FINANCING CONSTRAINTS AND INVESTMENT: THE CASE OF TURKISH MANUFACTURING FIRMS

A Master's Thesis

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To My Family

FINANCING CONSTRAINTS AND INVESTMENT: THE CASE OF TURKISH MANUFACTURING FIRMS

The Institute of Economics and Social Sciences
of
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by

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I certify that I have read this thesis and have found that it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Arts in Economics.

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ABSTRACT

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Using a comprehensive firm-level data that covers nearly 75% of total employment in Turkish manufacturing industry for the period 1992–2003, this study tests whether Turkish firms are financially constrained or not. Based on the pioneering work of Fazari, Hubbard and Peterson (1988), numerous studies have examined the role of financing constraints in determining investment decisions of firms. Most of these studies check for investment-cash flow sensitivity in order to identify financing constraints. This study follows the approach of Fazari, Hubbard and Peterson (1988) that interprets a significant positive relationship between firms' investment and the measure of their internal finance (cash flow) as evidence of financing constraints, which might arise due to capital market imperfections. The results presented here suggest a significant positive relationship between firms' investment and their cash flow. This finding is robust to controlling firm specific characteristics such as size and age. As a result, the study contributes to the financing constraints literature by studying the issue in a developing country context.

JEL Codes: G32, E22, G15

Key words: Financing Constraints, Investment, Emerging Markets

ÖZET

MALİ KISITLAR VE YATIRIM: TÜRK İMALAT SANAYİ FİRMALARI ÜZERİNE BİR ÇALIŞMA

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Bu çalışma, 1992-2003 periyodu için Türkiye imalat sanayindeki toplam istihdamın yaklaşık %75'ini içeren kapsamlı firma-düzeyi veri setini kullanarak, bu firmaların mali kısıtlı olup olmadığını incelemektedir. Literatürde Fazari, Hubbard ve Peterson (1988) öncü çalışmasını temel alarak, firmaların yatırım kararlarını belirlemelerindeki mali kısıtların rolünü inceleyen çok sayıda araştırma mevcuttur. Bu çalışmaların birçoğu, mali kısıtları tanımlamak için yatırım-nakit akışı duyarlılığını kontrol etmişlerdir. Sermaye piyasalarındaki bozukluklardan da kaynaklanabilen mali kısıtların kanıtı olarak, firmaların yatırımları ile içsel finansman ölçütü arasındaki anlamlı pozitif ilişkiyi kullanan Fazari, Hubbard ve Peterson (1988)'in yaklaşımı araştırmada temel alınmıştır. Bu çalışmadaki sonuçlara göre, firmaların yatırımları ile nakit akışları arasında istatistiksel olarak anlamlı pozitif bir ilişki mevcuttur. Bu bulgu, firmaların boyut ve yaş gibi spesifik özellikleri kontrol edildiğinde dahi geçerlidir. Sonuç olarak bu çalışma, mali kısıtlar literatürüne gelişmekte olan ülkeler bağlamında katkıda bulunmuştur.

Anahtar Kelimeler: Mali Kısıtlar, Yatırım, Gelişmekte Olan Piyasalar

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Of course, all remaining errors are mine.

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CHAPTER 1

INTRODUCTION

Modigliani and Miller (1958) argue that in perfect markets financing and real decisions of firms do not depend on each other. This implies that investment and business expansion are not constrained by the availability of firms' internal finance. In the real world the capital markets are imperfect and hence cost of external finance can exceed that of internal finance. Therefore, firms with high costs of external finance (i.e. financially constrained firms) will rely more on internal finance and invest less than the optimal amount.

Fazari, Hubbard and Peterson (1988) [FHP] and many subsequent studies provide empirical evidence of the pecking order of financing costs and its impact on firm investment spending which is much severe among the firms that have been identified as facing a high level of financing constraints.[1] The findings in these studies suggest that the availability of internal finance will be a crucial determinant of investment spending for financially constrained firms and the sensitivity of investment to internal finance (cash flow) will be increasing in the degree of financing constraints.[2]

This study provides a test of financing constraints in determining firms'

[1] See Chirinko (1993), Schiantarelli (1996), Hubbard (1998), Chatelain (2003), and Bond and Van Reenen (2007) for comprehensive surveys.

[2] The recent studies have questioned the interpretation of investment-cash flow sensitivity as a measure of financing constraints. For example, Kaplan and Zingales (1997) [KZ] provide evidence that while investment levels depend positively on cash flow, the investment decisions of firms that are less financially constrained are more sensitive to the availability of internal finance than those of more financially constrained firms.

investment in the spirit of FHP (1988), in the context of a developing country, namely Turkey. Most of the studies in the empirical literature that stress the importance of financing constraints for firms' investment behavior have appeared so far in the context of developed countries and only a few recent studies have been carried out in the context of transition economies. Most studies in the empirical literature use Q model of investment which precludes the investigation of the firms that are not quoted on the stock market. In developing countries, the number of publicly traded firms tends to be limited. Thus, the impact of the financing constraints on investment decisions of firms that are located in developing countries is not well known.[3]

The contribution of this study is in its focus on a developing country and the scope of its data. To the best of my knowledge, the data used in the existing studies on developing countries are not as comprehensive as the one used in this study.[4] Here, I use a firm-level data that covers nearly 75% of total employment in Turkish manufacturing industry for the period 1992–2003. It is a comprehensive panel with a time dimension long enough to record changes in individual firms' financial strengths and overall macroeconomic conditions in Turkey. It covers firms of different size, age and legal status from a variety of industries and regions.[5]

With this rich firm-level panel data, I estimate a reduced form regression out of a structural investment model based on Euler equation to test whether the firms in the Turkish manufacturing industry are financially constrained

[3]See Claessens and Tziomuis, (2006), using data gathered by World Business Environment Survey and Investment Climate Assessment surveys, they study the issue of measuring financing constraints for the case of developed and developing countries.

[4]Hericourt and Poncet (2007): China with panel of 2200 firms for the period 1999-2000, Terra (2003): Brazil with panel of 468 firms for the period 1986-1997; George et al. (2008): India with panel of 339 firms for the period 1995-2000; Gelos and Werner (1999): Mexico with panel for the period 1984-1994; Jaramillo et al. (1993): Ecuador with panel with 420 firms for the period 1983-1988; Bingsten (2000) and Mc Millan (2003): Africa with first panel for the period 1992-1996 and with second panel of 339 firms for the period 1974-1987.

[5]See Data Appendix for further details.

or not. According to the data on financing obstacles from WBES[6] and ICA[7] surveys, more than half of the private firms in Turkey (51.4%) see financing constraints as one of their primary obstacle for their investment decisions. This figure, more than the median of the sample (38.5%), ranks Turkish firms as some of the most financially constrained ones among their developing and transition country firm parts. However, quantifying the extent of the financing constraints of Turkish firms and verifying whether investment behavior is consistent with the above mentioned surveys have not so far been done.

Main results presented in this study suggest the sensitivity of investment to the availability of internal finance. Although the dynamics implied by the adjustment costs model are not rejected by the data, the measure of internal finance used in this study has a significant positive sign in Euler equation specification that is inconsistent with the standard neoclassical investment model developed under the null of no financing constraints. A significant positive coefficient on the measure of internal finance is consistent with the existence of financing constraints in the Turkish manufacturing industry. Moreover, this result is robust to controlling firm specific characteristics such as size and age.

The paper is organized as follows. The next section reviews the related literature on financing constraints and investment. Section 3 outlines the theoretical framework on which Euler equation model of investment depends and derives its empirical implications and discusses some related empirical issues. Section 4 presents the data underlying the estimation. Section 5 discusses the results of the empirical study and undertakes several robustness checks. Section 6 concludes. The details about data and further robustness checks are delegated to an appendix.

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[6]World Business Environment Survey (WBES) is a major firm-level survey conducted in 1999 and 2000 in 80 developing and developed countries around the world and led by the World Bank. In total, over 10,000 firms were surveyed, with the number varying across countries but with a minimum of 100 firms per country. 150 firms were surveyed from Turkey. For a more detailed discussion of the survey, see Beck et al. (2004).

[7]Investment Climate Assessment surveys (ICAs) have reviewed the investment climate in 58 countries based on firm-level surveys. The data and documentation are available at http://www.ifc.org.

CHAPTER 2

LITERATURE REVIEW

According to Modigliani and Miller Theorem (1958), the firm's real decisions are separable from its financial decisions. Since perfect capital markets ensure that the internal and external finance are perfect substitutes, the market value of the firm will not be dependent on the financial factors such as internal liquidity, debt leverage or dividend payments. The basic result of Modigliani and Miller Theorem is that the firm's choice of the optimal capital stock depends only on the user cost of capital and future profitability. It depends on the measures of the availability of internal finance only to the extent that they convey new information about the firm's future profitability.

This basic result offers a framework for neoclassical theoretical investment models in which the firm's choice of the capital stock is solved without reference to financial factors. Within the framework of these neoclassical theoretical investment models, many empirical studies have derived reduced form models. Using disaggregated data, they have tested these models whether they are able to explain the investment behavior of the firms.

However, standard investment models implicitly assume perfect capital markets and empirical studies depending on these models have failed to explain the investment behavior of the firms that operate in imperfect capital markets. Imperfections in the capital market are more likely to arise from the informational asymmetries between investors and lenders and a firm's management:

while investors and lenders are less well informed about a firm's performance, firm's managers have superior information about corporate financing prospects which are not shared with outside owners. These informational asymmetries may give rise to adverse selection and moral hazard problems.[1] The literature argues that because of moral hazard and adverse selection problems, external finance is more expensive than internal finance. Therefore, firms with high costs of external finance may face financing constraints, which means that financial factors such as internal liquidity, debt leverage or dividend payments will reflect on their investment decisions.

Over the past two decades, numerous studies have extended neoclassical investment models to incorporate a role for "financing constraints" in determining investment decisions of the firms.[2] Empirical studies have added the measures of internal finance to the reduced form of neoclassical investment models derived under the assumption of perfect capital markets and then tried to figure out whether they are significant for explaining investment behavior of the firms that are more likely to suffer from severe financing constraints.

