FIRMS' INVESTMENT BEHAVIOR IN THE FINANCIAL CRISIS ERA
-THE TURKEY CASE-

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ABSTRACT

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Keywords: Economic crisis, manufacturing sector, investment, Tobin's q

The Global Financial Crisis really started to show its effects in The USA and its negative effects widened to most of the countries including Turkey. The effects of the financially originated mortgage crisis were extended to the non-financial sector. In Turkey, there were contractions especially in the manufacturing sector which is one of the most important economic activity in GDP. In the existing economic conditions, firms in the manufacturing sector change their investment behavior.

This master thesis undertakes an econometric analysis to identify relation between investment and cash flow in the economic crisis period for the manufacturing firms. Empirical results are used to derive the relation between investment and cash flow in the crisis period and results are evaluated among different type of firms.

The results indicate that as firms' investment is affected from their cash holding and their sales revenues in a positive way. However, the results are not robust to claim that the cash flow and investment behavior change among different groupings of the firms and in the crisis period.

ÖZET

FİNANSAL KRİZ DÖNEMİNDE FİRMA YATIRIM DAVRANIŞLARI

-TÜRKİYE İNCELEMESİ-

Anahtar Sözcükler: Ekonomik kriz, imalat sanayi, yatırım, Tobin's q

Küresel Finansal Kriz, 2008'in son zamanlarında ABD'de etkilerini göstermeye başlamış ve olumsuz etkilerini Türkiye dahil birçok ülkede hissettirmiştir. Mortgage piyasasında başlayan finansal kaynaklı kriz etkisini reel sektörde de kısa zamanda göstermiştir. Türkiye'de özellikle Gayri Safi Milli Hasıla'nın en önemli kalemlerinden olan imalat sanayinde ciddi daralmalar olmuştur. Mevcut ekonomik şartlar altında imalat sanayindeki firmalar yatırım ile ilgili davranışlarını da değiştirmiştir.

Bu yükseklisans tezinde farklı özelliklere sahip imalat sektöründeki firmaların kriz döneminde yatırım ve nakit akışı arasındaki ilişkinin tanımlanması için ekonometrik bir çalışma yapılmıştır. Ampirik çalışma sonuçları ile firmaların yatırım ve nakit akışı arasındaki ilişki, kriz zamanındaki firma tutumundaki değişiklikler ve de bunların farklı özelliklerdeki firmalar açısından değerlendirilmiştir.

Elde edilen sonuçlarda nakit akışının ve de önceki döneme ait satış gelirlerinin firma yatırımları üzerinde etkisi gözlenmiştir. Ancak farklı firma grupları arasında ve de kriz dönemi sırasındaki nakit akışı ve firma yatırımları arasındaki ilişki net bir şekilde gözlemlenememiştir.

Acknowledgements

I will keep this part as short as possible because I know that it is difficult to pronounce all of the names who helped me during my master education.

I would like to gratitude to my thesis advisor İzak Atiyas. He was all the time supportive and very helpful to answer all of my questions with his endless patience. I believe that I owe a special thank to all of my professors in the Economics Department of Sabancı University for their helping hand. The assistants in the department and also my classmates in the Economics Master Program were also ready to help.

I am very grateful to my family members. When I give up, they encouraged me to keep going on. I believe that they also experience all ups and downs of my master education and thesis writing process. I feel myself so lucky to have them.

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LIST OF SYMBOLS AND ABBREVATIONS

CBRT   The Central Bank of the Republic of the Turkey

CPI   Consumer Price Index

EBITD   Earnings before Interest, Tax and Depreciation

FE   Fixed Effects

GDP   Gross Domestic Product

GLS   Generalized Least Squares

GSMH   Gayri Safi Milli Hasıla

ISE   Istanbul Stock Exchange

PDP   Public Disclosure Platform

SME   Small and Medium Sized Enterprises

TSI   Turkish Statistical Institute

TL   Turkish Lira

1. INTRODUCTION AND BACKGROUND

1.1. Introduction

U.S. experienced a mortgage crisis starting from the year 2007 because of a rise in subprime mortgage credits. U.S. mortgage crisis affected financial sector worldwide and also Turkey. Since financial system and aggregate economic behavior are related, the crisis in financial sector caused a decrease in Gross Domestic Product of Turkey. In Turkey, manufacturing sector has the biggest sectoral share which is around 20-25% in GDP and in the crisis era, decrease in the growth rate of manufacturing sector became severe which was measured as -22.1% (by taking 1998 as base year) in the 1st quarter of 2009 (Figure 1). These numbers attract the attention to the manufacturing sector and especially firms' behavior in the crisis era. The other discussion with the crisis period is related with the credit crunch. When Turkish credit market is evaluated, there is a decline in credit volume (Figure 2). General look into the credit markets in the financial crisis is as follows; uncertainty in the markets increases because of high default risk. Loan supply decreases and finding external funding becomes difficult for the firms. Therefore growth opportunities of the firms decrease. Firms try to avoid problems in finding credits by being more liquid. In this paper, main focus is how financial constraints and firms' access to finance affect their investment behavior in the financial crisis era in Turkey.

