REAL ESTATE PRICES AND CORPORATE BORROWING: EVIDENCE FROM TURKEY

A Master's Thesis

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Ankara
July 2025

To My Family

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The Graduate School of Economics and Social Sciences
of
İhsan Doğramacı Bilkent University

by

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In Partial Fulfillment of the Requirements for the Degree of
MASTER OF SCIENCE IN BUSINESS ADMINISTRATION

THE DEPARTMENT OF
MANAGEMENT
İHSAN DOĞRAMACI BİLKENT UNIVERSITY
ANKARA

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By Utku Çitli

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 Science in Business Administration.

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ABSTRACT

REAL ESTATE PRICES AND CORPORATE BORROWING: EVIDENCE FROM TURKEY

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M.S., Department of Management

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July 2025

This thesis examines the relationship between the capital structures of firms in Turkey and their collateral values, particularly through real estate assets. Using a rich dataset, including private SMEs, it investigates whether fluctuations in local real estate prices, which are used for measuring the changes in the value of firms' real estate holdings, affect firms' leverage. When firms' exposure to real estate prices is defined based on initial real estate ownership status, assumed to be identical across owner firms and fixed over time, the findings show that price increases are associated with higher long-term debt among owners compared to non-owners. Also, when ownership status is allowed to vary over time, by still assuming all owners have the same degree of exposure, the findings continue to show positive effects on leverage. These effects also extend to

short-term borrowing. However, when firms differ in their exposure based on the amount of real estate assets they own, the relationship between real estate values and leverage reverses. In this case, firms with more real estate assets are more likely to reduce both short and long-term debt when prices rise. These findings suggest that the relationship is highly shaped by the degree of firms' exposure to the real estate market.

Keywords: Collateral, Real Estate Prices, Capital Structure, SMEs, Developing Markets

ÖZET

GAYRİMENKUL FİYATLARI VE ŞİRKET BORÇLANMASI: TÜRKİYE ÖRNEĞİ

Çitli, Utku

Yüksek Lisans, İşletme Bölümü

Tez Danışmanı: Doç. Dr. Zeynep Önder

Temmuz 2025

Bu tez, Türkiye'deki firmaların sermaye yapıları ile teminat değerleri arasındaki ilişkiyi, özellikle gayrimenkul varlıkları üzerinden incelemektedir. KOBİ'leri de kapsayan zengin bir veri seti kullanılarak, firmaların gayrimenkul varlıklarının değerindeki değişimler yerel gayrimenkul fiyatlarıyla ölçülmekte ve bu fiyat dalgalanmalarının borçlanma oranlarına etkisi araştırılmaktadır. Firmaların fiyatlara maruziyeti, başlangıçtaki gayrimenkul sahipliği durumlarına göre tanımlandığında ve hem tüm sahip firmalar için eşit olduğu hem de zaman içinde sabit kaldığı varsayıldığında, fiyat artışları ile gayrimenkul sahibi firmaların uzun vadeli borçlanmaları arasında pozitif bir ilişki görülmektedir. Tüm sahip firmalar için maruziyetin eşit olduğu varsayımına devam ederek, sahiplik durumunun zaman içinde değişmesine izin verildiğinde ise uzun vadeli

borçlanma üzerindeki pozitif etkiler yine devam etmektedir. Ayrıca bu pozitif etkiler kısa vadeli borçlanmada da görülmektedir. Öte yandan, firmalar arasındaki maruziyet farkı, sahip oldukları gayrimenkul varlıklarının miktarına göre tanımlandığında, gayrimenkul değerleri ile borçlanma arasındaki ilişki tersine dönmektedir. Bu durumda, daha fazla gayrimenkule sahip firmaların fiyatlar yükseldiğinde hem kısa hem de uzun vadeli borçlarını azaltma eğiliminde oldukları görülmektedir. Bu bulgular, gayrimenkul fiyatları ile borçlanma arasındaki ilişkinin, firmaların gayrimenkul piyasasına olan maruziyet derecesine bağlı olarak önemli ölçüde değiştiğini ortaya koymaktadır.

Anahtar Kelimeler: Teminat, Gayrimenkul Fiyatları, Sermaye Yapısı, KOBİ'ler, Gelişmekte Olan Piyasalar

ACKNOWLEDGMENTS

I am deeply grateful to my advisor, Assoc. Prof. Zeynep Önder, for her continuous support and guidance. As her student and assistant since my undergraduate years at Bilkent University, I am thankful for everything she has taught me and the inspiration she has provided.

I am also grateful to Asst. Prof. Altan Pazarbaşı for all his guidance, not only in academic research but also in life. His door was always open, and his wisdom has been invaluable.

I am sincerely thankful to Prof. Oğuzhan Özbaş and Prof. Nuray Güner for generously dedicating their time to evaluate my thesis as members of the jury and for their invaluable feedback.

My appreciation also goes to the Republic of Türkiye Ministry of Industry and Technology for granting me access to the data used in this thesis and for their hospitality during my time at the Ministry.

I would like to thank the Scientific and Technological Research Council of Türkiye (TÜBİTAK) for their generous support and the grant provided for this study (Project Number: 223K218).

I am also thankful to my dear friends, Tunahan and Alper. Their friendship brought laughter to a journey that was sometimes challenging.

Lastly, I would like to express my deepest appreciation to my beloved family. I am indebted to my parents for their support at every stage of my life. A very special thanks goes to my dearest sister, Pınar. Since childhood, she has been my closest companion and a source of strength.

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CHAPTER 1

INTRODUCTION

In a world without financial frictions, collateral would not play a role in shaping firms' capital structure decisions. However, when there is information asymmetry between lenders and borrowers, it plays an important role in signaling the borrower's ability to repay. It not only eases firms' access to credit but can also influence their optimal debt levels. Among all types of assets, real estate is often preferred as collateral by creditors due to its durability and an active secondary market compared to other fixed assets such as vehicles and machinery. It is especially useful for securing long-term loans. Furthermore, small and medium-sized enterprises (SMEs) may rely more heavily on collateral to obtain credit since they are expected to be financially constrained and often lack established relationships with banks. In Turkey, SMEs account for 99.8 percent of all enterprises (TOBB, 2020). Accordingly, this thesis uses a large sample consisting mostly of SMEs, based on data provided by the Entrepreneurship Information System (EIS), to assess the relationship between collateral value and firm leverage in Turkey.

The literature refers to the mechanism through which higher collateral values alleviate borrowing constraints and support investment as the collateral channel. The positive effects of rising real estate values on borrowing have been documented in developed countries such as the US, UK, Japan, and France (e.g., Gan, 2007; Chaney, Sraer, & Thesmar, 2012; Cvijanović, 2014). However, later studies in the US cast doubt on the collateral channel by considering not only rising values but also the associated risk (Deng, Ong, & Qian, 2018; Campello, Connolly, Kankanhalli, & Steiner, 2022). They suggest that if the increase in real estate values is accompanied by increased risk, the collateral channel may not function as expected. In such cases, firms might turn to unsecured debt or reduce their borrowing.

Evidence from developing economies remains limited and mixed. Most of the existing research focuses on China (Wu, Gyourko, & Deng, 2015; Chen, Wang, & Liu, 2015), and their mixed findings regarding the existence of the collateral channel highlight the need for more studies across other developing countries. This thesis aims to address this gap by examining how changes in collateral values affect corporate borrowing in a developing country, Turkey, between 2007 and 2022, coinciding with years of sharp real price increases in housing compared to most other developing countries (IMF European Dept., 2017).

The findings of this thesis confirm the expected positive relationship between asset tangibility and leverage, as tangible assets are often considered more collateralizable. However, due to concerns about endogeneity in the relationship between asset structure and leverage, the focus shifts to changes in real estate values, which are measured by

city-level housing price indices. The relationship between real estate prices and leverage points to a more nuanced interpretation of the collateral channel in Turkey. In response to rising prices, firms that own real estate increase their long-term borrowing more than non-owners. While this finding aligns with the collateral channel, allowing firms to vary in their exposure to real estate prices offers a different picture. Firms with more real estate assets appear to reduce their leverage in response to price increases. This may reflect strategic asset sales or increased use of internal funding due to downside risks in the firms' real estate assets that are not observable in the available data. Overall, the results show that the impact of collateral depends on the degree of firms' exposure to real estate price changes, rather than operating uniformly across all firms.

This thesis contributes to the literature in two ways. First, it examines how the collateral channel operates in a developing country. Second, by focusing on SMEs in the analysis, it investigates the behavior of a group of firms that have received less attention in the context of the collateral channel. Bahaj, Foulis, and Pinter (2020) included SMEs in their sample and found supportive evidence from the UK, a developed country. However, to the best of my knowledge, the only study that investigates the collateral channel for SMEs in developing countries is conducted by Yeşiltaş (2016). Yet, her sample was not restricted to developing countries, and most observations came from developed economies. Moreover, her analysis was based on the introduction of loan-to-value (LTV) caps, which were treated as exogenous shocks to collateral values. In contrast, this study adopts a different empirical strategy that enables a more direct assessment of how real estate price changes influence SMEs' capital structure decisions.

The remainder of this thesis is organized as follows. Chapter 2 provides background on the role of collateral in capital structure decisions and reviews the related literature. Chapter 3 continues by presenting the hypotheses of the thesis and defining the empirical methodology. Chapter 4 describes the data used and summarizes key descriptive statistics. Chapter 5 presents empirical findings. Finally, Chapter 6 discusses the findings and the limitations of the study.

CHAPTER 2

LITERATURE REVIEW

This chapter reviews studies on how firms' borrowing decisions are related to the composition and value of their assets. It starts with the theory on how collateral value mitigates financial frictions and affects capital structure decisions. Then, it examines empirical studies on the relationship between asset tangibility and firms' financing choices. Following this, it covers studies on how firms' access to debt is affected by shocks to collateral value, which is often measured by real estate prices.

2.1. Theoretical Foundations of Collateral and Financial Frictions

Loans are an important source of external financing that allows firms to pursue investment and growth opportunities. However, banks and other financial institutions often lack complete information about a firm's ability to repay. This information asymmetry creates a fundamental friction in credit markets. To mitigate this problem, lenders may choose to require collateral. The pledged assets as collateral have a key role in reducing the risk borne by lenders and easing the firms' access to external financing.