FHP (1988) pave the way for a large body of research that studies the role of financing constraints on investment decisions in the framework of Q model of investment. Furthermore Whited (1992), Bond and Meghir (1994) and many others have discarded Q model of investment in favor of Euler equation model while studying financing constraints.[3] All these studies check for investment-cash flow sensitivity in order to identify financing constraints. Empirical studies developed in the spirit of FHP (1988) have proposed a test that exploits cross-sectional differences in the sensitivity of investment to cash flow which correspond to the cross-sectional differences in financing constraints.

This necessitates priori groupings of firms that are focused on sorting financially constrained and financially unconstrained firms. Studies typically

[1]For theoretical discussion of capital market imperfections, see Stiglitz and Weiss (1981); Jensen and Meckling (1976) and Myers and Majluf (1984).

[2]See footnote 1 in Chapter 1.

[3]See following chapter for further details on Q and Euler equation model of investment.

focus on a firm's characteristics that are associated with information costs as a criterion to select firms which are a priori likely to be financially constrained. Financially constrained firms are often thought to be the youngest, smallest, most indebted ones or the ones not paying dividends. Empirical studies test whether these firms have a higher positive correlation between investment and cash flow than financially unconstrained firms have. The intuition is that a higher investment-cash flow sensitivity corresponds to a higher degree of financing constraints.[4]

On the other hand, a series of papers have criticized the interpretation of investment-cash flow sensitivity. The hypothesis that financially constrained firms have high investment-cash flow sensitivity was firstly questioned by Kaplan and Zingales (1997) [KZ]. Cleary (1999), KZ (2000) have further conclusions that support the findings of KZ (1997). Basically, they show that the least financially constrained firms have higher investment-cash flow sensitivities than those of the most financially constrained firms. Moreover, Cleary et al. (2007) draw a new interpretation of investment-cash flow sensitivity by showing that the relationship between cash flow and investment is U-shaped. While some studies have been developed to propose justifications for the interpretation of investment-cash flow sensitivity as a measure of financing constraints [FHP (2000) and Allayannis and Mozumdar (2004)], Gomes (2001) and Altı (2003) continue to challenge this literature by proposing a further controversial evidence. They show that the investment-cash flow sensitivities can be positive even in the absence of financing constraints. Additionally, rather than indicating the degree of financing constraints, investment-cash flow sensitivity can be indicating other sources of misspecification in any investment equations.[5] Thus, it is true that use of investment-cash flow sensitivity as an indicator

[4]At the firm-level several sample separation criteria have been used. Some of the sample selection criteria used in the literature are the following ones. FHP (1988): payout ratio; Whited (1992): bond rating; Hubbard et al. (1995): dividend behavior; Hoshi et al. (1991): business group affiliation; Schianteralli and Sembenelli (1995): bank affiliation; Devereux and Schiantarelli (1990): size, age; George et al. (2008): ownership, size and age.

[5]See Bond and Van Reenen (2007) for further discussions.

of financing constraints is controversial and its interpretation is still an open question in the literature.

CHAPTER 3

THEORETICAL FRAMEWORK

In the empirical literature, most of the studies use Q model of investment to examine the impact of financing constraints in determining investment.[1] Although Q and Euler equation models of investment come from the same intertemporal value optimization problem that assumes convex adjustment costs (they are just two different ways to rearrange the first-order conditions), estimating Euler equation not only avoids several problems faced by the Q model, but also offers important advantages.[2]

The Euler equation specification has the advantage that it does not require to find an appropriate proxy for marginal q which creates estimation problem in the studies using Q model. It has the advantage that, under its maintained structure, the model captures the influence of current expectations of future profitability on current investment decisions and thus, it can be argued that the measures of internal finance should not enter this specification as proxies

[1]Q model was developed by Tobin (1969) and extended by incorporating convex adjustment cost function of capital stock by Hayashi (1982). Q model of investment basically refers to the first order condition of firm value maximization which states that the firm's investment in each period can be written as a function of marginal q. Marginal q is defined as the marginal value obtained from an additional unit of investment divided by the price of this unit of investment. For its detailed specification, see Bond and Van Reenen (2007).

[2]Several recent studies emphasize severe problems about the methodology of Q model. Difficulties arise due to non-linear or non-structural parameter in its estimated reduced form. The observed investment-cash flow sensitivity may or may not depend on the extent of financial constraints, measurement errors, short run valuation error on the equity market, and the lack of micro-level data for the value of unquoted firms at the microeconomic level. See Bond and Cummins (2001), Bond et al. (2004) and Gomes (2001) for further discussions on this issue.

for expected future profitability (Bond et al., 2003). Moreover, different from Q model, this specification can also be extended to allow for imperfectly competitive product markets and/or for diminishing returns to scale. Thus, this study adopts Euler equation model that derives an estimation equation to test the impact of financing constraints on investment behavior of the firms.

3.1 Euler Equation Model

I estimate a version of Euler equation model which closely follows the main insights of Bond and Meghir (1994), Bond et al. (2003) and Bond and Van Reenen (2007). Under its certain assumptions, the Euler equation specification relates company investment rates in adjacent periods derived from dynamic optimization.

The firm i is assumed to maximize expected present discounted value of current and future net cash flows. Letting F($K_{i,t}$, $L_{i,t}$) denote the production function gross of adjustment cost, G($I_{i,t}$, $K_{i,t}$) the adjustment cost function, $I_{i,t}$ denote gross investment, $w_{i,t}$ the price of variable factor input, $p_{i,t}$ the price of both final good and capital good, β^t_{t+j} the nominal discount factor between period t and period t+1, δ the rate of depreciation and E_t (.) the expectation operator conditional on information available in period t,[3] the firm solves the following optimization problem;[4]

$$\max_{I,L} \quad E_t \left\{ \sum_{j=0}^{\infty} \beta^t_{t+j} R(K_{i,t+j}, L_{i,t+j}, I_{i,t+j}) \right\} \tag{3.1}$$

subject to

$$K_{it} = (1-\delta)K_{i,t-1} + I_{it} \tag{3.2}$$

[3]The expectations are taken over future interest rates, input and output prices and technologies.

[4]The model is simplified here because it ignores taxation and the possibility of debt financing and internal financing depends on financial assets.

$$R_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it} - p_{it}I_{it} \tag{3.3}$$

The Euler equation characterizing the optimal investment path relates marginal adjustment costs in adjacent periods. This equation refers to the present value of the marginal adjustment cost of investing tomorrow and can be defined in the following form:

$$(\frac{\partial R}{\partial I})_{it} = (1-\delta)\beta^t_{t+j}E_t\left\{(\frac{\partial R}{\partial I})_{it+1}\right\} - (\frac{\partial R}{\partial K})_{it} \tag{3.4}$$

Since the firm i is a price taker, the derivatives of net revenue with respect to I and K can be written as $(\partial R_{it}/\partial I_{it}) = -p_{it}$ and $(\partial R_{it}/\partial K_{it}) = p_{it}(\partial F_{it}/\partial K_{it})$. Substituting them into equation (4) gives the expression;[5]

$$(\frac{\partial F}{\partial K})_{it} = 1 - \left\{\frac{(1-\delta)}{(1+\rho^t_{t+j})}\beta^t_{t+j}E_t[(\frac{p_{it+1}}{p_{it}})]\right\} = (\frac{r_{it}}{p_{it}}) \tag{3.5}$$

This equation proposes that the marginal product of capital will be equal to the real user cost of capital in every period that depends on the firm's required rate of return, depreciation rate and expected change in the price of output and capital good p_{it} in every period.[6] Assuming competitive markets and that F($K_{i,t}$, $L_{i,t}$) is constant returns to scale and specifying $G(I_{it}, K_{it}) = \frac{b}{2}[(\frac{I}{K})^2_{it} - a]K_{it}$, this yields the following expression,[7]

[5]The firm i is assumed to be risk-neutral and be paying no taxes, defining ρ^t_{t+j} to be equal to risk-free rate of interest between period t and period t+1 and to be given exogenously to the firm. Then, the firm's nominal discount factor between period t and period t+1 will be equal to $(1+\rho^t_{t+j})^{-1}$.

[6]See Jorgenson (1963) for further details.

[7]The major problem with Euler equations is related with the assumption of quadratic adjustment costs. Estimates of the adjustment cost parameter are sometimes very small and insignificant. The restrictive structure of adjustment costs has been criticized by the literature on investment under certainty and irreversibility (Dixit and Pindyck, 1994). There have been proposals for removing the assumption of quadratic adjustment cost to a polynomial specification (Whited, 1998; Chatelain and Teurlai, 2003) or to another specifications which allows a higher number of lags of the investment ratio (Gerard and Verschueren, 2002) or to another specification which assumes non-convex costs of adjustment (Cooper and Haltiwanger, 1999)

$$(\frac{I}{K})_{it} = a(1 - E_t[\psi_{it+1}] + E_t\left\{\psi_{it+1}(\frac{I}{K})_{it+1}\right\} + \frac{1}{b}\left\{(\frac{\partial\Pi}{\partial K})_{it} - (\frac{I}{K})^2_{it} - (\frac{r_{it}}{p_{it}})\right\} \tag{3.6}$$

where $\psi_{it+1} = \frac{(1-\delta)}{(1+\rho^t_{t+j})}\frac{p_{it+1}}{p_{it}}$ is a discount factor and $\Pi_{it} = p_{it}F(K_{it}, L_{it}) - p_{it}G(I_{it}, K_{it}) - w_{it}L_{it}$ is the gross operating profit.

Current investment is positively related to expected future investment and to the current-average-profits term (reflecting the marginal profitability of capital under constant returns), and negatively related to the user cost of capital. An attractive feature of the Euler equation model is that all relevant expectational influences are captured by the one-step-ahead investment forecast.