We aim to measure the effects of financial constraints on firms' investment behavior. If there is a cost difference for a firm between using internal and external finance, the firm is called as financially constrained. However, most of the firms have cost difference when using external funding instead of internal funding. Therefore, it can be said that a firm is financially constrained if it faces difficulties while finding external finance to do its optimal investment. Financial constraints have importance on firms' decision making mechanism since constraints might be binding and preventing them to do planned business. If a firm is financially constrained, it cannot do its planned investments so it will produce less output than planned and cannot reach their optimal growth path. In the literature, it is discussed that financial constraints differ depending on the characteristics of the firms. Especially in the economic recession and crisis periods, these constraints become binding and affect firms' business strategy. In this thesis, we aim to test the hypothesis whether financial constraints become more severe in the crisis period and whether the effect of the constraints change depending on
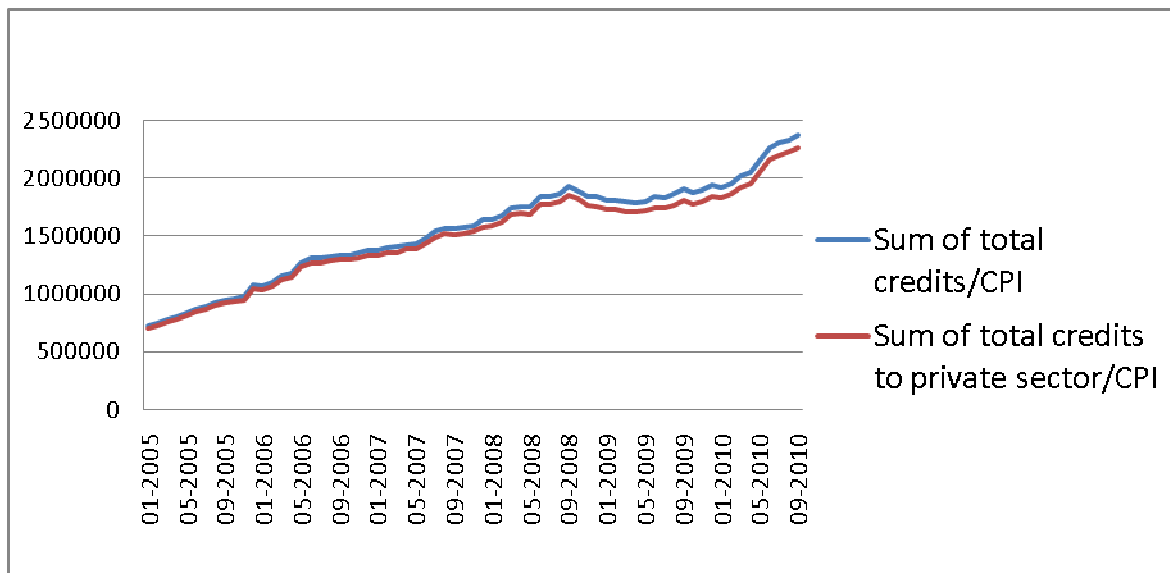
Figure 1 - Change in the GDP and manufacturing activity in Turkey
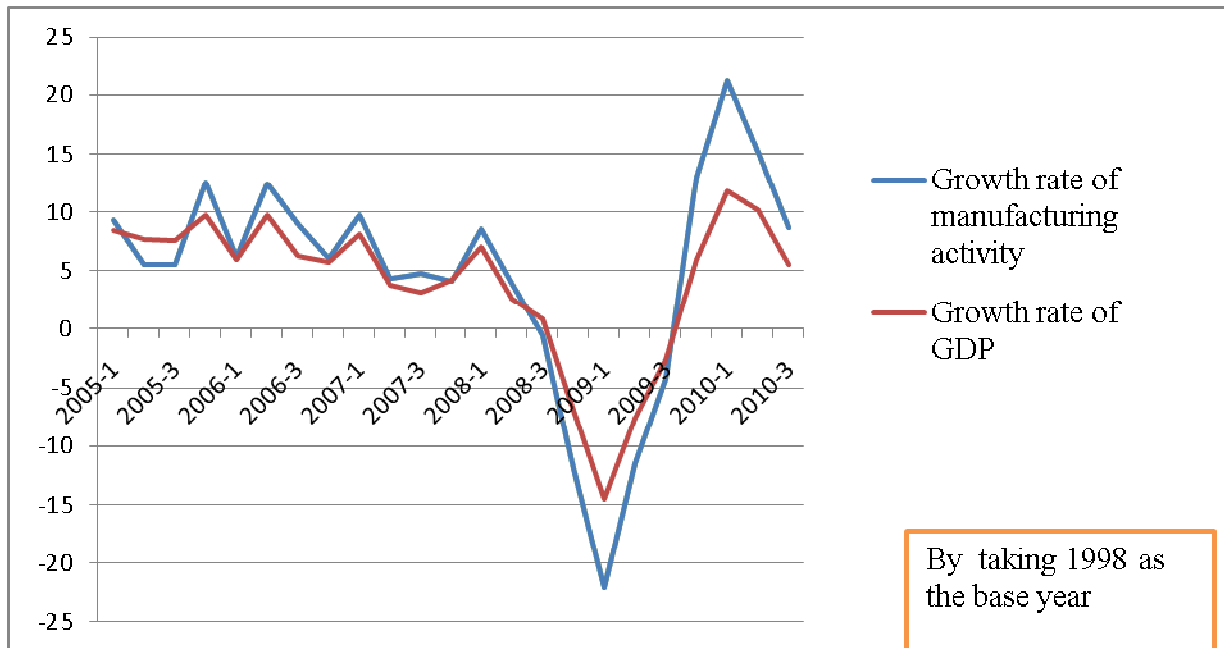
Source: Turkish Statistical Institute

Figure 2 – Credit Volume in Turkey
(x axis represents the time and y axis represents the total credit volume/consumer   price index in TL)

Source: Turkish Statistical Institute

the firm characteristics such as age, total asset size binding and affect firms' business strategy. In this thesis, we aim to test the hypothesis whether financial constraints become more severe in the crisis period and whether the effect of the constraints change depending on the firm characteristics such as age, total asset size and dividend payment status. In this manner, we use the Istanbul Stock Exchange data and test the hypothesis with Turkish data.

1.2. Different Measures of Financial Constraints

Discussing the existence of financial constraints and methodology of measuring them will be helpful to have some insight about the topic.