Barro (1976) and Hart and Moore (1994) suggest that pledging collateral improves a firm's financial capacity in the presence of incomplete contracts. Also, Stiglitz and Weiss (1981) emphasize that lenders may restrict credit as they are unable to differentiate between reliable and risky borrowers. Thus, requiring collateral reduces the risk of lending by filtering out less creditworthy firms and mitigates adverse selection.

Bernanke and Gertler (1989) emphasize the role of balance sheet assets. They argue that assets in hand will relieve the asymmetric information problem between borrowers and lenders. Shleifer and Vishny (1992) also argue that the type and liquidity of assets are important. If the pledged asset is hard to sell or loses value during a downturn, it becomes less useful for lenders. Therefore, they suggest that asset liquidity directly affects how much firms can borrow and limits their optimal debt levels. Similarly, Kiyotaki and Moore (1997) show that declining asset values reduce firms' borrowing capacity during economic crises and market illiquidity. This will lead to lower investment and output, which in turn worsens the downturn. The opposite can happen during economic booms. Rising asset prices can boost borrowing and amplify growth. This circular relationship, illustrated in Figure 1, creates challenges for later empirical research. It makes it difficult to distinguish cause from effect and leads to an endogeneity concern between asset values and firm behavior.

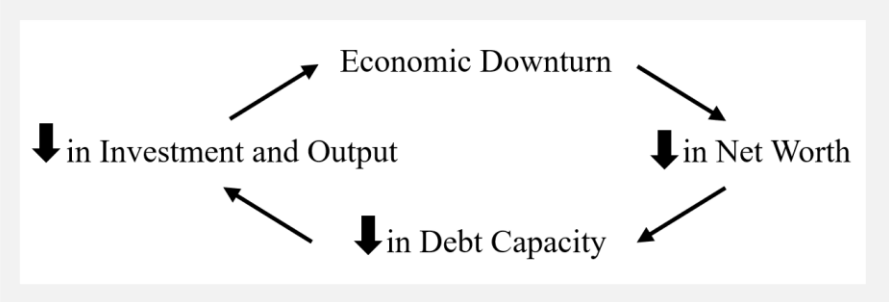


Figure 1: Link Between Economic State and Firm Borrowing, Investment, and Output

Rampini and Viswanathan (2010, 2013) emphasize the heterogeneous effect of collateral value for firms of different sizes. Smaller firms with low net worth have to bear higher costs to preserve their debt capacity. Since these firms often operate on a smaller scale, they tend to be more productive at the margin. However, they also face more financial constraints. As a result, they are more responsive to changes in collateral values. When asset values fall, these firms may reduce investment and postpone their growth opportunities. However, larger firms respond to cash flow shortages by selling and leasing back their assets to maintain liquidity. Therefore, their investments are less likely to be affected by the collateral value shocks.

2.2. Asset Tangibility and Capital Structure

The theoretical role of asset liquidity on firms' debt capacities leads to a closer examination of tangible assets, which are often much easier to liquidate than intangible assets. In their seminal study, Rajan and Zingales (1995) examined which firm characteristics help explain differences in leverage, using data from companies in G-7 countries. They find that firms with more tangible assets relative to their total assets

have higher leverage ratios. In addition to tangibility, they also examine other firm characteristics. The market-to-book ratio, which is used as a proxy for firms' growth opportunities, is negatively related to leverage across all countries. Following this, the authors conclude that firms expecting higher growth are less likely to consume their debt capacity to keep their financial flexibility for future investment opportunities. Profitability is also negatively related to leverage, except in Germany. This is consistent with the pecking order theory, as more profitable firms rely less on external finance (Myers & Majluf, 1984). Lastly, size is positively associated with leverage, since larger firms are considered less likely to default on their debt obligations.

Booth, Aivazian, Demirgüç-Kunt, and Maksimovic (2001) examine firms in ten developing countries, including Turkey. They find mixed results about the role of asset tangibility. They show that firms with more tangible assets tend to use more long-term debt, but higher tangibility can be associated with lower total debt. They conclude that firms may substitute long-term debt for short-term debt at a rate of less than one. Fan, Titman, and Twite (2012) also study the capital structure of firms across 39 developed and developing countries. Using a sample of 36,767 firms between 1991 and 2006, they conclude that asset tangibility is the strongest cross-sectional determinant of debt maturity. In their within-country analysis, this result also holds for firms in Turkey.

Cevheroğlu-Acar (2018) studies the factors that shape the capital structure of publicly traded non-financial firms in Turkey. She finds that asset tangibility has a positive impact on total and long-term debt, but a negative impact on short-term debt. These results suggest that firms with more tangible assets may prefer long-term borrowing

since they can pledge these assets as collateral. On the other hand, the negative relationship with short-term debt may reflect a substitution effect. Jermias and Yiğit (2019) further explore the effect of tangibility by examining whether there is a change in the relationship during periods of economic stress. Using data of publicly traded firms in Turkey between 1989 and 2012, they hypothesize that collateral would become more important during financial crises since lenders may face tighter liquidity. While they generally find a positive relationship between tangibility and leverage, they report limited evidence of this link becoming stronger in crisis times. Only in the 2001 crisis, the link between tangibility and leverage is significantly stronger.

In their recent study, Benmelech, Kumar, and Rajan (2025) also demonstrate a positive relationship between leverage and asset tangibility. However, they find that this relationship only holds for small and medium-sized firms. Among larger firms, which are less likely to be financially constrained, tangibility has no significant effect on leverage.

2.3. Real Estate Prices and Borrowing

Following the effect of asset tangibility on leverage, many studies turn their focus to real estate as a form of collateral. Among tangible assets, real estate plays a distinct role in corporate borrowing. Compared to other fixed assets like machinery or vehicles, it is more durable and less subject to obsolescence. Because of these features, lenders are generally more willing to accept real estate as collateral. As a result, firms holding more real estate assets are often able to borrow more easily, especially at longer maturities.

Therefore, real estate is also frequently used in literature to study how fluctuations in its price affect leverage. However, this kind of research is subject to endogeneity concerns, as noted in Figure 1 in Section 2.1. While real estate prices can affect firms' financing and investment decisions, firms' borrowing and investment behavior can also affect local real estate prices. This makes causal inference in empirical studies more difficult and requires careful identification strategies, which are discussed in the remainder of this section.

Gan (2007) studies the impact of Japan's real estate bubble burst in the early 1990s on firms' borrowing capacity. The sharp and widespread decline in land prices following the bubble burst serves as an exogenous shock to the value of collateral firms hold. Since this shock was driven by macroeconomic and financial factors beyond the firm-level effect, it provides a natural experiment to isolate the impact of collateral devaluation. Using matched firm-bank lending data for 847 Japanese firms, Gan (2007) finds that firms that experienced larger collateral losses are less likely to have their loans renewed and face tighter borrowing capacities.

Saiz (2010) introduces a measure of local housing supply elasticity, which is estimated based on the share of undevelopable land in metropolitan statistical areas (MSAs). After the introduction of this measure, it has become a widely used instrument to address endogeneity concerns. The use of it as an instrument relies on the assumption that housing supply elasticity affects firms' decisions only through its impact on real estate prices. On the other hand, the share of undevelopable land is geographically determined and not influenced by firm behavior.

Chaney et al. (2012) are among the first to use an instrumental variable strategy where they interact mortgage rates with local housing supply elasticity to predict variation in real estate prices. In this setting, national mortgage rates serve as a demand shifter, since lower mortgage rates tend to stimulate demand. The key idea is that a decline in mortgage rates increases demand for real estate, and this increase in demand has a more pronounced effect on prices in MSAs where housing supply is less elastic, as illustrated in Figure 2.

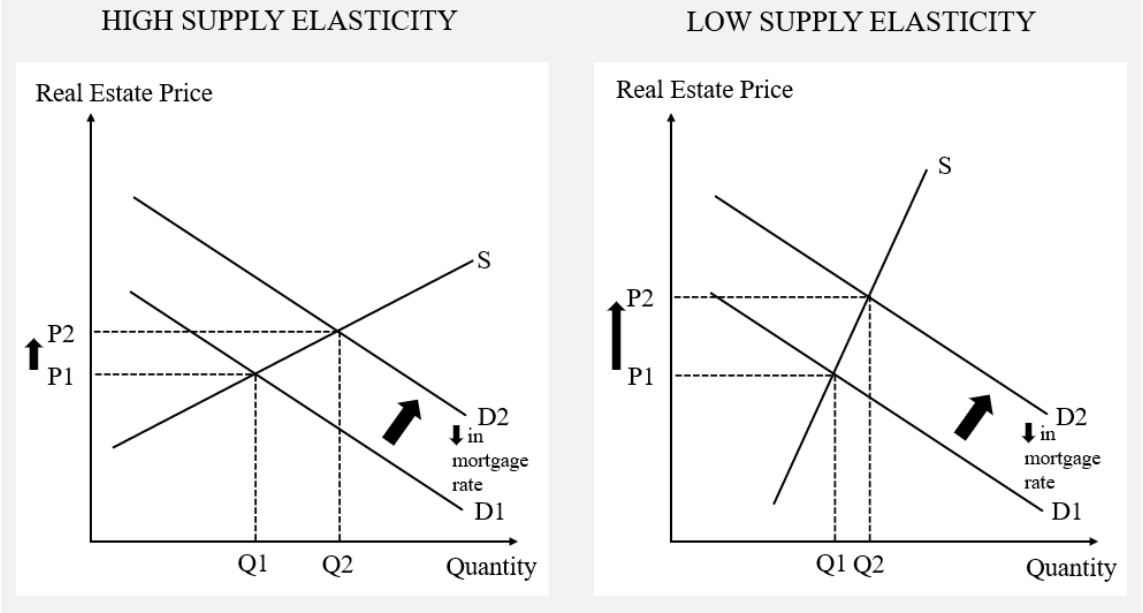


Figure 2: Demand Shocks and Supply Elasticity in Real Estate Markets

As another source of endogeneity, Chaney et al. (2012) argue that firms can buy or sell real estate assets based on expectations of future prices. Therefore, the decision to become a real estate owner is endogenous to both investment opportunities and borrowing decisions. To address this, Chaney et al. (2012) hold firms' real estate assets

fixed at their 1993 levels, the beginning of their sample period. Then, they inflate the value of these holdings using local real estate price changes. In this way, they create a measure of collateral value that varies with prices but is not influenced by the firms' actions. This method isolates variation in collateral values that is independent of firms' own investment choices. Their findings show that increases in predicted collateral value lead to higher firm leverage, especially through long-term debt.

