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ESSAYS ON HOUSING MARKET AND BANK LOANS

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ESSAYS ON HOUSING MARKET AND BANK LOANS

A Ph.D. Dissertation

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ABSTRACT

ESSAYS ON HOUSING MARKET AND BANK LOANS

Ayberk, İdil

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This dissertation comprises three essays about the housing market and banks' loan portfolios at the province level in Turkey. The first essay focuses on the supply side of the housing market. The price elasticity of housing supply is estimated using quarterly data over the period 2008-2017, and the factors that drive the differences across provinces are investigated. We find that Turkey has a low housing supply elasticity on average, but elasticity estimates exhibit variation across provinces. Our results suggest that population, geographical constraints and local regulatory conditions are significant factors in explaining the differences in housing supply elasticity estimates. In the second essay, we answer the question of whether banks change their loan allocation with the appreciation of house prices and whether state-owned banks behave like other banks with different ownership structures by using province-level data over the

2007Q4–2015Q2 period. The undevelopable land share and mortgage rate are employed as instruments for house price growth. We find that commercial loans are crowded out by mortgage, consumer, and construction loans with the increase in house prices; in addition, state-owned banks are found to reduce their commercial, and in particular agricultural loans, more than private banks as house prices appreciate. In the third essay, we examine the effect of house price appreciation on non-performing loans (NPLs) of domestic banks between 2009Q1–2016Q4, when real house prices were increasing. We document that non-performing total, commercial, and consumer loans decline as house prices increase. No difference among banks by ownership type is observed.

Keywords: Bank loans, non-performing loans, house price, state-owned banks, housing supply elasticity.

ÖZET

KONUT PİYASASI VE BANKA KREDİLERİ ÜZERİNE MAKALELER

Ayberk, İdil

Doktora, İşletme

Tez Danışmanı: Doç. Dr. Zeynep Önder

Ağustos 2022

Bu tez, konut piyasasının arz yönü ve bankaların kredi portföyleri hakkında üç makaleden oluşmaktadır. İlk makalede 2008-2017 yılları arasında üç aylık veriler kullanılarak Türkiye’de konut arzının fiyat esnekliğini tahmin edilip, iller arası farklılıkları açıklayan faktörler incelenmektedir. Yapılan analizler, Türkiye’de ortalama konut arz esnekliğinin düşük olduğunu; bununla birlikte esneklik tahminlerinin şehirler arasında farklılıklar gösterdiğini ortaya koymaktadır. Sonuçlar, nüfusun, coğrafi kısıtlamaların ve düzenleyici koşulların iller arasındaki fiyat esnekliği farklılıklarını açıklamada önemli rol oynadığını göstermektedir. İkinci makale, Türkiye’de konut fiyat değişikliklerinin bankaların verdiği kredilerin büyümesine olan etkisini ve kamu bankalarının farklı mülkiyet yapılarına sahip diğer bankalardan farklı davranıp davranmadığını 2007Ç4–2015Ç2 döneminde il düzeyindeki verileri kullanarak incelemektedir. Bu

alıřmada konut fiyatları ve banka kredileri arasındaki içsellik problemi gelişmeye uygun olmayan arazi alanı ve konut kredi faizi değışkenleriyle çözülmeye alıřılmıştır. Bulgular konut fiyatları arttıka, bankaların konut, tüketici ve inřaat kredilerini arttırdığını, buna karşılık ticari kredilerini düşürdüğünü göstermektedir. Konut fiyat artışı ile birlikte kamu bankaları tarafınca verilen ticari ve tarımsal kredilerin, özel bankalar tarafınca verilen kredilere göre daha fazla azaldığı da tespit edilmiştir. Son olarak, üçüncü makalede reel konut fiyatlarının artış eğiliminde olduğu bir dönem olan 20091-20164' de, Türkiye'deki yerel bankaların takipteki kredilerinin davranışı incelenmektedir. Analiz sonuçları, il düzeyinde konut fiyatları arttıka takipteki kredilerin düřtüğünü göstermektedir. Bu bulgular, toplam takipteki kredilerin yanı sıra takipteki ticari ve tüketici krediler için de geçerlidir. Konut fiyat artışı karşısında, kamu ve özel bankaların takipteki kredilerinin birbirinden farklı davranmadığı gözlenmiştir.

Anahtar sözcükler: Banka kredileri, takipteki krediler, konut fiyatları, kamu bankaları, konut arz esnekliği.

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CHAPTER 1

INTRODUCTION

1.1. Overview

Following the financial crisis in 2007/2008 that started in the US, house prices and their interaction with the financial system and economy have attracted great attention. Banks are sensitive to fluctuations in house prices since the bulk of their lending is backed by collateral, mortgage lending constitutes a significant portion of their loan portfolios, and they also hold real estate properties on their balance sheets. Moreover, housing expenditures account for a great share of the household wealth, and thus changes in house prices have an impact on household consumption. In this thesis, we study the supply side of the housing market and the association between bank loans and house prices in Turkey.

In the second chapter of the thesis, we estimate the price elasticity of housing supply and then provide empirical evidence on the determinants of the estimated elasticities at the province level in Turkey for the 2008Q1–2017Q4 period. The supply-demand mechanism in the real estate market suggests that house prices will rise in provinces if homebuilders cannot respond quickly to increased demand by building new homes. The price elasticity of housing supply is a measure that provides information on how housing supply responds to price increases, and it plays a crucial role in urban development (Glaeser et al.,

2006). The motivation for studying housing supply elasticity in Turkey stems from several reasons. First, over the last two decades, the construction industry has been the booster of the growth of the Turkish economy, and legal reforms support the rise of the sector by lifting regulatory restrictions on property development (Demiralp et al., 2016). Second, housing affordability has become one of the hot topics in Turkey due to rising house prices and an inflationary environment. This chapter aims to contribute to the housing studies literature by estimating a housing supply elasticity and determining the factors that explain the elasticities in an emerging economy. The studies on housing supply elasticities agree that barriers to residential construction in the form of land availability or regulations are the main causes of low supply elasticity. Our results suggest that Turkish provinces have relatively low housing supply elasticity, and in line with the literature, geographical constraints seem to be associated with lower elasticities. We also provide evidence that demographic characteristics and the local regulatory conditions matter in this environment.

In the third chapter, we study how banks change their loan allocation with the appreciation of house prices and whether the state-owned banks behave differently than private banks by using province-level data from Turkey over the 2007Q4–2015Q2 period. Evidence suggests that banks are sensitive to fluctuations in house prices, and the transmission of shocks from house prices to the banks can threaten the whole banking system. There are two main channels discussed in the literature regarding the impact of house prices on banks' lending. The first channel, known as the collateral channel, implies that banks increase their credit issuance because of a rise in loan demand due to an increase in the borrowers' collateral value (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). The second channel, the bank lending channel, suggests that an increase in house prices makes banks' assets less risky, thus, increasing their willingness to issue more mortgages. The increase in mortgage originations may cause a decline in other loans if banks, for instance, have a problem raising new capital. In this chapter, we study whether mortgage loans crowd out other

types of loans due to an appreciation in house prices. Our results suggest that banks increase their provision of mortgage, consumer, and construction loans but reduce the provision of commercial loans with the increase in house prices. We also examine whether the ownership structure of banks has any impact on their loan portfolio allocation decision in response to house price appreciation. There has been a long-going debate over the presence of government involvement in the banking sector (La Porta et al., 2002). Some studies suggest that state-owned banks played an essential role in restoring banking stability by increasing their credit more than private banks during the global financial crisis (Allen et al., 2017; De Haas and Van Lelyveld, 2014). Others show that state banks provide loans to favor politically connected firms and locations around election periods (Sapienza, 2004; Dinc, 2005; Claessens et al., 2008; Onder and Ozyildirim, 2013; Carvalho, 2014; Kumar, 2020; Bircan and Saka, 2021). In this chapter, we find that the state-owned banks reduce the provision of commercial loans more than private banks as house prices appreciate. Our results seem to support the view that state-owned banks misallocate their loans.

In the last chapter, we study the impact of house price growth on banks' non-performing loans (NPL) in Turkey using the provincial data for the 2009Q1–2016Q4 period. Given the importance of the NPLs, it is crucial to understand how an increase in house prices may affect the domestic banks' financial stability, especially for a developing country where the debt-fueled growth strategy is adopted (Acemoglu and Ucer, 2020). The literature suggests two views in explaining the impact of house prices on NPLs. According to the first view (collateral value hypothesis), an increase in house prices will result in the appreciation of collateral values pledged by the borrowers, reducing their probability of default. Hence, an increase in house values will improve bank stability (Niinimäki, 2009; Tajik et al., 2015; Wan, 2018). The second view suggests that increased collateral values will improve firms' and individuals' borrowing ability. However, the adverse selection of risky borrowers due to an improvement in their borrowing capacities may increase banks' credit risk. Our

results indicate that house price growth negatively affects NPLs of all domestic banks in Turkey, controlling for bank and province characteristics. We find no statistical difference between the state-owned and private banks' NPLs in their response to the real house price growth over the sample period.



CHAPTER 2

ESTIMATION AND DETERMINANTS OF HOUSING SUPPLY ELASTICITY IN TURKEY

2.1. Introduction

Housing supply elasticity has emerged as a key parameter of interest as it demonstrates how house prices will respond to changes in housing quantities and have become an important determinant of housing supply policies. It is an important concept in housing studies because it measures how responsive the prices are to housing construction.

Local housing supply elasticity plays a crucial role in urban development as it sheds light on how provinces will evolve, thus, affecting the overall productivity. For instance, Glaeser et al. (2006) show that in regions with low regulatory barriers and low densities, positive demand shocks facilitate a higher population and high-density levels, whereas regulatory barriers lead to higher house prices. It also affects the labor market through its impact on labor mobility (Saks, 2008). Thus, the nature of the housing market shapes urban development and the economy. In this study, we aim to understand the supply side of the housing market in Turkey, a developing country that experienced a rapid urbanization process over the last fifty years that has led to economic growth (World Bank, 2015).

The supply and demand mechanism of the housing market operates as in any other industry; when the demand for housing is high, house prices tend to rise. DiPasquale (1999) points out that the demand side of the housing market is much more studied than the supply side of the market. For instance, urbanization, changing demographics, and economic growth contribute to the demand for housing. If builders can increase the housing units easily to accommodate the growing population, an increase in housing units does not cause that much increase in house prices if the housing supply is elastic. However, if the housing supply is inelastic, any slight increase in housing units will translate into higher prices. This is because the slope of the elastic supply curve is lower than that of the inelastic supply curve. In addition, the price elasticity of housing is inelastic in the short run because of the time required to complete a house.

The cost of construction and the price of land mainly determine the supply curve. Therefore, factors that affect either of these will affect the slope of the supply function. No developer will build houses if the house prices are below the construction cost. If the developers believe they can sell the property above its cost, they continue increasing the housing supply. Thus, if the land is available, market competition drives down house prices to levels that are close to the cost of construction.

The land is a scarce source. Therefore, with the growing demand, land scarcity pushes up house prices or limits housing production. Literature on housing studies suggests that barriers to land development in the form of either physical or regulatory are important in explaining the cross-sectional variations in the housing supply elasticities. It is documented that the strict regulations, which are man-made restrictions on construction, negatively affect the housing supply elasticity (Green et al., 2005; Quigley and Raphael, 2005; Vermeulen and Rouwendal, 2007; Saks, 2008; Saiz, 2010). In addition to regulatory constraints,

Saiz (2010) highlights that geographical constraints, such as areas lost to water bodies and areas with steeper slopes, are also important in explaining the variations in the housing supply elasticity estimates across regions. Since Saiz (2010), studies incorporated undevelopable land due to geographical constraints into their models to explain the variations in the estimated elasticities (Wang et al., 2012; Dong, 2016; Liu and Otto, 2017; Aastveit et al., 2020) and provide evidence that the geographical barriers on constructions are associated with inelastic housing supply elasticities. Besides man-made or natural restrictions, demographical factors are also found to be crucial in explaining the local housing supply elasticities. Green et al. (2005) show that as the population and population density increase, housing supply elasticity falls. However, the prediction of the model regarding the relationship between elasticity and demographical variables is subject to endogeneity, as noted in the literature, and the sign of the relation is mixed. For instance, Wang et al. (2012), Oikarinen et al. (2015) document a positive relation between population density and housing supply elasticities, and Polidi (2016) and Liu and Otto (2017) document a negative association.

Modelling the housing supply is challenging for several reasons. One reason is the lack of standards in housing characteristics, making it hard to measure the monetary value of housing quantity (DiPasquale, 1999). For instance, housing units differ in their characteristics, such as area, the number of rooms, heating features, quality of construction and location. These differences may result in different values for dwellings located even in the same building. Apart from the lack of standards in housing units, estimation methods also differ. Kim et al. (2012) divide the studies into three groups based on estimation methodologies. The first group includes reduced-form estimates (for instance, Muth, 1960; Follain, 1979; Malpezzi and Mayo, 1997; Malpezzi and MacLennan, 2001) that are obtained from a system of simultaneous housing supply and demand equations. In the structural approach, the second group, supply elasticity is estimated by using a single supply equation where the dependent variable is

either house price or quantity supplied (for example, Mayer and Sommerville, 2000; Green et al., 2005, Saiz, 2010; Wang et al., 2012; Paciorek, 2013; Lerbs, 2014; Dong, 2016; Liu and Otto, 2017; Aastveit et al., 2020). Finally, studies in the last group adopt an error-correction framework to examine the market dynamics (for instance, Harter-Dreiman, 2004; Caldera and Johansson, 2013; Oikarinen et al., 2015).

In addition to the methods used, the empirical evidence on housing supply estimates differs depending on the period analyzed and the level of aggregation. For example, Muth (1960) and Follain (1979) find elastic housing supply in the US using aggregated data at the national level, whereas using MSA level data, Harter-Dreiman (2004) finds a supply elasticity within the range of 1.8 and 3.2 in the US. Green et al. (2005) calculate the housing supply elasticities for the 45 MSAs in the US, ranging from -0.30 to 29.9, with an average of 7. Saiz (2010) finds elasticities in the range between 0.59 and 12.14 for the 269 MSAs, with an average of 2.54. Aastveit et al. (2020) calculate the supply elasticity by comparing two subsequent periods (1996-2006 and 2012-2017) in the US at the MSA level and document that the median of the 90th percentile during the 1996-2006 period is 3.37, and it is 2.74 between 2012 and 2017. Studies outside the US are limited. Malpezzi and Maclennan (2001) show that the housing supply elasticity in the UK is lower than that of the US. In China, Wang et al. (2012) calculate price elasticity within the range between -0.70 and 37.05 for 35 cities. For the 413 counties and cities in Germany, Lerbs (2014) finds less than unit elasticity estimates. Similarly, Oikarinen et al. (2015) document less than unit elasticity estimates for the 15 Finnish cities. Polidi (2016) finds that supply elasticity for new housing construction is low in Russia, ranging between 0 and 3. In Sydney's local government areas (LGAs), Liu and Otto (2017) estimate the average supply elasticity of 0.2 for houses and 0.8 for apartments.

Since the 2000s, Turkey has experienced significant structural changes in the economy that have led to high growth and employment opportunities. With the

rapid urban expansion, people have left the rural areas and migrated to the urban areas. While the bulk of the population lives in the three largest provinces (Istanbul, Ankara, and Izmir), secondary provinces, also known as Anatolian Tigers, attracted a large share of urban migrants and firms (World Bank, 2015). The need for better and affordable housing became an issue not only for the major provinces in Turkey but also for the secondary ones that are able to attract new people with their promising employment prospects. Apart from high urbanization rates and changing demographics, urban renovation projects to convert slum settlements and transform buildings to increase resilience in high-risk areas, such as earthquakes or floods, contributed to the acceleration of the need for housing.

The motivation for calculating the supply elasticity of the Turkish provinces emanates from two reasons. First, the Turkish government's interest and involvement in the construction sector generate a unique environment to study house price dynamics. Over the sample period, the government has taken several actions to increase construction-related activities and centralization in the decision-making process regarding housing construction within urban boundaries, including the re-establishment of the Housing Development Administration (TOKİ). TOKİ has autonomy in the process of converting lands from public to private or vice versa, got an exemption from auditing by the Turkish Court of Accounts (in Turkish, T.C. Sayıştay Başkanlığı), developed for-profit projects, and also formed some partnerships with private developers (Sarioğlu-Erdoğan, 2014; Demiralp et al., 2016). In addition to TOKİ's restructuring, there were other legal interventions to diminish the role of local government bodies and promote the construction industry, including amendments made to increase the role of metropolitan municipalities in planning urban areas (Metropolitan Municipalities Law, No. 5216),¹ increasing the role of TOKİ in urban transformation processes (Law on the Transformation of Areas

¹ Ergenc and Yuksekkaya (2022) explain how the laws passed in 2012 have shifted powers from local to central government bodies and how they shaped urban policies.

Under Disaster Risk, Law No. 6306), and reducing VAT rates in home purchases (Law No. 13033).² For instance, according to the topic of getting a construction permit in Doing Business statistics,³ Turkey was ranked 53 among 190 countries in 2020 and 155 among 183 countries in 2012, indicating the time, procedures and cost for obtaining construction permits were reduced to accelerate the process. One distinctive feature of the Turkish housing market is that although the government has been highly involved in the housing market, it is characterized as having a lax regulatory environment based on the comparison of the size of the planned areas and freed-up land by the municipalities (Türel and Koc, 2015). Thus, studying the determinants of housing elasticity in a country where man-made restrictions are not that binding will provide additional insights to the literature.

Second, housing affordability has become one of the hot topics in Turkey due to rising housing prices and inflation. For instance, between 2012 and 2021, the increase in the number of households is around 5.1 million, whereas the total number of building construction permits is approximately 8 million and occupancy permits is about 7.2 million, including permits taken due to urban renovation projects. Based on the Income and Living Conditions Survey provided by the TURKSTAT, the homeownership rate was 65.45% in 2006 but declined to 61.18% in 2014 and 58.08% in 2020.⁴ Over this period, while the public and private companies produced a large amount of housing units, it has

² In 2012, the tax rate was changed depending on the price of the land per square and whether the property was in metropolitan provinces. The largest VAT rate is applied for the luxury houses in metropolitan provinces or houses larger than 150 m² as %18. In 2016, this rate was reduced to 8% to boost the market again, and it was extended until 2019.

³ The topic of dealing with construction permits in Doing Business provides statistics that assess how easy it is to get a construction permit in a country. For Turkey, it is constructed using the respondent answers by the construction firms operating in Istanbul, the biggest province in Turkey. It measures the number of procedures (such as licenses, permits, receiving necessary inspections and obtaining utility connections), time and cost to build a warehouse. Accessible through: <https://archive.doingbusiness.org/en/data/exploretopics/dealing-with-construction-permits>.