Modigliani and Miller (1958) discuss in their paper that in perfect capital markets firms can reach external funding without any cost. This makes firms indifferent between using internal funding and external funding. In that case, there is no link between firms' real decision and their financial structure. Under this assumption, financial constraints do not exist. However, perfect capital market assumption is a very strong assumption. Myers and Majluf (1984) examine a firm that has to issue equity to raise cash to finance a profitable investment. They show that under asymmetric information (i.e. when management knows more about the value of the firm than potential investors, firms which have a profitable investment opportunity may nevertheless decide not to issue stock and may pass up valuable investment opportunities. Models of the sort suggest a "pecking order" of finance: Under asymmetric information firms should prefer internal finance over external finance and debt over equity. Due to market imperfections, firms face different level of difficulties in finding external finance and being financially constrained prevent optimal growth of the firm. The reasons that cause firms to be financially constrained and how the degree of financial constraints becomes severe are important issues. Financial constraints are not directly measured and there is not only one accepted way of measurement. Discussion of literature related to measurement of financial constraints help to have broader perspective.

There are three different measures of financial constraints on inventory investment. These measures also apply to financial constraints not only on inventory investment but also investment in general definition namely; investment as a sum of fixed and inventory investment. These three measures are coverage ratio, cash stock and cash-flow sensitivity. Coverage ratio is interest expense divided by the sum of interest expense plus cash flow. It

shows the firm's ability to meet interest payments. Cash stock is the internal cash reserves. Firms with access to public debt give less importance to internal liquidity and hold less cash reserves. Cash flow known as cash is a stream variable and shows the created and used cash by the firm. It is an indicator of financial strength. Firms having cash can do investment to generate money. Coverage ratio, cash stock and cash-flow indicate the liquidity of the firms and they are all important measures of financial performance. These three financial variables are used to understand whether the firms are financially constrained or not.

There are three different papers, each focusing and using a different measure as a tool and one of the papers compares these three measures. In all of these three papers and also in the literature of financial constraints, there is a common approach to divide firms into groups according to a priori criteria that is related to existence of financial constraints. It gives opportunity to compare the severity of financial constraints across groups.

Kashyap et al. (1994) use cash stock as a tool for measurement of existence of financial constraints. The sample data is divided into two subsamples depending on whether they have a bond rating from Standard and Poor at the beginning of the year in interest or not. The firms with a bond rating are larger firms and their cash holding is relatively less compared to firms unrated. Results indicate that investments of firms without access to public debt market are significantly liquidity constrained whereas firms with access to public debt markets give less importance to internal liquidity.

Gertler and Gilchrish (1994) use coverage ratio as a tool for measurement of financial constraints. Coverage ratio is interest expense divided by the sum of interest expense plus cash flow. The classification is done by dividing firms into two groups as large and small according to their gross nominal assets. The results indicate that there is a sharp decline in manufacturing activities of small firms in recession times. The underlying reason is that borrower with strong balance sheet pays lower premium for external finance whereas small firms pay higher premium for external finance. Small firms face constraints while doing investment. Therefore coverage ratios of financially constrained firms are significant whereas it is insignificant for large firms. The authors state that large firms can easily reach external finance to make their planned investment while small firms cannot.

Carpenter et al. (1998) use cash flow sensitivity as a tool for measurement of financial constraints. It is a comparative study discussing three different measures of constraints. The results suggest that cash-flow sensitivity is the best measure for testing them. It is also the most common tool used for testing the existence of financial constraint. Therefore, a more detailed explanation of the term investment-cash flow sensitivity is necessary.

In perfect capital markets, investment decision of the firm is only explained with Tobin's q defined as ((market value of equity and debt) minus market value of inventories) divided by replacement cost of capital stock). It is known as Q model of investment (Fazzari et al. (1988)):

$$(I/K)_{i,t} = \alpha_i + \mu_i * Q_{i,t} + \varepsilon_{i,t} \qquad\qquad (eqn.1)$$

where I is investment in new capital goods (fixed investment) and inventory investment, K is capital stock at the beginning of the year, $Q_{i,t}$ is Tobin's q and $\varepsilon_{i,t}$ is error term where i stands for the firm i and t stands for time.

In this model, investment decisions are independent of firm's financial structure and the only factor that determines firm's investment is Tobin's q. High Tobin's q values encourage firms to invest because it is a sign that market value of the asset is higher than its replacement cost. However, as Gertler (1988) point out there is a link between financial system and economic activity. Informational asymmetries increase firms' sensitivity to disturbances. Balance sheets and cash flow have big role on firms' real decision like employment, investment. In his paper, it is mentioned that under capital market imperfections, an increase in cash flow makes the balance sheet of the firm stronger and decrease the cost of external funding. Constraints are expected to have more effect on decision of the small firms. Considering market imperfections, Tobin's q model is revised and another explanatory variable is added to explain firm's investment decision:

$$(I/K)_{i,t} = \beta_0 + \beta_1 * (CF/K)_{i,t} + \beta_2 * Q_{i,t} + u_{i,t} \qquad\qquad (eqn.2)$$

where CF is cash flow and β_1 measures investment-cash flow sensitivity (ICFS).

CF is used as a proxy for internal net worth. Fazzari et al. (1988) discuss that the existence of a relation between investment and internal funding is good measure to evaluate financial constraints faced by a firm. A firm facing difficulties in finding external funding will

use internal funding for investment; therefore it will hold more cash. For a financially constrained firm, ß$_1$ is expected to be statistically significant.

In their comparative study Carpenter et al. (1988) build a model to compare different measures of financial constraints namely cash stock, coverage ratio and cash-flow sensitivity. In this study, firms are divided into two subgroups as large and small depending on amount of total assets. According to regression results, the authors come to a conclusion that cash flow is the most appropriate measure to explain the changes in investment and the investment-financial constraints relation. It explains the effects of different firm size and captures different time periods better than the other two.

1.3. Existence and Severity of Financial Constraints

The firms that are thought to be financially constrained are classified according to different characteristics. The classifications are generally done depending on firm's dividend policy, being a member of industrial group affiliation, total asset size or establishment date of the firm. By classifying the firms, we can make analysis about the firm types and their investment policy.