3.2 Testing for Financing Constraints Using Euler Equation

To derive an empirical investment equation from this model, consistent with assumption of rational expectations, unobservable one-step ahead expected values in the equation (3.6) can be replaced by the realized values of these variables in period t+1 plus forecast errors that are orthogonal to the information available in period t. The user cost of capital term $(\frac{r_{it}}{p_{it}})$ and real discount factor term ψ_{t+1} can be replaced by time effects and firm-specific effects. Moreover, a term $(\frac{Y}{K})_{it}$ is included to allow for imperfectly competitive product market and/or for diminishing returns to scale. Thus, the empirical investment equation of this model can be expressed as:

$$(\frac{I}{K})_{i,t+1} = \beta_1(\frac{I}{K})_{it} - \beta_2(\frac{I}{K})^2_{it} - \beta_3(\frac{Y}{K})_{it} + \beta_4(\frac{\Pi}{K})_{it} + \mu_{t+1} + \eta_i + \vartheta_{i,t+1} \tag{3.7}$$

The dynamics implied by the adjustment cost of capital stock suggest that the coefficient on the lagged investment is positive and greater than one ($\beta_1 \geq 1$), while the coefficient on the lagged squared investment ratio is negative and greater than one ($\beta_2 \geq 1$). Moreover, a positive sign of the coefficient on the output term ($\beta_3 > 0$) implies the presence of imperfect competition and thus, underlines the demand factor in the product market. Under the null of no financing constraints that the firm can raise as much finance as it desires at a given cost, Euler equation specification proposes that the coefficient on gross operating profits is negative ($\beta_4 > 0$). The negative relationship between ending period investment and beginning period gross operating profits can be interpreted in the following sense. In case of declining gross operating profits in the beginning period, the firm as a profit maximizer pursues opportunity to raise its gross operating profits by expanding its production scale in the subsequent periods. Thus, it will undertake new investment in the ending period.

Under the alternative that introduces the constraints on external finance, investment will be positively related to internal finance. Then, the simple Euler equation (3.7) is misspecified. The gross operating profits term approximately measures internal finance, so a positive sign on this term will be expected to occur in the presence of financial constraints ($\beta_4 < 0$).[8] Moreover, the inclusion of the time-specific term μ_{t+1} may account for changes in macroeconomic conditions, while the term η_i captures firm-specific effect which are permanent, but unobservable. The disturbance term $\vartheta_{i,t+1}$ reflects cyclical and trend components.

3.3 Estimation Issues

The first issue in estimating the Euler equation (3.7) concerns the presence of the correlation between the firm-specific effects and the regressors. Since the regressors are not strictly exogenous that are correlated with past and possibly current realizations of the disturbance term, Ordinary Least Squares (OLS) and Within Group (WG) estimations would create biased estimates

[8] See Bond et al. (2003) for discussion of the coefficients.

(Bond, 2002). To remove firm-specific effects, I use first-differencing proposed by Arellano and Bond (1991) and Arellano and Bower (1995). While first-differencing eliminates the firm-specific effects, this introduces a bias arising from possible endogeneity of other dependent variables and from a correlation between transformed errors and lagged dependent variables. To correct this bias, Generalized Method of Moments (GMM) proposes available moment conditions as shown in the following:

$$E[y_{i,t-s}.(\vartheta_{i,t} - \vartheta_{i,t-1})] = 0 \;\; for \;\; s \geq 2; \;\; t = 3, ...T \tag{3.8}$$

$$E[X_{i,t-s}.(\vartheta_{i,t} - \vartheta_{i,t-1})] = 0 \;\; for \;\; s \geq 2; \;\; t = 3, ...T \tag{3.9}$$

In practice, very remote lags are unlikely to be informative instruments and I do not use all available moment conditions reported above. I estimate Euler equation by Difference GMM using as instrument t-2 and t-3 lags of all the variables in the regression, plus industry and time dummies and the interactions of cash flow with group dummies.[9]

Moreover, I estimate Euler equation by System GMM that combines the set of instruments for the first-differenced equations with the additional instruments specified for the level equations.[10] The additional moment conditions for the regression proposed by Arellano and Bover (1995) are given by the following:[11]

$$E[(\Delta y_{i,t-s}).(\eta_i + \vartheta_{i,t})] = 0 \;\; for \;\; s = 1 \tag{3.10}$$

$$E[(\Delta X_{i,t-s}).(\eta_i + \vartheta_{i,t})] = 0 \;\; for \;\; s = 1 \tag{3.11}$$

Consequently, both variants of GMM estimator will serve as a sort of com-

[9] All estimations include time dummies. Industry dummies were completely insignificant once I controlled for firm-specific effects.

[10] All estimations are performed using Stata 9.0's built-in command xtabond2. It is recently updated by Roodman (2008).

[11] Blundell and Bond (1998) argue that when both instruments, those proposed by Arellona and Bond (1991) and Arellona and Bower (1995) are used, the results have a dramatic gain in efficiency.

promise for OLS and WG approaches. Yet, in case of weak instruments GMM estimators may likewise be biased. Hence, three estimators should be included in econometric analysis. Considering the severe finite sample biases in the presence of weak instruments, Bond (2002) concludes that the comparison of these parameters may help detecting and avoiding the above mentioned biases.

In all GMM estimations, two-step procedure is applied.[12] I estimate the investment equations with GMM using optimal weighting matrix. This optimal weighting matrix makes two-step GMM asymptotically efficient. In GMM estimations of the investment equations using small samples, two-step procedure includes Windmeijer correction on standard errors of the estimators.[13]

To check the validity of instruments, I use the Hansen's J test of overidentifying restrictions.[14] In order to verify that the error term is not serially correlated, m_1 and m_2 statistics are included as tests for first and second order serial correlation in the differenced residuals, respectively. In case of OLS and WG estimations, R-squared statistic is reported. Additionally, Wald tests regarding the joint significance of all regressors and the interaction variables are included. For all tests, p values are reported in the tables.[15]

[12]For comparison, one step procedure is also applied. The results give consistent results, thus they are not tabulated in the study.

[13]Although a two-step GMM estimator that is asymptotically more efficient relative to the one-step GMM estimator, this procedure suffers from a problem when applied to samples with small sizes. Simulation studies show that asymptotic standard errors are downward biased. In order to correct this bias, Windmeijer (2000) proposes a finite-sample correction on standard errors.

[14]Different from Sargan, Hansen tests are robust to heteroscedasticity, albeit they are vulnerable to instrument proliferation (Roodman, 2006, 2008). Since I limit the number of instruments, I am confident in using these tests. Moreover, this recent version of xtabond2 automatically does a difference-in-Hansen test for the joint validity of the GMM-style instruments for the level equations.

[15]Considering WG estimations, the results of Hausman test support the use of fixed effects regression for all investment equations.

CHAPTER 4

DATA

4.1 Sample Construction and Variable Definitions

In this study, I use a comprehensive firm-level database collected by Central Bank of Republic of Turkey [CBRT]. This database comprises balance sheets and income statements provided by Turkish non-financial private firms. In addition to financial information, it contains information on firm demographics and 4-digit NACE code. I select for my study only the firms that operate in the manufacturing industries (NACE code 15-37). The selected sample consists of about 9,400 firms with 84,348 observations.[1]

There are several reasons for concentrating on the manufacturing industry in this study. First of all, private manufacturing firms recorded in CBRT database are the ones that have a clear and unambiguous need for steady investment in physical equipment, property and industrial buildings. Secondly, as seen in Panel A of Table 1, among the industries recorded in CBRT database, the manufacturing industry is the one that comprises the highest number of the firms that continuously report their financial statements. Moreover, as seen in Panel B and C of Table 1, the firms in this industry are the ones that

[1] The database has two breaks over time; one in 1994 and the other in 2004. In 1994, accounting system was transited to Uniform Accounting System. In 2004, inflation accounting on firms' accounts was adopted compulsory by Ministry of Finance.

comprise the largest portion of total employment and total assets.[2]

As seen in Table 2, the private firms covered by CBRT database account for nearly 75% the total employment of the manufacturing industry. This comprehensive firm-level panel of Turkish manufacturing firms can be considered a representative of Turkish private firms in the manufacturing industry.

The time period covered is 1989-2007, however I exclude the first two years because of the poor coverage. I exclude the last four years because of inflation accounting adopted on firms' accounts.[3]

The main variables I use in the investment equations are gross investment in tangible fixed assets, sales, net income and replacement cost value of capital stock. To calculate investment, a more widely used approach in the literature is taking the difference between ending and beginning period net capital stocks and plus depreciation expense.[4] Since depreciation expense figures are not available in CBRT database, gross investment can be calculated as the difference between ending and beginning period gross book value of tangible fixed assets minus ending period revaluation value of old tangible fixed assets.

To measure the internal finance, cash flow is widely used and measured as the current year's net income plus current's year depreciation and amortization expense. Since yearly depreciation and amortization expense items are not available in CBRT database, only net income item recorded in the income statements of CBRT database is used for cash flow in this study. As a flow variable, this measure of cash flow accounts for the current changes in internal funds.[5] Moreover, I use net sales figure recorded in the income statements of CBRT database to measure output.

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[2]See http://www.tcmb.gov.tr for further details. It provides detailed information on the database and sectoral data for the years after 1997.

[3]Inflation accounting comprises a range of applications prepared for the adjustment of a firm's accounts to reflect the effect of inflation. In 2004, this breaks the construction of the series of investment as the first difference of the balance sheet items. See the Data Appendix for further details.

[4]See Cleary et al. (2003), Harrison et al. (2004) and Love (2003).

[5]In some studies, EBITDA is used as the definition of cash flow in the Euler equation model of investment. EBITDA refers to earning before interest, taxes and depreciation allowances in finance (Chatelain, 2003).

Replacement cost values of the capital stock are not reported to CBRT database. I estimate them by using historic cost accounts on the capital stocks. The replacement cost value of the capital stock for the first year is calculated by using main insights of Singh et al. (1997) and Çelik (2003) and I estimate later values from the flow data on gross investment using a standard perpetual inventory method proposed by Bond et al. (2003). Further details on this calculation can be found in the Data Appendix.

After constructing replacement cost value of the capital stock, all main variables used in the investment equations are divided by the ending period replacement cost value of the capital stock.

I apply several sample selection criteria and quality checks on data. Details on sample construction are delegated to the Data Appendix. After constructing the main variables used in the investment equations, I require complete data on replacement cost value of capital, investment, sales, net income and employment. Accordingly, an additional year is lost by constructing the variables of interest as the first difference of the balance sheet items. Moreover, to eliminate the observations that appear to contain influential outliers, I exclude 1 % on each side of the distribution for each of the variables used in the investment equation.[6] I also require that at least three consecutive annual observations be available for the firms. Thus, this final sample consists of 4,559 firms with 30,922 observations.