⁴ Ceritoğlu (2020) argues that one possible explanation for this decline in the homeownership rate might be due to a decline in the return on housing investment.

been argued that a substantial share of this newly produced stock is for middle-high and high-income households (Özdemir-Sarı and Aksoy-Khurami, 2018). To overcome the difficulty of accessing housing for low-income families, TOKİ produced 904,000 housing units for this group from 2003 until 2021, corresponding to almost 85% of the total production by TOKİ.⁵ Several factors affecting housing demand in Turkey also reduced the housing affordability. One of them is the Syrian Civil war started in 2011, and the subsequent influx began in 2012. Until 2014, Syrian migrants settled in provinces near the border, hoping to turn back to Syria. Over time, Syrian migrants spread to almost all Turkish provinces and sought permanent homes (Tumen, 2016). Balkan et al. (2018) show that refugee inflows cause an increase in rents of high-quality houses in high migrant regions, whereas low-quality house rents have not been affected. While there is no study investigating the impact of foreign migration on house prices in Turkey, the segregation story observed in the rental house market could also be applied to homes for sale.⁶ Another factor that possibly increases the demand by foreign investors is the citizen by investment program initiated by the government in January 2017. While the first program requires \$1 million worth of investment, it becomes a minimum of \$250,000 as of 2018. A recent study by Gunduz et al. (2022) show that the new scheme caused %2 increase in house prices in Istanbul districts that immigrant investors target. More recently, in response to the Covid pandemic, the government introduced a new package to stimulate the economy, including a reduction in the monthly mortgage rates by the state-owned banks to 0.64% for new houses and 0.74% for second-hand houses. This rate cut boosted house purchases with mortgage loans, which have been on a declining trend since 2018, and it caused an increase in house prices (Akgunduz et al., 2021).

⁵ See, for instance, <https://emlakkulisi.com/toki-dar-gelirli-aileler-icin-904-bin-konut-insa-etti/691049>.

⁶ The house price evaluations of the provinces with a high Syrian migrant influx can be found in Figure A.3 in the Appendix section.

This study aims to contribute to the literature by estimating the price elasticity of housing supply and try to determine the factors that drive the differences across 68 provinces using quarterly data between 2008-2017, where house price data are available. This chapter consists of two parts. In the first part, we estimate the average price elasticity of the housing supply of Turkish provinces using pooled data. We show that a 10 percentage point increase in house prices is associated with an almost 0.35 percent point increase in housing supply growth. One potential problem in estimating the housing supply elasticity is the reverse causality between these two variables. To resolve the endogeneity problem, following the literature, we use mortgage rate and the log growth of population as instruments for the house price growth and find that a 10 percentage point increase in house prices is associated with an approximately 0.6 percent point increase in housing stock growth. Overall, our results suggest that Turkey seems to have an inelastic housing supply estimate on average. We also document that the geographical barriers to construction in a province affect the average elasticity of Turkish provinces: the tighter the geographical constraints of a province, the smaller the change in the housing supply for a given increase in house price growth.

In the second part, we estimate the province-level price elasticity of housing supply and try to understand whether there is a difference among provinces in terms of their elasticities and how the local characteristics affect the price elasticity of housing supply. Cross-sectional analysis of the estimated elasticities yields that geographical constraints measured by undevelopable land share, and average steepness, are important determinants. In addition to natural barriers to construction, we also provide some evidence that the local regulatory conditions matter. To the best of our knowledge, this study is the first attempt to understand Turkey's housing supply dynamics.

The structure of the chapter is as follows. In Section 2.2, we explain the data and the methodology we used. We provide the results in Section 2.3 and the robustness checks in Section 2.4. Finally, we conclude the study in Section 2.5.

2.2. Data and Methodology

2.2.1. Data

In this study, we utilize the housing market and macroeconomic variables for the 68 provinces (out of 81) spanning the time period 2008-2017 at a quarterly frequency. Total observation number is 2,720, with 40 year-quarters and 68 cross-sections.

We obtain monthly house price variables from REIDIN. REIDIN is a real estate information company that collects data from financial institutions, real estate offices, media (printed and internet), and residential housing projects. There is no data available for Agri, Ardahan, Artvin, Bayburt, Bingol, Bitlis, Gumushane, Hakkari, Igdir, Mus, Tunceli, Siirt, and Sirnak. Provinces that lack house price data belong to the less-developed regions of Turkey. Province-level variables such as construction permits, occupancy permits, consumer price index (CPI),⁷ population, GDP per capita,⁸ and construction cost index at the national level are obtained from TURKSTAT. The mortgage rate is taken from the Central Bank of the Republic of Turkey (CBT). All monetary values are expressed in 2008Q1 prices. Detailed explanations of the variables are provided in the following subsections.

⁷ CPI is available at the NUTS-2 level in Turkey. There are twenty-six NUTS-2 sub-regions. Therefore, each province in a given NUTS-2 level is assumed to have the same CPI.

⁸ Since GDP per capita and population are published with yearly frequency, we extrapolate the data for each province.

2.2.1.1. Housing Stock

The most recent survey on the quantity of housing stock at the province level was conducted in 2000. The total number of housing dwellings was around 16.2 million in 2000, which increased to 32.7 million as of 2017.⁹ While the three biggest provinces, Istanbul, Ankara, and Izmir, had the greatest housing stock in 2000, Yalova, Tekirdag, and Istanbul ranked the first in the number of residential housing units per 1,000 population (Figure 2.1).

In this study, we calculate the growth in the housing stock in each province as a fraction of residential construction permits to population multiplied by the average household size. This proxy can also be interpreted as the construction permits per household and is used by Green et al. (2005) and Polidi (2016) to estimate the regional housing supply elasticities in US and Russia, respectively.¹⁰ Figure 2.2 plots the proxied growth in housing stock and building construction permits over the years for Turkey.¹¹ As expected, these two figures show a great resemblance. It should be noted that, however, we do not take into account the vacant homes and demolishment rate in our calculations.

2.2.1.2. House Prices

REIDIN provides house prices at three levels: province-level for 68 provinces, national-level obtained from prices of the seven biggest provinces in terms of the

⁹ See <https://www.sbb.gov.tr/wp-content/uploads/2020/04/KonutPolitikalariOzellhtisasKomisyonuRaporu.pdf>

¹⁰ Construction permits are certifications that approve the construction, whereas occupancy permits are certificates that show the usable housing units. Although TURKSTAT provides the number of issued permits since 1992, the breakdown of whether these permits are for residential or nonresidential was started in 2002. The plot for each province is provided in Figure A.1 in the Appendix. Almost every year, building construction permits are higher than the building occupancy permits at the province level. As expected, the highest number of permits belong to the three biggest provinces, Istanbul, Ankara, and Izmir.

¹¹ We plot the proxy for the housing stock growth variable for each province in Figure A.2 in the Appendix.

population (TR7) since 2003 and national-level covering all provinces (TR81) since the beginning of 2012. Figure 2.3 provides the evolution of nominal house prices in each province compared to nominal TR7 and TR81 house prices. Given the rapid urbanization process and the developments in Turkey's housing market, provinces with high employment opportunities have higher nominal house prices, as Figure 2.3 depicts.

While nominal house prices are increasing in all provinces, real house prices are either stable or declining, especially in smaller provinces starting from early 2016. Figure 2.4 plots the real and nominal house prices for each province, where dotted lines show the nominal prices and solid lines indicate the real prices.

Figure 2.5 shows the evolution of real house prices of each province over the sample period, where the initial prices at 2008Q1 for each province are scaled as 100. In the second quarter of 2017, we observe a drop in the real prices in the metropolitan provinces as well. The average real house price is highest in Istanbul and lowest in Malatya (Table 2.2), and the average quarterly real house price growth rate is around -0.43% over the sample period of 2008Q1-2017Q4 (Table 2.3).

2.2.1.3. Construction Cost

TURKSTAT provides two indexes for labor and material cost of construction, as well as the aggregate construction cost index at the national level. Panel A of Figure 2.6 shows the evaluation of the real construction cost index and labor and material cost indexes, and Panel B shows the quarterly real growth rate of these indexes. The correlation between the growth in construction cost and material cost is around 0.9, and it is about 0.7 for the labor cost index. In the analyses, we use the aggregate construction cost index.

2.2.1.4. GDP per Capita

As can be seen in Figure 2.7, more industrialized provinces such as Istanbul, Kocaeli, and Ankara, have higher real GDP per capita. Provinces located mainly in the eastern part of Turkey, such as Agri, Sanliurfa, and Van, have the lowest GDP per capita, which has always been the case since 2004. On average, Istanbul has the highest, and Van has the lowest real GDP per capita for the study period (Table 2.2).

2.2.1.5. Population and Household Size

While Turkey is among the youngest OECD countries, its demographics change as fertility rates and household sizes decline. Over the study period, the average household size, defined as the ratio of the total household population to the total number of households, was around 3.7. The average household size declines as one moves from east to west. For instance, Batman has the largest household size with 6.3, and Canakkale has the smallest household size with 2.7.

2.2.1.6. Undevelopable Land Share

In this study, we follow Saiz (2010) to calculate the undevelopable land share for each province using digital elevation maps (DEM) and GIS methods.

Undevelopable land share, as Saiz (2010) defines, it is the area that is not suitable for building construction due to topographic restrictions such as wetlands, rivers, water bodies, and steepness.¹² In this study, we use the SRTM

¹² Following the architectural development guidelines, Saiz (2010) defines land with a slope greater than 15% as undevelopable as it faces difficulties in construction. To calculate the slope of the land, he uses USGS 90-meter DEMs. He then calculates the area lost to rivers, lakes, and wetlands within the land and combines these two features to compute the undevelopable land share of each MSA from a 50km radius around the center of each MSA's central province.

90 DEM obtained from Consortium for Spatial Information (CGIAR-CSI) in order to calculate undevelopable land share.¹³

We define the radius for each province as half of the shortest distance between the neighboring province centers considering the high divergence among the provinces in Turkey. Similar to our study, Wang et al. (2012) calculate the undevelopable land share for the 35 Chinese provinces by using a different radius for each province which is three times the actual province radius. We also add an additional 15km for the biggest metropolitan provinces, namely Istanbul, Ankara, and Izmir, since these are the biggest provinces in terms of population and they already have large build-up areas.

To calculate the undevelopable land of each province, we first change the spatial resolution of the DEMs to 30mx30m using the Resample Tool of ArcGIS. Then, we map project the DEM using the appropriate UTM¹⁴ system given in the Appendix Section (Table A.1) to increase the accuracy of our calculations. Next, we subtract the area lost to rivers, lakes, and wetlands from the total circle area. With the resampling of the data, each province consists of a number of 30mx30m squares. The Slope feature of ArcGIS then calculates the slope of that 30mx30m square and assigns 1 to the square if the slope exceeds 15%, 0 otherwise. To find the undevelopable land share of a circle around the province center, we calculate the ratio of the number of squares that are assigned as one to the multiplication of the total number of squares. We provide the resulting calculations in Table 2.1.

¹³ SRTM is an abbreviation for the Shuttle Radar Topography Mission. It's an international research collaboration spearheaded by NASA and obtains digital elevation maps of the earth's surface. Link for the web page: <http://srtm.csi.cgiar.org>

¹⁴ The UTM coordinate system is a map projection system that converts geographic coordinates to plane coordinates. This system divides the earth's surface into 60 zones, where each zone is 6 degrees in longitude in width. We map the 3-dimensional earth surface using UTM to get the most accurate location and distance calculations.

The average slope for Turkish provinces is 18.8%. Artvin, Rize, and Hakkari are the steepest, Edirne, Aksaray, and Sanliurfa are the flattest provinces. As undevelopable land share calculations are mainly based on the calculated slopes, ranking of the provinces based on undevelopable land shares closely resembles their ranking based on average slopes. Therefore, in line with our expectations, while provinces in the Northern part of Turkey have more undevelopable land share, inner parts have the least undevelopable land share (Figure 2.8).

Table 2.2 provides the mean values of the variables, where the provinces are ranked according to the average real house price over the sample period. Panel A of Table 2.3 shows the summary statistics of the variables used in the analysis, and Panel B of Table 2.3 reports the pairwise correlation coefficients.

2.2.2. Methodology

To calculate the price elasticity of housing supply, we estimate the following fixed effects model:

$$\Delta HousingStock_{i,t} = \alpha_1 \Delta \ln(HP)_{i,t} + \alpha_2 X_{i,t-1} + \gamma_i + \delta_t + \eta_q + \varepsilon_{i,t}, \quad (1)$$

where $\Delta HousingStock$ denotes the percent change in the housing stock defined as the housing unit permits per capita, multiplied by the average household size of each province from 2008 through 2017, as in Green et al. (2005). $\Delta \ln(HP)$ is the log growth rate of real house prices. X includes the logarithm of real construction cost and GDP per capita of a province as control variables to reduce the omitted variable bias in the error term. Province-fixed effects, γ_i , enable us to capture unobservable time-invariant heterogeneity across locations. The inclusion of quarter fixed effects, η_q , helps us capture the seasonality in the construction sector since the construction activities are higher during the summer compared to the winter months, and thus possibly permit

applications are higher during the winter months. Finally, δ_t , year-fixed effects capture the time-varying factors that affect the building activities similarly across all locations. In all models, we use robust standard errors.

We expect the coefficient on the growth rate of house prices to be positive because builders increase their permit applications when house prices increase or believe that house prices will increase in the subsequent periods. While we expect the coefficient on the construction cost to be negative as the cost of construction puts downward pressure on builders, the coefficient on GDP per capita is expected to be positive.

2.3. Results

2.3.1. Housing Supply Estimates

Table 2.4 provides the results of Equation (1) under different specifications. The dependent variable is the ratio of construction permits to population multiplied by the average household size for each province. Our main variable of interest is the coefficient on the real house price growth rate. Estimates in Columns (1)-(2) and (5)-(6) provide the OLS estimation results. It is found that house price and house stock growth are positively associated; a 10 percentage point increase in house price growth increases housing stock growth by 0.35 percentage points controlling for construction cost, GDP per capita and unobservable province, year and quarter characteristics (Column (2)). Our results suggest that, on average, Turkey has an inelastic housing supply estimate on a quarterly basis.¹⁵

¹⁵ We also provide the housing supply elasticity estimations using the same variables using yearly data in Table A.2 in the Appendix, which shows that the average elasticity estimates of the Turkish provinces are around 0.05. However, the first stage F statistics for the IV indicate that the instruments for the house price are weak.

One possible issue in our estimations is the potential reverse causality between house prices and construction activities. However, the results of the Hausman Test of endogeneity suggest that endogeneity is not a major issue, with a p-value of 0.17. Nevertheless, we also run Equation (1) using the instrumental variable approach. In the literature, Gitelman and Otto (2012), Wang et al. (2012), and Liu and Otto (2017) use mortgage rate, population, and income, and Aastveit et al. (2020) use crime rate and income as instruments for house prices. Following these studies, we use the lag of the real mortgage rate and the growth rate of the population as instruments for house price growth rate. Columns (3) and (4) of Table 2.4 provide the results of the IV estimation where the sign and significance levels remain the same with and without control variables,¹⁶ indicating that a 10 percentage point increase in real house prices increases housing stock growth by 0.6 percentage points.

Next, by interacting the house price growth with the undevelopable land share, we test whether the effect of supply restrictions in the form of geographical constraints reduced the housing supply elasticity with house price growth. Columns (5)-(8) provide the estimation results of this hypothesis using both OLS and IV. The coefficient on the interaction term is negative, implying that the tighter the geographical constraints of a province, the smaller the housing supply elasticity. However, the association is insignificant when we instrumented the house price growth. Similar to our findings for the IV estimation results, Aastveit et al. (2020) document an insignificant coefficient on the interaction term between house prices and undevelopable land share during the 2012-2017 housing boom period in the US, but the significant impact during the 1996-2006 boom period. In China, Dong (2016) finds an insignificant coefficient on the interaction variable.

¹⁶ The first stage results indicate that the coefficient on the mortgage rate is negative and significant, and the coefficient on the population growth is positive and significant.

2.3.2. Housing Supply Estimates at the Province Level

Apart from the estimated elasticity in the previous section, which is an average of the provincial elasticities, we also estimate the price elasticity of housing supply at the province level to understand the drivers behind the price responsiveness of housing supply. Existing literature provides evidence that the elasticities estimated at the local level vary substantially due to regulations regarding the land zoning plans, available land for construction, or demographic factors. To that end, we estimate Equation (2) for each province separately (Model 1):

$$\Delta Housing\ Stock_t = \alpha_1 \Delta \ln(HP)_t + \varepsilon_t, \quad (2)$$

where α_1 , the coefficient on the growth in real house price -the province-specific elasticity estimate- is our variable of interest. This simple model is used by Green et al. (2005) in the US for 45 MSAs, Accentturo et al. (2021) for Italian provinces, and Polidi (2016) for Russian provinces. It assumes that housing supply elasticity is only a function of the house price growth and ignores other factors (Model 1).¹⁷ Then, we estimate Equation (2) by controlling for several factors: first by including only quarter fixed effects to control seasonality (Model 2), second by including only construction cost (Model 3), and finally by including both construction cost and quarter dummies (Model 4). In Table 2.5, we provide the estimation results of Equation (2) under different model specifications.

Estimation results of Model 1 for each province indicate that the average elasticity of the Turkish provinces is around 0.06, with Aksaray having the most

¹⁷ We also run the same model using IV, where the real mortgage rate and population growth are the instruments for the house price growth. In this specification, we have two negative elasticities (namely, Adana and Van). The average elasticity is around 0.13, and the most and the least elastic provinces are Karabuk and Batman. Of these 66 cases, only 13 of them have the first stage F statistics above 10 (Figure A.4 in the Appendix). On the other hand, Hausman Test of endogeneity results reveals that for 21 provinces, house price is endogenous with a p-value less than 0.1 (Figure A.5 in the Appendix).

elastic housing supply (0.198) and Amasya having the least elastic housing supply (0.014). There are five provinces with negative elasticities. The average elasticity of the province-level elasticities using Model 2 is almost 0.08, and four provinces have negative elasticity estimates. As in the previous model, Aksaray has the most elastic housing supply. According to Model 3, the average elasticity estimate for 53 provinces is roughly 0.06. Consistent with other models, Aksaray has the most elastic housing supply. Finally, when we include both construction cost and quarter dummies, the average elasticity estimate is around 0.07, with 14 provinces having negative elasticity estimates. To increase the number of observations in the search for the determinants of the estimated supply elasticities and also to reduce the possible omitted variable bias in the estimations, we continue with the model that we include only quarter dummies in addition to the house price growth rate, i.e., Model 2 in Table 2.5.¹⁸

In our estimations, there are provinces that have negative housing supply elasticities. One of these provinces is Adana, and the anecdotal evidence suggests that the housing prices are increasing in Adana because of poor zoning planning and a lack of developable land due to agricultural lands located on the periphery of the province coupled with the foreign migrant influx following the Syrian war. Edirne lies in the Marmara region, is close to Istanbul, and has become the focal point for public and industrial investments. Unlike other provinces in this region, Edirne also has historical significance by being the old capital of the Ottoman Empire; thus, it is also possible that increasing housing supply through renovation within the province center is subject to more complex processes. Between the period 2008-2017, the population of Sivas declined. In line with this, Central Anatolia Development Agency¹⁹ claims that over the past

¹⁸ Table A.3 in the Appendix provides the correlation matrix of the elasticities we calculated in Models 1,2,3 and 4. The correlation matrix for the estimated elasticities indicates that province-level elasticities calculated using Models 1 and 2 have the highest correlation, and Models 1 and 4 have the lowest correlation.

¹⁹ The social profile research for Sivas is accessible here:
https://www.oran.org.tr/images/dosyalar/20180803160507_1.pdf

forty years, Sivas has been in the process of shrinking. Glaeser and Gyourko (2005) argue that the supply function is kinked due to the durable nature of housing, which causes a more elastic housing supply when cities are growing than shrinking.