1.3.1. Dividend Payout Ratio

Fazzari et al. (1988) evaluate the presence of financial constraints by classifying the firms according to retention rate. Retention rate is the proportion of net income which is not paid as dividends. The authors underline the fact that for a firm, if external funding is not so costly compared to internal funding; firm's retention rate does not have any effect on firm's investment decision. On the other hand, if external finance is costly, firm's investment will have a relation with its cash-flow and also its dividend policy. In the paper, Q model of investment with CF is estimated. The results show that investment is affected by financial structure and financial constraints differ among firms. ICFS (the coefficient ß$_1$ in equation (2)) is significant and higher if a firm has lower dividend payout ratio. The reason is explained as such that low dividend paying firms have more informational asymmetry problems. Therefore they have to hold more cash compared to high dividend paying firms.

The results of Fazzari et al. are generally accepted and supported with other studies. However, Kaplan and Zingales (1997) criticize the study of Fazzari et al. The authors have

doubts about use of ICFS as a measure of financial constraints. They argue that there is not a monotonic relationship between degree of financial constraints and ICFS so the regression results can be misinterpreted. One of the most possible underlying reasons is the differences in the management policy of the firms. Risk-averseness of the managements differs and this will affect liquidity policy of the firm. Therefore a firm may be holding more cash just because of precautionary savings. A firm holding more cash might be interpreted as financially constrained even though it might not be. In their study, they want to test the results of Fazzari et al. and do the same regression analysis again by using ICFS. However they restrict their sample to the 49 firms that are classified as low dividend paying that are defined as financially constrained by Fazzari et al. Kaplan and Zingales classify firms in a different way. They collect all of the firm's annual financial status data and create a new variable which represents all of qualitative and quantitative information related to financial status. By using this variable, they classify the firms into five subgroups as firms never constrained, possibly constrained, likely constrained, never/possibly constrained, possibly/likely constrained. Their conclusion about the estimation result is that firms that have a lower dividend payout ratio are less sensitive to cash flow. In other words ICFS is lower for low dividend paying firms.

These studies show that there is a relation between dividend payout ratio and financial constraints but the relation is explained differently in the studies. This might be due to different classification of the firms.

1.3.2. Industrial Group Affiliation

Hoshi et al. (1991) use a similar approach with Fazzari et al to evaluate the link between financial structure of a firm and its investment decisions. In their study, they divide firms into two groups according to being in an industrial group affiliation or not. Affiliation helps member firms to be coordinated. Firms that are not in an industrial group affiliation generally have weak relations with banks. Banks are important since they are generally primary source of external finance; this is especially the case for Japan where the study takes place in. Having good relation with banks decrease information asymmetries and firms having close bank relations give less importance to liquidity because finding external funding from banks is not very disadvantageous. Regression results of two groups indicate that liquidity is much more significant for independent firms which are not included in an industrial affiliation.

Deloof (1998) makes a study similar to Hoshi et al.'s. Deloof wants to test existence of financial constraints on holding companies in Belgium. The holding companies are important for financing firms and firms belonging to a corporate or holding group can be financed by internal capital of the group. It means that internal capital behaves as a substitute for external finance. He divides his sample into three groups depending on their long term debt at the beginning of the year. First group consists of the firms named as *bank firms* that borrow from a bank but does not have any loan within the group firms, second group consists of the firms named as *group firms* with intra group debt and bank debt situation is not important, third group consists of the firms with no debt to neither bank nor intra group. Cash flow has statistically significant effect on investment for bank firms but not for group firms and other firms. Holding companies can easily borrow from intra group firms so cash flow is not important for these firms. However, bank firms are financially constrained, facing difficulties in finding external finance, therefore cash flow sensitivity is high for those firms.

Firms having close bank relations or being in an industrial group affiliation or being in a holding company decrease information asymmetries between lender and borrower. Therefore these firms can reach external finance with less cost compared to independent firms. Independent firms give more importance to being liquid so cash flow sensitivity is statistically significant and higher for those firms.

1.3.3. Size and Age of the Firm

Devereux and Schiantarelli (1990) do a study to test effects of cash flow, debt and stock measures on firms' investment decisions. They categorize the firms by size and age and use Q model of investment. The study indicates that information asymmetries are high for young firms meaning that young firms' investment cash flow sensitivity is high compared to old firms. Large firms give more importance to cash flow than small firms. This is an unexpected result and the authors explain this such that large firms might have diverse ownerships and it can cause agency problems making large firms willing to stay liquid and hold more cash.

Hyytinen, A. and Vaananen, L. (2006) analyze the same factors as Devereux et al. (1989) did by using data for SME firms in Finland. Finnish financial system is classified as bank-centered meaning that banks have important role on firms' finance. Firm's being financially constrained can prevent it to make ideal investment if there are informational

problems that are adverse selection and moral hazard between banks and SMEs. Results suggest that as the age of the firm increases, informational asymmetries decrease.

The authors do several robustness tests to be sure about the estimation results. The two studies' results are consistent with each other. Information asymmetries are problem for SMEs because under information asymmetries, even good firms cannot obtain external finance. When external finance becomes costly, constraints become more binding. Therefore firms cannot do enough investment to reach their optimal path of growth and financial constraints are more severe for younger and smaller firms.

2. DATA

2.1. Data Characteristics and Data Source

In the thesis, the behaviors of the manufacturing firms are evaluated. All of the firms have trading stocks on the National Market of the Istanbul Stock Exchange (ISE) Stock Market. In ISE, publicly held companies from different sectors are quoted. The main reason of choosing these firms to work with is that they are all quoted in the ISE and their balance sheet, income statement and cash flow statement are publicly announced. Therefore necessary data is available for the econometric analysis.

The time range for the data is between the first quarter of 2005 and the fourth quarter of 2010. Data consist of 24 quarters that make 6 years. In total, data of 164 manufacturing firms are used in the analysis. The subsectors of the firms that under consideration are agricultural chemicals, automotive, automotive spare parts, automotive tires, beverage and soft drinks, cement, chemical products, communication equipment, construction equipment, durable goods, electrical machinery, food, furniture, glass, industrial textile, leather, meat products, paints and coat industry, paper and paper products, oil and gas, stationary, steel and iron, steel and iron goods, textile, textile and apparel, tile industry and wire and cable.