Unlike many other earlier studies, I work with unbalanced firm-level panel. The distribution of the firms by the number of consecutive years of data available is shown in Table A.5. My sample is a comprehensive firm-level panel with a time period 1992-2003. It covers firms of different size, age and legal status from a variety of industries and regions. Firms' categories are presented in Tables A.1-A.4 in data appendix.

[6]Excluding outliers leads to more robust results. This procedure allows for uniform definition of outliers. See Kapadakkam et al. (1998), Bond et al. (2003), Cleary et al. (2007) and Love (2003) for other studies using this procedure.

4.2 Summary Statistics

Table 3 presents summary statistics of several key variables in whole sample constructed for the 1992-2003 period. Both mean and median values are reported. All variables excluding age and leverage are highly skewed with mean values 2-10 times higher than median values.

Since I want to figure out whether investment-cash flow sensitivity, interpreted as measure of financing constraints, is robust to controlling firms specific characteristics such as size and age.[7] Two measure size, two criteria are used such as logarithm of mean of total employment and logarithm of mean of total assets. Firms are categorized as small and large depending on whether they are below or above the median of corresponding size criterion, respectively.

Age is measured as the number of years passed since the date of establishment as reported to CBRT database. To categorize the firms depending on their age, I follow the way proposed by Rajan and Zingales, (1998). Mature firms are the ones that have been established before at least ten years ago; correspondingly, young companies are the ones that have been established less than ten years ago.

Table 4 presents summary statistics based on different firm categories. The mean, median and standard deviations of each variable for all firm categories are reported. When mean values of sales and fixed assets in Panel A and B are taken into account, the validity of firm categories based on size is preserved. That is, the large firms have higher mean values in sales and fixed assets. The differences in mean of these figures are statistically significant. According to mean values in Panel A and B, the large firms record higher investment, net income and employment values averaged over 12 years. Moreover, the small firms are, on average, younger than the large firms. Consistent with the view that large firms tend to prefer internal funds and small firms may more likely be financially constrained (Myers and Majluf, 1984), the large firms, on average,

[7] See following chapter for related robustness checks.

have lower leverage ratio comparing to small firms. The differences in mean of all these figures are statistically significant.

In Panel C, focusing on the size, I find that the young firms are smaller than the mature firms. Sales, total assets, fixed assets and employment values of young firms are, on average, higher than mature firms. The differences in mean values of these figures are statistically significant. Moreover, mature firms record higher investment and net income values in mean. Compared to mature firms, young firms are, on average, more leveraged over 12 years.

Table 5-6 presents summary statistics of the variables used in the investment equations. In Table 5, all of the variables used in the investment equations for whole simple are highly skewed with mean value 8-10 times higher than the median values. Focusing on Panel A & B in Table 6, the mean, median and standard deviations of each variable used in the investment equations for all firm categories are reported over the 1992-2003 period. Accordingly, the investment rates (I/K), cash flow-to-capital ratio (CF/K) and sales-to-capital ratio (Y/K) appear very similar, on average, in all sub-samples. However, the investment rate, cash flow-to-capital ratio and sales-to-capital ratio are significantly larger, on average, for young firms.

CHAPTER 5

ESTIMATION RESULTS

5.1 Main Results

In Table 7, I present the parameter estimates for the basic Euler equation (3.7) using the full sample of firms. This is the equation estimated to test whether the availability of internal finance affects the investment behavior of the firms.

The first two columns present the results using GMM estimations and allow for firm-specific fixed effects. Concentrating on the results of Difference GMM estimations in the first column, according to the result of serial correlation tests, a MA (1) error in the levels equation is allowed. Thus, I exclude the instruments dated t-2 and the instrument set includes the right-hand side variables dated t-3.[1]

On the other hand, in the second column, the parameter estimates of System GMM are reported. In System GMM estimations, the instruments for the level equations are specified in addition to the instruments for the first-differenced equations. Since a MA (1) error in the level equation is allowed, the instrument set for the level equations includes the first-differenced values of all right-hand side variables dated t-2.

Before concentrating on the economic implications of the estimation results,

[1]As noted in Bond et al. (1994), a MA (1) error may arise in the Euler equation model for several reasons including time aggregation and decision lags. In GMM estimations, I check the validity of instruments dated t-2 and t-3 and find that instruments dated t-2 are invalid.

I should note that while the parameter estimates for the basic Euler equation using System and Difference GMM are quite similar, efficiency gain in terms of Hansen's J statistics is apparent in System GMM estimations. Difference GMM estimation has low acceptability for the instrument set ($\chi^2(32)$ =61.39, p-value=0.1 %), Hansen's J statistics in System GMM estimation accepts validity of the instrument set. Thus, the Euler equation estimated by System GMM is not rejected by the full sample of firms.

Concentrating on the results of System GMM estimations, I observe that the dynamics implied by the structural adjustment cost model are not rejected. The coefficients on both lagged and lagged squared investment terms are statistically significant. They have correct signs, but their magnitudes are quite smaller than those implied by the structural adjustment cost model.[2] The lagged investment has a positive and statistically significant correlation with current investment and this finding is consistent with the persistence of the investment. The output coefficient is negative and statistically insignificant which implies that there seems to be no significantly positive effect underlying the demand factor in the manufacturing industry.[3]

Moreover, according to the estimation of basic Euler equation, the key result is a significant positive coefficient on the cash flow term. The theoretical model based on Euler equation implies that, under the assumption of no financing constraints, the coefficient on the measure of internal finance (cash flow) should be negative. If this assumption is not true, then the measure of the internal finance (cash flow) may reflect financing constraints that arise due to imperfections in the capital market. As it can be seen from the results of System GMM estimation in Table 7, there is a significant positive correlation between investment and cash flow. This observed investment-cash flow

[2] See footnote 7 in Chapter 3.

[3] Across all other estimations of the investment equations, the sign of the coefficient on the output term is different from that found by using the full sample of firms. It has a sign which is consistent with the presence of imperfect competition in product markets. Therefore, its interpretation should be done with caution.

sensitivity provides strong evidence for the existence of financing constraints in Turkish manufacturing industry. This finding is in line with that of those studies following the approach of FHP (1988).

5.2 Robustness Checks

5.2.1 Controlling Firm Specific Characteristics

The main results just presented are consistent with the view that financing constraints in the capital market are reflected in investment cash flow sensitivity. In order to probe this finding further and to check the robustness of the main results, I estimate Euler equation controlling firm specific characteristics and test whether size and age affect the investment-cash flow sensitivity.

A priori belief on traditional literature suggests that the availability of the internal finance may constrain the investment spending more severely for the firms with greater cost of accessing to external financial markets. These firms would be the ones which are more likely subject to informational asymmetry and agency problems between corporate owners and external investors. To identify such firms, I form sub-samples according to size and age criteria.

Controlling Firms' Size

According to the literature, compared to large firms, small firms are more likely subject to informational asymmetry and external investors have higher costs to monitor those firms. Thus, they face much severe financing constraints and are expected to exhibit higher investment-cash flow sensitivity.[4] Considering this, I estimate Euler equation controlling firms' size and test whether

[4]Few of the existing empirical studies have a primary emphasis on the impact of firm size on investment-cash flow sensitivity. Moreover, their results based on size are somewhat mixed. Devereux and Schiantarelli (1990) segment their sample of UK firms according to size measured as the real value of capital stock. Kapadakkam et al. (1998) divide the firm level data of six OECD countries by size measured in three different ways: market value of equity, total assets and sales. George et al. (2008) divide the sample of Indian firms according to size measured on total assets. Contrary to traditional literature on capital market imperfections, these studies report higher investment-cash flow sensitivity for larger firms. On the other hand, Oliner and Rudebush (1992) and Terra (2003) show that there is no evidence that firm size has a significant effect on investment-cash flow sensitivity.

size affects investment-cash flow sensitivity.

The sub-samples of the firms based on the size are formed as mentioned before. Instead of estimating the investment equations separately for those sub-samples, another specification is used in this study. In this specification, I pool observations from two sub-samples and group dummies and the interaction variables (cash flow interacted with group dummy) are added in the investment equations. Moreover, using a statistical t-test for the equivalence of the coefficients on interaction variables, I check the statistical significance of the equivalence in the estimated cash flow sensitivities across sub-samples. A significant difference in observed coefficients for the interaction variables should provide relevant information on whether size affects firms' investment-cash flow sensitivity.[5]

Size Criterion Based on Total Employment

Table 8 presents estimation results for sub-samples based on firm size measured as total employment. Adding the instruments specified for level equations to the ones for first-differenced equations, Hansen's J statistics have been improved, indeed their p-values are sufficiently large to accept the validity of instruments.

Concentrating on the results of System GMM estimations (see second column), I find that cash flow coefficients are positive and statistically significant for both sub-samples of firms. However, a priori expectation of higher investment-cash flow sensitivity in the small firm size sub-sample as compared to large firm size sub-sample is not observed. The large firm size sub-sample has a cash flow coefficient that is greater than that of the small size sub-sample.

Moreover, t statistics testing the equivalence of the cash flow coefficients and significance levels are reported. The null hypothesis that the cash flow coefficient is equal for large and small firms can not be rejected. That is, while

[5]Due to heteroscedasticity inherent in the sample, the t statistics which test the statistical difference of the investment-cash flow sensitivities obtained in the separate estimations of sub-samples may be inappropriate (Allanyanis and Mozumdar, 2004). The specification used here tackles this problem.

the investment-cash flow sensitivity differs across sub-samples, the difference is not statistically significant.

Size Criterion Based on Total Assets

Table 9 presents estimation results for sub-samples based on firm size measured as total assets. As in the case of the first size criterion, adding the instruments developed for level equation to the ones developed for first-differenced equations, Hansen's J statistics have been improved, indeed their p-values are sufficiently large to accept the validity of instruments. Concentrating on the parameter estimates of System GMM, I observe that cash flow coefficients are positive and statistically significant for both sub-samples of firms. While the investment-cash flow sensitivity differs across sub-samples, the difference is not statistically significant. Therefore, I observe that both size criteria yield consistent results.[6]

Controlling Firms' Age

The literature states that young firms have, in general, worse credit records and are more likely subject to information asymmetry between corporate owners and external investors. Thus, young firms have greater cost of accessing to external funds and they are expected to have higher investment-cash flow sensitivity.