Using a similar methodology, Accentturo et al. (2020) calculate the average elasticity for the Italian provinces as 0.12. Polidi (2016) finds elasticity estimates vary from 0.34 to 2.95 in Russia. Green et al. (2005) show that the average elasticity for the 45 MSAs in the US is around 7, with the maximum being around 30. In a sparsely populated country, Oikarinnen et al. (2015) find that elasticity varies between 0.20 to 0.82 for the 15 Finnish provinces. In China, Wang et al. (2012) calculate the supply elasticity for 35 Chinese provinces, ranging from -7.70 to 37.05. Liu and Otto (2017) find that the supply elasticity estimate is between 2.3 and 4.3 within the local government areas of Sydney, Australia. Saiz (2010) shows that supply elasticity estimates in the US MSAs range between 0.60 and 5.45. Although our results show a little resemblance in terms of the magnitude to these studies, calculated elasticities display geographical variation (Figure 2.9).

2.3.3. Cross-Sectional Analysis of Determinants of Housing Supply Elasticity

In this section, we try to determine the factors that might explain the cross-sectional variation of the estimated housing supply elasticities by regressing the estimated elasticities on a number of variables that the literature suggests affect the housing supply elasticity.

As in Wang et al. (2012), we divide our set of variables into three groups as geographic, regulatory, and economical. We use the undevelopable land share and average slope of a province for the geographical controls. We expect these variables to be negatively associated with the estimated elasticities since natural

barriers to construction either decrease the available land for construction or increase the construction cost. Figure 2.10 provides evidence that the provinces with a larger share of undevelopable land or higher elevation have the lowest elasticities, which is in line with the evidence from the literature.

Our second set of control variables, the economic variables, includes the logarithm of the mean population over the sample period, the real house price in 2008, and the socio-economic development ranking index (SEGE). This index is provided by the Ministry of Industry and Technology, and is created by combining 61 variables in eight subcategories, including demographic, employment, education, health, competitive and innovative capacity, financial, accessibility, and life quality indicators. The available years for the SEGE index are 1996, 2003, 2011, and 2017. In this study, we create a dummy variable that takes 1 if the ranking of the province is improved - or stays the same- compared to 2003 in 2011, 0 otherwise. We choose the 2003 and 2011 SEGE indexes to minimize the potential endogeneity between the elasticities and provinces' economic developments.²⁰ We expect to observe a negative relationship between the elasticities and the socio-economic development ranking change since those variables indicate higher economic activities. For the population variable, we expect to observe negative relation since more populated provinces are already intensively urbanized, and thus it is now hard to expand the province. Finally, Green et al. (2005) show that the relationship between elasticity and house prices should be positive since builders increase their supply in these provinces to get a profit. On the other hand, it could also be negative since the already developed provinces have higher house prices. Figure 2.11 shows the scatter plot of elasticities and population and house prices. Evidence for the Turkish provinces suggests that both population and

²⁰ Instead of using the SEGE indexes themselves, we create a dummy variable identifying their changes in the ranking. The reason for this is the high correlation between the level of SEGE indexes between the population and house prices. However, when we include either SEGE 2003 or SEGE 2011 in the model, the significance levels of the variables remain the same, and the coefficient on the SEGE indexes is insignificant.

house prices are negatively associated with the estimated housing supply elasticities.

The third group includes the variables related to the regulatory environment of a province. Housing studies in the US use the Wharton Residential Land Use Regulation Index (WRLURI) (Gyourko et al., 2008), an index created by survey data to understand builders' perception of regulatory bodies' degree of control over land use. In Turkey, we do not have any such measure which helps us to quantify the regulatory environment at the local level. Instead, we create two proxies that aim to capture the regulatory barriers at the province level. The first measure is the change in green and agricultural areas from 2006 to 2012 per capita since these areas are considered as vacant lands with urban development potential.²¹ In Turkey, Law No. 5403 (Law on Soil Preservation and Land Utilization) establishes the rules and principles for identifying and classifying land and soil resources, preparing land plans for their use defining tasks required to ensure their preservation. According to this law, unless absolutely necessary, apart from marginal agricultural lands, these lands cannot be used for construction.²² In this study, it is assumed that if there is a decline in the green and agricultural areas from 2006 to 2012, that area is used for residential development. The more the decline in the green and agricultural areas, the laxer the regulatory environment in that province. As seen in Figure 2.12, provinces with less green and agricultural areas compared to 2006 have higher elasticities.

The second regulatory proxy is the dummy variable *Strict* that quantifies the province's regulatory conditions based on 2/B areas. 2/B areas are forest areas

²¹ Although Turkey has no green belt policy, the Ministry of Environment, Urbanization and Climate Change aims to increase the green area per capita within provinces to 15m², which is currently set as 10m².

²² However, these agricultural lands may be used for other purposes under certain circumstances. The cases in which the demand for misuse of agricultural lands may be valid are specified in the 13th article of this law.

that lost their forest features and were sold by the government. According to the Law No. 6292 (also known as Law 2/B), passed in 2012, the vacant land that lost its forest features or agricultural lands that belong to the Treasury can be sold. With this legislation, areas that had lost their forest features and were already used for residential purposes were sold to generate additional revenue for the state. To create *Strict*, we first calculate the ratio of the total 2/B area sold to the total purchase applications to buy 2/B area for each province over the 2012-2017 period. Those that have a ratio greater than the average of all provinces, i.e., 0.75, are considered to be as non-strict, and *Strict* variable takes a value of 0. Those that are less than 0.75 are considered to be strict, and the *Strict* variable takes a value of 1. For instance, the ratio of Adana is 0.91, and Turkey's average is 0.75, implying that the 2/B area sold in Adana is higher than the country's average; thus, it is less strict, and the *Strict* variable takes 0 (Table A.4 in the Appendix). On the other hand, the ratio of Amasya is 0.65, and it is less than the country average. Therefore, the *Strict* variable for Amasya takes 1 as being strict.

Among 81 provinces in Turkey, 63 provinces have 2/B state-owned land. Because the government body (the Ministry) defines areas as 2/B, we classify provinces with no 2/B land as strict as well. The map in Figure 2.13 shows the regulatory conditions of Turkish provinces. The three of the biggest metropolitans (Ankara, Istanbul, and Izmir) are classified as strict. It is interesting that most of the coastal provinces in the northern part of the country belong to the less strict group.

One possible concern for this division is the endogeneity of 2/B lands that are defined by the government. For instance, it is more likely that provinces with the higher forestry land possibly have more 2/B lands. Moreover, since the government generates additional revenue with the sale of 2/B lands, it is possible that more sales were observed in provinces with higher house prices. For the first concern, we test the differences between forestry areas for the

strictly and less strictly regulated provinces. The Ministry of Agriculture and Forestry publishes the forestry areas of each province for 1990, 2000, and every six years thereafter. In Table 2.6, we compare the mean forestry area for all provinces (81) and provinces with house price information (68 out of 81). One thing that emerges from this table is that provinces with strict regulatory conditions (*Strict* =1) have a larger forestry area before 2006 than those with less regulatory conditions. However, the mean forestry in the two groups is not insignificantly different after 2006, regardless of the house price data.

For the second concern, we test whether the means of real house prices and housing stock variables in strict and less strictly regulated provinces differ (Table 2.7). There is a significant difference between the strict and less strict regulatory classified provinces regarding house prices. However, observing a significant difference in house prices makes sense since strictly regulated areas are more populated and cover the biggest metropolitans. We find no significant difference in terms of growth in real houses or housing stock.

Table 2.8 depicts the correlation matrix of the variables used in the analysis and shows that housing supply elasticity and factors that are used to explain elasticities have the expected association. Table 2.9 reports the determinants of housing supply elasticities of Turkish provinces under different model specifications. It should be noted that due to multicollinearity between the variables, coupled with the low number of observations, it is not unexpected that we get insignificant results or unexpected signs (see, for example, Green et al., 2005; Wang et al., 2012, Oikarinen et al., 2015).

The variables we use to explain the cross-sectional differences across provinces seem to have the expected signs, though not always significant. Our results suggest that provinces with a larger share of undevelopable land or steeper slopes are associated with lower elasticities in all models. Furthermore, more populated provinces tend to have lower elasticities. Among the regulatory

variables, provinces that are classified as strict, i.e., those that convert 2/B forest areas to development areas less than the whole country, are associated with lower elasticities.

2.4. Robustness

Estimated elasticities for each province in Section 2.3 might suffer from omitted variable bias due to the small sample size when estimating the model for each province. For instance, there are regulatory changes from year to year affecting all provinces, which cannot be captured by including only real house price growth and quarter fixed effects. Thus, in this section, we estimate the housing supply elasticity using the model that we borrowed from Wang et al. (2012), where province-level estimates are the coefficients of the interaction term on house price and province dummy variables. Specifically, we estimate the following simple supply equation:

$$\Delta HousingStock_{i,t} = \alpha_1^i \Delta Ln(HP)_{i,t} + \alpha_3 X_{i,t-1} + \gamma_i + \delta_t + \eta_q + \varepsilon_{i,t}, \quad (3)$$

where α_1^i represents the estimated elasticities for province i . In particular, α_1^i is the coefficient on the interaction term between real house price growth and province fixed effects. The control variables are construction cost and real GDP per capita. Panel C of Table 2.10 provides the coefficient of $\Delta Ln(HP)$ for each province. There are 14 provinces with negative elasticities, and the average elasticity estimates across provinces are around 0.05. The correlation between the elasticity estimates of Equations (2) and (3) is around 0.84, and the provinces with a negative elasticity in the individual estimations also continue to have negative signs.

Table 2.11 reports the estimations using new elasticity estimates, which suggest that economic conditions, as measured by the improvement in the ranking in the socio-demographic index and regulatory conditions, matter in explaining the

cross-sectional differences in the estimated elasticities. The only significant association among the geographical control variables is found for the average slope.²³

2.5. Conclusion

Considering the rising urbanization rate and debates regarding housing affordability in Turkey, this study aims to calculate the housing supply elasticity, which is regarded as one of the key economic measures in understanding the regional housing market dynamics. Using data for the period 2008Q1-2017Q4 and 68 provinces in Turkey, we estimate the housing supply elasticity and try to identify the factors that could explain the cross-sectional differences across provinces. On average, housing supply elasticity in Turkey seems low. Moreover, our elasticity estimates exhibit geographical variation across provinces. In line with empirical evidence from other countries, population, geographical constraints, and local regulatory conditions seem to be important factors in explaining the differences in price elasticity among provinces in Turkey.

Our results offer some policy implications. First, our findings indicate divergent supply conditions across Turkish provinces, suggesting that local characteristics matter, thus emphasizing the role of local authorities in urban planning. Second, the low estimated elasticities indicate that provinces, especially those that are geographically constrained or more populated, might struggle to meet housing demand, and further house price upsurges in these provinces might be inevitable. Increasing the housing supply will help stabilize the housing market. Given the current high inflationary environment and reduced construction activities in Turkey, providing more flexible financing options to housing producers might help them to increase the housing supply.

²³ Although the coefficient on average slope term is only weakly significant in Column (6), p-values of the coefficient of the average slope are around 0.15 in Columns (5) and (8).

To the best of our knowledge, this study is the first attempt to understand the supply conditions of the housing market in Turkey. One of the shortcomings of this study comes from the lack of data such as actual housing stock, vacancy rate and demolition rate. In addition, because the housing supply is inelastic in the short run and our housing supply elasticity estimations are calculated for a relatively short period of time, further studies are needed to fully understand the housing market dynamics in the medium to long run. Furthermore, the lack of spatially disaggregated construction costs might be preventing us from estimating the supply elasticities more precisely by neglecting the regional heterogeneity in the construction sector. Another shortcoming of this study is the lack of the appropriate regulatory index that measures the extent to which man-made constraints on residential construction can explain housing supply elasticities. Given these limitations, this study can be extended further. First, the undevelopable land share measure can be improved by incorporating already developed urban areas into the calculations. Second, constructing measures that capture the central or local governments' land allocation decisions might also help us increase our understanding of the housing market at the province level in Turkey.

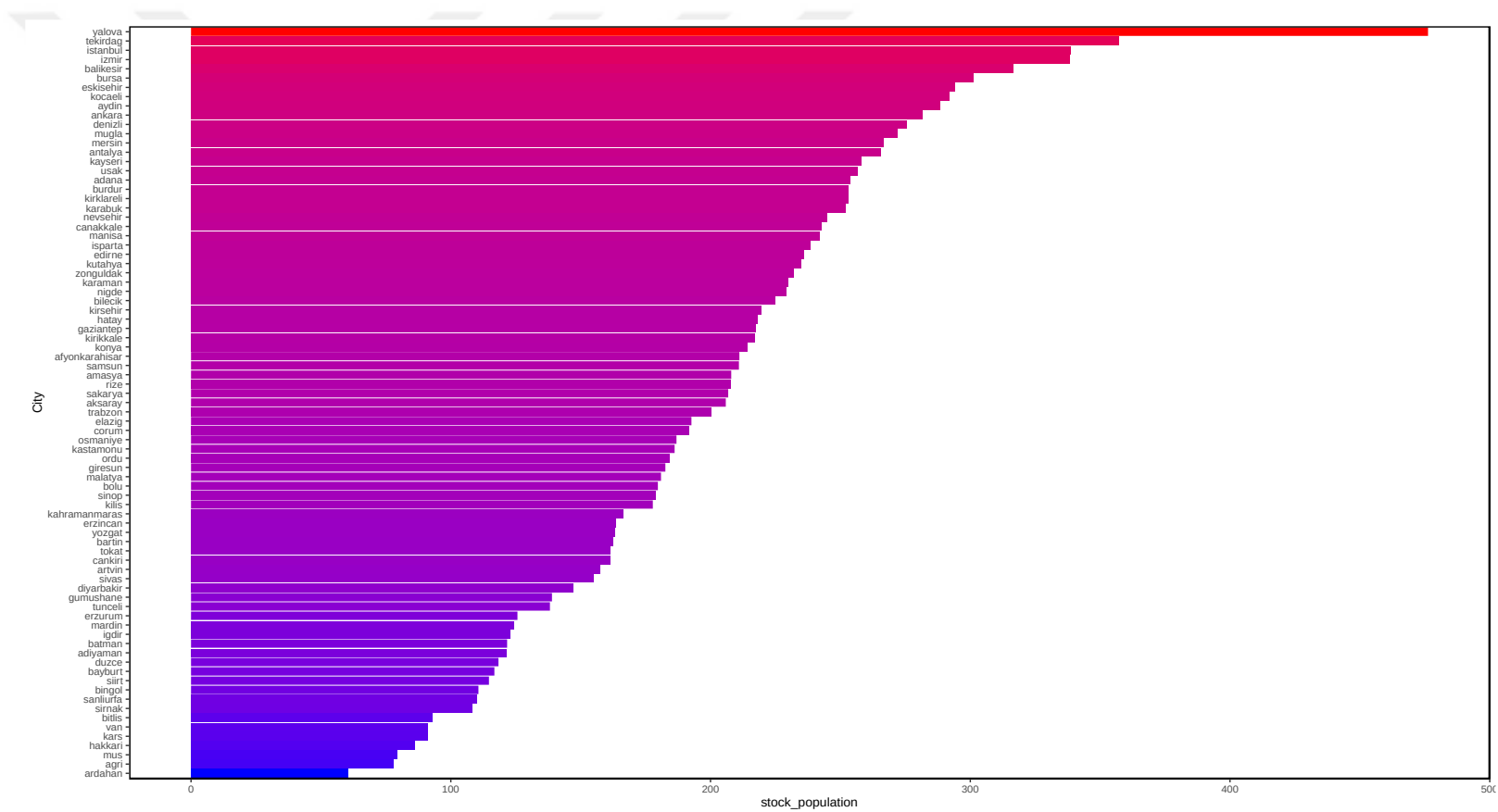


Figure 2.1: Housing Stock per 1,000 Population, 2000.

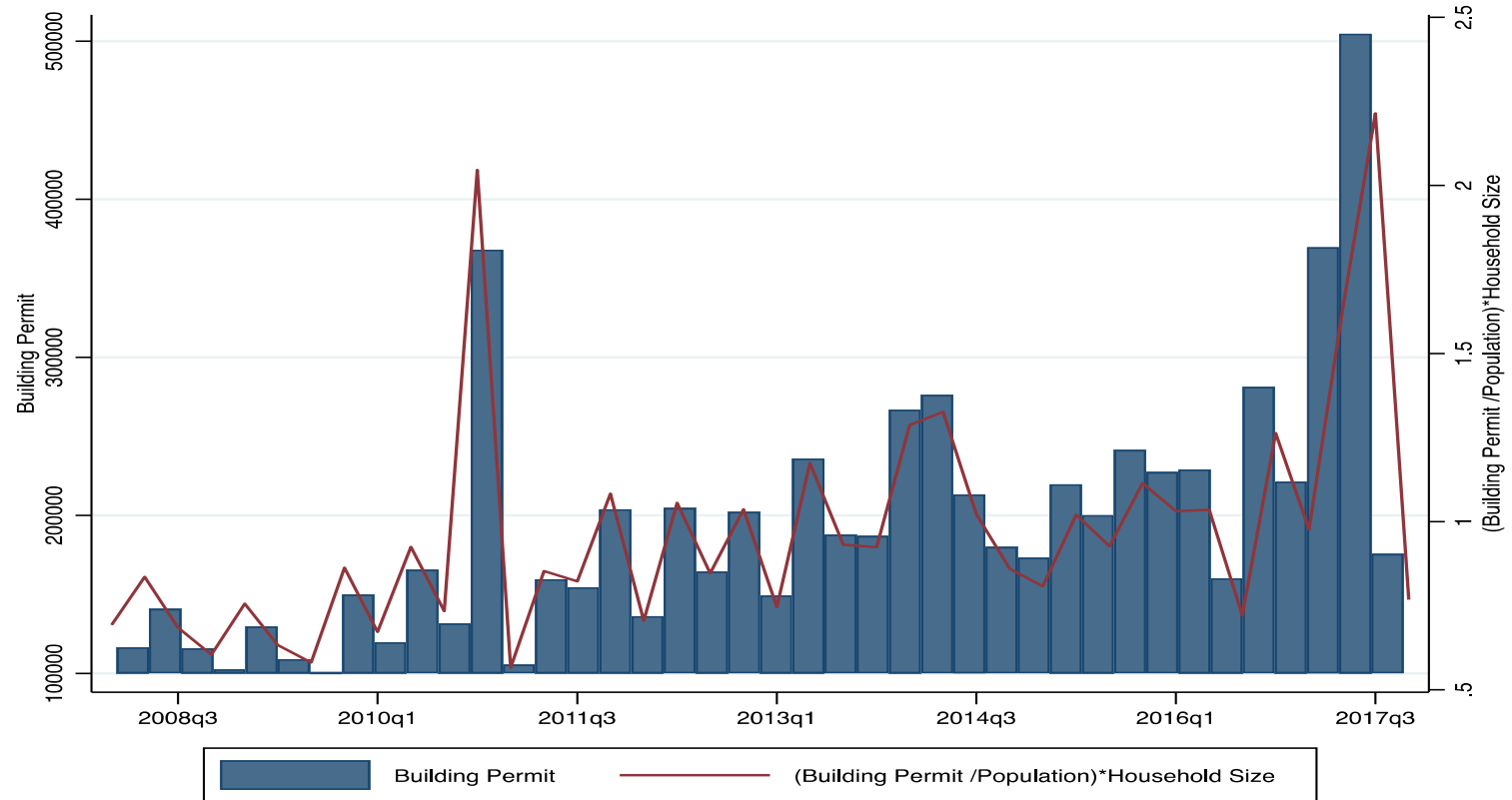


Figure 2.2: The Evolution of Construction Permits over Years, 2008Q1-2017Q4.



Figure 2.3: Evolution of Nominal HP at the Province Level, 2007Q4-2017Q4.