Cvijanović (2014) also examines the impact of real estate price fluctuations on publicly traded U.S. firms' capital structure. The study pays special attention to whether firms use secured or unsecured borrowing. She finds that increases in real estate prices raise firm leverage, mainly through long-term debt. Also, she suggests that increases in real estate values lead to greater use of secured debt, while there is no significant effect on unsecured debt. Studies in other developed countries also find a positive relationship between real estate prices and leverage. Bahaj et al. (2020) analyze a sample of private SMEs in the UK. Their approach is slightly different since they look at both firm-owned real estate and directors' personal property. They find that increases in corporate real estate values lead firms to issue more short-term and long-term debt. However, increases in the value of directors' assets only affect short-term borrowing. This may suggest that directors' personal real estate helps alleviate immediate liquidity constraints. By examining French firms, Fougère, Lecat, and Ray (2019) identify a positive relationship between real estate prices and firm borrowing. They show that firms with larger initial real estate holdings increase their borrowing significantly when local real estate prices rise.

Compared to developed markets, evidence on the collateral channel from developing countries is relatively limited. Yeşiltaş (2016) explores the effects of loan-to-value (LTV) caps on firms' financing by treating their implementation as an exogenous policy shock. Her sample includes firms from Bulgaria, Hungary, the Netherlands, Norway, Sweden, and Turkey, where an LTV cap is implied. Using a difference-in-differences methodology, she shows that firms with more tangible assets reduced their debt more than those with less tangible assets. She also argues that when collateral restrictions are tightened, firms rely more on trade credit rather than bank loans. However, it is important to note that firms from Sweden dominate the sample. For comparison, among the 40,016 firms included, 32,895 were from Sweden, while only 682 small, medium, and large firms were from Turkey.

Wu et al. (2015) analyze Chinese firms from 2003 to 2011 by separating state-owned enterprises (SOEs) and non-SOEs. They use ordinary least squares regressions since suitable instrumental variables, such as local housing supply elasticity, are not strong enough for China. They conclude that the collateral channel is not significant for either SOEs or non-SOEs in China. While they explained the lack of collateral channel effects in SOEs with favoritism in the Chinese economy, they attributed the insignificant result for non-SOEs to the nature of Chinese financial markets. In contrast, Chen et al. (2015) provide evidence supporting the collateral channel for private (non-SOE) firms in China. While they again concluded that SOEs are not credit-constrained, they showed that the collateral channel effect exists for non-SOEs. However, a notable limitation in their approach is that they do not distinguish between firms that own real estate and those that do not. By examining all firms' responses to price changes without accounting for actual

ownership, the interpretation of their results offers only limited evidence for the collateral channel.

There are also studies that investigate the effect of real estate prices on household-level and bank-level outcomes. Mian and Sufi (2011) showed that real estate prices affect households' borrowing decisions. In their study on a sample of US homeowners, they found that rising home equity leads households to increase their borrowing. Glancy (2021), in a study covering the period before and during the Great Recession, finds that banks operating in regions with sharp real estate price declines reduced both mortgage and small business lending across their national branch networks. Ayberk and Önder (2022) investigate the loan allocation behavior of banks in Turkey between 2007 and 2015. They use an instrumental variable strategy based on the interaction of mortgage rates and the share of undevelopable land. They show that as housing prices increase, banks reallocate credit away from commercial and industrial loans toward mortgage, consumer, and construction lending.

While much of the collateral channel literature focuses on the value of real estate, some recent studies take a more skeptical view by looking at real estate risk instead of just value. Deng et al. (2017) analyze U.S. listed firms from 1985 to 2013 and propose two ways to measure real estate risk. The first is the volatility of real estate investment trust (REIT) returns that cannot be explained by general stock market movements, which they call industry-specific risk. The second is each firm's sensitivity to real estate market risk in a two-factor model. They find that higher values for both risk measures are associated with lower debt issuance.

Campello et al. (2022) also take a critical approach toward the narrative in the collateral channel literature. They argue that earlier studies misidentify the link between real estate values and leverage by inflating a fixed amount of real estate holdings with local price changes. They suggest that new acquisitions or sales of real estate assets should be taken into account. Although such changes in firms' collateral assets have been identified as a source of endogeneity in earlier studies, Campello et al. (2022) argue that they can affect firms' exposure to real estate market risk and borrowing capacity. With access to contract-level data, they construct a new measure that reflects new acquisitions and asset sales. They find that increases in real estate values are actually associated with unsecured borrowing, not secured borrowing. Also, this effect is especially strong when a firm's real estate assets are more exposed to market risk, or when the riskiness of firms' collateral exceeds that of other assets. Campello et al. (2022) suggest that although secured debt is backed by assets, it is not always the safer option for either lenders or borrowers. The actual risk also depends on how those assets perform during downturns. If real estate assets in the firms' portfolio carry higher downside risk, lenders may require higher compensation, such as loan haircuts, so secured debt indeed becomes more costly for firms.

CHAPTER 3

HYPOTHESES AND METHODOLOGY

This chapter defines the main hypotheses of the thesis and explains how they are tested. It focuses on two key relationships: asset tangibility and leverage, and real estate prices and leverage. For both relationships, it develops hypotheses based on findings from literature and then addresses the empirical approach used to test them.

3.1. Asset Tangibility and Leverage

As a first step, I test whether firms with more tangible assets have higher leverage. Before testing the impact of collateral value shocks, which will be measured by changes in real estate prices, this helps to see whether tangibility is associated with borrowing. Since tangible assets can be pledged more easily as collateral, firms with higher tangibility are expected to have easier access to debt. This leads to the following hypothesis:

- H1: Firms with higher asset tangibility have higher leverage.

The findings may be ambiguous if firms substitute long-term debt with short-term debt (Booth et al., 2001; Cevheroğlu-Acar, 2018). Therefore, the effect of asset tangibility on long-term bank debt is especially important to establish the idea that collateral affects leverage, since long-term bank loans often require collateral pledging. Based on this reasoning, I test the following sub-hypothesis:

- H1a: Asset tangibility is positively associated with the long-term bank debt ratio.

Lastly, since larger firms are often considered to be less financially constrained (Benmelech, Kumar, & Rajan, 2025) and have more alternatives for external financing, I test whether the effect of tangibility on leverage differs by firm size:

- H1b: The effect of tangibility on leverage is smaller for larger firms.

To test these hypotheses, I estimate the following linear fixed effects regression model:

$$Leverage_{i,t} = \lambda_i + \delta_t + \beta\, Tangibility_{i,t-1} + \theta_1\, Profitability_{i,t-1} + \theta_2 \ln(Sales)_{i,t-1} + \theta_3 SharePremium_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where $Leverage_{i,t}$ represents various dependent variables:

- Total financial debt over total assets (FD)
- Short-term and long-term financial debt over total assets (SFD, LFD)
- Total bank debt and its short and long-term components over total assets (BD, SBD, LBD)
- Trade credit over total assets (TC)

λ_i represents firm fixed effects, which control for time-invariant characteristics such as corporate culture and persistent risk preferences. δ_t denotes year fixed effects to account for macroeconomic and regulatory shocks, such as changes in interest rates or credit conditions. Lagged values are used for *Tangibility*, *Profitability*, and *ln(Sales)* since the effect of these variables will not be reflected on capital structure immediately. These variables are detailed in Table 2 in Chapter 4. All variables, which are expressed as ratios, are winsorized at the 1st and 99th percentiles to limit the influence of outliers. While market-based measures such as Tobin's Q or market-to-book ratios are common in the literature to control for growth opportunities, they are not available in the sample of this study. It consists mostly of private firms, and there are public firms that cannot be identified. Therefore, the *SharePremium* dummy, which takes the value of 1 in the years following a firm's report of paid-in capital in excess of par value, is added to proxy for firms with greater access to equity financing. Following Benmelech et al. (2025), I cluster standard errors at the firm-level to account for within-firm serial correlation. To explore heterogeneity by firm size, I replicate the analysis across different asset quartiles.

3.2. Real Estate Prices and Leverage

As an increase in real estate prices will have a positive impact on the value of assets that can be pledged as collateral, I test the following hypothesis:

- H2: Firms with more real estate assets increase their leverage more in response to rising real estate prices.

To mitigate endogeneity concerns between local real estate prices and firms' financing and investment decisions, I predict city-level real estate prices using an interaction between the city's share of undevelopable land and the national housing loan interest rate. The idea follows the identification strategy of Saiz (2010) and Chaney et al. (2012), where supply constraints are interacted with credit conditions to isolate the exogenous variation in real estate prices. The first-stage regression is specified as follows:

$$REprice_t^c = \lambda^c + \delta_t + \beta UndevLand^c * InterestRate_t + \varepsilon_t^c \quad (2)$$

λ^c and δ_t denote city and year fixed effects. $REprice_t^c$ represents the inflation-adjusted real estate price in city *c* in year *t*. $UndevLand^c$ is the share of undevelopable land in city *c*, which is constant over time. $InterestRate_t$ is the real interest rate on housing loans that varies over time, but it is fixed across cities. The interaction term between the two creates an instrument that varies across both cities and years.

The reduced form equation to test *H2* is specified as follows:

$$Leverage_{i,t}^c = \lambda_i + \delta_t^c + \beta \widehat{REvalue}_{i,t-1}^c + \theta_1 Profitability_{i,t-1}^c + \theta_2 ln(Sales)_{i,t-1}^c + \theta_3 Share\ Premium_{i,t}^c + u_{i,t} \quad (3)$$

The dependent variable $Leverage_{i,t}^c$ refers to various debt ratios used in the previous model with asset tangibility. The construction of $REvalue_{i,t-1}^c$ is detailed in Table 2 in Chapter 4. The model also includes standard firm-level controls: *Profitability*, *ln(Sales)*,

and *SharePremium*. Firm fixed effects λ_i are again included to account for unobservable firm-specific characteristics. The model also includes city-year fixed effects δ_t^c, following Bahaj et al. (2020) and Campello et al. (2022). This allows to control for regional economic developments that may influence firms' leverage within a given city and year. Standard errors are clustered at the city-year level.