The data for the evaluations and regressions are obtained from the website of ISE, Turkish Statistical Institute (TSI), Central Bank of the Republic of the Turkey (CBRT), Public Disclosure Platform (PDP). In addition to these, Financial Information News

Network (Finnet) and StockGround software programs are used to obtain balance sheet and income statement information of the firms. These programs help cumulate and set up financial statement variables in a more user-friendly format.

2.2. Describing the Data

Data consist of the variables to estimate the equation (2). In this part, the properties of the variables and the calculation method of them will be explained.

2.2.1. Investment

The dependent variable in the regression model is investment divided by capital. Investment is not a listed variable in any of the financial reports and has to be calculated. The formula used for investment divided by capital is as follows:

$$I_t/K_t = (K_t - K_{t-1})/K_t \qquad \text{(eqn. 3)}$$

where K_t is capital stock. Net fixed assets are used as capital stock variable. I_t is the investment. Investment is estimated to be the difference of capital stocks between two periods. Net fixed assets is used for K_t values as capital stock and K_t is divided by Consumer Price Index (CPI) to get rid of the impact of inflation. The CPI is obtained from the website of the TRCB. Since our data starts from the first quarter of 2005, in the calculations March of 2005 is used as the base year. The ratio of I_t/K_t is negative in some periods. Since K_t is positive in all terms, I_t/K_t value becomes negative due to the negative I_t value which is calculated by first difference equation. Negative investment value means disinvestment and it can be interpreted as a company decision not to replace depleted capital. In the I_t/K_t calculation, some I_t/K_t values were around -2000 and also some were around -10. Since these values do not represent reality, they are excluded from the data. Therefore, around 50 observations out of nearly 4000 observations are deleted. The values of I_t/K_t under consideration in this study are all between -1 and 1. In all of the regressions listed below in the tables, the dependent variable is I_t/K_t.

2.2.2. Tobin's Q

In the study where firms' investment behavior is evaluated in the financial crisis era, Tobin's q is used as an indicator to evaluate the firms' performance and decide for investment. Tobin's q is a ratio of market value of the firm's assets to the replacement cost of the same physical asset. When Tobin's q is greater than 1, it means that firm's market value is greater than the replacement cost of capital. Having a Tobin's q value greater than 1 can be interpreted as an encouragement to invest more because investment of 1 unit have a value more than 1 in the market.

However replacement cost of capital is abstract and difficult to estimate. Therefore Chung and Pruitt's approach for Tobin's q is used in this study. Chung and Pruitt (1994) make an approximation of Tobin's q as follows:

> "Approximate q = (MVE+PS+DEBT)/TA   (eqn. 4)
> where MVE is the product of a firm's share price and the number of common stock shares outstanding, PS is the liquidating value of the firm's outstanding preferred stock, DEBT is the value of the firm's short-term liabilities net of its short term assets, plus the book value of the firms' long-term debt, and TA is the book value of the total assets of the firm."

In this study, the formula of approximate q= (MVE+ DEBT) / TA is used. Related to the variables in Tobin's q calculation, the necessary values to calculate MVE are obtained from StockGround. MVE is market value of the equity and calculated by multiplying the share price with the total number of shares outstanding of the firm. PS is ignored because most of the firms in ISE do not have preferred stock. For the variable DEBT, total debt is used. TA is the book value of net fixed assets. MVE, DEBT, TA and Tobin's q values are calculated for every quarter between the years 2005 and 2010. The Tobin's q values being greater than 2 are excluded from the analysis because large q values do not represent the data and can cause misinterpreting the regression results.

2.2.3. Cash Flow

Gertler (1988) states that the role of money decreases whereas the role of intermediaries becomes important. The reason behind is explained as money does not measure intermediary credit exactly and nonbank intermediaries such as leasing and factoring companies offer alternative liquid instruments rather than holding money. However, cash flow is important within the concept of "Q Model of Investment". Fazzari et al. (1988) argues the relation between investment and internal funding for a firm. A firm facing difficulties in finding external funding will be induced to hold more cash and use internal funding for investment. Since especially in the crisis period, information asymmetries increase, Jaffee and Russell (1976) mention informational problems in borrower and lender relation in their paper. They summarize this as follows; when borrower's quality cannot be monitored, default risk of the borrower is assumed to increase when loan size increases. Due to increase in default risk, interest rate on loan will increase which makes loan more expensive. Therefore borrower quality decreases and amount of loan becomes more sensitive to exogenous conditions.

In the financial crisis period, market imperfection increases and informational asymmetries become a severe problem. External finance becomes costly because lenders become less willing to lend more because of increase in default risk and interest rate on credits increases. Firms that do not have severe liquidity problems prefer using internal finance rather than using more costly external finance or alternatively they try to increase their cash flow to signal that they have a strong balance sheet and decrease cost of loan.

Cash Flow is the key component that we want to test. In the literature, the importance of cash flow on investment is emphasized. In the thesis, earnings before interest, tax and depreciation (EBITD) is used for cash flow variable. EBITD data for the firms is obtained from Finnet. In the regressions cash flow is scaled by net fixed assets (K) to fit the format to the Q model of investment.

In addition to this, lagged value of cash flow value is in the model. The reason behind is that there might be a delay for firms between observing the current liquidity and taking an action to change their financial situation.

2.2.4. Net Sales Revenue

One of the main indicators for firms to do investment is their current economic activities' profitability. Net sales revenue of the firm is a good indicator to interpret the firm's profitability. Firms will invest more depending on their sales revenue.

In this thesis, net sales is lagged for one period and used to explain the relation between investment and the profitability of the firm. This variable is lagged because it takes time for firms to observe their economic performance and decide to do investment. The variable of net sales is obtained from StockGround. In the regressions net sales is scaled by net fixed assets (K) like the other variables which are stated in money values. Net sales divided by capial is labeled as *sk* and lagged net sales divided by capital is labeled as *sk lagged* in the regression equations in Table.

