures taken during workout, such as debt restructuring, and other internal changes in the company continue to influence performance in the long term. This paper controls not only the firms' unobservable and time-invariant heterogeneity through Pooled OLS, Fixed Effect, and System GMM, but also controls for the endogeneity problem generated by considering the lagged dependent variable as an independent variable.

When analyzing the short term effects of workout on corporate performance in dynamic model, one arrives at two things. First, debt-equity swap and a reduction in labor costs per employee contribute immediately in improving short term performance. Such suggestions were arrived consistently through all three estimations, which amplify the credibility of the statement. Second, the debt ratio, which was a controlled variable, was

found to have a negative correlation with corporate performance through all the estimations, namely the OLS, fixed effect, system GMM. It is notable that poor financial status, which can exhibited through metrics such as the debt ratio, obtrudes profitability.

Meanwhile, studying both short term and long term performances gives two implications. First, it was found through the fixed effect estimation, which controlled for heterogeneity, and system GMM estimation to control for the endogenous problem generated from the correlation between lagged dependent variables and error terms that debt-equity swap has a significant positive effect on performance. Debt-equity swap not only had a short term positive effect on performance, but also correlated with long term performance, that is ex-post workout performance. Such results indicate that the positive effects of doing a debt-equity swap, a decision made through a long term future corporate valuation, is likely to also happen in a more distant future, perhaps in a several years' time. The finding that it may aid in better performance in the long term may be considered a sign of functionality in the part of creditor banks in screening properly for the best candidates, ones with the best future growth potential, for debt-equity swap. Second, reductions in labor cost per employee and non-operating costs in a workout firm significantly and immediately improve corporate performance through system GMM estimation. The importance of self-restructuring during the workout program is thus underlined.

Table 4.8 Short-Term Effect of Workout Process on Corporate Performance (Static Model)

	(1) Pooled OLS	(2) Fixed Effects
Debt-Equity Swap	0.120**	0.146**
	(2.050)	(2.133)
Wage Cost	-0.028	-0.022
	(1.310)	(0.958)
Non-Operating Cost	-0.049**	-0.026
	(2.470)	(1.288)
Large Share	0.000	-0.001
	(0.269)	(0.672)
Debt Ratio	-0.538***	-0.615***
	(12.207)	(11.676)
Potential	-0.004	-0.012
	(0.596)	(1.400)
Age	-0.001	-0.002
	(0.777)	(0.232)
Competition	0.121	-0.011
	(1.560)	(0.089)
Worker	0.061***	0.185***
	(3.873)	(6.141)
Industry Dummy	Yes	
Time Dummy	Yes	Yes
R-squared	0.326	0.335
F-test		[0.000]***
Observations	812	812
Number of ID		67

Note: Dependent variable is return on asset(ROA). *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively.

Table 4.9 Short-Term Effect of Workout Process on Corporate Performance (Dynamic Model)

	(1) Pooled OLS	(2) Fixed Effect	(3) System GMM
ROA_{t-1}	1.27***	1.24***	1.26***
	(7.062)	(6.621)	(6.634)
Debt-Equity Swap	0.151***	0.181***	0.161***
	(2.629)	(2.710)	(2.611)
Wage Cost	-0.049**	-0.040*	-0.132***
	(-2.294)	(-1.771)	(-4.656)
Non-Operating Cost	0.002	0.022	-0.016
	(0.102)	(1.053)	(-0.884)
Large Share	0.000	-0.001	-0.001
	(0.507)	(-0.654)	(-1.540)
Debt Ratio	-0.425***	-0.496***	-0.193***
	(-9.286)	(-9.103)	(-4.552)
Potential	-0.001	-0.005	0.005
	(-0.126)	(-0.581)	(0.982)
Age	-0.000	0.002	-0.000
	(-0.180)	(0.198)	(-0.108)
Competition	0.147*	0.014	0.182***
	(1.937)	(0.120)	(3.089)
Worker	0.047***	0.164***	0.024***
	(3.067)	(5.526)	(3.679)
Industry Dummy	Yes		
Time Dummy	Yes	Yes	Yes
Observations	808	808	808
Number of ID		67	67
R-squared	0.368	0.374	
F-test		[0.000]***	
Wald test			[0.000]***
AR test			[0.822]
Hansen test			[0.811]

Note: Dependent variable is return on asset (ROA). *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively. T-7 period of lagged dependent variable, and year dummies are used for instrument variables in system GMM estimation.