Notes: The dotted line plots the nominal TR7 house price, dashed line plots the nominal TR81 house price, and solid line plots the nominal house price in a province.



Figure 2.4: Evolution of Real HP at the Province Level, 2007Q4-2017Q4.

Notes: The dotted and solid lines plot the nominal and the real house prices in a province, respectively. Real house prices are in terms of 2008Q1 prices.

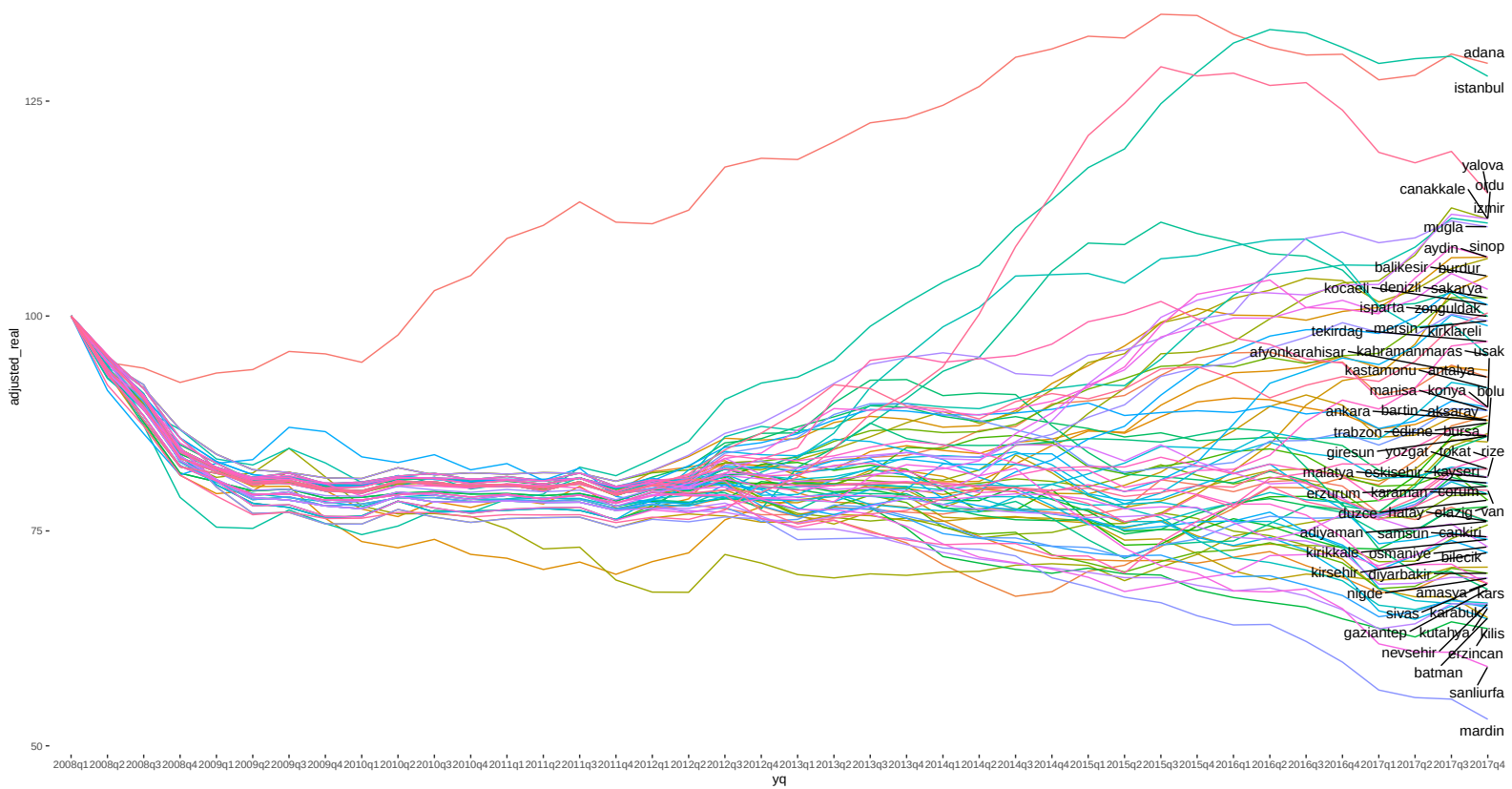


Figure 2.5: Evolution of Real House Prices, 2008Q1-2017Q4.

Notes: All values are real and expressed in terms of 2008Q1 prices.

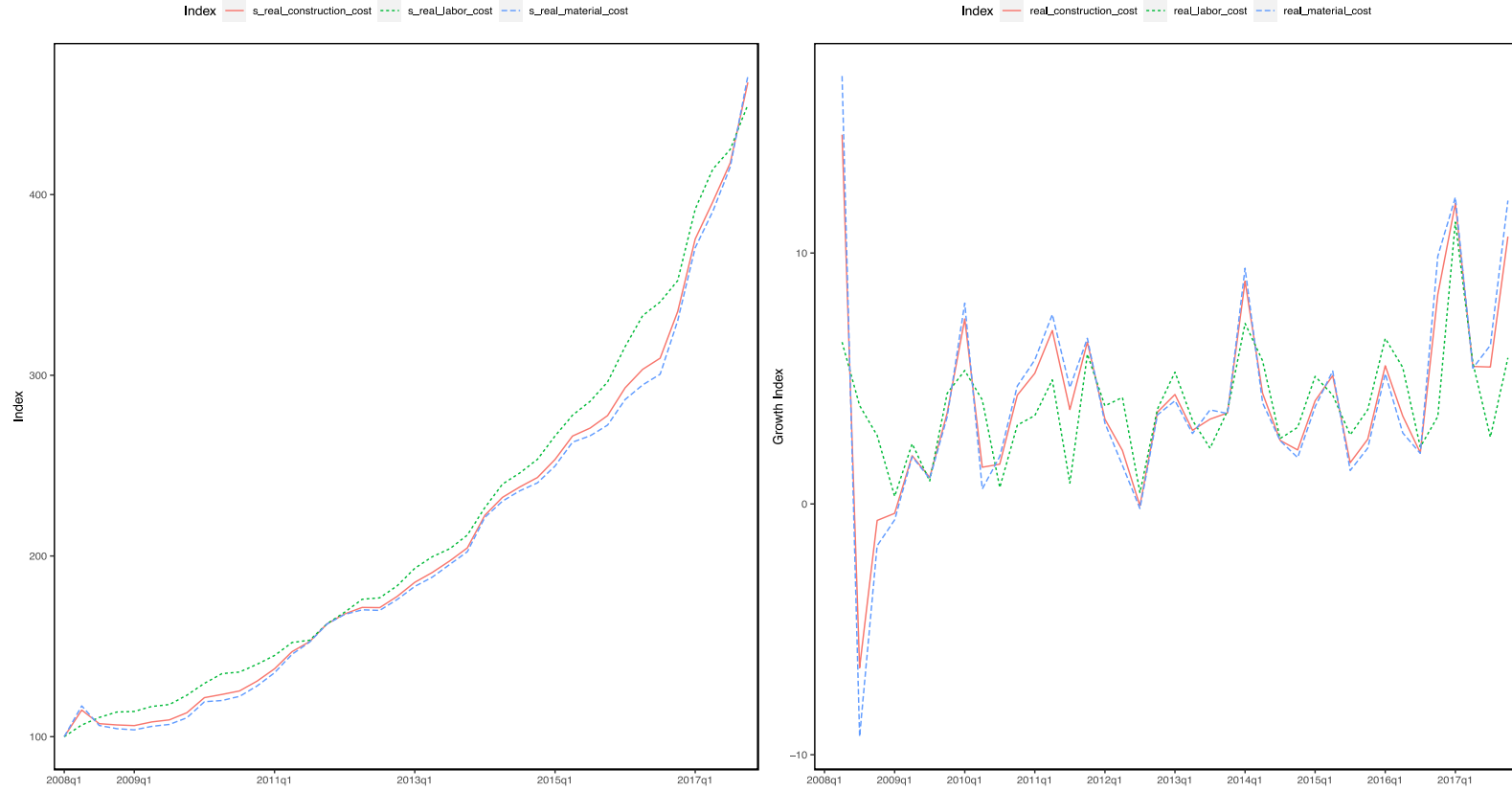


Figure 2.6: Construction Cost Index for Residential Buildings, 2008Q1-2017Q4.

Notes: Construction cost, material cost, and labor cost indexes are real in terms of 2008Q1 prices, calculated by using the national level CPI. The initial value at 2008Q1 is scaled as 100 for all indexes.

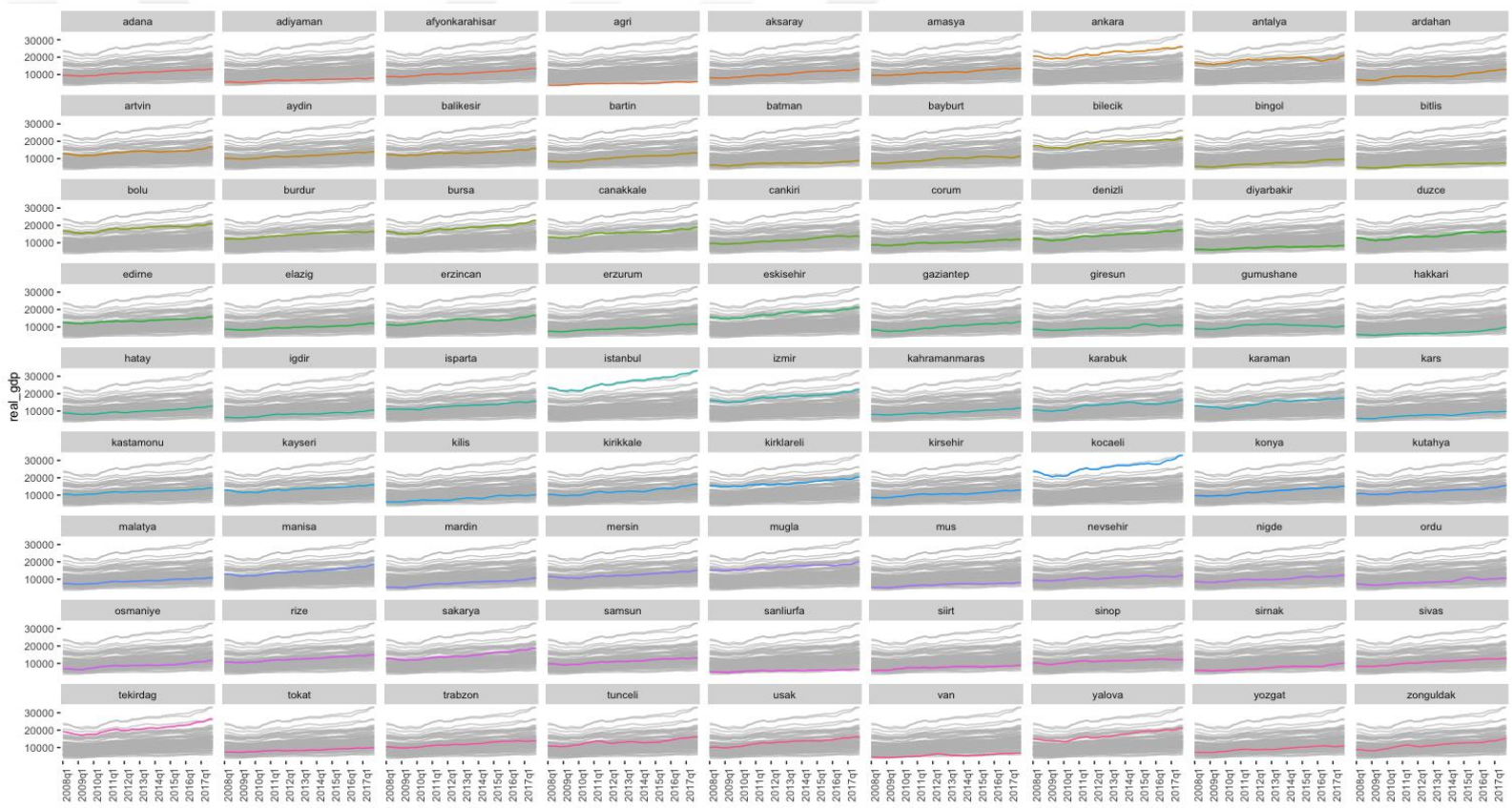


Figure 2.7: Real GDP per capita for each Province, 2008Q1-2017Q4.

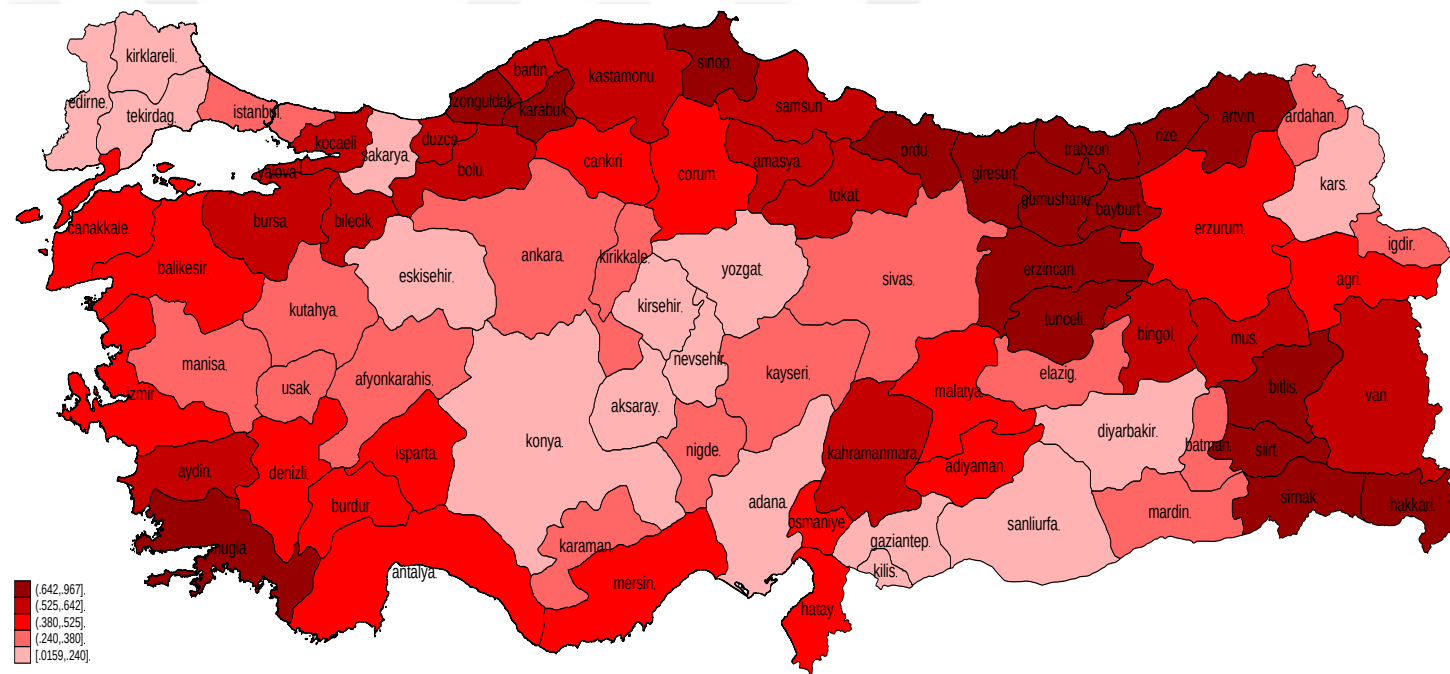


Figure 2.8: Map of Provinces with their Undevelopable Land Share.

Figure 2.9: Map of Provinces with their Housing Supply Elasticity Estimates.

Figure 2.10: Scatter Plot of Housing Supply Elasticity vs. Undevelopable Land Share and Average Slope.

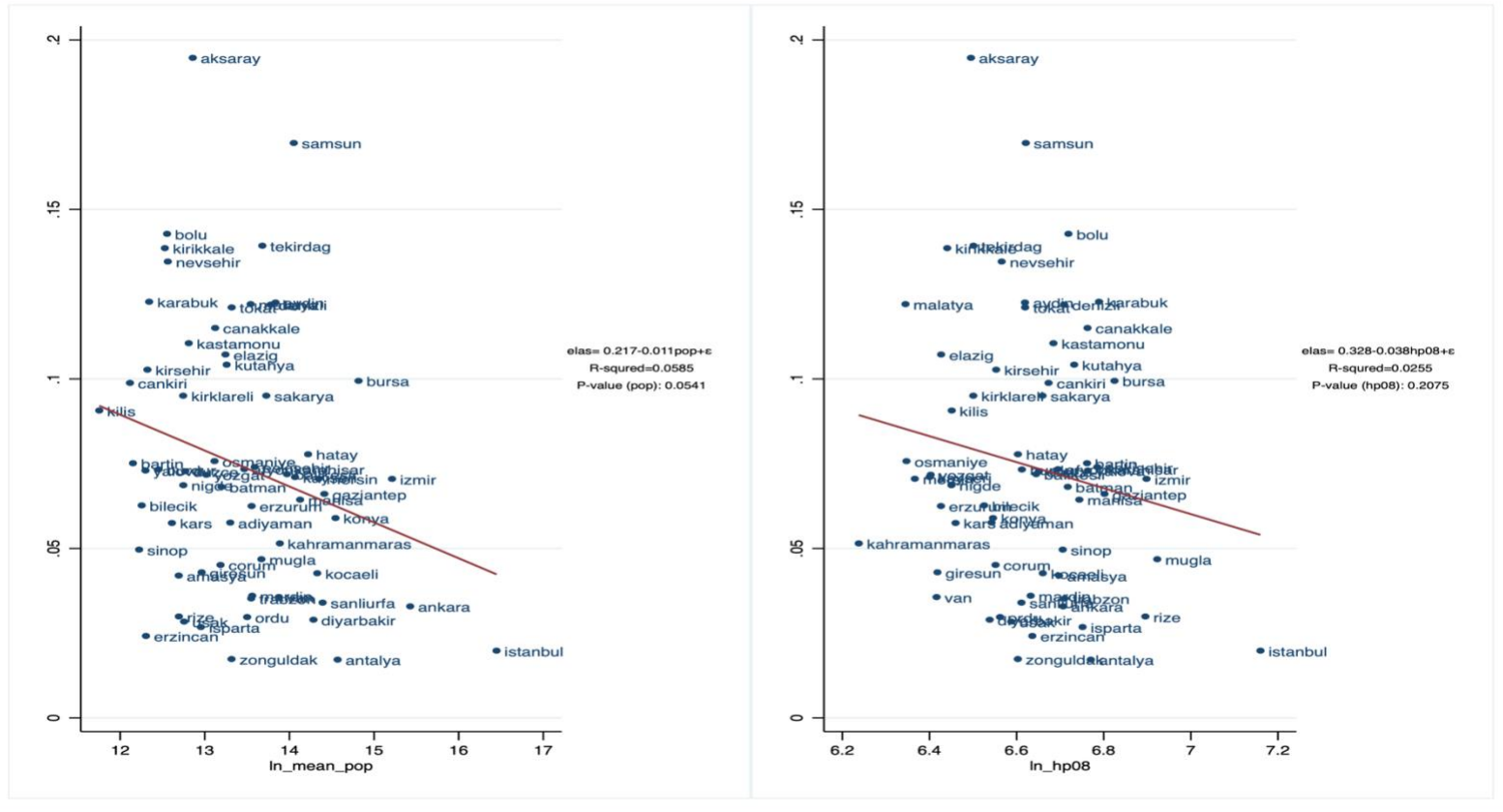


Figure 2.11: Scatter Plot of Housing Supply Elasticity and Population and House Prices.