2.2.5. Dummy Variables

As the mentioned literature points out, firms hold cash depending on their financial conditions. Especially, in the crisis period financially constrained firms are expected to increase their cash holdings because of increasing cost in external funding.

We add dummy variables to capture some variability in the main model. The first type of dummy variable is time dummy. Dumt refers to year dummy where t stands for that specific year such as dum9 refers to the dummy of the year 2009. All firms are exposed to same economic conditions and by using time dummies we try to capture the changes over time. In this model, there are year dummies from 2005 to 2010. If the data belongs to that year, the variable is equal to 1; otherwise 0. In addition to them; there is a dummy variable dum8439 that refers to the time range starts from the 4th quarter of the year 2008 and includes 1st, 2nd and the 3rd quarters of the year 2009. These quarters are accepted as the crisis period therefore we created a common dummy including this time range. If time is 4th quarter of 2008 or 1st, 2nd, 3rd quarter of 2009, dummy equals to 1; otherwise 0.

Fazzari et al. (1988) classify the firms according to retention ratio to make an analysis about cash flow sensitivity. In this regression model, the firms are grouped into two depending on dividend policy. Firms' dividend payment status in the years 2007 and 2008 is evaluated. If the firms pay dividend at least in of the years 2007 and 2008, it is classified as

dividend payer firm. The reason behind is that the firms pay dividend depending on their previous years' profit so their dividend payment can be interpreted as being profitable firm. The number of the firms paying dividend in 2008 is so small so the firms which pay dividend in the year 2007 are also classified as dividend paying firm. The important point is that dividend payment in 2007 and/or 2008 indicates that the firms are profitable before the crisis period. In the model, there is a dummy named as dumdiv and if a firm pays dividend in the year 2007 or/and 2008, the variable is equal to 0, otherwise.

Classifying the firms depending on their age is also a common approach in this literature. Devereux and Schiantarelli (1990) use this classification. In this data, I divide the firms into two groups depending on their establishment date. I divide the firms into two by keeping the size of the groups close to each other. The firms established before 1971 are classified as old firms whereas the ones established after 1972 are classified as young firms. Dumage refers to establishment date of the firm and if the firm is established before 1971, the variable is equal to 0; otherwise 1.

Gertler and Gilchrish (1994) classify the firms according to their total asset size. This type of classification is common in this literature. Firms having small total asset size are expected to be financially constrained compared to the firms having large total asset size. A priori small firms have difficulties in finding debt. These firms might not be well-known and the asymmetry information is higher for those firms compared to large firms.

We group the firms depending on their total asset size in the beginning of the year 2007. In this manner, in the classification, there are two groups and the sizes of the groups are close to each other. Dumta variable refers to total asset size of the firm. In the first classification if the firm has asset size larger than 178,000,000, the variable is equal to 0; otherwise 1 whereas in the second classification if the firm's asset size is larger than 70,000,000, Dumta equals to 0; otherwise 1.

Hoshi et al. (1991) and Deloof (1998) use industrial group affiliation as a different classification criterion. However, in ISE this classification would not work because of the limited number of the firms. In total there are around 170 manufacturing firms which are quoted in ISE and only small numbers of the firms are in industrial group affiliation. Therefore this criterion is disregarded.

The explanations of the interactive dummies listed in the table below are as follows: cfkdiv means cash flow divided by capital is multiplied with dummy of dividend payment, cfkta means cash flow divided by capital is multiplied with dummy of total asset size, cfkta89 means flow divided by capital is multiplied with dummy of total asset size and year dummy of 2008 and 2009 (dum89).

3. EMPIRICAL ANALYSIS

3.1. The model

The interest of this thesis is the behavior of two variables I/K (Investment/Capital) and CF/K (Cash Flow/Capital) in the crisis period where Cash Flow/Capital is labeled as cfk in the regression results listed in Table. The method that is used to evaluate the main determinants of the investment/capital under the Q model of investment is linear regression analysis. In regression analysis, the aim is to estimate the relationship between the dependent variable and independent variables; evaluate how a change in independent variable affects dependent variable whether in a positive or negative way.

3.2. Independent Variables

The variability in investment is attempted to be evaluated by the help of independent variables. These variables are Tobin's q, cash flow, lagged sales revenue and interactive dummy variables. As mentioned in the literature review part, the relation between investment and cash flow is estimated via Q model of investment. Therefore the selection of the variables is based on literature and also the avaibility of the variables.

3.3. The Data Set

The data have two dimensions; time and cross section. Each dimension makes a contribution to explain the relation between dependent and independent variables. Therefore, we will use regular least square regression over pooled data as well as panel data analysis. There are some

problems with the data; for example some variables in the firms' financial report are missing that prevents the necessary calculations. Therefore the data set becomes unbalanced.

The software package that is used for regression analysis is Stata. The main reason of studying with Stata is its wide usage in econometrics studies.

3.4. The Regression Results

In the regression analysis, the firms are grouped as large and small depending on their total asset size in the end of 1st quarter of 2007. In the grouping, half of the firms are grouped as small and the others as large which mean 83 firms out of 164 firms are small and 81 large. Firms having total asset size larger than 18.000.000 TL in the end of 1st quarter are classified as large, whereas the others small. Other groupings are done depending on dividend payment status in the years 2007 and 2008 and also the establishment year of the firm.

3.4.1. Data Range Years 2005-2010

The first analysis is done with pooled data and the data consists of the variables starting from the year 2005 (Regression1, Table 1). In this regression, the coefficient of cash flow/capital has positive sign and it is significant; this is an expected result. As firms hold more cash, they do more investment. However the coefficient of Tobin's q is negative and it is insignificant; this is an unexpected result because the theory suggests that Tobin's q should have a positive and significant coefficient. An additional regression is done but this time random effects in other words GLS is used (Regression 2, Table 2). The GLS regression results are similar with the pooled estimation results. According to GLS regression, Tobin's q is not significant and its coefficient is negative. Similar with the pooled data results, cash flow/capital is significant and it has positive coefficient.