Table 4.10 Long-Term and Short-Term Effect of Workout Process on Corporate Performance (Static Model)

	(1) Pooled OLS	(2) Fixed Effects
Period after Completion	-0.269	0.589
	(0.785)	(1.332)
Debt-Equity Swap × Period	0.009	0.055**
	(0.473)	(2.509)
Wage Cost × Period	0.016	-0.034
	(0.777)	(1.297)
Non-Operating Cost × Period	-0.006	-0.040
	(0.162)	(0.944)
Large Share × Period	-0.000	0.000
	(0.060)	(0.770)
Debt-Equity Swap	0.119*	0.168**
	(1.941)	(2.387)
Wage Cost	-0.030	-0.021
	(1.383)	(0.888)
Non-Operating Cost	-0.049**	-0.026
	(2.445)	(1.307)
Large Share	0.000	-0.001
	(0.204)	(0.446)
Debt Ratio	-0.541***	-0.613***
	(12.072)	(11.428)
Potential	-0.005	-0.013
	(0.668)	(1.431)
Age	-0.002	-0.010
	(0.950)	(0.964)
Competition	0.120	-0.029
	(1.521)	(0.239)
Worker	0.062***	0.197***
	(3.830)	(6.453)
Industry Dummy	Yes	
Time Dummy	Yes	Yes
R-squared	0.326	0.342
F-test		[0.000]***
Observations	809	809
Number of ID		67

Note: Dependent variable is return on asset (ROA). *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively.

Table 4.11 Long-Term and Short-Term Effect of Workout Process on Corporate Performance (Dynamic Model)

	(1) Pooled OLS	(2) Fixed Effect	(3) System GMM
ROA_{t-1}	1.29***	1.27***	1.27***
	(7.070)	(6.763)	(10.863)
Period after Completion	-0.084	0.651	-0.033
	(-0.249)	(1.431)	(-0.320)
Debt-Equity Swap × Period	0.020	0.062***	0.008*
	(1.045)	(2.886)	(1.785)
Wage Cost × Period	0.005	-0.038	0.002
	(0.224)	(-1.422)	(0.310)
Non-Operating Cost × Period	0.006	-0.018	0.001
	(0.158)	(-0.435)	(0.195)
Large Share × Period	0.000	0.000	0.000
	(0.237)	(0.801)	(1.022)
Debt-Equity Swap	0.147**	0.209***	0.041*
	(2.466)	(3.044)	(1.772)
Wage Cost	-0.051**	-0.036	-0.030**
	(-2.351)	(-1.597)	(-2.376)
Non-Operating Cost	0.003	0.023	-0.063***
	(0.126)	(1.087)	(-6.007)
Large Share	0.000	-0.000	-0.000
	(0.398)	(-0.437)	(-1.411)
Debt Ratio	-0.431***	-0.492***	0.017
	(-9.296)	(-8.912)	(0.722)
Potential	-0.002	-0.005	0.001
	(-0.276)	(-0.633)	(0.440)
Age	-0.001	-0.005	0.001
	(-0.440)	(-0.499)	(1.578)
Competition	0.145*	0.007	0.008
	(1.889)	(0.056)	(0.332)
Worker	0.047***	0.178***	0.020***
	(2.940)	(5.939)	(3.774)
Industry Dummy	Yes		
Time Dummy	Yes	Yes	Yes
Observations	805	805	805
Number of ID		67	67
R-squared	0.370	0.382	
F-test		[0.000]***	

Wald test			[0.000]***
AR test			[0.307]
Hansen test			[0.864]

Note: Dependent variable is return on asset(ROA). *t* statistics are in parentheses and *p*-values are in brackets. The superscripts *, **, and *** following the *t* statistics and *p*-values represent a 10%, 5%, and less than1% significant level, respectively. T-6 period of lagged dependent variable, year dummies, and interaction terms with period are used for instrument variables in system GMM estimation.