To assess how firms with and without real estate assets respond to collateral value shocks, I construct an interaction term between a static ownership dummy and $\widehat{REprice}_{t-1}^c$. The dummy variable equals 1 if the firm owned real estate in the first year of the sample and remains constant over time. Based on this, I restructure Equation 3 as follows:

$$Leverage_{i,t}^c = \lambda_i + \delta_t^c + \beta REowner_{i,2007}^c * \widehat{REprice}_{t-1}^c + \theta_1 Profitability_{i,t-1}^c + \theta_2 ln(Sales)_{i,t-1}^c + \theta_3 Share\ Premium_{i,t}^c + u_{i,t} \quad (4)$$

Finally, although fixing real estate ownership to the initial year of the sample period helps mitigate endogeneity concerns, it also limits the variation captured in the sample. At the beginning of the sample period, only 22,615 out of 94,137 firms owned real estate. However, 21,375 additional firms became owners later in the sample period. Also, 3,170 initial owners disinvested all their real estate assets at some point in time. Such changes may not have a great influence on a sample used by Chaney et al. (2012), who analyze publicly listed firms in a developed market. However, as Campello et al. (2022) emphasized, changes in ownership positions are likely to affect results since

the ownership situation directly determines firms' exposure to real estate market risk. Unfortunately, I do not have access to detailed contract-level data to measure direct real estate exposure precisely. Instead, I adjust my empirical specification by redefining the ownership dummy from static, $REowner^{c}_{i,2007}$, to time-varying, $REowner^{c}_{i,t-1}$. This time-varying ownership dummy equals 1 in any year of the sample if a firm owns real estate. Thus, it provides a basis for comparing results under alternative definitions of ownership.

CHAPTER 4

DATA AND DESCRIPTIVE STATISTICS

This chapter first presents the data sources for the variables used in the analysis and then continues with descriptive statistics.

4.1. Data

4.1.1. Firm-Level Data

My source for firm-level data is the Entrepreneurship Information System (EIS), provided by the Ministry of Industry and Technology of the Republic of Türkiye. The EIS includes several datasets, such as balance sheets, intellectual property rights, and foreign trade records. For this study, I utilize two modules: the balance sheet module, which provides firm financials, and the firm registry module, which contains administrative information such as the industry a firm operates in and its city of headquarters. Although firm names are withheld for confidentiality reasons, the two

modules can be merged using unique firm identifiers. Both modules cover the years between 2006 and 2023.

I start with a sample of firms that were active and had available balance sheet data in 2007, since this is the first year for which real estate index data is available. Using NACE industry codes from the firm registry data, I exclude firms in the finance and insurance sectors, since they operate under different regulatory rules and accounting practices that limit comparability with non-financial firms. Following Chaney et al. (2012) and Cvijanovic (2014), I further exclude firms in the real estate, construction, and mining industries as their debt capacity and investment opportunities are already directly linked to real estate price shocks due to the nature of their operations.

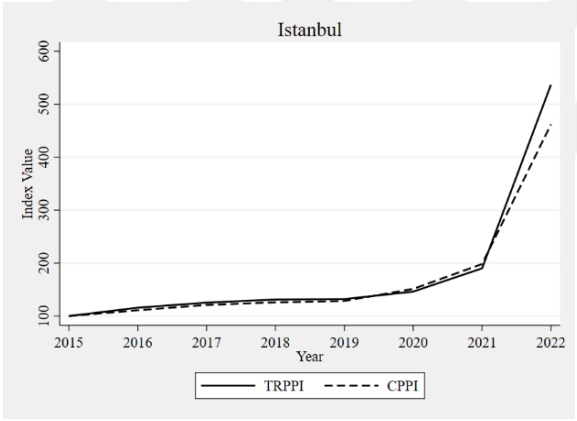
The EIS contains a wide range of firms operating under different tax regimes, including corporate tax, income tax, and simplified schemes for small businesses. To keep the financial data consistent and comparable, I exclude sole proprietorships and any firms that are not subject to corporate income tax, as these entities often follow more flexible and changing accounting practices. Instead, I focus on firms with more standardized reporting by restricting the sample to limited liability companies and corporations. Based on Article 507 of the former Turkish Commercial Code No. 6762, limited liability companies were required to have a minimum capital of 5,000 TL in 2007. Therefore, I exclude firms whose capital falls below this threshold.

I remove duplicate firm-year observations and exclude cases where a firm's annual change in total assets is unusually large, since such fluctuations may not reflect regular

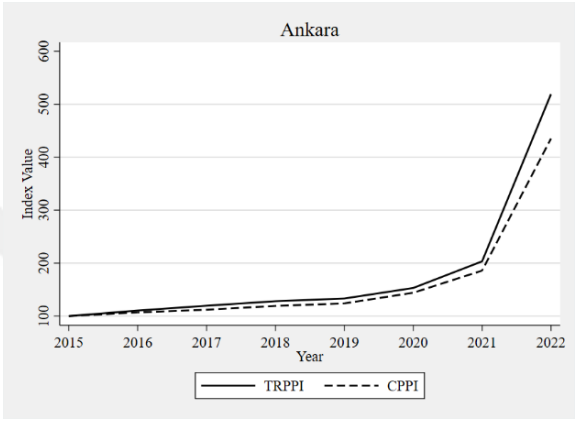
business activity. I identify these cases by comparing each year's total assets with the preceding or following year's values and cross-checking with total liabilities and equity. I also exclude observations with missing debt data for key variables used in the analysis. I exclude the year 2023 entirely due to a high number of missing values in accounts needed for my analysis. Also, data from this year may still be subject to revision. Finally, following Chaney et al. (2012) and Cvijanovic (2014), I retain only firms with at least three consecutive annual observations during the 2007–2022 period to avoid spurious relationships driven by firms with only a single-year observation. The resulting sample consists of 94,137 firms and 1,282,301 firm-year observations.

4.1.2. Real Estate Price Data

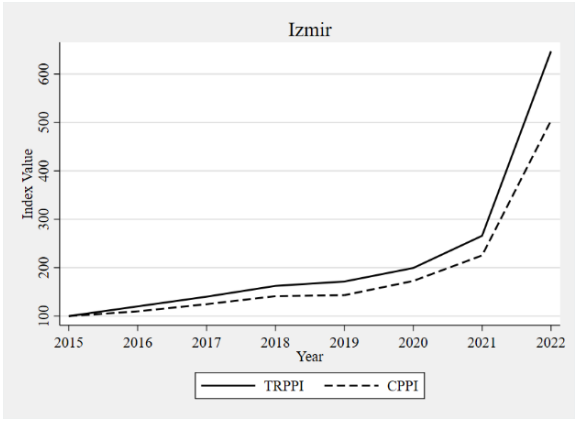
I use REIDIN's city-level price indices, Turkey Residential Property Price Indices (TRPPI), as a proxy for the fluctuations in the value of firms' real estate assets. The TRPPI is constructed through data collected from multiple sources such as real estate agents, asset management firms, newspapers, magazines, and internet platforms. Here, one concern may be the use of residential property prices as a proxy for corporate real estate prices. Data regarding corporate real estate prices is provided by the Central Bank of the Republic of Turkey (CBRT), but it is only available as of 2015 for three major cities. Figure 3 shows the comparison of annual averages of CBRT's Commercial Property Price Index (CPPI) and REIDIN's TRPPI. The two indices move in a similar pattern in the available cities for CPPI. Due to the limited availability of commercial property price data across regions and years, TRPPI serves as the most relevant proxy for capturing real estate price fluctuations throughout the sample period.



(a)



(b)



(c)

Figure 3: Comparison of CBRT's Commercial Property Price Index (CPPI) and REIDIN's Turkey Residential Property Price Index (TRPPI) for a) Istanbul, b) Ankara, and c) Izmir

Before expanding to cover all cities in Turkey in 2015, TRPPI had been available for 68 cities across Turkey since 2007. For cities with missing data, I assign values from another city in the same NUTS-2 region by assuming cities within a region tend to follow similar economic and housing market dynamics. Table 1 shows the missing cities along with their proxies. Since TRPPI is available at a monthly frequency, I use the value from the last month of each year to align the timing of real estate prices with firms' financial reporting. Also, I use inflation-adjusted values of the index to account for the significant variation in Turkey's inflation rate over the sample period. This adjustment ensures that observed changes in prices reflect real purchasing power and asset values, rather than nominal increases driven by general price levels.

Table 1: List of Missing Cities and Assigned Proxy Cities for TRPPI

Missing City	Proxy City
Ağrı, Ardahan, Iğdır	Kars
Artvin, Gümüşhane	Trabzon
Bayburt	Erzurum
Bingöl, Tunceli	Malatya
Bitlis, Hakkari, Muş	Van
Siirt, Şırnak	Mardin

4.1.3. Undevelopable Land Share and Mortgage Rates

Data on the share of undevelopable land are from Ayberk and Önder (2022), while housing loan interest rates (series TP.KTF12) are obtained from the Central Bank of the

Republic of Turkey (CBRT). The interaction of these two variables is used as an instrument for real estate prices.

4.2. Variable Definitions and Descriptive Statistics

Table 2 presents the definitions of the variables used throughout the empirical analysis and their corresponding account numbers from the EIS. Financial variables are derived from firm-level balance sheets and income statements. They are scaled by total assets, unless otherwise specified. All financial variables, which are expressed as ratios, are winsorized at the 1st and 99th percentiles.

To determine the real estate assets of a firm, I follow Chaney et al. (2012) and Cvijanović (2014) and define real estate assets as buildings, land, improvements, and construction in progress. Due to endogeneity concerns, I use the real estate values reported in 2007. Then, I inflate them by using real estate price changes in the following years to calculate *REvalue* of each firm. When inflating real estate values, I assume that the majority of a firm's real estate holdings are located in the city where it is headquartered. Thus, I use city-level real estate price indices based on the firm's headquarters location.