There are other results that need to be discussed in terms of pooled data regression. When the firms are divided into two equal groups depending on their asset size, the results suggest that the effect of cash flow on investment is larger for firms that are grouped as small (Regression 3, Table 1). Small firms might be more prone to hold more cash to do an investment. As discussed in the literature review part, smaller firms generally have problems in finding external funding or external funding might be costly for them. Therefore investments of smaller firms are more sensitive to cash flow.

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The other pooled data regression result is related with the firms that do not pay dividend. The results present that the investment of the firms that do not pay dividend is more sensitive to their cash flow (Regression 4, Table 1). This is an expected result according to the study of Fazzari (1988). The firms do not pay dividend because these firms might not be profitable or they might have financial problems. Therefore they prefer not to pay dividends to stay more liquid.

In addition to these regressions, other regressions are done in which panel data techniques are used for the time range between the years 2005 and 2010. In panel data regressions, Generalized Least Squares (GLS) and Fixed Effects (FE) methods are used. The panel data regression results in which GLS method are used are similar to the results obtained from the pooled data (Regressions 2 and 5 and 6, Table 2). Therefore, from these regressions we can come up to a conclusion that smaller firms' and also the firms' that do not pay dividend investments are more sensitive to their cash holdings. These types of firms are generally known as financially constrained meaning when they do not want to delay their investment plans, they try to stay more liquid by holding more cash.

However, the regression results with the FE method are slightly different than the other cases. The relation between cash flow and investment is same. The coefficient of cash flow divided by capital is again positive and significant. In addition to this, the coefficient of Tobin's q is negative and significant (Regression 7, Table 3). This result is unexpected according to the literature. Fazzari et al. (1988) suggest that the firms having high Tobin's q value more willingly invest more because market value of their investment is higher than the cost of their investment. Moreover, when FE method is used, there is no significant difference between neither the small and large firms nor dividend paying and not paying. We have not been able to understand why the inclusion of fixed effects yields such different results (Regression 8, Table 3).

3.4.2. Data Range Years 2006-2010

In the regression analysis, we divide the firms according to their total asset size, firms' establishment date and also their dividend payment policy. In these regressions, we restrict our data to the years between 2006 and 2010.

When the pooled data is used, the results are same as the regressions that are done with the year range 2005-2010. From the regression results, we can again claim that smaller firms and also the firms that do not pay dividend hold more cash to do investment.

However when the fixed effects method is used in the panel data, Tobin's q has an insignificant coefficient (Regression 9, Table 3). This result is different from the panel data regression result which is done with the year range 2005-2010. In the old regression, we have significant and negative Tobin's q coefficient which conflicts with the theory. By evaluating the regression results, we can claim that there might be something wrong with Tobin's q value in the year 2005 and this leads to misinterpretation of the relation between Tobin's q and investment. Here, also the results show that investment is sensitive to cash holdings of the firms.

3.4.3. Definition of the Crisis Period

The main argument of this thesis is to understand how investment behavior of the firms is affected from the cash holdings. We especially aim to test how cash flow holding attitude change among different firm characteristics and also in the economic crisis period. The subprime mortgage crisis in the US started in the year 2007 but in Turkey it is effective starting from the year 2008. As seen in the figure 1, the harsh period of the crisis in Turkey is between the 4th quarter of 2008 and the 3th quarter of 2009. Therefore a new time dummy is created named d8493 to capture the differences in the cash flow in the crisis period. If the time is between 4th quarter of 2008 and the 3th quarter of 2009, the variable is equal to 1; otherwise 0.

In both of the observations starting from the year 2005 and 2006, the same pooled regression model is used. In the regressions, as usual, the cash flow divided by capital has positive and significant coefficient. In addition to this, we would like to discuss a variable that is generated by multiplying three different variables namely cash flow divided by capital, total asset dummy and the crisis dummy of d8493. This variable has positive and significant coefficient in both observations (Regression 10, Table 1). This result suggests that the investments of the firms which are grouped as small are more sensitive to cash holdings in the crisis period between the 4th quarter of 2008 and the 3th quarter of 2009. This is an expected result. It verifies the discussed literature that smaller firms generally have financial constraints

and in the crisis period, these constraints become severe. Therefore the investments of the firms that have weak financial structure are more sensitive to cash holdings.

When the FE method is used in the panel data, cash flow divided by capital has positive sign and significant but we are unable to capture the crisis period effect.

3.4.4. Lagged Variables

In this thesis, firms' investment behavior under different groupings is evaluated by using Tobin's Q Model of Investment. We made a slight change in the model by adding lags to investigate how investment is affected from previous terms' profitability. In the new model, the dependent variable is again investment divided by capital, whereas the independent variables are Tobin's q variable, cash flow divided by capital, lagged value of cash flow divided by capital, net sales divided by capital and also interactive dummy variables. The underlying reason to add lagged values is that the coefficient of Tobin's Q does not explanatory power on investment. In the literature, it is discussed that firms make their future investment plans depending on Tobin's q value in other words the market valuation of the firms' assets. Since Tobin's q does not have any explanatory power on investment with this data, we investigate using previous terms' profitability as an indicator to make investment. The data time range is between the years 2005 and 2011.

When the analysis is done with the pooled data, the results indicate that firms' investment is affected from the lagged value of cash flow divided by capital, lagged value of net sales (Regression 11, Table 4). The results can be interpreted as the investment of the firms is cash sensitive and as firms' net sales revenue increases, they make more investment. Moreover it can be claimed that investment of the firms that do not pay dividend is more sensitive to their cash holdings.

GLS regression results are also similar to pooled data regressions. It also tells that as lagged cash flow divided by capital increases; firms do more investment and also lagged sales divided by capital affect investment affect investment in a positive way (Regression 12, Table 4). The overall explanatory power of the data increases when lagged variables are used.