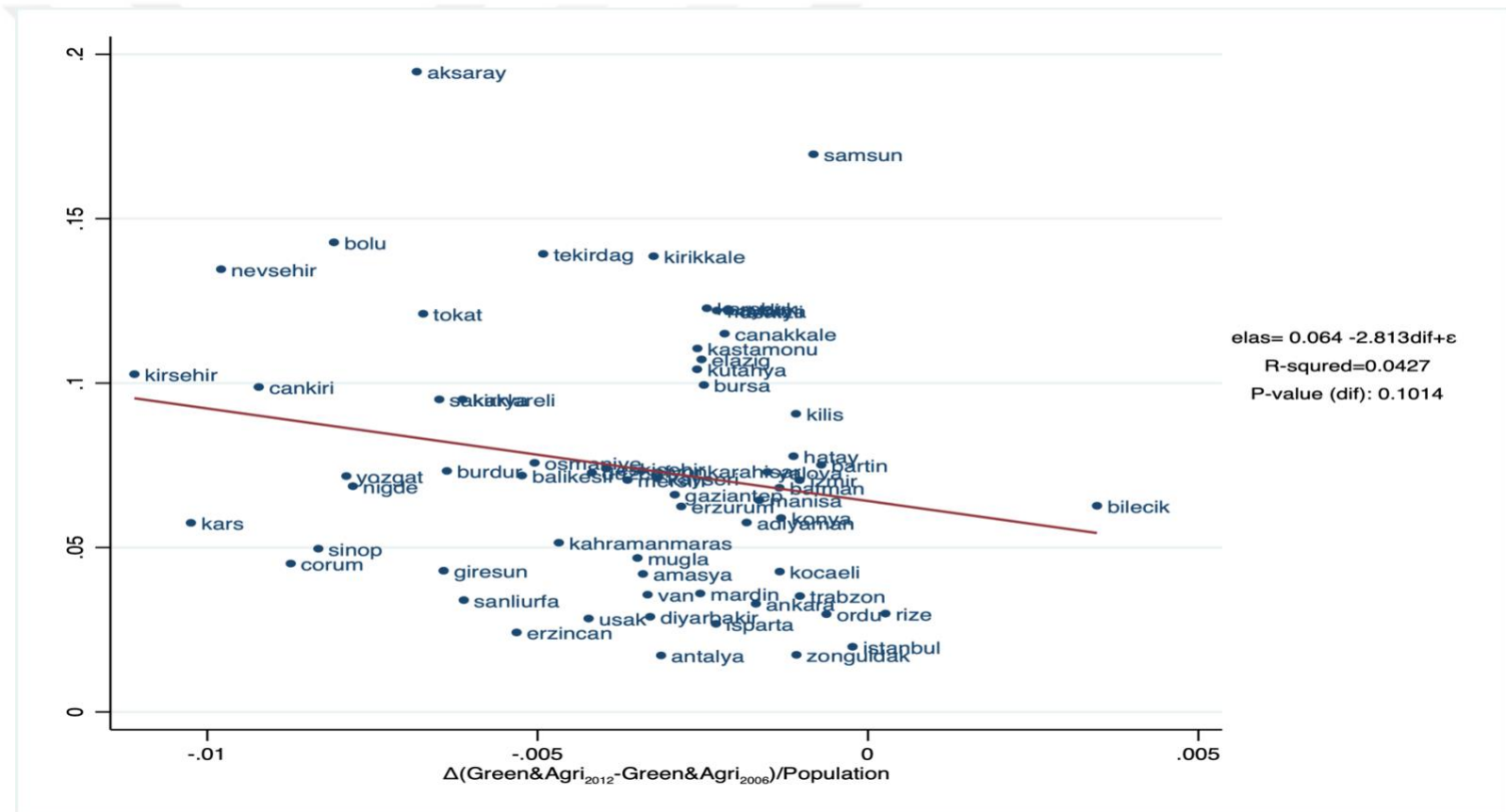


Figure 2.12: Scatter Plot of Housing Supply Elasticity and Per capita Change in Green and Agricultural Areas in the period of 2006 and 2012.

Figure 2.13: Map of Regulatory Classification of 81 Provinces.

Table 2.1: Radius, Undevelopable Land Area and Undevelopable Land Share of Provinces in Turkey.

Province	Radius (km)	Area(km ²) > 15%	Undev. Share (%)	Province	Radius (km)	Area(km ²) > 15%	Undev. Share (%)
adana	36.1	331.0	10.1	k.maras	34.7	2201.4	62.4
adiyaman	32.5	1107.2	42.5	karabuk	26.8	1389.6	73.1
afyon	43.9	1649.1	29.1	karaman	50.4	1428.5	28.6
agri	45.3	2202.6	41.9	kars	33.2	598.5	17.9
aksaray	33.4	383.2	11.3	kastamonu	43.7	3071.7	52.8
amasya	36.3	1717.9	56.6	kayseri	33.8	1100.3	32.0
ankara	43.4	2676.4	30.3	kilis	22.7	152.5	17.2
antalya	49.1	2676.2	50.2	kirikkale	28.4	368.6	26.9
ardahan	33.2	1088.2	37.4	kirklareli	28.0	279.4	12.4
artvin	37.3	4033.8	96.7	kirsehir	37.9	514.4	14.0
aydin	42.3	2112.1	52.5	kocaeli	20.5	652.7	53.0
balikesir	58.8	4244.4	49.2	konya	50.4	1788.3	22.5
bartin	24.5	817.6	60.7	kutahya	30.1	750.2	27.7
batman	35.9	598.6	33.5	malatya	32.5	955.2	43.5
bayburt	33.7	1845.9	65.1	manisa	17.2	306.6	33.0
bilecik	30.9	1383.5	53.7	mardin	36.9	1148.1	29.5
bingol	43.2	2466.1	61.9	mersin	36.1	1438.9	45.9
bitlis	29.1	1783.8	73.1	mugla	42.3	3034.7	64.2
bolu	19.8	696.6	57.0	mus	32.8	1867.1	55.3
burdur	12.3	124.6	38.0	nevsehir	33.4	452.6	15.0
bursa	27.9	1328.2	57.6	nigde	36.1	2582.8	35.3
canakkale	65.9	2829.8	40.8	ordu	21.2	704.5	79.6
cankiri	42.3	2210.4	44.1	osmaniye	41.1	925.1	41.3
corum	37.6	1640.5	41.6	rize	34.0	1277.6	93.1
denizli	44.9	2300.6	43.0	sakarya	20.5	144.3	15.2
diyarbakir	39.7	197.8	4.2	samsun	40.4	1829.7	55.6
duzce	19.8	683.7	57.3	sanliurfa	40.9	328.4	6.4
edirne	28.0	22.1	1.6	siirt	29.1	1580.9	67.3
elazig	26.3	544.3	36.8	sinop	64.2	2706.2	74.5
erzincan	37.7	2328.3	70.8	sirnak	32.2	2211.5	72.2

Table 2.1 (cont'd)

Province	Radius (km)	Area(km ²) > 15%	Undev. Share (%)	Province	Radius (km)	Area(km ²) > 15%	Undev. Share (%)
erzurum	48.8	3739.4	50.2	sivas	37.0	1378.8	32.2
eskisehir	30.1	444.2	17.3	tekirdag	43.8	361.7	9.9
gaziantep	22.7	239.2	15.1	tokat	36.3	2210.1	60.2
giresun	21.2	723.5	89.2	trabzon	32.0	1481.5	90.2
gumushane	32.0	2439.4	90.7	tunceli	26.3	1550.9	73.2
hakkari	54.0	3347.7	88.2	usak	48.4	1130.7	26.0
hatay	48.3	1776.9	45.4	van	54.0	3299.5	56.3
igdir	45.3	1020.0	34.0	yalova	23.4	230.8	61.8
isparta	12.3	183.5	50.2	yozgat	41.0	814.3	20.0
istanbul	38.4	699.1	24.0	zonguldak	24.5	788.8	81.0
izmir	32.2	1935.8	44.5				

Table 2.2: Mean Values of the Selected Variables by Province, 2008Q1-2017Q4.

Province	HP	GDP (per capita)	Pop.(mil)	Avg. HH Size	Construction Permit	ΔHousing Stock
istanbul	1,429.31	26,523.59	13.967	3.60	39,575.00	1.01
mugla	1,005.14	17,023.29	0.866	3.01	2,174.58	0.75
izmir	974.13	18,096.72	4.049	3.17	9,532.03	0.74
yalova	918.46	16,934.83	0.220	3.25	1,116.00	1.6
rize	866.55	12,494.19	0.326	3.55	607.95	0.66
isparta	855.69	12,939.54	0.423	3.15	965.88	0.72
canakkale	827.91	15,595.34	0.501	2.77	1,908.13	1.04
eskisehir	816.05	17,645.74	0.799	2.93	3,418.35	1.25
gaziantep	798.91	10,077.41	1.822	4.60	3,848.28	0.95
sinop	795.56	11,254.84	0.204	3.10	498.38	0.76
bartin	786.86	10,554.68	0.189	3.37	453.48	0.8
antalya	786.69	18,381.79	2.133	3.33	8,098.40	1.25
denizli	774.67	14,221.37	0.964	3.19	2,627.58	0.86
manisa	771.97	14,476.65	1.365	3.27	3,173.53	0.76
karabuk	768.34	13,144.10	0.230	3.13	755.30	1.02
bursa	766.34	18,306.77	2.727	3.48	7,586.43	0.95
ankara	759.76	22,292.86	5.020	3.29	16,408.58	1.07
kocaeli	751.69	25,897.98	1.675	3.68	5,493.98	1.2
afyonkarahisar	751.23	10,764.61	0.706	3.69	1,860.55	0.97
sakarya	747.56	14,608.91	0.917	3.80	3,472.80	1.42
bolu	735.61	18,207.54	0.284	3.30	1,031.20	1.18
sivas	733.67	10,624.73	0.627	3.72	1,461.03	0.87
burdur	725.42	14,563.80	0.256	2.97	582.23	0.67
aydin	723.97	11,614.22	1.022	3.12	2,956.08	0.89
kastamonu	720.19	11,943.23	0.366	3.26	972.10	0.86
trabzon	716.13	11,882.87	0.766	3.53	2,493.60	1.15
zonguldak	710.35	11,340.51	0.607	3.39	826.93	0.46
balikesir	701.82	13,383.68	1.169	2.90	3,040.03	0.75
duzce	697.35	14,015.83	0.351	3.68	1,166.20	1.20
kutahya	694.74	12,306.11	0.573	3.20	1,458.45	0.81

Table 2.2 (cont'd)

Province	HP	GDP (per capita)	Pop.(mil)	Avg. HH Size	Construction Permit	ΔHousing Stock
usak	693.3	12,920.36	0.347	3.24	929.55	0.86
ordu	689.01	8,564.23	0.730	3.43	1,822.05	0.86
amasya	684.32	11,381.86	0.325	3.40	793.83	0.83
batman	683.76	7,244.61	0.540	6.34	657.45	0.77
cankiri	676.49	11,505.33	0.183	3.13	549.9	0.94
tokat	669.13	8,453.27	0.608	3.64	988.05	0.59
adana	662.24	11,060.02	2.135	3.97	3,985.05	0.74
konya	646.27	12,069.16	2.076	3.70	5,497.03	0.97
edirne	640.59	13,565.32	0.399	3.00	974.88	0.74
hatay	635.97	9,907.34	1.501	4.16	3,477.90	0.96
erzincan	635.02	13,586.25	0.221	3.40	570.33	0.87
samsun	631.11	11,150.98	1.267	3.72	3,743.83	1.09
corum	618.85	10,125.59	0.533	3.35	1,179.58	0.74
kirklareli	617.71	16,931.83	0.343	3.03	1,181.48	1.04
sanliurfa	617.14	5,786.69	1.785	6.19	2,933.85	0.99
tekirdag	613.23	20,851.45	0.876	3.35	4,189.95	1.57
47 karaman	612.38	14,607.99	0.238	3.38	602.83	0.85
kirsehir	604.54	10,608.98	0.225	3.38	718.05	1.07
mardin	597.00	7,745.30	0.775	6.13	1,589.88	1.25
adiyaman	595.99	6,726.15	0.598	4.82	918.58	0.74
bilecik	583.44	19,067.14	0.210	3.15	614.6	0.91
nevsehir	582.24	10,671.68	0.286	3.49	713.4	0.87
diyarbakir	577.58	7,226.49	1.600	5.72	2,282.70	0.81
aksaray	566.75	10,338.74	0.384	3.93	1,141.73	1.15
giresun	558.01	9,506.43	0.427	3.20	944.93	0.71
mersin	549.88	12,420.04	1.702	3.61	4,633.45	0.97
kars	548.94	7,620.48	0.300	4.71	410.33	0.65
kirikkale	546.69	12,223.36	0.276	3.32	963.45	1.16
erzurum	543.5	9,247.23	0.769	4.46	1,204.30	0.70
kilis	538.91	7,975.65	0.127	4.13	328.13	1.06
van	538.4	5,485.93	1.061	6.19	1,014.45	0.59

Table 2.2 (cont'd)

Province	HP	GDP (per capita)	Pop.(mil)	Avg. HH Size	Construction Permit	Δ Housing Stock
kayseri	537.25	13,526.85	1.287	3.79	4,252.35	1.25
nigde	536.34	10,078.76	0.344	3.61	962.2	1.01
elazig	532.63	9,818.20	0.565	3.93	1,422.88	0.99
yozgat	528.79	9,119.52	0.450	3.67	879.20	0.72
kahramanmaras	510.24	9,354.69	1.074	4.31	2,711.68	1.08
osmaniye	506.93	8,771.01	0.497	4.09	1,253.93	1.02
malatya	486.73	8,892.70	0.761	4.00	1,942.45	1.02

Notes: All monetary values are real, expressed in 2008Q1 prices. *HP* indicates the average real house price per meter square, *GDP* indicates the average real GDP per capita, *Construction Permits* indicates the average number of residential construction permits, Δ *Housing Stock* is the fraction of residential construction permits to population multiplied by the average household size.

Table 2.3: Summary Statistics and the Correlation Matrix of the Variables, 2008Q1-2017Q4.

Panel A. Summary Statistics						
	N	Mean	p50	Sd	Min	Max
$\Delta\text{HousingStock}$ (%)	2,652	0.949	0.792	0.74	0	10.421
$\Delta\text{Ln(HP)}$ (%)	2,652	-0.43	-0.15	2.368	-10.062	7.541
Ln(Cost)	2,652	4.816	4.808	0.048	4.718	5.01
Ln(GDP)	2,652	9.384	9.38	0.349	8.354	10.409
Panel B. Pairwise Correlation Coefficients						
	$\Delta\text{HousingStock}$	$\Delta\text{Ln(HP)}$	Ln(Cost)	Ln(GDP)		
$\Delta\text{HousingStock}$	1.000					
$\Delta\text{Ln(HP)}$	0.175*	1.000				
Ln(Cost)	-0.084*	-0.380*	1.000			
Ln(GDP)	0.213*	0.234*	0.112*	1.000		

Notes: $\Delta\text{HousingStock}$ is the ratio of construction permits to population, multiplied by the average household size. $\Delta\text{Ln(HP)}$ is the real house price growth for each province, Ln(Cost) is the logarithm of the real construction cost index, and Ln(GDP) is the logarithm of real GDP per capita. * Indicates significance level at %5.

Table 2.4: Housing Supply Elasticity Estimates, 2008Q1-2017Q4.

	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) OLS	(6) OLS	(7) IV	(8) IV
$\Delta \ln(HP)$	0.029*** (0.007)	0.035*** (0.007)	0.055** (0.024)	0.065*** (0.024)	0.047*** (0.012)	0.053*** (0.012)	0.065** (0.029)	0.074** (0.030)
$\Delta \ln(HP) * Undev$					-0.043** (0.019)	-0.043** (0.019)	-0.027 (0.035)	-0.023 (0.036)
$\ln(Cost)$		-0.010 (0.554)		0.093 (0.539)		0.099 (0.556)		0.150 (0.547)
$\ln(GDP)$		2.125*** (0.373)		2.254*** (0.384)		2.118*** (0.372)		2.247*** (0.383)
N	2,652	2,652	2,652	2,652	2,652	2,652	2,652	2,652
R-squared	0.267	0.280	0.264	0.276	0.268	0.280	0.266	0.277
Control Vars.	No	Yes	No	Yes	No	Yes	No	Yes
Kleibergen-Paap rk Wald F			135.5	130			68.11	65.03
Overidentification p-value			0.834	0.718			0.636	0.665

Notes: The dependent variable is the ratio of construction permits to population, multiplied by the average household size. $\Delta \ln(HP)$ is the real house price growth for each province, $\ln(Cost)$ is the logarithm of the real construction cost index, $\ln(GDP)$ is the logarithm of real GDP per capita, and $Undev$ is the undevelopable land share. The model includes province, year, and quarter fixed effects. Robust standard errors are reported in parenthesis. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 2.5: Estimation of Housing Supply Elasticity at Province Level, 2008Q1-2017Q4.

Province	Model 1	Model 2	Model 3	Model 4	Province	Model 1	Model 2	Model 3	Model 4
aksaray	0.198**	0.195**	0.261*	0.241*	elazig	0.056*	0.107***	0.105*	0.145**
bolu	0.149**	0.143***	0.171**	0.169**	mersin	0.055	0.071**	-0.008	-0.037
tekirdag	0.139***	0.139*	0.19***	0.196***	erzurum	0.055**	0.063**	0.075**	0.079**
denizli	0.126*	0.122***	0.175*	0.187*	kilis	0.054	0.091***	0.016	0.055
nevsehir	0.119***	0.135*	0.089	0.107	konya	0.053*	0.059	0.039	0.039
kirikkale	0.119**	0.139***	0.045	0.054	k.maras	0.048*	0.051*	-0.018	-0.055
karabuk	0.118***	0.123**	0.078	0.076	mugla	0.040*	0.047	0.017	0.032
samsun	0.117***	0.17***	0.169**	0.232**	osmaniye	0.039	0.076*	0.01	0.04
aydin	0.112***	0.123***	0.089*	0.106*	van	0.038	0.036*	0.048	0.034
tokat	0.107	0.121**	0.141	0.151	diyarbakir	0.038	0.029	0.029	0.013
kutahya	0.098***	0.104**	0.06**	0.043	sinop	0.037*	0.05*	0.022	0.027
cankiri	0.097**	0.099***	0.08	0.049	adiyaman	0.032	0.058**	-0.018	0.006
kastamonu	0.090**	0.111***	0.09	0.097	batman	0.031	0.068*	-0.029	0.005
canakkale	0.090***	0.115***	0.085	0.138**	s.urfa	0.031	0.034	-0.022	-0.04
bursa	0.089**	0.099*	0.107**	0.125***	usak	0.03	0.028	-0.006	-0.036
nigde	0.089**	0.069***	0.077	-0.017	bilecik	0.029	0.063	0.003	0.035
eskisehir	0.087**	0.074***	0.121*	0.097**	isparta	0.028*	0.027**	0.016	0.006
kirsehir	0.083**	0.103***	0.079*	0.084	kocaeli	0.027*	0.043	0.008	0.021
malatya	0.083**	0.122**	0.059	0.097	rize	0.025*	0.03	0.003	-0.001
afyon	0.078*	0.073***	0.112	0.09	mardin	0.025	0.036*	-0.055	-0.026
kars	0.075**	0.058**	0.009	-0.051*	istanbul	0.024*	0.02	0.032	0.031
duzce	0.071	0.073**	0.074	0.083	corum	0.024	0.045**	0.007	0.026
kirklareli	0.071**	0.095*	0.084	0.104	trabzon	0.023	0.035	-0.093	-0.072
sakarya	0.069	0.095**	0.091*	0.128**	zonguldak	0.019**	0.017	0.014	0.009
bartin	0.066**	0.075***	0.049	0.057	erzincan	0.019	0.024	-0.042	-0.052
yozgat	0.064***	0.072**	0.074***	0.076***	giresun	0.018	0.043	0.003	0.027
burdur	0.064***	0.073	0.082*	0.089*	ankara	0.017	0.033*	0.051	0.078*
gaziantep	0.064**	0.066**	0.031	0.028	ordu	0.015	0.03	0.01	0.025
hatay	0.062**	0.078**	0.026	0.052	amasya	0.014	0.042*	-0.015	0.009
balikesir	0.062**	0.072**	0.06	0.081*	edirne	-0.002	-0.003	-0.004	-0.013
kayseri	0.061	0.071***	0.072	0.059	antalya	-0.003	0.017	-0.018	0.001

Table 2.5 (cont'd)

Province	Model 1	Model 2	Model 3	Model 4	Province	Model 1	Model 2	Model 3	Model 4
yalova	0.061**	0.073**	0.044	0.053*	sivas	-0.009	-0.001	-0.093	-0.157*
manisa	0.061*	0.064*	0.058	0.048	adana	-0.023	-0.029	-0.053*	-0.075**
izmir	0.057**	0.071*	0.049	0.074*	karaman	-0.024	-0.023	-0.076	-0.093

Notes: The dependent variable is the ratio of construction permits to population, multiplied by the average household size. The reported estimates are the coefficient on $\Delta \ln(HP)$ is the real house price growth for each province. Model 1 includes only $\Delta \ln(HP)$, Model 2 includes $\Delta \ln(HP)$ and quarter fixed effects, Model 3 includes $\Delta \ln(HP)$ and construction cost, and Model 4 includes $\Delta \ln(HP)$, construction cost and quarter fixed effects. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 2.6: Test of the Equality of Means of the Ratio of Forestry Area to Total Area in Strict and Less Strict Provinces.