The sub-samples depending on firms' age are formed as mentioned before. While estimating investment equations that test whether age affects the investment-cash flow sensitivity, the same specification mentioned above is used i.e. group dummy variables as well as interaction variables (cash flow interacted with group dummy) are included in the investment equations.

Concentrating on the estimation results in Table 10, it can be seen that the performance of both Difference and System GMM in terms of Hansen's J statistics is unsatisfactory (they both reject the validity of instruments),

[6]Firms are also categorized as small and large depending on whether they are below or above the *mean* of corresponding size criterion, respectively. This results depending on this alternative categorization yield similar results and therefore, they are not tabulated.

whereas the performance of the OLS and WG estimations can be regarded as satisfactory. Here, OLS and WG estimates should be taken into account for inference.[7]

Across OLS and WG estimations, I observe that cash flow coefficients are positive and statistically significant for both sub-samples of firms. However, according to t-statistics testing the significance of the equivalence between cash flow coefficients, the null hypothesis that the cash flow coefficient is equal for young and mature firms can not be rejected. While investment-cash flow sensitivity differs across these age groups, the difference is not statistically significant.

In testing whether firm characteristics affect the investment-cash flow sensitivity, I consider alternative size and age groupings of firms. Moreover, investment estimations regarding alternative firm groupings yield consistent results with those of the ones mentioned above. The details about this analysis can be found in the Results Appendix.

5.2.2 Controlling Possible Risk of Bankruptcy

As mentioned so far, in imperfect capital markets, firms face a higher premium on external finance i.e. financing constraints. They also face the risk of not being able to meet their repayment obligations i.e. the risk of bankruptcy. Consequently, the observed investment-cash flow sensitivity which is interpreted as evidence of financial constraints may be mistaken with bankruptcy risks (Wald, 2003).

The possible risk of bankruptcy should be taken into account for this analysis. As mentioned before, I work with an unbalanced panel in which the firms do not appear in CBRT database throughout the period 1991-2003 (see panel structure in Table A.5). Therefore, some firms which disappear in the database may be in the risk of bankruptcy and the results may be misinterpreted with

[7]Remember the details in estimation issues.

the inclusion of those firms.

For robustness check, I test basic Euler equation controlling possible risk of bankruptcy. In order to do that I form a new sample which consists of the firms that continuously report their financial statements to CBRT database throughout the period 1991-2003. These firms can be considered as the ones which are more stable and thus, they are not in risk of bankruptcy throughout this period.

The estimation results of investment equation using this selected sample are reported in Table 11.[8] The estimation results of OLS and WG suggest that there is a significant positive relationship between investment and cash flow. This finding is consistent with that of those investment estimations discussed so far.

[8]As it can be seen the performance of both Difference and System GMM in terms of Hansen-J statistics are unsatisfactory. In both GMM estimations, the Hansen's J statistics reject the validity of overidentifying restrictions. Since the performance of the OLS and WG estimations seems to be much satisfactory, OLS and WG estimates should be taken into account for inference.

CHAPTER 6

CONCLUSION

With a comprehensive firm-level data, I test whether Turkish manufacturing firms are financially constrained or not, using the standard approaches in the literature. I find a significant positive relationship between firms' investment and their cash flow. While the investment-cash flow sensitivity differs across size and age groups, this difference is not statistically significant in the case of Turkish manufacturing industry. This finding provides strong support for the argument that Turkish manufacturing firms are financially constrained overall.

Contributions of this study are twofold. First, the results may provide a benchmark to those researchers who try to quantify the extent of financing constraints in other developing countries, with similar comprehensive firm-level datasets. Second, the evidence provided suggests important policy implications. The firms in manufacturing industry make up a major part of Turkish economy. The results support the fact that those firms are in need of external sources to fund their investments. Therefore, decreasing the financing constraints of those firms, which in turn will allow them to invest according to their growth opportunities and improve their capital allocation, should be high on policy makers' agenda.

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APPENDIX A

DATA APPENDIX

A.1 Variable Definitions

The balance sheet and income statement items from CBRT database, 1991-2003, are used to construct the relevant variables. These items in CBRT database belong to the fourth quarter of the fiscal year.

Since the reduced form model of Euler Equation is formulated in real terms and the items in financial statements are nominal, I transform equation (3.7) in nominal terms:

$$(\frac{p^I I}{p^I K})_{it+1} = \beta_1(\frac{p^I I}{p^I K})_{it} - \beta_2(\frac{p^I I}{p^I K})^2_{it} - \beta_3(\frac{p^f CF}{p^f K})_{it} + \beta_4(\frac{p^f Y}{p^f K})_{it} + \mu_{t+1} + \eta_i + \vartheta_{i,t+1} \tag{A.1.1}$$

The relevant variables used in the investment equations are constructed as follows:

Gross book value of tangible fixed assets $(FA)_{it}$: Gross book value of tangible fixed assets is comprised of different types of capital stocks of equipment (plant, machinery, furniture and fixtures); property (motor vehicle and land) and industrial buildings (buildings and land improvements). This figure also includes another item recorded as "construction in progress and advances given" in balance sheet.

Revaluation value of tangible fixed assets $(R)_{it}$: Revaluation value of old tangible fixed assets. All tangible fixed assets excluding land are subject to revaluation. In balance sheet, the revaluation item is recorded as "revaluation fund of tangible fixed assets".

Price of investment goods $(p^I)_t$: Aggregate price deflator of investment goods in manufacturing industry.[1]

Price of final goods $(p^f)_t$: Price deflator of final goods in manufacturing industry calculated at the sub-industry level.[2]

Gross investment in tangible fixed assets $(p^I I)_{it}$: Gross book values of tangible fixed assets are available, and then it is possible to construct gross investment in tangible fixed assets in the way that Lewellen and Badrinath (1997) propose. Since land is not subject to revaluation, gross investment in tangible fixed assets excluding land is constructed as follows:

$$(p^I I)_{it} = FA_{it} - FA_{it-1} - R_{it} \tag{A.1.2}$$

On the other hand, gross investment in land is equal to the difference between its ending and beginning period gross book values. Thus, gross investment in tangible fixed assets is equal to the sum of gross investment in land and gross investment in other items of tangible fixed assets.

Inflation adjustment factor $\varphi(.)_{it}$: Inflation adjustment factor is constructed as estimating the ratio of the value of wholesale prices in fourth quarter of the fiscal date in year t to the average value of wholesale prices of the year that tangible fixed assets are acquired by firm i. Thus, it depends on the average age of the tangible fixed assets.

Initial replacement value cost of the capital stock $(K)_{i0}$: Initial replacement cost value of capital stock is calculated in the way that Singh et al. (1997) and Çelik (2003) propose.[3] Initial replacement cost value of capital stock depends

[1] The series are obtained from the study done by Saygılı et al. (2005).

[2] The PPI series are obtained from TurkStat.

[3] Hyper-inflation can have an insidious effect on company accounts that is apparent from

on the starting gross book value of tangible fixed assets and the inflation adjustment factor evaluated in the initial year. The starting gross book value of tangible fixed assets is assumed to be the gross book value of tangible fixed assets for the first year that the firms appear in the sample (usually 1991).[4] Inflation adjustment factor evaluated in the initial year is used to adjust the starting gross book value of tangible fixed assets for previous years' inflation. It depends on the average age of the tangible fixed assets acquired by firm i in the initial year.

Average age of tangible fixed assets is widely measured as estimating the ratio of accumulated depreciation to depreciation expense, assuming straight-line depreciation. Since yearly depreciation expense figures are not available in CBRT database, the average age of tangible fixed assets held by firm i in the initial year is calculated as taking the difference between the date of the initial year that firm i appears in the sample and date of establishment of firm i.[5] Having calculated the inflation adjustment factor for the initial year, the initial replacement cost value of the capital stock $(K)_{i0}$ held by the firm i is calculated as follows:

$$K_{i0} = FA_{i0} \times \varphi(.)_{i0} - R_{i0} \tag{A.1.3}$$

where K_{i0} is the replacement cost and FA_{i0} is the book and R_{i0} is the revalu-

financial statements of developing countries. For instance, partial revaluation ratios adopted compulsory in 1983 are not sufficient to correct the problems in company accounts that arise due long-lasting hyperinflation in Turkey. Singh et al. (1997) develop a simple algorithm based on the inflation accounting method applied in Brazil and apply it to the accounts of Turkish companies quoted in Istanbul Stock Exchange Market for the period 1982-1990. The adjusted figures give a more plausible picture of corporate growth and profitability that support the success of this method. In the same manner, Çelik (2003) implements Current Purchasing Power Method on the accounts of two different companies, a trading company and a manufacturing company from CBRT database. In her study, adjusted figures also support insidious effect of inflation on company accounts.

[4]The sample in which I calculate the replacement cost value of capital stock comprises of 8,487 firms. 3,772 firms from this sample appear in the sample for the first time in 1991 (approximately 45 % of the sample).

[5]Here, it is assumed that the firm i acquires all of its tangible fixed assets at the same time in the year that it has been established. It should be noted that I exclude those firms established before 1970 to reduce the impact of this assumption. See the related robustness checks.

ation value of gross tangible fixed assets held by the firm i in the initial year. Since land is not subject to revaluation, its initial replacement cost value is equal to its starting gross book value multiplied by inflation adjustment factor evaluated in the initial year.

Depreciation rate (δ): for all types of tangible fixed assets excluding land, depreciation rate is assumed to be 8 %.

Replacement cost value of the capital stock $p_t^I(K_{it})$: Since land is not subject to depreciation, it is calculated separately for land and other items in tangible fixed assets by perpetual inventory method used in Bond et al. (2003) as follows:

For land item;

$$p_t^I(K)_{it} = p_{t-1}^I(K)_{it-1}\frac{p_t^I}{p_{t-1}^I} + p_t^I(I)_{it} \tag{A.1.4}$$

For other items in tangible fixed assets;

$$p_t^I(K)_{it} = (1-\delta)p_{t-1}^I(K)_{it-1}\frac{p_t^I}{p_{t-1}^I} + p_t^I(I)_{it} \tag{A.1.5}$$

Thus, replacement cost value of capital stock is equal to the sum of replacement cost value of land and replacement cost value of other items in tangible fixed assets.