The primary variable of interest for measuring leverage is the financial debt-to-asset ratio (FD). It serves as the main dependent variable throughout the empirical analysis. To further examine the composition of leverage, I separately consider short-term

Table 2: Variable Definitions and Corresponding EIS Account Numbers

Variable	Definition	EIS Account
FD	Total financial debt to total assets ratio	124 + 174
SFD	Short-term financial debt to total assets ratio	124
LFD	Long-term financial debt to total assets ratio	174
BD	Total bank debt to total assets ratio	125 + 175
SBD	Short-term bank debt to total assets ratio	125
LBD	Long-term bank debt to total assets ratio	175
TC	Total trade credit to total assets ratio	134 + 182
Tangibility	Tangible fixed assets, normalized by total assets	84
REvalue	Value of a firm's real estate assets, calculated as the 2007 book value and inflated by REprice in the following years, normalized by inflation-adjusted total assets	85+86+87+93
REowner_2007	Dummy = 1 if a firm owns real estate in 2007	85, 86, 87, 93
REowner_t	Dummy = 1 if a firm owns real estate in any year	85, 86, 87, 93
Profitability	Operating profit, normalized by total assets	253
ln(Sales)	Natural logarithm of net sales (inflation-adjusted)	242
SharePremium	Dummy = 1 for years after a firm reported paid-in capital in excess of par	215
REprice	Real estate price index (CPI-adjusted), normalized to 1 in 2007 at the city level	-
UndevLand	Share of undevelopable land in a city	-
InterestRate	Real interest rate on housing loans	-

financial debt (SFD) and long-term financial debt (LFD). Short-term debt is generally more sensitive to liquidity and working capital needs. On the other hand, long-term debt reflects more of the strategic financing decisions. Also, it is often more tied to asset-backed borrowing. By separating these components, the analysis can reveal how tangibility or real estate price changes influence firms' temporary borrowing needs or

their long-term capital structure. Since financial debt includes various items such as bank debt, leasing obligations, and promissory notes, I analyze bank debt (BD) separately. It is more relevant for understanding the relationship between collateral value and secured debt. Bank debt is further decomposed into short-term (SBD) and long-term (LBD) components to assess the maturity structure of loans obtained from banks. Separately from financial debt, I include trade credit (TC) to evaluate the relationship between collateral value and unsecured leverage offered by suppliers. Trade credit alone is a subject of a vast literature that discusses how it can act as a substitute for or complement to bank credit. However, this is not the central focus of this thesis. My decision to include trade credit as a leverage component follows the approach of Yeşiltaş (2016). Since I cannot directly distinguish between secured and unsecured debt in the dataset, I treat trade credit as a proxy for unsecured borrowing. In contrast, bank debt is more likely to be secured, although it may not always be the case.

Table 3 shows that trade credit corresponds to 21.93% of total assets based on the sample average. This ratio is substantially higher than any other leverage ratio used in the analysis. For comparison, financial debt accounts for only 10.26% of total assets on average. However, for the median firm, this ratio is only 1.30%. Bank debt ratios closely follow financial debt ratios in both the short-term and long-term. This is because, under financial debt, most firms in the sample are SMEs that rely on bank financing and do not issue bonds or other market-based instruments. When financial debt is further disaggregated, the long-term portion is slightly more than half the size of the short-term portion. Moreover, even in the 75th percentile, firms in the sample hold no long-term bank debt. This is consistent with the idea that SMEs face collateral constraints and have

Table 3: Descriptive Statistics

Variable	N	Mean	SD	p25	p50	p75
FD	1,282,301	0.1026	0.1574	0.0000	0.0130	0.1534
SFD	1,282,301	0.0650	0.1159	0.0000	0.0003	0.0817
LFD	1,282,301	0.0363	0.0908	0.0000	0.0000	0.0048
BD	1,282,301	0.0952	0.1513	0.0000	0.0071	0.1385
SBD	1,282,301	0.0600	0.1118	0.0000	0.0000	0.0704
LBD	1,282,301	0.0339	0.0876	0.0000	0.0000	0.0000
TC	1,281,890	0.2193	0.2124	0.0399	0.1576	0.3443
Tangibility	1,282,226	0.1885	0.2041	0.0366	0.1135	0.2714
REvalue	1,282,301	0.0380	0.1160	0.0000	0.0000	0.0000
REowner_2007	94,137	0.2402	0.4272	0.0000	0.0000	0.0000
REowner_t	1,282,301	0.3606	0.4802	0.0000	0.0000	1.0000
Profitability	1,282,301	0.0738	0.1032	0.0168	0.0486	0.1079
ln(Sales)	1,282,301	13.8523	1.8521	12.8318	13.7103	14.9214
REprice	1,296	0.8569	0.2034	0.7697	0.8018	0.8985

limited access to long-term borrowing. Tangible assets account for 11.35% of total assets for the median firm. However, based on the initial 2007 data, only 24.02% of the 94,137 firms in the sample own any real estate assets.

Figure 4 shows average leverage ratios across asset quartiles, which are constructed by ranking firms based on initial total assets and dividing them into four equal-sized groups. Quartile 1 includes the smallest firms, while Quartile 4 includes the largest firms.

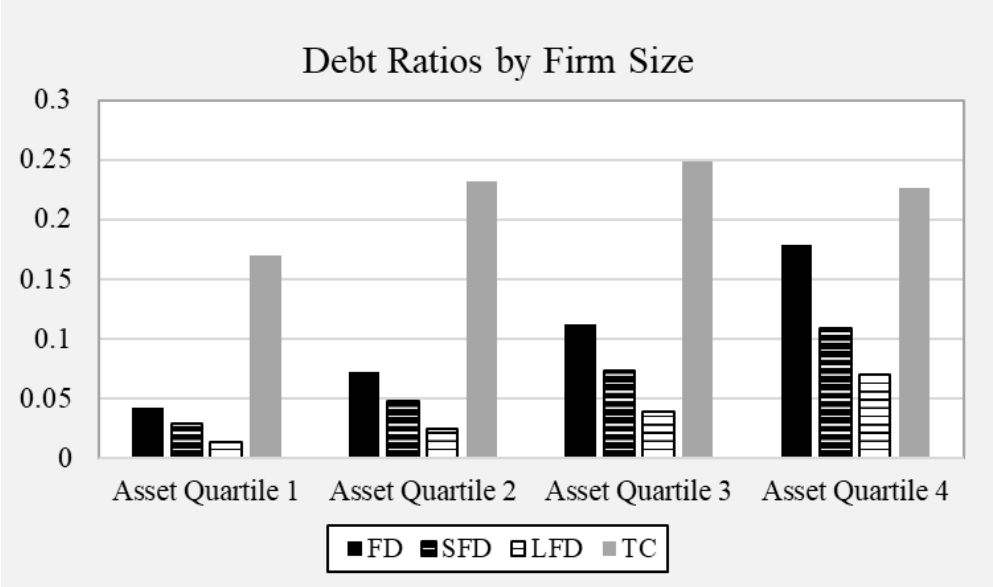


Figure 4: Comparison of Firm Leverage by Size

Financial debt increases consistently with firm size. It accounts for only 4.30% of total assets for the smallest firms. However, it rises to 18.07% for the largest firms. Both short-term (SFD) and long-term financial debt (LFD) follow this upward trend. However, the short-term portion of financial debt is higher than the long-term portion in

all groups. Even among the largest firms, short-term debt exceeds long-term debt by 3.97 percentage points (10.92% vs. 6.95%). Trade credit (TC) also varies by firm size but shows a less consistent pattern across quartiles. It is relatively low among the smallest firms and peaks in the middle quartiles, especially in Quartile 3. Then, it slightly declines for the largest firms. This may suggest that mid-sized firms make the most use of supplier credit, while smaller firms may have limited access. However, larger firms may depend more on financing through formal financial institutions.

Finally, Figure 5 compares the average debt ratios of firms that owned real estate at the beginning of the sample with those of non-owners. Owner firms have 6.64 percentage points more financial debt (FD) than non-owners (15.26% vs. 8.62%). They also hold more debt in both short-term (SFD) and long-term (LFD) portions. In contrast, they rely less on trade credit (TC) than non-owners (19.01% vs. 22.89%).

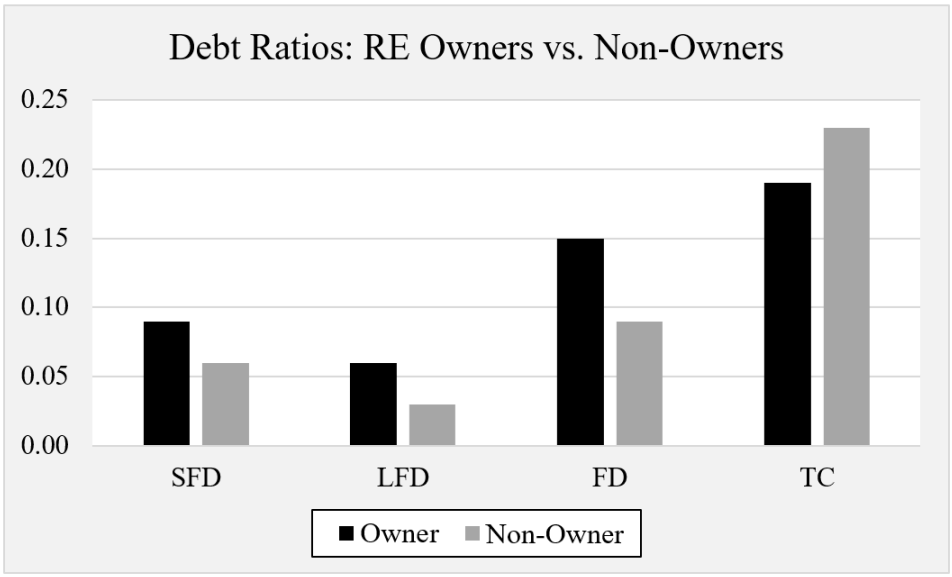


Figure 5: Comparison of Firm Leverage by Real Estate Ownership

CHAPTER 5

EMPIRICAL RESULTS

This chapter first presents the empirical results related to the hypotheses developed in the previous chapter on the relationship between asset tangibility and leverage. It then proceeds to examine the relationship between real estate prices and leverage.

5.1. Empirical Results: Asset Tangibility and Leverage

Table 4 presents regression results for the relationship between asset tangibility and the financial debt ratio under different fixed effects specifications. The coefficient on tangibility is positive and statistically significant at the 1% level across all specifications. However, when firm fixed effects are included, the magnitude of the coefficient drops by more than half. This suggests that the observed relationship may be driven by variation between firms, rather than changes within firms over time. Considering that the sample includes firms with limited or no fixed assets, this pattern is not unexpected. Based on the results in Column (6), a one standard deviation increase in tangibility corresponds to

an increase in the financial debt ratio by approximately 8.75% of its mean (0.2041*0.044/0.1026).