Year	All Provinces			Provinces w/ HP Data		
	Forest Area Share (%)					
	Less Strict	Strict	p-value	Less Strict	Strict	p-value
1990	50.306	58.246	0.038	49.57	53.143	0.36
2000	50.512	58.333	0.038	49.696	53.239	0.363
2006	49.517	55.926	0.089	48.443	51.206	0.465
2012	49.272	55.239	0.116	48.182	50.699	0.508
2018	49.18	55.105	0.119	48.095	50.542	0.52
N	39	42		37	31	

Source: The Ministry of Agriculture and Forestry.

Table 2.7: Test of the Equality of Means of Housing Related Variables.

	Less Strict	N	Strict	N	p-value
$\Delta HousingStock$	0.943	1,480	0.930	1,240	0.637
HP	676.789	1,480	698.972	1,240	0.000
$\Delta Ln(HP)$	-0.400	1,443	-0.465	1,209	0.486

Notes: $\Delta HousingStock$, HP and $\Delta Ln(HP)$ denotes the housing stock growth, the real house prices and the growth of real house prices, respectively.

Table 2.8: Correlation Matrix of the Variables Used in Explaining Housing Supply Elasticities.

	Elasticity	Undev	Avg. Slope	Ln(Population ₂₀₀₈₋₂₀₁₇)	Ln(HP ₀₈)
Elasticity	1.000				
Undev	-0.252	1.000			
Avg. Slope	-0.305	0.913	1.000		
Ln(Population ₂₀₀₈₋₂₀₁₇)	-0.242	-0.165	-0.181	1.000	
Ln(HP ₀₈)	-0.160	0.165	0.172	0.269	1.000
$\Delta(\text{Green\&Agriculture})$	-0.207	0.295	0.265	0.338	0.297

Note: Ln(Population₂₀₀₈₋₂₀₁₇) is the average population in a province for the period of 2008-2017, $\Delta(\text{Green\&Agriculture})$ is the change in green and agricultural areas per capita in a province between 2006 and 2012.

Table 2.9: Determinants of Housing Supply Elasticity.

	(1) Elasticity	(2) Elasticity	(3) Elasticity	(4) Elasticity	(5) Elasticity	(6) Elasticity	(7) Elasticity	(8) Elasticity
Geographic								
Undev	-0.051** (0.023)	-0.052** (0.022)	-0.049* (0.024)	-0.051** (0.023)				
Avg. Slope					-0.177*** (0.056)	-0.176*** (0.055)	-0.167*** (0.061)	-0.171*** (0.060)
Economic								
Ln(Population ₂₀₀₈₋₂₀₁₇)	-0.012** (0.005)	-0.010* (0.005)	-0.012** (0.005)	-0.010** (0.005)	-0.013*** (0.005)	-0.011** (0.005)	-0.013** (0.005)	-0.011** (0.005)
Ln(HP ₀₈)	-0.008 (0.023)	-0.011 (0.023)			-0.004 (0.023)	-0.007 (0.024)		
Rank_Improve			-0.011 (0.010)	-0.010 (0.010)			-0.009 (0.010)	-0.008 (0.010)
Regulatory								
Δ(Green&Agriculture)	-0.273 (1.640)		-0.471 (1.610)		-0.088 (1.652)		-0.248 (1.620)	
Strict		-0.021** (0.010)		-0.020** (0.009)		-0.021** (0.009)		-0.020** (0.009)
N	64	64	64	64	64	64	64	64
R-squared	0.148	0.215	0.166	0.228	0.185	0.253	0.198	0.263

Notes: The dependent variable is the estimated elasticities using Equation (2) for each province. *Undev* is the undevelopable land share, *Avg. Slope* is the average slope. *Ln(Population₂₀₀₈₋₂₀₁₇)* is the logarithm of the mean population over the sample period, and *Ln(HP₀₈)* is the logarithm of the real house price in 2008, *Rank_Improve* is the dummy variable indicating the improvement in the socio-economic development ranking index from 2003 to 2011, *Δ(Green&Agriculture)* is the change in green and agricultural areas from 2006 to 2012 per capita, and *Strict* is a dummy variable that takes the value 1 if the ratio of sold 2/B areas to the total application area is below the average, 0 otherwise. Robust standard errors are reported in parenthesis. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 2.10: Housing Supply Elasticity Estimates by Province Using a Pooled Sample, 2008Q1-2017Q4.

Panel A. Variables		Panel B. Statistics	
Ln(Cost)	-0.029 (0.582)	N	2,652
Ln(GDP)	2.320*** (0.418)	R-squared	0.294
		Province FE	Yes
		Year&Quarter FE	Yes
Panel C. Province Elasticities			
bolu	0.131**	sanliurfa	0.032
aksaray	0.126	burdur	0.029*
kirikkale	0.107***	sinop	0.029*
tekirdag	0.090**	mugla	0.028
tokat	0.090	bartin	0.025
nevsehir	0.089**	diyarbakir	0.025
samsun	0.088***	osmaniye	0.024
eskisehir	0.086*	elazig	0.023
kutahya	0.080***	yozgat	0.023
gaziantep	0.076***	batman	0.022
karabuk	0.074**	isparta	0.022
duzce	0.073*	ankara	0.018
aydin	0.065***	bilecik	0.014
kirklareli	0.062**	istanbul	0.014
nigde	0.060	kocaeli	0.014
kilis	0.059	erzurum	0.013
kastamonu	0.058*	giresun	0.013
k.maras	0.057**	adiyaman	0.012
canakkale	0.056**	corum	0.009
denizli	0.054	mardin	0.007
kayseri	0.053	usak	0.007
bursa	0.052*	amasya	0.001
cankiri	0.051	erzincan	-0.004
kirsehir	0.051	konya	-0.006
yalova	0.051**	trabzon	-0.006
hatay	0.049**	rize	-0.011

Table 2.10 (cont'd)

Panel C. Province Elasticities

kars	0.045*	adana	-0.013
balikesir	0.044**	antalya	-0.022
mersin	0.043	van	-0.022
izmir	0.041**	edirne	-0.024
malatya	0.040	sivas	-0.027
afyon	0.036	zonguldak	-0.033**
manisa	0.033	ordu	-0.041
sakarya	0.032	karaman	-0.045

Notes: The dependent variable is the ratio of construction permits to population, multiplied by the average household size. $\ln(\text{Cost})$ is the logarithm of the real construction cost index, $\ln(\text{GDP})$ is the logarithm of real GDP per capita. Estimates in Panel C. is the coefficient on the interaction term between the $\Delta \ln(\text{HP})$ and the province fixed effects. The model includes province, year, and quarter fixed effects. Robust standard errors are reported in parenthesis. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 2.11: Determinants of the Housing Supply Elasticity, Pooled Sample.

	(1) Elasticity	(2) Elasticity	(3) Elasticity	(4) Elasticity	(5) Elasticity	(6) Elasticity	(7) Elasticity	(8) Elasticity
Geographic								
Undev	-0.020 (0.025)	-0.028 (0.021)	-0.015 (0.027)	-0.024 (0.022)				
Avg. Slope					-0.109 (0.078)	-0.125* (0.072)	-0.094 (0.085)	-0.112 (0.076)
Economic								
Ln(Population ₂₀₀₈₋₂₀₁₇)	-0.004 (0.004)	-0.005 (0.004)	-0.002 (0.003)	-0.003 (0.003)	-0.005 (0.004)	-0.005 (0.004)	-0.003 (0.003)	-0.004 (0.004)
Ln(HP ₀₈)	0.024 (0.024)	0.020 (0.021)			0.024 (0.023)	0.020 (0.021)		
Rank_Improve			-0.014* (0.008)	-0.013* (0.008)			-0.013* (0.008)	-0.012 (0.008)
Regulatory								
Δ(Green&Agriculture)	-1.701 (1.561)		-1.773 (1.543)		-1.502 (1.529)		-1.540 (1.493)	
Strict		-0.016** (0.008)		-0.017** (0.008)		-0.016** (0.008)		-0.016** (0.008)
N	54	54	54	54	54	54	54	54
R-squared	0.070	0.120	0.106	0.155	0.101	0.151	0.132	0.183

Notes: The dependent variable is the estimated elasticities using Equation (3). *Undev* is the undevelopable land share, *Avg. Slope* is the average slope. *Ln(Population₂₀₀₈₋₂₀₁₇)* is the logarithm of the mean population over the sample period, and *Ln(HP₀₈)* is the logarithm of the real house price in 2008, *Rank_Improve* is the improvement in the socio-economic development ranking index from 2003 to 2011, *Δ(Green&Agriculture)* is the change in green and agricultural areas from 2006 to 2012 per capita, and *Strict* is a dummy variable that takes the value 1 if the ratio of sold 2/B areas to the total application area is below the average, 0 otherwise. Robust standard errors are reported in parenthesis. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

CHAPTER 3

HOUSE PRICES AND BANK LOAN PORTFOLIOS IN AN EMERGING MARKET: THE ROLE OF BANK OWNERSHIP[†]

3.1. Introduction

The global financial crisis of 2007/2008 increased interest in the relationship between house prices and bank lending. Several studies show that banking stability is highly sensitive to fluctuations in house prices and any shock to house prices propagates across banks, which can jeopardize the whole banking system (for example, see Tajik et al., 2015; Deng et al., 2019). Mainly, two channels are discussed in the literature to explain how house prices can affect banks' lending. The first mechanism, the collateral channel, implies that banks increase their credit provision because of a rise in loan demand with the increase in the collateral value of borrowers' pledged assets (Bernanke and Gertler, 1989; Kiyotaki and Moore, 1997). The second channel, also known as the bank lending channel, suggests that an appreciation in house prices makes banks' assets less risky and increases their willingness to provide credits to take advantage of profitable opportunities in the mortgage market. However, if banks have a problem raising new capital or selling their loans, they may reduce their commercial and industrial loans. This crowding-out effect of mortgage loans due

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to house price appreciation is observed in the US (Chakraborty et al., 2018), but we are not aware of any evidence from emerging economies²⁴ where loan misallocation may have adverse effects on economic growth because of their less-developed financial systems and firms' bank dependence in these economies.

In this chapter, we try to fill the gap in the literature and study how domestic banks (namely, private and state-owned) allocate their loans as house prices appreciate in an emerging market, Turkey. To analyze this relationship, we focus on the mortgage, consumer, commercial loans, and loans made to several industries where firms might have difficulty accessing financing. In the literature, it is shown that house price crashes cause a decline in bank lending (Gan, 2007; Cuñat et al., 2018), but there is mixed evidence on how banks change their loan allocations during the housing boom period for developed economies. For example, Chakraborty et al. (2018) report that banks increased mortgage lending but decreased commercial lending over the period 1988–2006 in the US. The crowding out of commercial loans toward housing loans by the big four banks, with the increase in house prices, is also found in Australia (Li et al., 2019). However, they do not find a similar crowding-out effect on consumer loans. Martin et al. (2021) document that an increase in house prices in Spain first crowded out credits to the non-housing sector, but then banks increased the credit supply to all industries. Tai (2017) reports that banks reduced their non-mortgage consumer credit supply during the period 2002-2006 in the US.

Banks' loan allocation decisions are crucial in developing countries for several reasons. First, firms in these countries depend more on bank financing because of their less-developed capital markets (Meghana et al., 2012). Also, bank lending constitutes the primary source of financing economic growth in these

²⁴ There are several studies that investigate how bank loans affect house prices in emerging markets; for instance, Tunc (2019) studies the effect of exogenous credit supply shocks on house prices in Turkey. However, none of these studies investigates how banks change their loan portfolio with the appreciation in house prices.

countries (Vo, 2018). Second, even though household credit has overgrown in emerging economies,²⁵ several studies indicate that mortgage credits and credits to households do not significantly affect economic growth. For example, Beck et al. (2008) document that credits to enterprises positively affect economic growth, but credits to households do not have any significant impact. Moreover, Bezemer et al. (2016) report that financial development during the 1990–2011 period was mainly through credit to real estate and other asset markets that negatively affected the economic growth. Both of these studies investigate developed and developing countries. Nevertheless, Lim (2018) shows that economic growth is accelerated due to improvement in business owners' borrowing capacities during housing boom periods, especially in countries with less developed financial systems. These studies suggest that if banks do not provide commercial loans but issue mortgage or consumer loans when house prices increase, this loan misallocation may adversely affect the economic growth of emerging economies.

We also examine whether the ownership structure of banks has an impact on banks' loan allocation decisions in response to house price appreciation. State-bank ownership is common outside the US, and such ownership is higher in countries with less developed financial systems and low GDP per capita (La Porta et al., 2002). The average share of state-owned banks in developing (developed) countries was 18% (12%) in 2010 (Cull et al., 2018). Cooray (2011) finds that even though the size of government has a positive effect on the size of the financial sector in low-income countries, the government ownership of banks reduces the sector's efficiency. State-owned banks played an essential role in restoring banking stability by increasing their credit more than private banks

²⁵ For instance, Bahadir and Gumus (2016) show that the fraction of household debt to GDP ratio rose in emerging countries between the 1993-2014 period, especially in Korea, Brazil and Turkey. Garber et al. (2019) document that the household debt to GDP ratio increased from 10% in 2005 to 25% in 2014 in Brazil. According to Bank for International Settlements (BIS) statistics, household credits as a percentage of GDP in Turkey increased from 4.0% in 2000 to 11.2% in 2007 and 17.8% in 2015.

during the global financial crisis (Allen et al., 2017; De Haas et al., 2014). However, many studies show that they lend with political incentives. For instance, Coleman and Feler (2015) document that state-owned banks in Brazil increased their lending after the collapse of Lehman Brothers, but their lending was political and reduced productivity growth. These banks also provide loans to politically connected areas and favor some sectors or firms around election periods (Sapienza, 2004; Dinc, 2005; Claessens et al., 2008; Carvalho, 2014; Kumar, 2020). Onder and Ozyildirim (2013) document that state-owned banks provide credit for political reasons during election years in Turkey. Similarly, Bircan and Saka (2021) find that state-owned banks adjust their lending around local elections and increase their commercial lending in provinces based on the degree of political competition.²⁶ In this study, we investigate how banks allocate their loans with the appreciation in house prices in Turkey and whether state-owned banks behave differently from private banks in order to achieve economic growth in the economy.

We use data from Turkey to examine the relationship between the change in house prices and the growth of loans provided by private and state-owned banks at the province level for the period 2007Q4–2015Q2. Turkey can be considered a representative of emerging countries in terms of its banking structure and growth strategies. As stated in the 2013 World Bank Country report, Turkey’s rapid economic and social progress provides valuable lessons for policymakers in other emerging markets (Orhangazi and Yeldan, 2020). Similar to many emerging economies (such as China, Malaysia, and Mexico), the government has had a growth strategy driven by consumption, credit, and government spending without sufficient investment, resulting in “low-quality” growth (Acemoglu and Ucer, 2020). Over the last decade, the construction sector has been the backbone of the Turkish economy. The Turkish government

²⁶ All of these studies examine the specific periods in which politicians may use their power to influence state-owned banks’ lending decisions. In this study, we focus on an extended period instead of examining how these banks’ lending decisions change around election periods at the province level.

has provided several incentives for developing construction and real estate industries, including legal interventions and the centralization of investment decisions. The average real GDP growth rate in the post-2009 period was around 6.5% per annum in Turkey, and this growth rate was fueled by credit and a massive surge in the construction industry. Demiralp et al. (2016) show that the public spending in the construction sector as a share of GDP grew rapidly since 2004, while private spending in the construction sector declined following the global financial crisis. Although the mortgage market did not develop well due to a high inflation rate,²⁷ it is highly promoted by the government.²⁸ Finally, several studies report that state-owned banks operate with not only political incentives but also development incentives in Turkey. Onder and Ozyildirim (2011) show that state-owned banks provide loans to politically connected but less developed provinces; their lending during crisis periods mitigates the adverse effects of crises (Onder and Ozyildirim, 2013). Ongena and Sendeniz-Yuncu (2011) show that young firms, considered opaque and risky, prefer to get loans from state-owned banks. Thus, our findings can shed light on other developing countries that take the same path for growth and have similar banking characteristics.

In our empirical setting, the major challenge is the endogeneity of house prices. In order to solve the endogeneity problem and estimate the impact of the house price growth on the provision of different types of bank loans, we follow the literature and apply the instrumental variable (IV) approach in the estimations.

²⁷ The inflation rate in Turkey was 68.53% in 2001. It declined to 8.39% in 2007 and was 7.20% in June 2015. Mortgages, commonly used in developed markets, were introduced in 2007 in Turkey.

²⁸ For anecdotal evidence, state-owned banks have recently offered mortgage loans with interest rates below market rates to boost the sale of housing units and reduce housing stock. The Minister of Finance announced that state-owned banks (Ziraat, Vakif, and Halk Bank) provided mortgage loans with the monthly interest rate of 0.79% for the newly constructed housing units on January 2, 2020, while the monthly interest rate on mortgage credits offered by other banks was more than 1.00 percent. (See, for instance, <https://www.dailysabah.com/finance/2019/12/27/turkeys-public-lenders-to-lower-interest-rates-in-first-house-sales>.)