5. Conclusion

This research aims to verify the effectiveness of the workout system, which was introduced originally to avoid bankruptcies due to short term liquidity crises, in improving corporate performance after the program was terminated. The original purpose of the workout was to identify companies with strong growth potentials from a pool of financially distressed firms, help strengthen their financial health, and ensure continuation of business and management thereafter. Therefore, in order to state that the workout system functions well according to its original purposes, companies that underwent workout ought to experience ameliorated performance after the program is over. In order for this to happen, the workout program should be well structured. What is most important is that the creditors function well in discerning companies worthy of the program, with the greatest potential for future profitability and growth. Therefore, this research checks whether the creditor banks perform well on this criterion, together with studying the post reorganization performances of workout firms. It does so by noting on firm growth potentials and creditor bank financial stability as measures. More specifically, it notes on debt-equity swap as the most important method of debt restructuring to check on the banks' functionality for discerning

companies worthy of workout. Debt-equity swap is a proactive debt restructuring method in which creditors swap their bonds into equity of the respective company. Therefore, debt-equity swap is likely to be decided upon if one can anticipate lucrative future growth of the concerning firm. If banks function well in identifying such companies, it only makes sense if those successful in receiving a debt-equity swap perform well after workout.

The workout system was mainly introduced to South Korea after the 1998 Asian Financial Crisis, and 68 Korean manufacturing companies have been selected to participate in a workout program. Through two models, this research studies these 68 companies to verify whether creditors function well in discerning financially distressed companies with great potential for future growth and profitability, and review the relationship between workout and corporate performance. The first model, the debt-equity swap decision model analyzes whether major creditor banks' function significantly properly in screening out firms with greatest potential for future lucrative growth. The second model analyzes whether future performances significantly improved for workout firms that underwent debt-equity swaps.

Results of analyzing the debt-equity swap decision model boils down to three things. First, if the proportion of stock ownership held by the largest single shareholders is low, debt-equity swap is more likely. In other words, large shareholders, who have to share their management control rights with creditors in the case of debt-equity swap, tends to dislike and avoid such measures. Second, results of analysis between firms, (thus, results derived through the random effect model) show that creditor banks are more likely to decide upon a debt to equity swap if the firm's asset size, in relation to the number of its employees, is larger. Thus, the increase in asset size during

workout does not play a critical role in the decision of debt to equity swap, but the swap is more probable if the firm's size scale is relatively large in comparison with other firms. Such results imply that main creditor banks tend to decide to swap debt to equity because it is concerned of the macroeconomic impact of the serial bankruptcy anticipated if a conglomerate goes bankrupt. Third, this research measures the BIS ratio of main creditor banks and the growth potential of firms to verify the creditor banks' functionality in screening out properly the companies with future lucrative growth potential. It was thereby found that there was no significant relationship between BIS ratio and debt-equity swaps. On the other hand, that proportion of intangible assets in total assets had a positive relationship with debt-equity swap shows that the growth potential of companies influences the decision to carry out debt-equity swap. This is an interesting research result as it suggests that the creditor banks function well in discerning companies with the best potential for growth in the process of deciding which financially distressed firms it should swap debt for equity.

This research has come to two conclusions by analyzing the post reorganization performance of workout firms to evaluate the effectiveness of the workout system. First, debt-equity swap, the main debt restructuring method for workout firms not only immediately improve performance of the workout firm, but also continue to help workout firms achieve improved performance after completion of workout program. Such results imply that the creditor banks have well functioned deciding which firms to swap debt to equity, and that their company valuations had adequately calculated for the firms' future growth potential. Second, reductions in labor costs per employee immediately improve performance of the workout firm. This underlines that self-restructuring efforts during workout play an important

part in achieving a successful one.