Table 4: Tangibility and Financial Debt

	Financial Debt (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
Tangibility	0.105***	0.104***	0.100***	0.043***	0.099***	0.044***
	(57.88)	(57.18)	(52.22)	(24.42)	(51.50)	(24.74)
Profitability	-0.080***	-0.080***	-0.064***	-0.052***	-0.063***	-0.024***
	(-35.96)	(-35.26)	(-28.00)	(-30.24)	(-26.79)	(-13.49)
ln(Sales)	0.025***	0.025***	0.024***	0.011***	0.024***	0.008***
	(107.64)	(102.04)	(101.59)	(56.98)	(95.46)	(41.53)
SharePremium	0.002	0.001	0.004	-0.021*	0.003	-0.034**
	(0.27)	(0.17)	(0.44)	(-2.01)	(0.35)	(-3.18)
Year FE	N	Y	N	N	Y	Y
Industry FE	N	N	Y	N	Y	N
Firm FE	N	N	N	Y	N	Y
Observations	1,158,179	1,158,179	1,158,179	1,158,179	1,158,179	1,158,179
Adjusted R^2	0.10	0.10	0.11	0.60	0.11	0.61

Notes: All models include standard control variables, and standard errors are clustered at the firm level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

The coefficients on the control variables are in line with those of earlier studies. Profitability is negatively associated with leverage. This supports the idea that firms prefer internal financing over external financing. The coefficient on ln(Sales), used as a proxy for firm size, is positive and statistically significant in all models. Larger firms are more likely to access credit markets and build stronger relationships with lenders. Therefore, they can maintain higher debt ratios. Lastly, the SharePremium dummy, which I included to capture financing opportunities, becomes statistically significant and negative when firm fixed effects are introduced. As firms gain access to equity markets, their reliance on debt decreases.

Table 5: Tangibility and Decomposition of Leverage

Dependent var.	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
Tangibility	0.044***	0.015***	0.029***	0.046***	0.014***	0.032***	-0.055**
	(24.74)	(11.69)	(23.54)	(26.96)	(11.15)	(27.06)	(-27.08)
Profitability	-0.024***	-0.018***	-0.006***	-0.020***	-0.016***	-0.004**	-0.137***
	(-13.50)	(-13.23)	(-4.92)	(-11.91)	(-12.43)	(-3.27)	(-56.61)
ln(Sales)	0.008***	0.005***	0.004***	0.008***	0.004***	0.004***	0.008***
	(41.54)	(34.80)	(28.57)	(40.99)	(32.91)	(29.44)	(34.52)
SharePremium	-0.034**	-0.014	-0.019**	-0.027**	-0.014*	-0.012	-0.012
	(-3.18)	(-1.85)	(-2.93)	(-2.76)	(-2.20)	(-1.88)	(-1.09)
Firm FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,158,179	1,158,179	1,158,179	1,158,179	1,158,179	1,158,179	1,157,804
Adjusted R^2	0.61	0.53	0.48	0.60	0.53	0.47	0.57

Notes: All models include standard control variables, and standard errors are clustered at the firm level. T-stats are in parentheses.

*** p<.001, ** p<.01, * p<.05

As I further examine the effect of asset tangibility on different debt maturities in Table 5, the results show that tangibility is positively and significantly associated with financial debt in both short-term and long-term. This positive relationship also extends to bank debt, including its short-term and long-term components. Moreover, the effect is larger for long-term bank debt compared to short-term bank debt. This can be interpreted as firms with more tangible assets are able to secure longer-maturity loans. However, having more tangible assets is related to lower reliance on trade credit. A one standard deviation increase in tangibility is associated with a decrease in the trade debt ratio by approximately 5.12% of its mean ($0.2041 \times 0.055 / 0.2193$). This finding is consistent with the idea that tangibility improves access to secured bank loans and reduces the need to rely on trade credit. Also, similar results are obtained when tangibility is redefined as the ratio of the book value of real estate assets to total assets. The results from this specification are reported in Appendix A.

Table 6 presents the heterogeneous effects of asset tangibility on firms' leverage across asset size quartiles. This analysis is motivated by the theoretical expectation that collateral should matter more for financially constrained firms. When firm size is taken as a proxy for financial constraints, I would expect tangibility to have a stronger effect for smaller firms, where access to credit is more limited. The results for short-term financial debt support this view. The effect on short-term debt becomes statistically insignificant in Quartile 4. However, the effect of tangibility on long-term debt is less aligned with expectations. It seems to increase with firm size and is largest among the least constrained firms.

Table 6: Tangibility and Leverage by Asset Quartiles

	Quartile 1				Quartile 2			
	(1) FD	(2) SFD	(3) LFD	(4) TC	(1) FD	(2) SFD	(3) LFD	(4) TC
Tangibility	0.037***	0.019***	0.017***	-0.036***	0.045***	0.018***	0.026***	-0.042***
	(12.62)	(9.38)	(8.79)	(-9.23)	(12.47)	(7.03)	(10.69)	(-9.50)
Profitability	-0.025***	-0.017***	-0.007***	-0.131***	-0.022***	-0.013***	-0.007***	-0.140***
	(-8.95)	(-7.83)	(-4.56)	(-29.97)	(-6.30)	(-5.24)	(-3.38)	(-27.25)
ln(Sales)	0.008***	0.004***	0.004***	0.011***	0.009***	0.004***	0.004***	0.009***
	(19.93)	(16.36)	(15.10)	(18.45)	(20.04)	(15.45)	(15.60)	(15.18)
SharePremium	0.003	0.005	-0.001	-0.049	0.025	0.030	-0.005	-0.019
	(0.10)	(0.20)	(-0.05)	(-1.33)	(1.07)	(1.37)	(-0.77)	(-0.42)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	267,710	267,710	267,710	267,514	298,665	298,665	298,665	298,567
Adjusted R^2	0.48	0.42	0.39	0.53	0.53	0.47	0.43	0.55

Notes: All models include standard control variables, and standard errors are clustered at the firm level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

Table 6: Tangibility and Leverage by Asset Quartiles (continued)

	Quartile 3				Quartile 4			
	(1) FD	(2) SFD	(3) LFD	(4) TC	(1) FD	(2) SFD	(3) LFD	(4) TC
Tangibility	0.051***	0.015***	0.036***	-0.064***	0.039***	0.002	0.038***	-0.075***
	(13.81)	(5.58)	(13.81)	(-15.30)	(9.59)	(0.86)	(12.67)	(-20.74)
Profitability	-0.014***	-0.008**	-0.006*	-0.129***	-0.047***	-0.028***	-0.017***	-0.109***
	(-3.72)	(-2.67)	(-2.43)	(-25.54)	(-9.83)	(-7.87)	(-5.57)	(-23.30)
ln(Sales)	0.009***	0.005***	0.004***	0.008***	0.008***	0.004***	0.003***	0.006***
	(23.00)	(18.06)	(17.19)	(15.55)	(21.65)	(18.62)	(14.00)	(16.62)
SharePremium	-0.020	-0.018	0.001	0.026	-0.056***	-0.022**	-0.032***	-0.006
	(-0.69)	(-0.75)	(0.05)	(0.85)	(-4.18)	(-2.66)	(-3.51)	(-0.47)
Firm FE	Y	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y	Y
Observations	305,078	305,078	305,078	305,009	286,726	286,726	286,726	286,714
Adjusted R^2	0.60	0.52	0.47	0.58	0.66	0.57	0.51	0.64

Notes: All models include standard control variables, and standard errors are clustered at the firm level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

Public credit guarantee programs may also play a role in these results. In Turkey, small firms often benefit from schemes like the Credit Guarantee Fund (CGF), which reduces the need for physical collateral while accessing debt. Güngör and Sümer (2018) report that the average maturity of CGF guaranteed loans reached 3.4 years, compared to 2.4 years for non-guaranteed loans extended to the same group of firms before the expansion of the CGF. This may suggest that smaller firms were able to access longer-term financing through guarantee support. Therefore, the effect of collateral could be less important for them. Another explanation is also possible. Even though small firms hold collateral, banks may still be reluctant to lend to them due to their higher perceived risk. Thus, the smaller firms' ability to pledge collateral could be limited, and the effect of asset tangibility on their capacity to issue debt may seem smaller. Apart from these results, there is also an observable pattern in how tangibility affects trade credit across size quartiles. The negative relationship between tangibility and trade credit appears to become larger as firms get bigger. This may suggest that when firms become less financially constrained and hold more collateral, they can move away from supplier financing and access long-term debt from financial institutions.

5.2. Empirical Results: Real Estate Prices and Leverage

Table 7 presents the first-stage regression results, where real estate prices are predicted by the interaction between undevelopable land share and the real interest rate on housing loans.

Table 7: First-Stage Regression Results

	REprice	
	(1)	(2)
UndevLand * InterestRate	-0.106** (-2.58)	
2nd tercile of UndevLand		-0.068** (-2.90)
3rd tercile of UndevLand		-0.072** (-3.05)
City FE	Y	Y
Year FE	Y	Y
Observation	1,296	1,296
Adjusted R^2	0.76	0.76

Notes: T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05. A Wald test indicates no statistical difference between the coefficients on the 2nd and 3rd terciles of undevelopable land ($F(1,1198) = 0.02$, $p = 0.885$).

Column (1) shows that the interaction term is statistically significant at the 1% level and explains 76% of the variation in real estate prices. Following Chaney et al. (2012), I also test whether cities' sensitivity to interest rate changes varies with the degree of their supply constraints. Cities with a higher share of undevelopable land are assumed to have less elastic housing supply. Therefore, they should respond more to demand shocks, which are measured by changes in interest rates. To test this, I group cities into terciles based on their undevelopable land shares. The first tercile includes cities with the lowest share of undevelopable land. Thus, they are expected to have the most elastic supply. Column (2) reports the results from the interaction of interest rates with these terciles. Although the coefficients for the second and third groups are not statistically different from each other, both are negative and statistically significant compared to the first tercile. The results suggest that cities with more land constraints, or less elastic supply,

are more sensitive to interest rate changes. Thus, when interest rates rise, real estate prices in those cities fall more sharply. Therefore, the instrument can be considered relevant.