The share of unavailable land²⁹ in the province is used as an IV (for example, see Adelino et al., 2015; Loutskina and Strahan, 2015; Chakraborty et al., 2018; Cuñat et al., 2018). In order to add a time variation to the instrument, we interact the unavailable land share in a province with the mortgage interest rate, similar to Chakraborty et al. (2018). Another challenge in the analysis is controlling for bank and provincial characteristics that might affect banks' loan provisions. Similar to Cuñat et al. (2018), we include province-quarter and bank-province fixed effects in the model to solve this problem. The time-varying bank characteristics are controlled with bank-quarter fixed effects in the models.

The analysis of house prices and the growth of loans issued by private and state-owned banks at the provincial level in Turkey indicates that commercial loans, and some selected industrial loans that are expected to increase private sector employment, are crowded out by mortgage, consumer, and the construction loans with the increase in house prices. The crowding-out effect on commercial loans due to house price increases observed in developed markets is also found in this emerging market. Further, we document that bank ownership matters as state-owned banks are found to reduce their commercial and agricultural loans more than private banks when house prices appreciate. No significant difference is found between state-owned and private banks regarding the effect of house prices on mortgage loan growth rates. These findings indicate that the crowding-out effect of mortgage loans is more pronounced for state-owned banks. We contribute to the literature by showing that loan misallocation by state-owned banks is not specific to election periods, and these banks seem to support the debt-based and construction-oriented growth objective of the government by increasing their mortgage loans during the normal periods. Our findings are robust to including foreign and Islamic

²⁹ Unavailable land share, defined as the percentage of undevelopable land, is used as a geographic determinant of house prices and house supply after Saiz (2010). It reflects the area constrained to construction due to topographic restrictions, and it is not related to the demand for housing or mortgage. For an area to be classified as undevelopable, its slope must be higher than 15%.

banks in the sample, controlling for the banks' credit risks in the model, and controlling for province-industry distribution with regional fixed effects.

The chapter is organized as follows: The next section provides information about the banking industry and house prices in Turkey. Our methodology and the data used in the analysis are explained in the third section. In the fourth section, we provide the results of the main models and several robustness checks. The conclusion and some policy implications are discussed in the last section.

3.2. Banking and Housing Industries in Turkey

The Turkish banking system is mainly dominated by commercial banks. They hold almost 90% of the total assets of the Turkish banking industry, whereas investment and development banks and Islamic banks have a share around 5% in 2015. Table 3.1 provides the characteristics of deposit collecting banks (classified based on their ownership as private, foreign, or state-owned) and the Islamic banks operating in Turkey for the period 2007–2015. The importance of state-owned banks stems from the fact that these banks were established for the development of several industries in Turkey (such as agriculture, real estate, small- and medium-sized enterprises, merchants, and craftsmen) and have played an important role in the economic growth of the country by providing subsidized or regular loans to underserved markets since their establishments.

The asset shares of domestic-private, state-owned, and foreign deposit collecting banks in 2015 are 37.8%, 30.1%, and 26.8%, respectively. The loan provisions and loan compositions of banks changed over the sample period, depending on their ownership. While the credit share of state-owned banks increased from 22.3% in 2007 to 30.3% in 2015, it is consistent with the debt-driven growth strategy of the government. Private banks' credit share declined from 56.9% to 38.3% in the same period. A part of the decline in the share of private banks can be explained by the acquisition of some private banks by

foreign banks. The credit share of Islamic banks has not increased much compared to the increase in their number of branches. During the sample period, all banks increased the share of commercial loans and decreased the share of consumer and mortgage loans, except Islamic banks. Private and state-owned banks have branches over the whole country and had at least one branch in each province during the sample period.

The mortgage loan is new to households in Turkey. Until 2007, home purchases were mostly made by personal savings, family borrowings, cooperative housing, or the sale of previously owned housing units (Sarioglu-Erdogdu, 2014). Since the enactment of the mortgage law in March 2007, mortgages have been used as a way of financing home purchases. Although they have been highly promoted to finance home purchases, high interest rates have restricted potential home buyers from getting a mortgage. Figure 3.1 shows the share of house purchases financed by mortgages in Turkey and the mortgage interest rates over the period 2007–2017. The average mortgage rate was more than 10% in this period, and it fell from more than 20% in 2008 to less than 10% in the second quarter of 2013. While home buying with a mortgage constituted 42% of the total sales in the first quarter of 2013, it declined to 37% in June 2015. The percentage of housing units sold with mortgage financing is negatively related to the mortgage rate, as shown in Figure 3.1. Over the sample period, the amount of mortgage loans provided by private and state-owned banks increased gradually, with an average quarterly real growth rate at around 3.7%.

In line with the advances in the mortgage market, house prices in the Turkish provinces have increased as well. Figure 3.2 presents the nominal and real house price indexes developed by REIDIN for the seven largest provinces (TR7) and for the whole country (TR81),³⁰ as well as for the provinces that

³⁰ REIDIN compiles house prices from various sources, including real estate realtors, printed media, online sources, and housing projects.

experienced the highest (Istanbul) and the lowest (Mardin) growth rate in house prices. The house price index developed by the Central Bank of the Republic of Turkey (CBT) is also presented.³¹ While real house prices at the aggregate level decreased in Turkey during the global recession period, nominal and real house prices increased thereafter. Nevertheless, this increase in house prices is not considered to be a bubble (Coskun et al., 2017). Over the sample period, not all provinces had the same upward trend. For instance, while real house prices in Istanbul were rising, they were declining in Mardin.

3.3. Methodology and Data

3.3.1. Empirical Model

To examine the relationship between house prices and loan provisions by banks at the province level, we estimate the following fixed-effects model:

$$Growth\ Loan_{bit} = \alpha_1 Growth\ HP_{it} + \alpha_2 X_{bit-1} + \alpha_3 State + \rho_{it} + \mu_{bi} + \theta_{bt} + \delta_t + \varepsilon_{bit}, (1)$$

where $Growth\ Loan_{bit}$ is the quarterly growth rate of loans provided by bank type b , in province i at quarter t . It stands for mortgage, consumer, and commercial loans, as well as for loans provided to three industries that are usually subsidized by the government (i.e., agriculture, food, and textile industries).³² $Growth\ HP_{it}$ is the real quarterly appreciation rate of house price in a province. X_{bit-1} represents the variables included in the model to control for the economic conditions of a province, including quarterly GDP growth, deposit

³¹ Besides REIDIN, CBT reports the house price index available at the national and the 26 sub-regions, called NUTS-2 levels, since 2010. These indexes are constructed from house appraisal values at the time of mortgage origination by banks.

³² Commercial loans include loans to industries including agriculture, textile, food, mining and quarrying, manufacturing, electric, gas, and water resources, wholesale and retail trade, tourism, and transportation. We separately estimate our models for the loans to agriculture, food, and textile industries because small and medium enterprises that might have limited access to financing usually operate in these industries.

growth, and employment growth rates.³³ *State* is a dummy variable that takes the value 1 if loans are issued by state-owned banks and 0 otherwise. In estimating loans to specific industries, employment growth rate in that industry is used in the model. To reduce the potential endogeneity concerns, the lagged values of control variables are included in the model. ρ_{it} , μ_{bi} , θ_{bt} , and δ_t represent the province-quarter, bank-province, bank-quarter, and year fixed effects.

Province-quarter fixed effects, ρ_{it} , are included in the model to control for any time-varying heterogeneous characteristics of the provinces and also to account for seasonality. For instance, governments have provided some subsidies to specific industries located in certain areas; with industrialization or with an increase in the population of provinces, the demand for consumer and commercial loans changes. Bank-province fixed effects, μ_{bi} , are included in the model to control the time-invariant characteristics of province-bank pairs. For example, branches of private banks are concentrated mostly in the western part of the country; state-owned banks have more branches in less developed provinces than private banks. Time variant bank characteristics are controlled by bank-quarter fixed effects.³⁴ With the year fixed effects, δ_t , we try to eliminate

³³ Employment growth rate is used as a proxy to control for the demand for commercial or industrial loans in a province. In order to check whether it is a good proxy for loan demand, the correlation coefficients between the employment growth rate and the growth in capital expenditures of the industry with its subindustries are calculated. Because capital expenditure is not available at the province level, we use the yearly national employment levels available since 2009. The correlation coefficients between national employment growth rate in the food, beverages, and tobacco industries and the growth rate in capital expenditures in these industries in the period 2009-2015 are 46.97%, 19.60%, and 72.57%, respectively. Similarly, the correlation coefficients between growth rates of employment growth rate in the textile and apparel industries and their annual capital expenditures in these industries are 79.26% and 70.10%, respectively. These high correlation coefficients between employment and capital expenditure growth rates suggest that we can use the employment growth rate at the province level as a proxy for loan demand for these industries. The correlation coefficient between employment growth rate and growth in capital expenditures in the agriculture industry is lower, 46.98%. This relatively low correlation can be explained by the presence of seasonal or temporary employment in agriculture.

³⁴ Unlike Cuñat et al. (2018), we do not have data at the bank level. Therefore, we include bank-quarter fixed effects in order to control for time-varying characteristics of bank types.

the possible impacts of the global financial crisis of 2007–2008, elections, and changes in regulations enacted during the sample period.

We expect a positive relationship between the appreciation of house prices and the growth rate of mortgage loans if banks provide more mortgage loans with the increase in house prices. Hence, α_1 is hypothesized to be positive for mortgage loans. This relationship is not obvious for other types of loans. On the one hand, banks may increase their commercial or consumer lending because their net worth as well as the collateral value of borrowers increases with the appreciation in house prices. In that case, the collateral channel or bank lending channel can be used to explain the positive coefficient on commercial and consumer loans. On the other hand, banks may cut their non-mortgage loans to meet the increased mortgage demand. Then, the coefficient, α_1 , is expected to be negative in explaining the growth rate of non-mortgage loans. In the literature, Chakraborty et al. (2018) and Tai (2017) document a negative coefficient of appreciation in house prices to explain the growth rate of commercial and non-mortgage consumer loans, respectively. However, Flannery and Lin (2017) find a positive coefficient in explaining the growth rates of commercial loans provided to small businesses in the US.

In order to investigate whether state-owned and private banks behave in the same way with the change in house prices, we estimate the model in Equation (1) by including an interaction term between the variables *State* and *Growth HP*. If state-owned banks support the growth strategy of the government by providing mortgage, consumer, and construction loans, we expect the coefficients of the interaction variable to be positive in explaining the growth rates of these loans. However, the coefficient of the interaction variable is expected to be negative in explaining the growth rates of commercial and industrial loans if state-owned banks reduce their provision of these loans more than private banks do with the appreciation in house prices in a province. In other words, the negative coefficient of interaction term indicates that crowding-out of commercial and

industrial loans issued by state-owned banks is more than that of private banks in the sample period.

In analyzing the effect of house price appreciation rate on loan originations, one should eliminate the reverse causality problem. An increase in loan provisions may also increase house prices. For example, Kim and Min (2011) show that an increase in household lending causes bubbles in house prices in Korea. To solve this issue, we follow the literature (for example, Saiz, 2010; Chakraborty et al., 2018; Cuñat et al., 2018) and estimate the model by using unavailable land share as an instrument. Unavailable land share in each province is an appropriate instrument because it is not related to credit demand but affects house prices through housing supply. It is exogenous to any change in economic activity in the province, and it is not associated with the growth rate of loan provisions by private and state-owned banks. Because of the difficulty to increase house supply in provinces with more unavailable land, house prices in these provinces are expected to increase more than in other provinces with less unavailable land. Thus, provinces with more unavailable land are expected to have higher house price growth than provinces with less constrained land for a given decline in mortgage rates. Similar to Chakraborty et al. (2018), we use the national level mortgage rate³⁵ and its interaction with unavailable land share in each province as instruments to predict house price appreciation rate. While the interaction of unavailable land share with the mortgage rate will introduce time variation to the unavailable land measure, adding mortgage rate will control for demand conditions in the province.

In this study, we examine only the lending behavior of private and state-owned banks. The credit share of these banks is approximately 70% in the loan market, as presented in Table 3.1. Foreign banks are not included in the analysis

³⁵ Anecdotal evidence suggests no difference between state-owned and private banks in terms of mortgage rates during our sample period, even though state-owned banks reduced their mortgage rates in recent years, especially during the Covid-19 pandemic.

because they may get funding from their parent companies in the case of profitable investment opportunities, although they are expected to behave like private banks in loan provisions. Islamic banks are not included in the analysis since their loan products are different from traditional loans. Because of the unavailability of individual bank-level data, we use aggregated loans issued in each province by bank type (private and state-owned).

3.3.2. Data and Summary Statistics

3.3.2.1. Instrumental Variable – Unavailable Land Share

We estimate the unavailable land share in each province by employing a procedure similar to that of Saiz (2010) as explained in Chapter 2. First, we draw a circle around the province center of each province; the radius for each province is determined by the distance between the province centers of the closest adjacent province.³⁶ Second, we calculate the slope of each cell within the circle around the province center using ArcGIS. The ratio of the area with a slope higher than 15% to the area of a circle (excluding the water bodies) is defined as unavailable land or undevelopable land share of that province. The average slope of a province in Turkey is around 19%, and the average unavailable land share is approximately 41%, changing between 1.58% and 93.13% (Table 3.2). Figure 3.3 shows the map of provinces with their unavailable land shares. The inner provinces are flatter and have a lower unavailable land share than those located in the northern and eastern parts of Turkey.

3.3.2.2. Bank and Province Characteristics

³⁶ Unlike Saiz (2010), the radius from the province center is not the same for all provinces, as in Wang et al. (2012).

We combine bank loan data and house price information at the provincial level in the analysis. Both datasets have been available since the last quarter of 2007. Their availability determines the beginning of the sample period. Bank-related data are obtained from FINTURK, a database maintained by Banking Regulation and Supervision of Agency (BRSA). They aggregate the data in each province by bank groups classified as private, state-owned, foreign, and Islamic, as well as by types of loans at each quarter. The total loans, commercial loans, mortgage loans, consumer loans, and loans provided to specific industries (such as agriculture, textile, and food) are available at the province level. Only cash loans are used in the analysis. In addition to loans, the deposit amounts of banks in each province are collected from the same database.

House price data are obtained from the databases maintained by REIDIN. Monthly house prices have been available for 68 provinces in Turkey³⁷ since December 2007. In order to be consistent with loan data, we use the end-of-quarter prices in calculating house price appreciation rates.

The summary statistics of the variables used in the estimations for the period 2007Q4–2015Q2 are reported in Table 3.2. The mean (median) quarterly real house price appreciation rate is negative during the sample period, -0.67% (-0.36%), whereas the average quarterly nominal house price growth rate is 1.29%. There were variations among provinces in terms of nominal and real house price appreciation rates. Figure 3.4 shows average quarterly real house price appreciation rates in each province over the sample period. The highest increase in house prices is observed in the western part of Turkey, mainly in the coastal provinces. While Istanbul (the most populated province in Turkey, with a population of more than 15 million) had the greatest house price appreciation

³⁷ There are 81 provinces in Turkey. House price data are not available for 13 provinces (Agri, Ardahan, Artvin, Bayburt, Bingöl, Bitlis, Gumushane, Hakkari, Iğdir, Mus, Siirt, Şirnak, and Tunceli). The majority of these provinces are located in the eastern and southeastern parts of Turkey.

rate, Mardin experienced a greatest decline in house prices over the sample period, as shown in Figure 3.2.

In our analysis, we winsorized all the loan growth rates at 5% level to remove the effects of extreme values. The quarterly growth rate of mortgage loans is higher than the appreciation rate of house prices in Turkey during the sample period. While the average growth rate of commercial loans is close to that of total loans, mortgage loans grow slightly more than consumer loans in Turkish provinces.

The average real GDP growth in the Turkish provinces, which is published by The Turkish Statistical Institute (TURKSTAT), was 1.07% during the sample period.³⁸ The real growth rates are obtained using the Consumer Price Index (CPI) published by TURKSTAT at the NUTS-2 level and assumed to be the same in each province in that NUTS-2 subdivision.³⁹ We obtained the national-level quarterly mortgage rate from CBT. Quarterly private sector employment data at the province level are obtained from databases maintained by the Ministry of Industry and Technology.

Table 3.3 presents the loan characteristics of private and state-owned banks separately. We observe that state-owned banks have a higher quarterly growth rate in loan originations than private banks for all types of loans except consumer loans. On average, the total amount of loans issued by state-owned banks in Turkish provinces increased quarterly by 4.39%, whereas the growth rate of the total loans provided by private banks is 4.05% for the sample period 2007Q4–2015Q2. The median percentage increase in mortgage loans and

³⁸ The GDP at the provincial level is available annually. We extrapolate yearly rates to quarterly values assuming that historical trend in each province will continue.

³⁹ NUTS level is a system for the division of the territory. There are twenty-six NUTS-2 sub-regions in Turkey. The three biggest provinces have their own NUTS-2 regions. Because CPI is reported at the NUTS-2 level, each province in a given NUTS-2 level is assumed to have the same CPI.

commercial loans by state-owned (private) banks is 3.76% (3.06%) and 3.38% (3.03%), respectively. Loans provided to specific industries analyzed in this study were increased more than commercial loans during the sample period. However, there is high variation in the growth rates of these loans among provinces.

We observe a variation in banks' exposure to the real estate market over time. Figure 3.5 plots the real house prices exposed by private and state-owned banks over the sample period. In these calculations, the price level in each province is weighted by mortgage loans issued by the corresponding bank type. The price levels are assumed to be one at the beginning of the sample period. Until the end of 2012, both banks have a similar index. However, after 2012, the index for state-owned banks lies below the index for private banks. It suggests that state-owned banks provide more mortgages in provinces with lower house prices than private banks.

3.4. Empirical Results

3.4.1. Are Bank Loans Affected by the Growth in House Prices?

We report the results of the first stage estimation in the last column of Table 3.4 (Column 8). There is a significant and negative relationship between house price appreciation rate and mortgage rate. A one percentage point decrease in the mortgage rate causes an increase in house prices by 0.23 percentage point. The statistics testing the validity of the IVs are reported at the bottom of Table 3.4, suggesting that we solve a weak instrument problem in the estimations. Kleibergen-Paap Wald F statistics are well above the threshold value, and the Hansen J test (Sargan test) fails to reject the hypothesis that there is no overidentification.

Columns (1) – (7) of Table 3.4 present the results of the second stage estimations examining the effect of the appreciation rate of house prices on the growth rate of bank loans.⁴⁰ There is heterogeneity across loan categories in their association with the change in house prices. It is found that, as house prices appreciate, growth rates of mortgage, consumer, and construction loans increase, but growth rates of commercial loans issued by banks decrease significantly, controlling for province, bank type characteristics and time effects. The negative coefficient on the appreciation rate in house prices in explaining the growth rate of commercial loans suggests that banks reduce their provision of commercial loans when house prices increase in a province. Hence, a crowding-out effect is observed on commercial loans in an emerging market, similar to the evidence in the US (Chakraborty et al., 2018). However, the findings related to consumer loans are different from those in the US. Unlike Tai (2017) who shows that lenders reduce their non-mortgage consumer loans to expand their mortgage lending with the appreciation of house prices in the US, our findings indicate that banks increase their provision of non-mortgage consumer loans in Turkey. This positive coefficient of *Growth HP* in the model for consumer loans suggests that mortgage borrowers might also get consumer loans from banks to complete the finance of their home purchases in Turkey.

Among the selected industrial loans, the association between the house price appreciation rate and the growth in loans to the textile and food industries is found to be significantly negative. These findings indicate that crowding-out effect is also observed for the industries that small- and medium-sized enterprises operate and need bank loans to finance their investments. The only insignificant effect is found in explaining the growth rate of agricultural loans. One reason for getting an insignificant coefficient is that agricultural loans may be more affected by land values in rural areas than house values in urban areas.