This research investigates the efficiency of the workout system, which is an agreement between creditors and the financially distressed firm to reorganize the company, in order to evaluate the effectiveness of a social system that functions to help companies facing bankruptcy overcome its crisis. The efficiency of the workout system can be proved if companies with high potentials for future growth and profitability, despite being financially distressed, are well discerned and are walked through workout to achieve improved performances. Therefore, the ability of the creditor banks to identify potential among financially struggling firms is central in ensuring the efficiency of the workout system. This paper pays attention to such functions of the creditor banks, and analyzes the banks' decision making process for debt-equity swap. Results illustrate that creditor banks decide for a debt-equity swap if potential for future growth can be anticipated. Also workout firms that underwent debt-equity swap during reorganization experienced improved performances in the long term after termination of workout. Meanwhile reduction in labor costs per employee was found to be essential while analyzing the significance of the self-restructuring efforts of the firm during workout. This research verifies that the creditor banks function well in discerning potential for growth among financially distressed firms. This is a central function which needs to operate well in order for the workout system to be efficient. Furthermore, this research has great implications in the revelation that self-restructuring efforts during workout plays an essential part in keeping the workout system efficient, together with the well-functioning of the creditor banks' screening process for growth potential.

Appendix

Appendix 4.1 Description of Regression Variables

	Variable	Description
Dependent variable	Debt-Equity Swap	Debt-Equity Swap *(binary)*
	ROA	Return on Assets : Operate Profit/Total Assets
Firm Characteristics	Debt ratio	Total Debt/Total Asset *(log form)*
	Size	Number of workers/Assets *(log form)*
	Large share	Total share of large shareholders
	Wage Cost	Wage cost per workers
	Non-Operating Cost	Non-operating cost/Net sales
	Period	1) Period after completion of workout program 2) Period after initiation of workout program
Screening Ability	Potential	Intangible asset/Total asset (%)
	BIS ratio	BIS ratio of main bank
Control	Competition	Inverse of HHI *(log form)*
	Age	Period since the date of the establishment
	Industry	Industry dummy of 24 categories
	Year	Year dummy: 1993-2010

Appendix 4.2 Descriptive Statistics of Regression Variables

Variable	Obs.	Mean	Std. Dev.	Min	Max
Debt-Equity Swap	964	0.11618	0.32061	0	1
ROA	838	-0.00438	0.57591	-15.4619	0.8715
Debt ratio	838	-0.25090	0.73555	-2.5701	6.0282
Workers	822	6.32660	1.44574	0	9.9994
Large Firms	964	0.71888	0.44978	0	1
Large share	964	17.86168	20.54876	0	99.72
Wage Cost	949	14.74551	5.85935	0	24.4097
Period	964	1.47510	2.71995	0	12
Potential	964	1.08202	2.76743	0	24.8757
BIS ratio	694	12.83480	2.82035	8.66	18.08
Competition	918	-8.87648	0.34710	-9.2103	-8.0029
Age	964	32.77593	13.54749	1	70

Appendix 4.3 Correlation of the Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(1)	1.00											
(2)	0.01	1.00										
(3)	0.11	-0.4	1.00									
(4)	0.10	0.14	-0.2	1.00								
(5)	0.07	0.15	-0.4	0.34	1.00							
(6)	0.02	0.05	-0.1	0.14	0.17	1.00						
(7)	0.07	0.0	0.13	-0.1	0.03	0.02	1.00					
(8)	-0.2	0.07	-0.4	-0.1	0.21	0.0	0.0	1.00				
(9)	0.10	0.0	0.01	0.32	0.0	0.0	-0.1	-0.1	1.00			
(10)	-0.1	0.01	-0.1	0.00	0.02	-0.1	0.02	0.29	0.02	1.00		
(11)	0.03	0.05	0.0	0.00	0.02	0.0	0.06	0.03	0.0	-0.1	1.00	
(12)	0.04	0.02	-0.1	-0.1	0.10	0.10	-0.1	0.10	-0.1	-0.3	-0.1	1.00