Fixed capital evaluated at output prices $p_t^f(K)_{it}$: It is calculated by multiplying replacement value cost of capital stock by price of final goods $(p^f)_t$.

Nominal Cash Flow $p_t^f(CF)_{it}$: Nominal cash flow is used to proxy internal finance. As widely measured in the literature, it is equal to net income plus depreciation expense. Since yearly depreciation expense figures are not available in CBRT database, I use nominal net income figures recorded in income statements to proxy nominal cash flow.

Nominal Cash $p_t^f(CS)_{it}$: Nominal cash is also used to proxy the internal finance. It is equal to the sum of cash and cash equivalents. Moreover, as a stock variable recorded in balance sheet, it accounts for the liquid assets with a maturity of one year or less that can be liquidated reasonably quickly.

Nominal Output $p_t^f(Y)_{it}$: Nominal net sales item recorded in the income statement is used to proxy nominal output.

A.2 Sample Selection Criteria

I use a comprehensive database of Turkish non-financial private firms collected by Central Bank of Republic of Turkey (CBRT) since 1989 and I select for my study only the firms operating in manufacturing industries (NACE code 15-37) The selected sample consists of about 9,400 firms with 84,348 observations.

The time period covered is 1989-2007, however I exclude the first two years because of the poor coverage. I exclude the last four years because of inflation accounting applied on financial statements. The resulting sample consists of 9,076 firms with 59,937 observations. I apply following selection criteria on this sample in order to follow perpetual inventory method properly.

- If a firm has a faulty report on its date of establishment, then delete: 68 firms with 580 observations.
- If a firm has empty observations of years without data on tangible fixed assets, then delete: 498 firms with 4010 observations.[6]
- If ending period gross book value of tangible fixed assets are missing, then delete: 23 firms with 106 observations.

Thus, the resulting sample consists of 8,487 firms with 55,241 observations that include replacement cost values of capital stock. Moreover, following sample selection criteria are applied to obtain the final sample:

[6]Empty observations occur, because some firms recorded in CBRT database firstly disappear and after some years passed they reappear in CBRT database. Moreover, I avoid using "interpolation" method to fill those empty observations of years without data on tangible fixed assets.

- If a firm has a faulty report on its balance sheet items, then delete: 40 firms with 305 observations.

- If observations suggest a major merger or acquisition, where real sales, real gross tangible fixed assets and real total assets jump by more than two times from one year to the next, then delete: 605 observations.

- If a firm does not have complete data on variables of main interest such as employment and ratio of investment, net sales, net income to ending period replacement cost value of capital stock, then delete: 1,403 firms with 16,986 observations.

- If a firm has observations that appear to contain influential outliers, then exclude 1% on each side of the distribution for each of the variables used in the investment equations such as the ratio of either investment, net sales, net income to ending period replacement cost value of capital stock in the regression: 241 firms with 1745 observations.

The resulting sample consists of 7,163 firms with 35,550 observations. I also require that at least three consecutive annual observations be available for the firms. Thus, this final sample consists of 4,559 firms with 30,922 observations over the period 1992-2003.

APPENDIX B

RESULTS APPENDIX

B.1 Measuring the Internal Finance

There is no consensus on a single correct way to employ a measure of internal finance in the literature. For this reason, I estimate the same investment equations using alternative measures of internal finance and the results are reported in Table B.1.1-B.1.2.

Cash: While cash flow accounts for the current changes in internal finance as a flow variable, cash accounts for the liquid assets with a maturity of one year or less that can be liquidated reasonably quickly as a stock variable.

The basic Euler equation (3.7) is estimated using this measure of internal finance.[1] The estimation results are reported in Table B.1.1. The estimation results of OLS and WG suggest that there is a significant positive relationship between investment and this measure of internal finance.

Cash plus cash flow: The effect of an extra dollar of funds should be the same, independent of whether it enters the firm this period (as cash flow) or whether it was already present in the firm at the beginning of the period (as cash). Following this, the sum of cash and cash flow can be considered as an alternative measure of the internal finance.

The investment equation is also tested using this alternative measure and

[1] See footnote 8 in Chapter 5.

the estimation results are reported in Table B.1.2.[2] According to the estimation results of OLS and WG there is a significant positive relationship between investment and this measure of internal finance.

In case of controlling the measure of internal finance, the results just presented suggest that not only flow but also stock variables of internal finance affect investment spending of the firms. That is, the investment-cash flow sensitivity is robust to using different measures of internal finance.

B.2 Further Robustness Checks

Alternative Measure of Capital Stock

I also test whether the investment-cash flow sensitivity is robust to alternative measure of capital stock. To calculate capital stock, I take the difference of ending and beginning period gross book value of tangible fixed assets. Calculation of capital stock by this method does not require that kind of sample selection criterion applied in calculation of replacement cost value of capital stock. Using this measure of capital stock, I am able to test whether the availability of internal finance affects the investment decisions of the firms that have been established before 1970.[3] The estimation results are reported in Table B.2.1.[4] The estimation results of OLS and WG suggest that there is a significant positive relationship between investment and cash flow. This result is consistent with that found by using the other measure of capital stock.

Robustness Check for Measure of Initial Replacement Cost Value of Capital Stock

In calculation of the initial replacement value of capital stock, the average age of tangible fixed assets in the initial year is one of the main variables used in investment equations. Since CBRT database does not have any information

[2]See footnote 8 in Chapter 5.

[3]Remember that, in order to calculate the initial replacement cost value of capital stock, I exclude the firms that have been established before 1970.

[4]See footnote 8 in Chapter 5.

about the year in which the firms acquire their tangible fixed assets, I assume that the firm acquires its all tangible fixed assets at the same time in the year that it has been established. As a robustness check of this assumption, I construct a new sample which contains the firms that have been reported the value of their tangible fixed assets to CBRT database since they have been established. Then, using this selected sample I test the investment equation to figure out whether the availability of internal finance affects the investment. The results are reported in Table B.2.2. Considering on System GMM estimation, I observe that there is a significant positive relationship between cash flow and the investment, but it is not statistically significant.[5]

Alternative Grouping of Firms Based on Size

For further robustness check, I consider alternative groups of firms. Firms are categorized into five groups by percentiles based on size measured as corresponding criterion (total employment and total assets). I test investment-cash flow sensitivity using those size groups. According to estimations of investment equations, both size criteria yield consistent results with those of the ones mentioned above and therefore, they are not tabulated. Investment-cash flow sensitivity differs across those size groups, but the difference is not statistically significant.

Alternative Grouping of Firms Based on Age

For further robustness check regarding age, I consider an alternative groups of firms. Firms are categorized into three groups such that first, second and third groups include the firms whose age is between 0-10, 11-20, 21-30, respectively. The inclusion of those groups in the investment equation yield similar results and therefore, they are not tabulated. While investment-cash flow sensitivity differs across those age groups, the difference is not statistically significant.

[5]It should be noted that since this sample is small, Windmeijer's correction (2000) on standard errors is applied in two-step GMM estimations.

Table 1: Shares of Industries in CBRT Database

Panel A

	1998	1999	2000	2001	2002	2003
Manufacturing	48	46.1	46.9	47	49	50
Transportation	4	4.3	4.5	5	5	4
Construction	13	13.1	13.3	13	12	10
Trade	21	20.6	19.1	19	19	19
Other	14	15.9	16.2	16	15	17

Panel B

	1998	1999	2000	2001	2002	2003
Manufacturing	57	56.6	56.3	58	59	61
Transportation	15	14.8	14.9	13	12	11
Construction	10	6.8	7.4	8	7	6
Trade	6	6.2	7.3	7	7	8
Other	12	15.6	14.1	14	15	14

Panel C

	1998	1999	2000	2001	2002	2003
Manufacturing	50	44.9	41.9	44	45	43
Transportation	9	6.9	9.4	11	10	11
Construction	10	10.1	10.2	10	11	10
Trade	8	8.7	9.7	10	9	10
Other	23	29.4	18.8	25	25	26

Notes: Table 1 presents the shares of industries recorded in CBRT database. In Panel A & B & C, the shares of industries depending on number of firms, total employment and total assets are presented, respectively.

Table 2: Representativeness of CBRT Database for Manufacturing Industry

Year	Total Employment (A)	Total Employment (B)	%
1997	779730	987960	78
1998	758016	1058844	71
1999	721134	975667	73
2000	752333	1001304	75
2001	747981	977256	76

Notes: In Table 2 A represents the total employment of private manufacturing firms with 10^+ employees that are recorded in CBRT database. B represents the total employment of private manufacturing firms with 10^+ employees that are surveyed by TurkStat.

Table 3: Summary Statistics: All Firms

Sample Period:1992-2003				
	# Obs.	Mean	S.D.	Median
Sales	30922	3687.61	21375.51	958.43
Total assets	30922	3031.03	13181.79	599.51
Fixed assets	30922	1898.37	9541.19	231.31
Investment	30922	267.91	2268.89	21.76
Net income	30922	96.92	1581.74	14.26
Cash stock	31243	234.33	2261.86	19.49
Cash Stock+ Net income	30850	336.82	3394.85	42.96
Leverage (%)	30922	0.54	0.67	0.54
Age (years)	30922	13.74	6.77	13
Employment	30922	181.53	4101.54	60

Notes: In Table 3 sales, total assets, fixed assets, investment, net income, cash stock and cash stock plus net income are all deflated using output price indices at the sub-industry level. They are in billions New Turkish Liras. Leverage is equal to debt-assets ratio. Age is calculated as the number of years passed since establishment. Employment is equal to total number of employees.