Table 8 reports regression results for the relationship between instrumented real estate value and the financial debt ratio under different fixed effects specifications.

Table 8: Real Estate Value and Financial Debt

	Financial Debt (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
REvalue	0.021***	0.023***	0.018***	-0.206***	-0.183***	-0.183***
	(6.50)	(6.99)	(5.66)	(-31.74)	(-30.83)	(-30.51)
Profitability	-0.095***	-0.091***	-0.097***	-0.039***	-0.027***	-0.026***
	(-23.09)	(-23.81)	(-23.46)	(-13.65)	(-11.57)	(-10.87)
ln(Sales)	0.026***	0.026***	0.026***	0.009***	0.008***	0.008***
	(45.85)	(45.76)	(45.91)	(19.40)	(18.52)	(18.20)
SharePremium	0.003	0.003	0.006*	-0.034 ***	-0.039 ***	-0.039 ***
	(1.04)	(0.97)	(2.01)	(-4.58)	(-5.15)	(-5.11)
REprice	0.690***	0.634***		0.812***	0.211***	
	(7.93)	(6.56)		(10.15)	(3.69)	
Firm FE	N	N	N	Y	Y	Y
Year FE	N	Y	N	N	Y	N
City-Year FE	N	N	Y	N	N	Y
Observations	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208
Adjusted R2	0.09	0.09	0.10	0.60	0.61	0.61

Notes: REvalue and REprice are instrumented. All models include standard control variables, and standard errors are clustered at city-year level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

City-level real estate prices (REprice) are positively associated with financial debt in all specifications. However, they are omitted in Columns (3) and (6) due to perfect collinearity with city-year fixed effects. On the other hand, the coefficient on REvalue

becomes negative when firm fixed effects are introduced (Columns 4 to 6). This change may suggest that although firms with greater real estate assets tend to have higher leverage in cross-sectional comparisons, within-firm increases in real estate holdings are negatively associated with leverage over time. This finding contradicts the collateral channel narrative, which would expect higher leverage in response to rising real estate values. Therefore, the results are difficult to reconcile with standard collateral theory.

One possible explanation could be that firms with higher initial real estate holdings may respond to price increases by liquidating some of their assets instead of using them as collateral for additional borrowing. In such a case, they may rely on internal funds generated from asset sales instead of expanding their external debt. However, if this were a common behavior among all firms in the sample, I would not expect to observe a positive relationship between city-level real estate prices and financial debt. This discrepancy may suggest that while firms generally increase their leverage in response to real estate price fluctuations, their responses are heterogeneous. Depending on their exposure to real estate price fluctuations, firms may pursue alternative strategies through acquisitions or sales. However, it is difficult to capture these dynamics, as firm-level real estate values are calculated based on their initial holdings due to the endogeneity concerns discussed earlier.

Table 9 further decomposes leverage, based on the specification used in Column (6) of Table 8, into short-term and long-term components of financial debt and bank debt. It also shows the relationship between real estate values and trade credit.

Table 9: Real Estate Value and Decomposition of Leverage

	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
REvalue	-0.183***	-0.057***	-0.120***	-0.163***	-0.049***	-0.110***	0.014***
	(-30.51)	(-16.96)	(-27.07)	(-29.58)	(-14.92)	(-26.38)	(3.32)
Profitability	-0.026***	-0.019***	-0.006***	-0.023***	-0.017***	-0.005***	-0.133***
	(-10.87)	(-12.03)	(-4.75)	(-9.68)	(-11.57)	(-3.45)	(-30.50)
ln(Sales)	0.008***	0.005***	0.003***	0.007***	0.004***	0.003***	0.009***
	(18.20)	(17.44)	(16.14)	(17.67)	(16.69)	(16.01)	(20.61)
SharePremium	-0.039***	-0.016**	-0.021***	-0.032***	-0.016**	-0.014***	-0.008
	(-5.11)	(-2.67)	(-5.62)	(-5.93)	(-3.15)	(-4.22)	(-1.29)
Firm FE	Y	Y	Y	Y	Y	Y	Y
City-Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,157,833
Adjusted R^2	0.61	0.53	0.48	0.60	0.53	0.47	0.57

Notes: REvalue is instrumented. All models include standard control variables, and standard errors are clustered at the city-year level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

The negative effect of REvalue appears to be larger for long-term financial debt and bank debt, which are more likely to be secured. However, the coefficient is positive and statistically significant for trade credit, which I use as a proxy for unsecured leverage. In this sense, these results may contradict the standard interpretation of the collateral channel. They also stand in contrast to the findings in Table 5 and Appendix A, where I investigated the effect of tangibility on leverage.

Table 10 investigates the negative relationship between real estate value and financial debt by excluding firms that do not own real estate.

Table 10: Real Estate Value and Financial Debt (Excluding Non-Owners)

	Financial Debt (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
REvalue	-0.090***	-0.087***	-0.086***	-0.223***	-0.194***	-0.193***
	(-30.10)	(-26.76)	(-28.49)	(-36.51)	(-34.76)	(-34.27)
Profitability	-0.093***	-0.088***	-0.089***	-0.064***	-0.052***	-0.051***
	(-15.57)	(-14.74)	(-14.53)	(-13.39)	(-12.22)	(-11.74)
ln(Sales)	0.021***	0.021***	0.021***	0.006***	0.005***	0.005***
	(49.08)	(49.69)	(50.82)	(19.07)	(16.08)	(15.63)
SharePremium	0.011**	0.011**	0.015***	-0.065***	-0.070***	-0.067***
	(2.87)	(2.81)	(3.88)	(-5.72)	(-6.22)	(-6.11)
REprice	0.615***	0.695***		0.682***	0.244*	
	(6.18)	(4.77)		(8.42)	(2.21)	
Firm FE	N	N	N	Y	Y	Y
Year FE	N	Y	N	N	Y	N
City-Year FE	N	N	Y	N	N	Y
Observations	284,693	284,693	284,693	284,693	284,693	284,693
Adjusted R2	0.07	0.07	0.08	0.64	0.64	0.64

Notes: REvalue and REprice are instrumented. All models include standard control variables, and standard errors are clustered at city-year level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

The results show that the negative effect becomes even more pronounced. Remarkably, this relationship holds across all specifications, including those without any firm fixed effects (Columns 1–3). This finding supports the earlier claim that the positive relationship without firm fixed effects in Table 8 is driven by the fact that firms with real estate assets tend to have higher leverage than non–real estate holders in cross-sectional comparisons (see Figure 5). Based on the results in Table 10, this effect disappears when the sample is restricted to real estate holders only. Yet, the coefficient on city-level real estate prices remains positive, as in the full sample. However, as mentioned in Chapter 3, this coefficient may be difficult to interpret, since other regional economic developments may be influencing leverage when city-year fixed effects are not included.

To check the robustness of these findings, I replicate the same analysis using a sample of publicly listed firms in Turkey that were already listed by 2007. Financial data for this sample is obtained from LSEG Workspace (formerly Refinitiv), and the estimates are presented in Appendix C. They closely resemble the results in Table 10, which reports estimates for firms that own real estate, in terms of the sign of the coefficient on REvalue. This similarity in results may stem from the fact that almost all publicly traded firms, except for two, already owned real estate in 2007.

To directly compare real estate owners with non-owners regarding their leverage response to real estate price fluctuations, I replace the real estate value variable with an interaction term between REOwner_2007 and REprice. The results are presented in

Table 11: REOwner_2007*REprice and Leverage Decomposition

	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
REOwner_2007*REprice	-0.081	-0.222***	0.137***	-0.106*	-0.252***	0.143***	-0.177**
	(-1.64)	(-6.24)	(4.69)	(-2.30)	(-7.44)	(4.97)	(-2.75)
Profitability	-0.026***	-0.018***	-0.007***	-0.023***	-0.017***	-0.005***	-0.132***
	(-10.84)	(-11.27)	(-5.52)	(-9.62)	(-10.72)	(-4.24)	(-30.29)
ln(Sales)	0.009***	0.005***	0.004***	0.008***	0.004***	0.004***	0.009***
	(18.54)	(17.87)	(16.68)	(18.03)	(17.13)	(16.47)	(20.97)
SharePremium	-0.033***	-0.013*	-0.019***	-0.026***	-0.013**	-0.012***	-0.008
	(-4.36)	(-2.23)	(-4.81)	(-4.96)	(-2.65)	(-3.44)	(-1.22)
Firm FE	Y	Y	Y	Y	Y	Y	Y
City-Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,157,833
Adjusted R^2	0.61	0.53	0.48	0.60	0.53	0.47	0.57

Notes: REprice is instrumented. All models include standard control variables, and standard errors are clustered at city-year level. T-stats are in parentheses.
*** p<.001, ** p<.01, * p<.05

Table 11. Compared to firms that did not own real estate at the beginning of the sample, real estate owners reduce their short-term financial and bank debt when real estate prices rise. However, they increase their long-term financial and bank debt in response to higher prices. This pattern suggests that while rising real estate prices facilitate access to long-term borrowing for firms with real estate assets, they also potentially lead them to substitute away from short-term debt. Additionally, as real estate prices increase, real estate owners rely less on trade credit compared to non-owners. Under this methodology, the results are more consistent with the collateral channel. In response to rising real estate prices, firms with real estate assets appear to increase their use of long-term debt, which is more likely to be secured if support schemes like CGF are not considered. Also, they reduce their reliance on unsecured sources of financing, such as trade credit.

The contrast between the results using the real estate value variable and those based on the interaction between real estate ownership and prices highlights an important distinction. While owning real estate assets appears to facilitate access to long-term borrowing when prices rise, holding larger amounts of these assets is associated with the opposite pattern. Firms with greater real estate holdings, or in other words, those with higher exposure to real estate prices, appear more inclined to deleverage. As discussed earlier, this pattern may suggest that rising real estate values enable firms to sell assets or rely more on internal financing, reducing the need for debt.