Note: (1) debt-equity swap, (2) roa, (3) debt ratio, (4) workers, (5) large firms (6) large share, (7) wage cost (8) period (9) potential, (10) BIS ratio, (11) competition, (12) age

V. Conclusion

This research investigates the effectiveness of rescue programs targeting financially distressed firms facing temporary liquidity problems. Firms facing risks of bankruptcy have been rescued through different means based on various motives, including direct or indirect government intervention and profit seeking efforts on the part of creditors. For example, the government rescues financially distressed firms because of its concerns about the macroeconomic impact of corporate bankruptcy, its paternalistic relationship with companies, or its industrial policy aiming for economic development (Kornai, 1979; Shleifer and Vishny, 1994; Kornai et al., 2003; Bai and Wang, 1999). Meanwhile, when the potential for growth is anticipated for such financially distressed firms, or if the firm's survival value is greater than liquidation value, banks continue to extend loans for them or provide them with additional loans in order to continuously receive interest (Dewatripont and Maskin, 1995; Peek and Rosengren, 2005; Hoshi et al., 1991).

Previous studies point out that such rescue and support, provided to financially distressed firms, give rise to moral hazard problems among those companies. Also, in the macroeconomic perspective, they assist the accumulation of non-performing loans and become a cause of financial crises (Kornai, 1979; Kornai et al., 2003; Krugman, 1998; Bai and Wang, 1999; Huang and Xu, 1999). However, such studies have limitations in that they do not take firm heterogeneity into consideration. Among financially distressed firms, there are less competitive and inefficient firms that ought to leave the market. However there are also financially distressed firms with great growth potential that are facing temporary liquidity problems. For companies whose problems relate to short term liquidity, not growth

potential, rescue through giving additional financial aid might be appropriate. More specifically, in order for the rescue of insolvent firms to have more positive social impact, it is essential that social institutions develop to function well in discerning firms with good growth potential and those that fulfill the positive condition of pursuing long term growth. Therefore, in order to properly evaluate the effectiveness of rescue targeted to save financially distressed firms, one needs to pay attention to the development of such social institutions and positive firm characteristics.

This research studies the effectiveness of rescue given to financially distressed firms through looking at the cases of Korean manufacturing companies in the three following ways. The first study uses data from the 1980's until 2010 to observe how bank behaviors have changed in giving additional loans to financially distressed firms. More specifically, it analyzes how banks' methods of screening for growth potential have evolved through the dynamic economic conditions of South Korea which included economic development and financial crisis. The second and third research analyzes the effect of rescue, provided to financially distressed firms. More specifically, the second research examines whether financially distressed firm, if it possesses potential for growth and is motivated to pursue long term growth, achieves technological innovation if additional bank loans are provided. In the cases that long term investments are required for the technological innovation, financial difficulties may occur due to temporary liquidity problems until profitability is secured. Therefore, this research looks at companies that were in such situations to evaluate whether additional financial aid to such companies has a significant positive effect on the realization of the technological innovation. The third research focuses on evaluating the effectiveness of rescue for financially distressed companies

by investigating the validity of workout programs. More specifically, it has studied whether the workout program, the autonomous restructuring agreement between financially distressed firms and its creditors, successfully keeps the firm from going bankrupt. While the second research deals with the internal characteristics of companies, the third research focuses on a social institution to analyze the validity of its function to rescue financially distressed firms.

Our results of studying the effects of rescue for financially distressed firms on firm performance can be summarized as follows. First, it has been verified that South Korean banks had been giving additional loans to troubled firms before and during about a decade after the Seoul Olympics of 1988. However, no additional lending to financially distressed firms was observed after the Asian Financial Crisis of 1997. Especially after the Global Financial Crisis of 2008, banks were observed not to provide additional loans to companies if they encountered risks of bankruptcy. Such results imply that banks' screening process has been functioning effectively after the Asian Financial Crisis of 1997. Second, the analysis of banks' lending behavior towards unhealthy firms according to different characteristics of firms showed that troubled conglomerates were given loans in the early periods of economic development. However such loans were no longer given to troubled firms after the Asian Financial Crisis in 1997. Meanwhile, bank loans were found to be provided to SMEs that faced bankruptcy after year 2000. This may be a result of South Korea's industrial policy which focused on strengthening SMEs during this period. Third, a positive correlation between additional loans to financially distressed firms and technological innovation was shown using the data after the year of 2000. More specifically, there was an improvement in technological