3.4.5. Alternative Method to Eliminate Outliers

In this thesis, we eliminate the outliers in the data according to literature review. Moreover, we used the "Centile" method in Stata program. When %2 of the data is cut off from the tails, the regression results are not significant. Therefore, we only report the results which are obtained via eliminating according to literature.

4. CONCLUSION

In this thesis, our originating point is the 2008 global financial crisis. In Turkey, growth rate of manufacturing activities became -22.1% in the crisis period. There is a huge decrease in investment activities of the manufacturing firms. The reason for this decrease can be difficulties in finding external finance of the firms and also firms having less desire to invest. In this thesis, we aimed to test how financial constraints affect firms in different characteristics however financial constraints cannot be directly measured. Therefore we made an econometric modeling and tried to examine whether firms' investments are sensitive to the availability of cash flow. We used the data of manufacturing firms which are quoted on the ISE and classified them according to dividend payment status, the firm's establishment date and total asset size of the firm. By classifying the firms into groups which *a-priori* are expected to differ according to the severity of financial constraints, we tried to capture similarities within the same groups.

Related to econometric approach, we did the same regressions by using different methods of panel data in Stata program. The results somewhat verify what we suggested. In most of the regressions, cash flow has positive effect on investment. This is what the literature says and what we expect. When lagged sales revenue is used as an indicator for profitability of the firm, it has explanatory power on investment. As the previous period's sales increases, firms do more investment. Related to classification results, in some analysis, we also found that firms which have smaller asset size are more prone to having more cash to do investment. Moreover, the firms which do not pay dividend also try to be more liquid by having more

cash to do their planned activities. These are the results that confirm the terminology of being financially constrained and the trial of being more liquid to decrease the cost of external funding. In some regressions, we could observe the effect of the crisis period. In the time range between the 4th quarter of 2008 and 3rd quarter of 2009, investments of firms having small asset size are more sensitive to cash flow. This result is exactly what we claim in the thesis.

However, not all the results are as we expected. The firms having high Tobin's q meaning that firms market value of the assets are higher than the cost of the same assets replacement value generally make more investment. There should be a positive relation between Tobin's q and investment. However, in this study we could not figure out this. In some regressions Tobin's q and investment has a negative relation which conflicts with the theory. This result is found in only some of the regressions, and may reflect problems in the data or in the way Tobin's Q is calculated. This is why we included the lagged value of net sales divided by capital to investigate the profitability of the economic activities of the firm.

In this study, we try to show the financial constraints and their behavior in the financial crisis era. We aim to investigate the investment behavior of the firms and come up to a same type of relation for the firms having similar characteristics. Therefore we make different classifications of the firms. We figured out the importance of holding cash on investment, especially for the firms who are defined as financially constrained give more importance to liquidity. The regression results suggest that as net sales of the firms increase, their investment increases. However the data does not exactly confirm what we suggest for the crisis periods. We can claim the importance of cash and net sales on investment but the distinction among different group of the firms and the behavioral change in the crisis period cannot be observed exactly. The results in general are not robust and since adjusted R-squared is so low, overall explanatory power of the model is low within this empirical study. Only in some regressions, we obtain the results that fit to the literature review. This might be because of the data in general. We only have the financial statement of the firms that are quoted on the ISE. These are the largest firms in Turkey and most of them are well-known firms so there might be a selection bias. Probably, these firms also had problems like financial shortage but the financial constraints are not that much binding.

Table 1: Pooled Method

	Regression 1	Regression 3	Regression 4	Regression 10
q	-0.00556	-0.00536	-0.00536	-0.00616
	(0.00675)	(0.00675)	(0.00675)	(0.00678)
cfk	0.0171***	0.00810	0.00810	0.0183***
	(0.00511)	(0.00636)	(0.00636)	(0.00542)
cfkta		0.0222**	0.0222**	-0.0219
		(0.00936)	(0.00936)	(0.0161)
cfkdiv			0.0222**	
			(0.00936)	
cfkd8493	-0.00755	-0.00786	-0.00786	0.0462*
	(0.00786)	(0.00785)	(0.00785)	(0.0270)
cfktad8493	3,572	3,572	3,572	-0.00706
				(0.00789)
constant	-0.00755	-0.00786	-0.00786	
	(0.00786)	(0.00785)	(0.00785)	
no of observations	3,572	3,572	3,572	3,572
R-squared	0.003	0.005	0.005	0.004

Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table 2: Generalized Least Squares Method

	Regression 2	Regression 5	Regression 6
q	-0.00690	-0.00628	-0.00628
	(0.00720)	(0.00708)	(0.00708)
cfk	0.0166***	0.00830	0.00830
	(0.00533)	(0.00665)	(0.00665)
cfkta		0.0203**	
		(0.00975)	
cfkdiv			0.0203**
			(0.00975)
constant	-0.00579	-0.00660	-0.00660
	(0.00846)	(0.00830)	(0.00830)
no of observations	3,572	3,572	3,572
R-squared between	0.0184	0.0184	0.0680

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3: Fixed Effects Method

	Regression 7	Regression 8
q	-0.0206**	-0.0200*
	(0.0103)	(0.0104)
cfk	0.0133**	0.0127*
	(0.00666)	(0.00679)
cfkta89		0.00908
		(0.0192)
constant	0.0101	0.00928
	(0.0117)	(0.0119)
no of observations	3,572	3,572
R-squared	0,002	0,002

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Estimation with Lagged Variables
(Regression 11 with Pooled Data Method
Regression 12 with Generalized Least Squares Method)

	Regression 11	Regression 12
q	-0.00185	-0.00254
	(0.00231)	(0.00271)
cfk	-0.00256	0.00266
	(0.00581)	(0.00516)
cfk lagged	0.00150***	0.00146***
	(0.000200)	(0.000199)
sk lagged	0.00110***	-0.0176***
	(8.73e-05)	(0.00383)
cfkdiv	0.0195**	
	(0.00865)	
constant	-0.0176***	-0.0169***
	(0.00383)	(0.00469)
no of observations	3,748	3,748
R-squared	0.063	0.063

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

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