Following the motivation in Campello et al. (2022), I replace the static ownership dummy with a time-varying one to allow firms to become real estate owners at any point

Table 12: REOwner_timevar*REprice and Leverage Decomposition

	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
REOwner_timevar *REprice	0.032*** 30.70	0.011*** 16.40	0.020*** 30.46	0.031*** 29.87	0.010*** 14.98	0.020*** 31.34	-0.026*** -18.51
Profitability	-0.025*** -10.01	-0.018*** -11.45	-0.005*** -3.95	-0.021*** -8.81	-0.017*** -10.99	-0.004** -2.63	-0.135*** -30.24
ln(Sales)	0.008*** 18.75	0.005*** 18.22	0.003*** 16.37	0.008*** 18.24	0.004*** 17.48	0.003*** 16.22	0.010*** 20.47
SharePremium	-0.032*** -4.22	-0.014* -2.30	-0.017*** -4.41	-0.026*** -4.83	-0.014** -2.78	-0.010** -2.97	-0.010 -1.54
Firm FE	Y	Y	Y	Y	Y	Y	Y
City-Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,158,208	1,157,833
Adjusted R^2	0.61	0.53	0.48	0.60	0.53	0.47	0.57

Notes: REprice is instrumented. All models include standard control variables, and standard errors are clustered at city-year level. T-stats are in parentheses.
*** p<.001, ** p<.01, * p<.05

in time during the sample period, or to be classified as non-owners if they disinvest all of their holdings. I then interact this time-varying dummy with real estate prices. The results are presented in Table 12. Although I use one-year lagged values for both REOwner_timevar and real estate prices (see Chapter 3.2 for methodology), there may still be concerns about endogeneity. Firms may have increased their borrowing to finance real estate purchases, and these elevated debt levels could persist in subsequent years. However, if this were the case, I would expect the effect to be more visible in long-term debt. Compared to the static specification in Table 11, the magnitude of the long-term effect appears to become smaller, while the coefficients on short-term debt become positive and statistically significant. Nevertheless, the estimated effect still seems to be larger for long-term debt than for short-term debt.

Since contract-level details such as acquisition and sale prices are not available, it is difficult to determine the underlying mechanism behind this shift. Earlier results based on real estate value and static ownership already indicated that the amount of real estate held by a firm shapes its response. The findings in Table 12 further suggest that allowing firm exposure to real estate prices to vary over time can affect the estimated relationship with leverage. However, this variation only captures whether a firm owns real estate or not, without indicating the degree of exposure or enabling consistent comparisons across firms. Therefore, the results should be interpreted with caution, since they may be subject to change due to differences in exposure that are not fully captured in the data.

CHAPTER 6

CONCLUSION

This thesis investigates how firms' capital structure decisions are influenced by their collateralizable assets. It utilizes a rich dataset from the Entrepreneurship Information System, which offers detailed firm-level information on Turkish SMEs. Focusing on the period from 2007 to 2022, the analysis first shows that firms with more tangible assets tend to have higher leverage. This supports the idea that such assets help firms access borrowing. However, since tangibility is shaped by a firm's own investment and financing choices, it is endogenously linked to leverage. For causal identification, the analysis focuses on real estate assets and uses city-level real estate prices to estimate exogenous changes in the value of firms' collateralizable assets. Nevertheless, even city-level prices may be affected by firm activity in that region. To reduce this concern, the study uses an instrumental variables strategy. Local real estate prices are predicted using local supply-side constraints, such as undevelopable land, and national interest rates. Then, these predicted prices are interacted with firms' real estate exposure to study their impact on leverage.

The findings show that firms with real estate holdings increase their long-term debt more than firms without such holdings when real estate prices rise. At the same time, they tend to reduce their short-term debt and reliance on trade credit. However, this conclusion depends heavily on how real estate exposure is measured. When exposure is defined based on the amount of real estate assets owned, the results contradict the collateral channel narrative. Specifically, firms with greater real estate holdings appear more likely to deleverage by reducing both short-term and long-term bank debt. One possible explanation is that these firms respond to rising real estate prices by selling off a portion of their assets and relying more on internal funds, which is not directly observed in the data since the value of real estate holdings is constructed based on initial book values. Furthermore, when firms' exposure to real estate prices is allowed to change over time using time-varying dummy variables, which allow firms to enter or exit real estate ownership over time, the observed relationship between leverage and prices again changes. It becomes positive not only for long-term debt, but also for short-term debt. Although the results do not offer conclusive evidence in favor of the collateral channel, they contribute to a more nuanced understanding of its functioning in a developing country. They suggest that firm-level heterogeneity, particularly in the amount of real estate assets owned and the timing of exposure, plays an important role in shaping responses to real estate price shocks. This implies that the effectiveness of the collateral channel may vary across firms and over time, depending on firm-specific characteristics and financial strategies.

Despite the findings, the analysis faces some limitations. First, it is unable to account for any responses in the credit supply. For example, Ayberk and Önder (2022) show that

Turkish banks reduce their commercial lending when real estate prices increase, which may cancel out positive collateral effects at the firm level. Second, credit guarantee schemes such as the CGF, which may affect borrowing capacity regardless of collateral, cannot be taken into account in the analysis. Third, the study relies on observed debt levels rather than debt issuance, as loan-level data is not available. This makes it difficult to distinguish between new borrowing and repayment, or to separate secured debt from unsecured debt. Finally, due to the unavailability of contract-level data for real estate transactions, the study cannot capture the firms' time-varying heterogeneous exposure to real estate prices. Therefore, these limitations should be taken into account when interpreting the results.

Finally, this study relates to the United Nations Sustainable Development Goals. It is especially relevant to Goal 8, decent work and economic growth. In countries like Turkey, SMEs are the backbone of economic development. Therefore, for sustainable development, it is important to ensure that these firms have fair access to credit. The findings of this thesis suggest that borrowing based on collateral may increase the gap between firms that own real estate assets and those that do not. Policymakers should consider these dynamics when designing credit support schemes to help disadvantaged SMEs. Furthermore, considering the expansion of the CGF in Turkey in 2017, future research could examine how SMEs respond to collateral value shocks before and after this period. Such research could provide valuable insights into the effectiveness of credit guarantee programs and their role in easing asset-backed borrowing constraints.

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APPENDICES

Appendix A**:** Book Value of Real Estate Assets and Leverage

Dependent var.	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
BV of Real Estate Assets	0.067*** (23.62)	0.016*** (8.35)	0.049*** (24.44)	0.068*** (24.72)	0.014*** (7.47)	0.052*** (26.67)	-0.079*** (-28.53)
Profitability	-0.024*** (-13.41)	-0.018*** (-13.39)	-0.005*** (-4.60)	-0.020*** (-11.88)	-0.016*** (-12.61)	-0.003** (-3.01)	-0.137*** (-56.76)
ln(Sales)	0.008*** (41.21)	0.005*** (34.62)	0.004*** (28.17)	0.008*** (40.65)	0.004*** (32.75)	0.003*** (29.00)	0.009*** (35.47)
SharePremium	-0.033** (-3.14)	-0.014 (-1.89)	-0.018** (-2.83)	-0.027** (-2.73)	-0.015* (-2.25)	-0.011 (-1.78)	-0.013 (-1.14)
Firm FE	Y	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	1,157,593	1,157,593	1,157,593	1,157,593	1,157,593	1,157,593	1,157,218
Adjusted R^2	0.61	0.53	0.48	0.60	0.53	0.47	0.57

Notes: All models include standard control variables, and standard errors are clustered at the firm level. T-stats are in parentheses.

*** p<.001, ** p<.01, * p<.05

Appendix B: Real Estate Value and Decomposition of Leverage (Excluding Non-Owners)

	(1) FD	(2) SFD	(3) LFD	(4) BD	(5) SBD	(6) LBD	(7) TC
REvalue	-0.193***	-0.065***	-0.123***	-0.173***	-0.056***	-0.111***	-0.004
	(-34.27)	(-22.06)	(-27.43)	(-32.79)	(-19.82)	(-26.38)	(-0.88)
Profitability	-0.051***	-0.032***	-0.017***	-0.044***	-0.030***	-0.013***	-0.096***
	(-11.74)	(-10.18)	(-6.54)	(-10.59)	(-9.76)	(-5.20)	(-21.87)
ln(Sales)	0.005***	0.004***	0.002***	0.005***	0.003***	0.002***	0.006***
	(15.63)	(16.44)	(7.54)	(15.87)	(16.00)	(8.55)	(16.72)
SharePremium	-0.067***	-0.028***	-0.037***	-0.057***	-0.026***	-0.027***	-0.005
	(-6.11)	(-3.54)	(-5.69)	(-7.01)	(-3.76)	(-4.78)	(-0.77)
Firm FE	Y	Y	Y	Y	Y	Y	Y
City-Year FE	Y	Y	Y	Y	Y	Y	Y
Observations	284,693	284,693	284,693	284,693	284,693	284,693	284,651
Adjusted R^2	0.64	0.55	0.51	0.63	0.55	0.50	0.59

Notes: REvalue is instrumented. All models include standard control variables, and standard errors are clustered at the city-year level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05

Appendix C: Real Estate Value and Leverage (Publicly Traded Firms)

	Financial Debt (FD)					
	(1)	(2)	(3)	(4)	(5)	(6)
REvalue	-0.036***	-0.054***	-0.052***	-0.015*	-0.037**	-0.047**
	(-4.37)	(-3.99)	(-3.69)	(-2.27)	(-2.81)	(-2.76)
Profitability	-0.109*	-0.201***	-0.197***	-0.180***	-0.267***	-0.315***
	(-2.05)	(-3.95)	(-3.83)	(-3.85)	(-5.64)	(-6.21)
ln(Sales)	0.006***	0.008***	0.008***	-0.001	0.002	0.002
	(5.39)	(6.42)	(6.12)	(-1.08)	(1.57)	(1.30)
MV_to_BV	0.014***	0.013***	0.015***	0.013***	0.011***	0.010***
	(6.74)	6.40	(8.65)	(4.10)	(3.69)	3.33)
REprice	-0.058	1.584		-0.045	0.906	
	(-0.90)	(1.96)		(-0.66)	(0.96)	
Firm FE	N	N	N	Y	Y	Y
Year FE	N	Y	N	N	Y	N
City-Year FE	N	N	Y	N	N	Y
Observations	1,775	1,775	1,775	1,775	1,775	1,775
Adjusted R2	0.05	0.08	0.11	0.59	0.61	0.62

Notes: REvalue and REprice are instrumented. All models include the Market-to-Book Value ratio instead of the SharePremium dummy. The Market-to-Book Value ratio is divided by 100 for ease of interpretation. Standard errors are clustered at city-year level. T-stats are in parentheses. *** p<.001, ** p<.01, * p<.05