innovation when the market conditions were more competitive and the performance-based bonus was higher. Financially distressed firms are less likely to innovate their technologies because of liquidity constraints and because they need to avoid further risks. However, amongst those financially distressed, the provision of appropriate motives to pursue growth, such as being placed in competitive market conditions or given performance-based bonus, leads to a higher probability of innovations. Such results bear significant implications in that it has been presented that the positive firm characteristics play crucial roles in mitigating the negative effect of bank loans to distressed firms on technological innovation. Fourth, the analysis on the efficacy of the workout system, which was introduced in 1998, found that firms which underwent debt to equity swap experienced improved corporate performance after the completion of workout program. In particular, it has been shown that the banks' decision to swap debt to equity is made contemplating the future growth potential that the company possesses. In other words, if potential for growth is recognized within companies undergoing workout, main creditor banks decide to swap debt to equity. Workout firms adjusting its debt structure through debt to equity swap meets the intention of swapping debt to equity, and thus it is found to yield a positive long term corporate performance. Such results imply that the banks' screening system for growth potential amongst workout firms function properly. Furthermore, the results of this research confirms the effectiveness of the workout program, which discerns and supports companies with potential amongst those facing bankruptcy in order to help them continue their existence, and manage themselves through restructuring.

This research, which has studied the efficacy of bank loans and rescue systems for financially distressed companies, has made contributions

in three aspects. First, it shows the changes in how South Korean banks screened for better lending candidates among financially distressed companies by using long term panel data from the 1980's until 2010. The research further displays the evolution of the banks' lending trends according to the dynamic South Korean economic conditions covering periods of economic development to financial crises. Second, this research finds that providing financially distressed companies with additional financial support is an efficient measure to improving firm performance if the firm has good internal and external characteristics, such as pursuing long-run growth. If the banks' screening system fails to discern the best candidates for lending, or, in other words, if there are no developed institutional basis for this function, liquidity support for financially distressed firms may prove to be an inefficient measure. This study notices that paying attention to the inherent characteristics of the financially distressed firms may reduce such inefficiency from taking place. Furthermore, this study shows that if appropriate motives drive efforts for long term growth within the financially troubled firm, funding is beneficial and efficient. This research makes a meaningful contribution to the literature in that it has presented the requirements that pledge efficiency in funding the financially distressed firms regardless of institutional development. Third, this research finds that the creditor banks function well in discerning potential for growth among financially distressed firms, which is a central function which needs to operate well in order for the workout system to be efficient. Moreover, this research has great implications in the revelation that self-restructuring efforts during workout plays an essential part in keeping the workout system efficient, together with the well-functioning of the creditor banks' screening process for growth potential.

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국문 초록

한국 제조업의 부도위험 기업에 관한 연구: 은행대출, 기술혁신, 구조조정

본 연구는 한국의 제조업체를 대상으로 재정적으로 어려운 기업에 대한 구제의 실효성을 다음 세 가지 측면에서 연구하였다. 첫 번째 연구에서는 1980년부터 2010년까지의 자료를 사용하여 재정적으로 어려운 기업에 대한 은행의 추가적인 자금 지원이 어떻게 변화되어 왔는지 관찰하였다. 두 번째 연구와 세 번째 연구는 재정적으로 어려운 기업에 대한 구제의 효과를 분석하였다. 보다 구체적으로 두 번째 연구에서는 재정적으로 어려운 기업이 장기성장을 추구하고자 하는 동기를 가지고 있을 때, 추가적인 자금 지원을 통해 기술혁신을 달성하는지 연구하였다. 기술혁신 활동은 상당한 투자자금이 필요하고 혁신을 성공하기까지 장기간이 소요되는 바, 혁신 성과로 인한 수익성이 확보되기 전까지 기업들은 일시적인 유동성 위기를 겪을 수 있다. 따라서 본 연구에서는 기술혁신활동에 주목하여 재정적으로 어려운 기업이 추가적인 자금 지원을 받았을 경우, 혁신을 달성하는데 긍정적인 영향을 주는지 분석하였다. 세 번째 연구에서는 재정적으로 어려운 기업에 대한 구제의 실효성을 워크아웃 프로그램에 주목하여 분석하였다. 파산 위기에 놓인 기업과 채권단간의 자율적인 협약을 통해 구조조정을 실행함