Table 4: Summary Statistics: Firm Categories

Panel A

	Small			Large		
	Mean	S.D.	Median	Mean	S.D.	Median
Sales	722.79	1212.81	395.67	6653.2[a]	29915.1	2513.34
Total assets	427.9	731.75	234.43	5634.76[a]	18261.48	1806.88
Fixed assets	188.06	428.28	698	3609.1[a]	13268.8	851.62
Investment	29.48	152.03	7.16	506.78[a]	3187.6	94.78
Net income	15.25	102.82	6.35	178.6[a]	2231.7	47.01
Leverage (%)	0.55	0.90	0.55	0.53[a]	0.31	0.53
Age (years)	12.53	6.32	12	14.9[a]	7.00	14
Employment	78.65	5629.07	30	284.43[a]	1391.00	150

Panel B

	Small			Large		
	Mean	S.D.	Median	Mean	S.D.	Median
Sales	648.15	812.89	402.27	6728.26[a]	29914.58	2610.44
Total assets	527.82	388.42	235.9	5674.66[a]	18257.69	1862.33
Fixed assets	176.63	316.96	73.38	3620.76[a]	13269.4	871.76
Investment	33.106	118.11	17.5	502.82[a]	3189.64	89.7
Net income	12.32	88.51	6.54	181.54[a]	2232.22	46.08
Leverage (%)	0.55	0.90	0.55	0.53[a]	0.31	0.53
Age (years)	12.94	6.33	12	14.6[a]	7.1	14
Employment	108.42	5785.39	35	254.66[a]	398.06	132

Panel C

	Young			Mature		
	Mean	S.D.	Median	Mean	S.D.	Median
Sales	2103.2	5985.67	669.37	4527.77[a]	26041.75	1180.37
Total assets	1739.49	5685.29	405.73	3715.88[a]	15729.27	745.59
Fixed assets	1125.07	5412.59	138.73	2308.42[a]	11103.59	307.11
Investment	153.5	963.76	15.89	328.58[a]	2715.63	26.63
Net income	27.84	769.49	8.28	133.54[a]	15729.27	745.59
Leverage (%)	0.58	0.32	0.59	0.52[a]	0.80	0.51
Age (years)	7.11	7	2.82	17.25[a]	5.52	17
Employment	169.26	6764.37	45	188.03[c]	1217.14	72

Notes: In Table 4 Panel A & B present summary statistics of key variables of the firm categories based on size measured as total employment and total assets. Firms are categorized as small and large depending on whether they are below or above the median of corresponding size criterion, respectively. Panel C presents summary statistics of key variables of the firm categories based on age. Age is measured as the number of years passed since the date of establishment. Mature firms are the ones that have been established before at least ten years ago; correspondingly, young companies are the ones that have been established less than ten years ago.a, b, c indicate statistical difference from zero at the 1%, 5%, and 10% significance levels respectively. See notes in Table 3.

Table 5: Summary Statistics of Variables Used In Estimation: All Firms

Sample Period: 1992-2003				
	#Obs.	Mean	S.D.	Median
$(\frac{I}{K})_{t-1}$	30922	0.044	0.104	0.0045
$(\frac{CF}{K})_{t-1}$	30922	0.026	0.956	0.003
$(\frac{CS}{K})_{t-1}$	31243	0.0497	0.0040	0.1420
$(\frac{CS+CF}{K})_{t-1}$	30850	0.0794	0.2107	0.0105
$(\frac{Y}{K})_{t-1}$	30922	1.35	3.17	0.264

Notes: In Table 5 summary statistics of all variables used in the estimation for all firms are presented.

Table 6: Summary Statistics of Variables Used In Estimation: Firm Categories

Panel A:						
		Small			Large	
	Mean	S.D.	Median	Mean	S.D.	Median
$(\frac{I}{K})_{t-1}$	0.043	0.104	0.004	0.045^b	0.104	0.0050
$(\frac{CF}{K})_{t-1}$	0.030	0.101	0.004	0.023^a	0.089	0.002
$(\frac{Y}{K})_{t-1}$	1.61	3.60	0.347	1.09^a	2.64	0.202
Panel B:						
		Small			Large	
	Mean	S.D.	Median	Mean	S.D.	Median
$(\frac{I}{K})_{t-1}$	0.043	0.102	0.004	0.046^b	0.106	0.004
$(\frac{CF}{K})_{t-1}$	0.029	0.99	0.0045	0.02^a	0.09	0.002
$(\frac{Y}{K})_{t-1}$	1.5	3.26	0.33	1.21^a	3.06	0.21
Panel C: n						
		Young			Mature	
	Mean	S.D.	Median	Mean	S.D.	Median
$(\frac{I}{K})_{t-1}$	0.094	0.147	0.048	0.018^a	0.057	0.001
$(\frac{CF}{K})_{t-1}$	0.052	0.138	0.023	0.012^a	0.056	0.001
$(\frac{Y}{K})_{t-1}$	2.85	4.47	1.32	0.56^a	1.71	0.077

Notes: In Table 6 Panel A & B present the summary statistics of variables used in the estimations by firm categories based on size measured as total employment and total assets, respectively. Panel C presents summary statistics of of variables used in the estimations by firms categories based on age. a, b, c indicate statistical difference from zero at the 1%, 5%, and 10% significance levels respectively. See notes in Table 4.

Table 7: Investment Estimations Using the Full Sample of Firms

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.7910***	0.8340***	0.5788***	0.1833***
	(0.1760)	(0.1106)	(0.0198)	(0.0252)
$(\frac{I}{K})^2_{t-1}$	−1.1901*	−0.9583***	−0.3330***	−0.1303**
	(0.4969)	(0.3114)	(0.5117)	(0.0616)
$(\frac{CF}{K})_{t-1}$	0.2840**	0.4273***	0.1292***	0.1418***
	(0.1105)	(0.0871)	(0.0127)	(0.0182)
$(\frac{Y}{K})_{t-1}$	0.0104	-0.0011	0.0038***	0.0107***
	(0.0095)	(0.0022)	(0.0004)	(0.0012)
m_1	-8.44	-11.81		
m_2	2.24	3.80		
m_3	-1.39	-1.40		
R^2			0.3667	0.1130
z_1	589.88 (13)	4923.21 (14)	328.46 (14)	43.44 (14)
Hansen	61.39 (32)	80.76 (68)		
(p-value)	0.001	0.138		

Notes: Table 7 presents the investment estimations using the full sample of firms. In Table 7, first and second coulumn presents the results of Difference and System GMM estimation, respectively. In Difference GMM estimation, third lag of all right-hand side variables are used for the first-differenced equations. In System GMM estimation, additionally second difference of all right-hand side variables are used for level equations. In GMM estimations, two step procedure is applied. m_i is a serial correlation test of order i using residuals in first differences, asymptotically standard normal. Hansen test is a test of overidentifying restrictions. In OLS and FE estimations standard errors are clustered by firm. Across all estimations, standard errors are robust to heteroscedasticity and are reported in parantheses. z_1 is a test of joint significance of reported coefficients. All other test statistics are asymptotically χ^2 with degrees of freedom in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Investment Estimations Controlling Firms' Size Based on Total Employment

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.8300***	0.8554***	0.5767***	0.1830***
	(0.1666)	(0.1072)	(0.0198)	(0.0252)
$(\frac{I}{K})^2_{t-1}$	−1.3545***	−1.082***	−0.3342***	−0.1315**
	(0.4642)	(0.3016)	(0.0515)	(0.0614)
$(\frac{CF}{K} \times D_S)_{t-1}$	0.1183	0.2949**	0.0957***	0.0898***
	(0.1571)	(0.1207)	(0.0149)	(0.0241)
$(\frac{CF}{K} \times D_L)_{t-1}$	0.3942***	0.4221***	0.1670***	0.1941***
	(0.1037)	(0.0737)	(0.0178)	(0.0263)
$(\frac{Y}{K})_{t-1}$	0.0121	0.0001	0.0039***	0.0108***
	(0.0086)	(0.0017)	(0.0004)	(0.0012)
m_1	-8.69	-12.06		
m_2	2.05	3.64		
m_3	2.05	-1.35		
R^2			0.3679	0.1151
z_1	610.44 (14)	4561.23 (15)	310.47 (15)	41.77 (15)
$t(\gamma_L - \gamma_S)$	2.65 (1)	0.88 (1)	11.65 (1)	8.70 (1)
(p-value)	0.1033	0.3482	0.0006	0.0032
Hansen	66.28 (85)	101.79 (85)		
(p-value)	0.006	0.104		

Notes: Table 8 presents the investment estimations testing whether investment-cash flow sensitivity of the firms is robust to controlling firms' size. Firms are categorized as small and large depending on whether they are below or above the median of total employment. t statistic testing the statistical significance of the equivalence in the estimated cash flow sensitivities across those sub-samples is reported. See notes in Table 7.

Table 9: Investment Estimations Controlling Firms' Size Based on Total Assets

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.7345***	0.8538***	0.5780***	0.1836***
	(0.1635)	(0.1044)	(0.0197)	(0.0252)
$(\frac{I}{K})^2_{t-1}$	−1.042**	−1.0068***	−0.3332***	−0.1307**
	(0.4588)	(0.2965)	(0.0515)	(0.0615)
$(\frac{CF}{K} \times D_S)_{t-1}$	0.2112***	0.3320***	0.0987***	0.1204***
	(0.1248)	(0.1365)	(0.0154)	(0.0263)
$(\frac{CF}{K} \times D_L)_{t-1}$	0.3554***	0.4108**	0.1621***	0.1635***
	(0.1510)	(0.1365)	(0.0174)	(0.0250)
$(\frac{Y}{K})_{t-1}$	0.0069	-0.0006	0.0039***	0.0107***
	(0.0093)	(0.0019)	(0.0004)	(0.0012)
m_1	-8.19	-12.05		
m_2	2.29	3.82		
m_3	-1.52	-1.41		
R^2			0.3676	0.1134
z_1	593.71 (14)	5272.39 (15)	310.16 (15)	41.52 (15)
$t(\gamma_L - \gamma_S)$	0.72 (1)	0.31 (1)	9.24 (1)	1.42 (1)
(p-value)	0.3953	0.5767	0.0024	0.2233
Hansen	65.60 (40)	94.92 (85)		
(p-value)	0.007	0.217		

Notes: Table 9 presents the investment estimations testing whether investment-cash flow sensitivity of the firms is robust to controlling firms' size. Firms are categorized as small and large depending on whether they are below or above the median of total assets. t statistic testing the statistical significance of the equivalence in the estimated cash flow sensitivities across those sub-samples is reported. See notes in Table 7.

Table 10: Investment Estimations Controlling Firms' Age

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.7208***	0.8724***	0.5791***	0.1832***
	(0.1685)	(0.1112)	(0.0198)	(0.0253)
$(\frac{I}{K})^2_{t-1}$	−1.0318**	−1.1807***	-0.3342***	-0.1300**
	(0.4570)	(0.2991)	(0.0520)	(0.0619)
$(\frac{CF}{K} \times D_Y)_{t-1}$	0.2333*	0.4468***	0.1314***	0.1407***
	(0.1224)	(0.1031)	(0.0146)	(0.0220)
$(\frac{CF}{K} \times D_M)_{t-1}$	0.1380	0.2035	0.1314***	0.1450***
	(0.1391)	(0.1280)	(0.0146)	(0.0295)
$(\frac{Y}{K})_{t-1}$	0.0079	0.0004	0.0038***	0.0107***
	(0.0089)	(0.0022)	(0.0004)	(0.0012)
m_1	-8.18	-11.85		
m_2	2.16	3.50		
m_3	-1.39	-1.22		
R^2		0.3667	0.1130	
z_1	580.39 (14)	4743.56 (15)	309.93 (15)	42.08 (15)
$t(\gamma_M - \gamma_Y)$	0.37 (1)	2.52 (1)	0.18 (1)	0.001 (1)
(p-value)	0.5456	0.1124	0.6672	0.9049
Hansen	80.85 (40)	11.73 (85)		
(p-value)	0.000	0.028		

Notes: Table 10 presents the investment estimations testing whether investment-cash flow sensitivity of the firms is robust to controlling firms' age. Mature firms are the ones that have been established before at least ten years ago; correspondingly, young companies are the ones that have been established less than ten years ago. t statistic testing the statistical significance of the equivalence in the estimated cash flow sensitivities across those sub-samples is reported. See notes in Table 7.

Table 11: Investment Estimations Controlling Possible Risk of Bankruptcy

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.8382***	0.6980***	0.4999***	0.1226*
	(0.2379)	(0.1845)	(0.0591)	(0.1348)
$(\frac{I}{K})^2_{t-1}$	-1.1499	-0.4846	-0.3120**	-0.1608
	(0.8295)	(0.6715)	(0.1303)	(0.1348)
$(\frac{CF}{K})_{t-1}$	0.2828**	0.1548	0.1016***	0.1248***
	(0.1388)	(0.1174)	(0.0293)	(0.0399)
$(\frac{Y}{K})_{t-1}$	0.0146**	0.0009	0.0027**	0.0060*
	(0.0059)	(0.0028)	(0.0011)	(0.0031)
m_1	-6.91	-8.22		
m_2	-3.06	3.58		
m_3	-0.50	-0.40		
R^2			0.2275	0.1438
z_1	205.55 (13)	1929.37 (14)	26.82 (14)	8.30 (14)
Hansen	52.82 (32)	103.94 (68)		
(p-value)	0.012	0.003		

Notes: Table 11 presents the investment estimations controlling possible risk of bankruptcy. See notes in Table 7.

Table A.1: Industrial Distribution

Industry	NACE Codes	Number
Food product, beverages, tobacco	15,16	842
Textile and textile products, clothes and wearing apparel	17,18	1186
Leather and leather products	19	108
Wood products	20	149
Pulp, paper and products, printing, publishing	21,22	195
Coal and petroleum products and nuclear fuel	23	8
Chemicals and synthetical fibres	24	237
Plastic and rubber products	25	257
Other non-metal mineral products	26	287
Basic metal and fabricated metal products	27,28	440
Machinery and equipment	29	299
Electric machinery and professional goods	30,31,32,33	197
Transportation vehicles	34,35	218
Other industries not elsewhere classified	36	136

Notes: In Table A.1 industries are classified according to 4-digit NACE codes.

Table A.2: Size and Age Distribution

Panel A: Size Distribution	Number
Small	2610
Large	1949

Panel B: Size Distribution	Number
Small	2467
Large	2092

Panel C: Age Distribution	Number
0-10	1965
11-20	1934
21-30	660

Notes: In Table A.2 Panel A & B present the distributions of manufacturing firms based on size measured as total employment and total assets, respectively.

Table A.3: Regional Distribution

Region	Number
Istanbul	1850
West Marmara	157
Agean	838
East Marmara	583
West Anatolia	372
Mediterranean	269
Central Anatolia	112
West Black Sea	132
East Black Sea	80
North East Anatolia	14
Central East Anatolia	28
South East Anatolia	124

Notes: Provincial information is present in CBRT database. In Table A.3 firms are classified according to regions determined by TurkStat.

Table A.4: Organizational Distribution

Legal Status	Number
Joint Stock Company	3134
Holding	NA
Limited Partnership	1238
Limited Liability Partnership	2
Corporation	50
Agent-owned Companies	100
Sole Proprietorship	4
Cooperatives	1

Notes: In Table A.4 industries are classified according to their legal status.

Table A.5: Panel Structure

Number of annual observations	3	4	5	6	7	8	9	10	11	12
Number of firms	919	651	475	353	264	289	449	366	309	484

Notes: In Table A.5 the distribution of the firms by the number of consecutive years of data available throughout the period 1992-2003 is shown.

Table B.1.1: Investment Estimations Using Alternative Measure of Internal Finance

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.7586***	0.8960***	0.5833***	0.1871***
	(0.1751)	(0.1154)	(0.197)	(0.0250)
$(\frac{I}{K})^2_{t-1}$	−1.0511**	−1.0623***	−0.3590***	−0.1349**
	(0.4752)	(0.3181)	(0.0521)	(0.0617)
$(\frac{CS}{K})_{t-1}$	0.0345	0.0956**	0.0634***	0.0583***
	(0.0430)	(0.0616)	(0.0060)	(0.0087)
$(\frac{Y}{K})_{t-1}$	0.0071	0.0007	0.0036***	0.0109***
	(0.0086)	(0.0027)	(0.0004)	(0.0013)
m_1	-7.90	-11.41		
m_2	2.18	3.65		
m_3	-1.33	-1.40		
R^2			0.3701	0.1059
z_1	481.62 (13)	6327.81 (14)	330.74 (14)	39.91 (14)
Hansen	72.74 (32)	106.93 (68)		
(p-value)	0.000	0.002		

Notes: Table B.1.1 presents the investment regressions testing whether investment-cash flow sensitivity is robust to using alternative measure of the internal finance i.e. cash stock. See notes in Table 7.

Table B.1.2: Investment Estimations Using Alternative Measure of Internal Finance

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.6609***	0.7592***	0.5885***	0.1883***
	(0.1541)	(0.1101)	(0.0192)	(0.0244)
$(\frac{I}{K})^2_{t-1}$	−0.6707	−0.6168**	−0.3589***	−0.1216**
	(0.4173)	(0.3049)	(0.0507)	(0.0608)
$(\frac{CS+CF}{K})_{t-1}$	0.0213	0.0457	0.0680***	0.0532***
	(0.0702)	(0.0540)	(0.0077)	(0.0112)
$(\frac{Y}{K})_{t-1}$	0.0115*	0.0074***	0.0041***	0.0110***
	(0.0065)	(0.0026)	(0.0003)	(0.0011)
m_1	-8.00	-10.94		
m_2	2.44	3.65		
m_3	-1.11	-1.14		
R^2	0.3550	0.1003		
z_1	594.29 (13)	6682.50 (14)	317.69 (14)	40.57 (14)
Hansen	70.86 (32)	102.48 (68)		
(p-value)	0.000	0.004		

Notes: Table B.1.2 presents the investment regressions testing whether investment-cash flow sensitivity is robust to using alternative measure of the internal finance i.e. cash stock plus net income. See notes in Table 7.

Table B.2.1: Investment Estimations Using Alternative Measure of Capital Stock

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.1665***	0.2484***	0.4063***	0.734***
	(0.0185)	(0.0170)	(0.0119)	(0.0128)
$(\frac{I}{K})^2_{t-1}$	-0.0089	-0.0242	−0.0338*	0.0407**
	(0.0261)	(0.0254)	(0.0196)	(0.0207)
$(\frac{CF}{K})_{t-1}$	0.0204***	0.0449***	0.0476***	0.0497***
	(0.0079)	(0.0074)	(0.0041)	(0.0057)
$(\frac{Y}{K})_{t-1}$	0.0064***	0.0046***	0.0023***	0.0062***
	(0.0007)	(0.0005)	(0.0001)	(0.0004)
m_1	-24.79	-28.58		
m_2	1.31	3.58		
m_3	-1.51	-1.11		
R^2			0.2501	0.1925
z_1	2268.93 (13)	8348.17 (14)	477.63 (14)	196.89 (14)
Hansen	124.29 (72)	320.51 (112)		
(p-value)	0.000	0.000		

Notes: Table B.2.1 presents the investment estimations testing whether investment-cash flow sensitivity is robust to alternative measure of capital stock. In Difference GMM estimation, third lag of all right-hand side variables are used for the first-differenced equations. In System GMM estimation, additionally second difference of all right-hand side variables are used for level equations. See notes in Table 7.

Table B.2.2: Robustness Check for Measure of Initial Replacement Cost Value of Capital Stock

Dependent variable: $(\frac{I}{K})_{i,t}$	(Diff. GMM)	(Sys. GMM)	(OLS)	(FE)
$(\frac{I}{K})_{t-1}$	0.1404	0.4590***	0.5526***	0.2723***
	(0.0870)	(0.0758)	(0.0350)	(0.0408)
$(\frac{I}{K})^2_{t-1}$	-0.0232	−0.3414**	−0.2896**	-0.1470
	(0.1467)	(0.1572)	(0.1147)	(0.1304)
$(\frac{CF}{K})_{t-1}$	0.0251	0.0765	0.1687***	0.2018***
	(0.0751)	(0.0588)	(0.0199)	(0.0234)
$(\frac{Y}{K})_{t-1}$	0.0022	0.0043	0.0034***	0.0116***
	(0.0040)	(0.0027)	(0.0006)	(0.0015)
m_1	-6.10	-7.23		
m_2	0.69	1.80		
m_3	-1.53	-1.25		
R^2			0.3865	0.1636
z_1	10.74 (13)	57.33 (14)	133.66 (14)	31.78 (14)
Hansen	77.07 (72)	112.13 (112)		
(p-value)	0.320	0.479		

Notes: Table B.2.2 presents the investment estimations testing whether investment-cash flow sensitivity is robust to alternative measure of the initial replacement cost value of capital stock. Since this sample is small, the standard errors are also incorporating Windmeijer's correction. See notes in Table 7.