으로써 기업의 파산을 막는 워크아웃 제도가 실효성이 있는지 연구한 것이다. 재정적으로 어려운 기업에 대한 구제의 실효성을 분석하기 위해서 두 번째 연구가 기업의 특성에 주목한 반면, 세 번째 연구는 제도에 주목하였다는 측면에서 그 차이가 있다.

재정적으로 어려운 기업에 대한 구제 효과를 이상의 세가지 측면에서 연구한 결과, 본 연구는 다음과 같이 세 가지 특징을 발견하였다. 첫째, 1988년 서울 올림픽을 전후로 우리나라 은행들은 부도 위험이 있는 기업에 대한 추가적인 대출을 제공하는 것으로 검증되었다. 하지만 이러한 양상은 1997년 외환위기 이후에는 관찰되지 않았으며, 특히 2008년 글로벌 금융위기 이후에는 파산 위험이 있는 기업에게 은행이 추가적인 대출을 하지 않는 것으로 검증되었다. 이와 같은 추정 결과는 부실기업에 대한 은행의 선별 기능이 1997년 외환위기 이후 적합하게 작동하고 있다는 것을 시사한다.

둘째, 2000년 이후의 자료를 사용하여 부도위험 기업에게 제공된 추가 대출과 기술혁신간의 관계를 검증한 결과 이들간의 양의 상관관계가 검증되었다. 보다 구체적으로 재정적으로 어려운 기업들 가운데 성과급이 제공되거나 경쟁적인 시장환경에 놓인 기업일수록 추가적인 은행 대출을 통해 기술혁신을 달성하는 것으로 검증되었다. 재정적으로 어려운 기업은 유동적으로 제약이 있고 위험을 회피할 가능성이 높다. 따라서 이들 기업이 기술혁신 달성할 가능성은 낮다. 하지만, 재정적으로 어려운 기업들 가운데 장기

적인 성장을 추구할 동기가 부여된 경우, 즉, 성과급이 지급되거나 시장환경이 경쟁적인 경우, 이들 기업은 추가적인 자금 지원을 통해 기술혁신을 달성하는 것으로 검증되었다. 부도위험 기업에 대한 은행대출이 기술혁신에 미치는 부정적인 효과를 고려하였을 때, 그 악영향을 감소시키기 위한 일환으로 기업의 좋은 내·외적 요건을 제시하였다는 점에서 본 연구의 추정 결과가 시사하는 바는 크다.

셋째, 1998년 이후 도입된 워크아웃 제도의 실효성을 분석한 결과 워크아웃 기간 동안 출자전환을 한 기업은 워크아웃 종료 이후 기업성과가 개선되는 것으로 검증되었다. 특히 출자전환 결정시 주채권은행은 워크아웃 기업의 잠재적인 성장 가능성을 고려하는 것으로 검증되었다. 즉, 워크아웃 기업의 잠재성이 예측될 경우, 주채권은행은 출자전환을 결정하며, 출자전환을 통해 부채를 조정한 워크아웃 기업은 장기적으로 기업 성과가 개선되는 것으로 검증된 것이다. 이와 같은 추정결과는 워크아웃에 선정된 기업들 가운데 잠재성이 있는 기업을 구별하는 은행의 선별기능이 제대로 작동하고 있다는 것을 시사한다.

주요어: 부도위험 기업, 은행 대출, 기술혁신, 워크아웃, 출자전환, Dynamic Panel Model

학 번: 2008-30802