⁴⁰ We also estimate our models with weighted least squares using the number of bank branches as weights because we use aggregated data at province and bank-type levels. The test statistics indicate a weak instrument problem, and the results can be found in Table B.1 in Appendix B.

The second reason might be that as house prices increase, agricultural landowners would profit from converting their agricultural lands into residential land (especially those located at the periphery of provinces), and they may not demand agricultural loans.

The coefficients of the control variables are, in general, consistent with our expectations. There is a positive relationship between the GDP growth rate in the Turkish provinces and the issuance of all types of loans, but the coefficient is insignificant in explaining loans provided to the agriculture and construction industry. Employment growth rate, which is a proxy for commercial loan demand, is found to be negative and significant for mortgage and consumer loans. These findings suggest that when the demand for non-consumer loans increases, banks reduce their provision of consumer loans, holding house price growth rate constant. The deposit growth rate of banks in the province has no significant relationship with loan growth rates, except for mortgage loans. The insignificant coefficient may be explained by the transfer of local deposits by banks to their headquarters so that banks do not use local deposits for the provision of commercial loans.

The decline in the provision of commercial loans with the increase in house prices is economically significant as well. For example, a one-standard-deviation increase in house prices (2.45%) is expected to lead to a 0.89 percentage point⁴¹ decrease in commercial loans. Considering the average growth in commercial loans of 4.46% over the sample period, this decline corresponds to almost a 20% decline in commercial loan provisions. The same increase in house prices is estimated to increase consumer loans by 1.92 percentage point. Both the increase in consumer loans and decline in commercial loans may have significant impact on economic growth of provinces in Turkey.

⁴¹ Economic significance is obtained by dividing the multiplication of the coefficient of *Growth HP* in Column (2) of Table 3.4 and the standard deviation of *Growth HP* by the mean value of the dependent variable. For example, for the commercial loans it is $0.89\% = (2.45\% \times (-1.618)) / 4.46\%$.

3.4.2. Do State-owned and Private Banks Behave in Similar Ways?

Table 3.5 presents the results of the models where we examine whether state-owned banks allocate their loans similar to private banks with the change in house price appreciation rates in Turkish provinces. Consistent with previous findings, we find a positive and significant association between house price appreciation and the growth rates of mortgage, consumer, and construction loans, and a negative and significant association with the growth rates of commercial loans and loans to textile and food industries when an interaction variable between state-owned banks and growth in house prices is included in the model. The only exception is agricultural loans, where a positive association between the provision of agricultural loans and house price growth is found.

The estimated coefficients of the interaction variable between state-owned banks and the house price appreciation rate suggest that state-owned banks reduce their provision of consumer and commercial loans, and loans to the agriculture and construction industries significantly more than private banks as house prices appreciate. However, state-owned banks do not act differently from private banks in the provision of mortgage loans and loans provided to the textile and food industries. Loans provided to particular industries deserve more attention because state-owned banks are established to provide credit to disadvantageous industries, such as agriculture. Unlike our expectations, we find a negative coefficient on the construction loans for state-owned banks. This finding suggests that although the government supports construction-based growth, the construction loans issued by the state-owned banks do not increase as much as private banks do with the increase in house values.

The total effects of the appreciation in house prices for state-owned banks are reported at the bottom of Table 3.5. We find that an increase in house prices is positively and significantly associated with the growth rate in mortgage,

consumer, and construction loans issued by state-owned banks, but it is negatively associated with the increase in total commercial loans and loans provided to agriculture, textile, and food industries. These coefficients suggest that mortgage, construction, and consumer loans issued by state-owned banks crowd out commercial loans as house prices appreciate. The significant crowding-out effect is also observed for loans to industries, textile, agriculture and food, that are considered to have lending constraints and expected to be served by state-owned banks.

In terms of economic significance, one-standard-deviation rise in house price appreciation rate led to a 1.22 percentage point decline in growth rate of commercial loans provided by state-owned banks, and a 1.12 percentage point increase in mean growth rate on consumer loans, although it is less than for private banks. Considering the average growth rate of commercial loans issued by state-owned banks to be around 5%, the decline corresponds to almost one-fourth of the quarterly growth in commercial loan provisions, and this decrease may have significant effects on economic growth in Turkish provinces. Growth rate in agricultural loans issued by state-owned banks drops by 0.71 percent point in response to one-standard-deviation increase in house prices, corresponding the one-fifth of the agricultural loans provided by these banks.

In summary, banks are found to increase their provision of mortgage, consumer and construction loans and reduce their provision of commercial loans with the house price appreciation in Turkey. The impact of house price appreciation on loan growth changes with bank ownership in a developing country. Compared to private banks, state-owned banks are found to distribute less commercial and industrial loans, particularly to industries where small- and medium-sized establishments are concentrated, such as agriculture, textile, or food when house prices increase in provinces.

3.5. Robustness Check

We did several robustness checks to see whether our results hold under different specifications and inclusions of other banks. Table 3.6 presents the estimated coefficients of the growth rate in house prices and its interaction with the indicator variable for state-owned banks. First, the geographical features of the provinces may affect how their economies evolve, and thus, the types of loans demanded and issued. For instance, the provinces with the largest amount of unavailable land are located in the northern part of Turkey, and their economies mostly rely on forestry and agriculture. Even though the province-quarter fixed effects are included in the models to control for sectoral differences among provinces, we further control the other omitted regional characteristics by adding NUTS-2 regional fixed effects where these regions are classified based on their geography/topology, socio-economic, and demographic factors (Table 3.6 – Panel A). No significant change in the sign and the significance of the coefficients of house price related variables is observed when NUTS-2 regions are controlled in the model.

Although we winsorized the loan growth rates at 5% in the analysis, the extreme values might still affect the estimated coefficients. Thus, as a second robustness check, the observations are excluded from the sample if loan growth rate in a province is more than doubled between two consecutive quarters. As reported in Table 3.6 – Panel B, the state-owned banks are found to reduce their provision of commercial and agricultural loans with the increase in house prices. The coefficients of *Growth HP* turn to be insignificant in explaining the growth rates of loans to the textile and food industries when extreme values are excluded from the estimations. As a third check, we estimate the model by using logarithmic growth rates instead of percent growth rates. Although the sign and the significance of the coefficients of interaction variables with state-owned banks are found to be robust (Table 3.6 – Panel C), no significant relationship is observed between commercial loans and house values. However, state-owned

banks are still found to reduce their provision of commercial, agricultural, construction and consumer loans significantly more than private banks.

Fourth, in addition to state-owned and private banks, we include loans provided by foreign and Islamic banks in our sample (Table 3.6 – Panel D). The positive association between house prices and provision of mortgage, consumer, agriculture, and construction loans, and the negative association between house prices and provision of loans to the textile and food industries, are still valid when new types of banks are included in the sample. However, unlike previous findings when other banks are included in the sample, house price changes and growth rate of commercial loans are found to be positively associated. Consistent with the findings reported in Table 3.5, state-owned banks significantly decrease their issuance of consumer loans, commercial loans, and loans to the agriculture and construction industries as house prices increase in a province more than private banks do. While De Haas et al. (2010) document that foreign banks play an active role in mortgage lending in transition countries, we find that as house prices appreciate, foreign banks cut their mortgage loans as well as other types of loans more than private banks do in Turkey. Similarly, Islamic banks reduce their provision of all types of loans more than private banks, except in loans to the textile and food industries as house prices increase. Although Islamic banks have a significant share in the mortgage market in Turkey, the insignificant effect can be explained by the characteristics of the mortgage contracts offered by these banks: Either Islamic banks buy the property on behalf of their borrowers and rent it, or they jointly purchase the property, and the ownership share of the bank diminishes with each payment. Therefore, risk-sharing between buyer and lender might prevent the excessive growth of mortgage loans with house price appreciation in Turkey, even though the share of Islamic banks in mortgage lending increases (World Bank, 2016). Joint ownership feature of the contracts by Islamic banks is not only limited to mortgage lending, it is valid for commercial lending as well. Thus, compared to conventional banks, Islamic bank borrowers face less restrictive collateral

requirements (Aysan et al., 2016), and the negative coefficients of the interaction variables can be explained by the special features of loan contracts offered by these banks.

It can be argued that if banks provide riskier loans, their loan provisions might be negatively affected by house price changes. Thus, we add the non-performing loan ratio as a proxy for the riskiness of loans issued by banks (Table 3.6 – Panel E). The sign and significance of the coefficients of house price related variables are similar to those reported in Table 3.5 when the credit risk of banks is controlled in the model. Moreover, it can be argued that if state-owned banks become financially constrained because of their accumulated non-performing loans, they are more likely to cut their lending. Thus, we estimate the model with an interaction variable between non-performing loans and the house value appreciation rate in a province by using only loans issued by state-owned banks (Table 3.6 – Panel F). The coefficient of the interaction variable is found to be negative and significant for all loan types, except for mortgage loans and loans to the food industry. These coefficients suggest that state-owned banks decrease both commercial and consumer lending with the increase in house prices when they have more non-performing loans.

3.6. Conclusion

In this chapter, we examine how changes in house prices at the provincial level affect banks' loan allocation decisions by their ownership types in an emerging economy, Turkey, where construction and debt financing are considered to be important drivers of the country's growth. By using the mortgage rate and unavailable land share as instruments for the house price growth at the province level, we document that banks increase their provision of mortgage, consumer, and construction loans but reduce provision of commercial loans with the increase in house prices. The crowding-out of commercial loans observed in this emerging market is in line with the findings in developed countries (Chakraborty

et al., 2018). Our findings indicate that not all bank types respond the same to an increase in house prices. State-owned banks are found to reduce their commercial and agriculture loans more than private banks when house values appreciate. It indicates that a crowding-out effect of mortgage and consumer loans is more pronounced for state-owned banks. The findings seem to support the view that state-owned banks misallocate their loans. We estimate that a one-standard-deviation rise in house price appreciation rate is expected to reduce a 1.22 percentage point decline in commercial loans provided by state-owned banks. This decline corresponds to almost one-fourth of total commercial loan growth rate and might have adverse effects on economic development because of the importance of bank loans to finance firms' investments in emerging economies.

There are several policy implications of our results for developing countries. First, policymakers should consider the possible unfavorable consequences of appreciation in house values. Although rising house prices indicate a strong real economy, a decline in commercial and industrial loans with house price increases might wipe away the positive effects of a strong housing market. Small- and medium-sized establishments in developing countries might be adversely affected because of their dependence on banks for funding. Second, an increase in construction loans might accelerate construction activities and increase labor-intensive employment in the related sectors, causing "low-quality" growth, as suggested by Acemoglu and Ucer (2020). Third, governments, and in particular, state-owned banks, should be more careful in promoting mortgage lending. Excessive mortgage and consumer lending, especially by state-owned banks, might exacerbate the impact of any recessions through deterioration in households' balance sheets. Lastly, state-owned banks should provide loans to underserved areas depending on their specialization, such as agriculture or small- and medium-sized enterprises, to improve productivity and technology in order to achieve a "high-quality" growth.

The findings of this study should be interpreted with caution because we use aggregated data by the bank ownership type at the province level due to the unavailability of the bank-firm level data. We assume that all private banks or all state-owned banks behave in the same way in a province. Even though banks, regardless of their ownership type, extend loans in a similar way to all positive NPV projects, state-owned banks may provide loans depending on their specialty to riskier borrowers. Moreover, since we do not have data at the firm level, we cannot control industry or firm characteristics that might affect banks' lending decisions. In order to identify all potential mechanisms, and the consequences of loan misallocation on the real economy, especially on firms' investments and local economic growth, further studies should be conducted using more granular data.

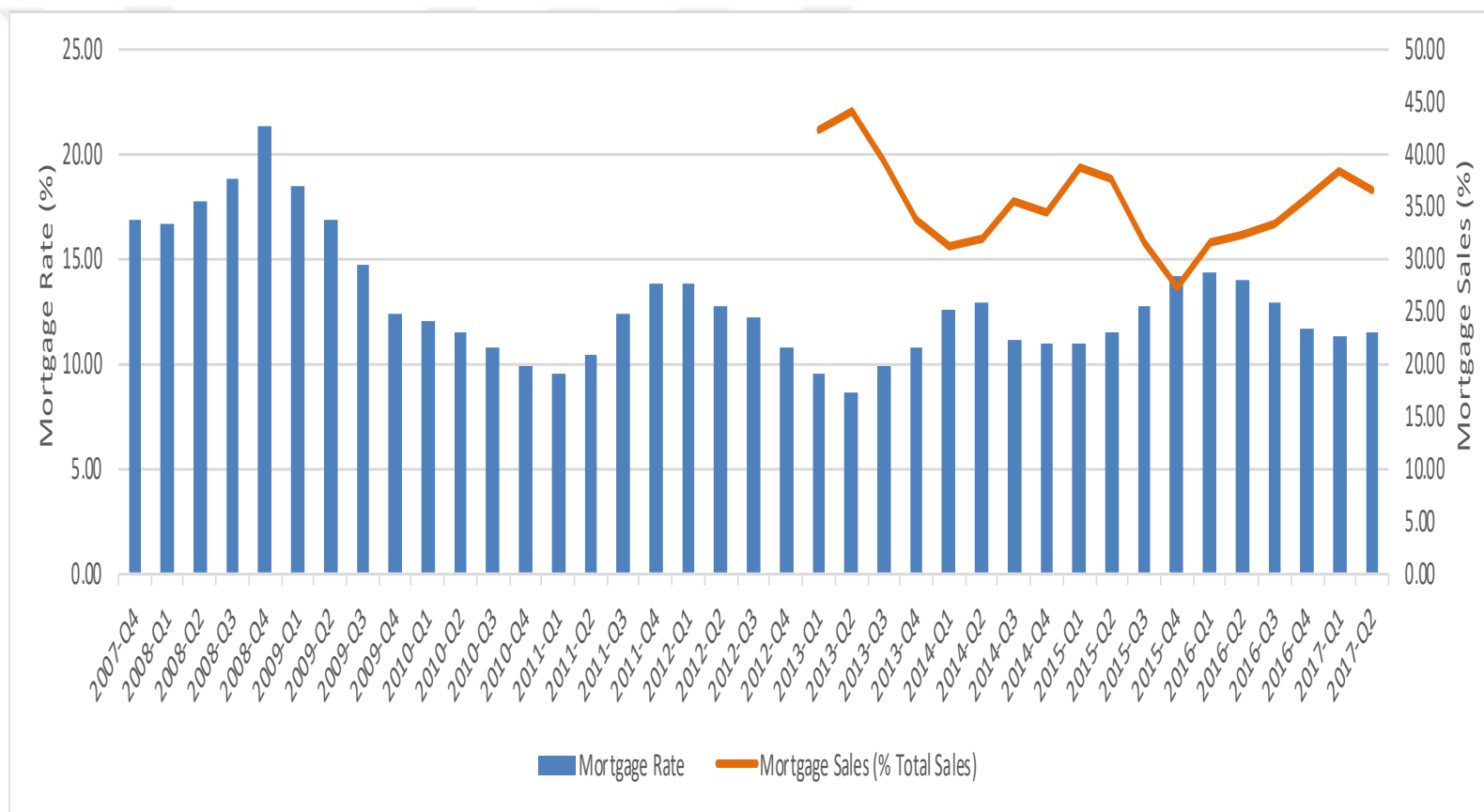


Figure 3.1: The Nominal Mortgage Interest Rates and the Share of House Purchases Financed with Mortgage Loans, 2007Q4–2017Q4.

Notes: The number of housing units sold is reported since December 2013. **Source:** CBT.

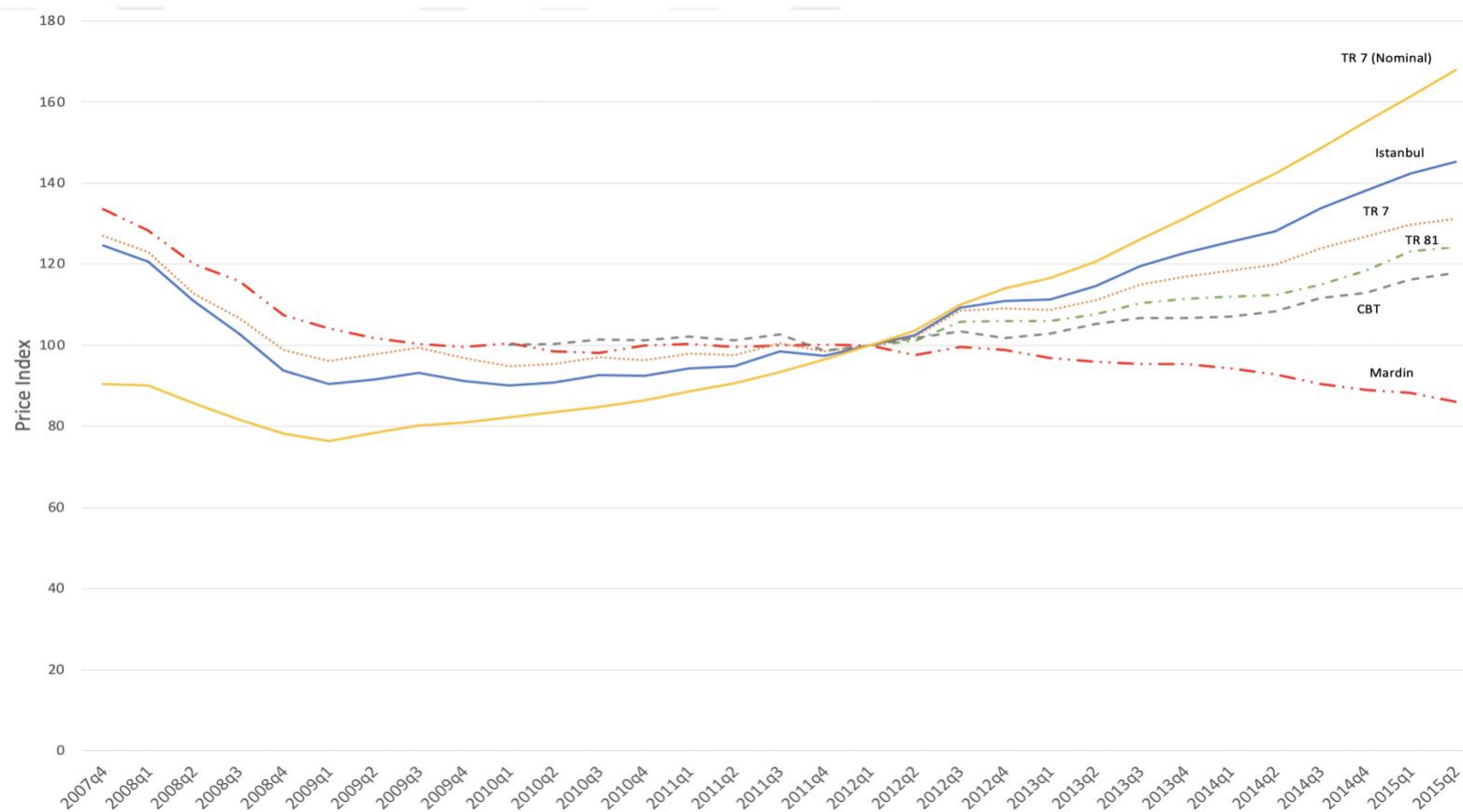


Figure 3.2: House Price Indexes in Turkey, 2007Q4–2015Q2.

Notes: The house price index produced by CBT has been available since 2010. TR7 is calculated by using house prices in the seven largest provinces since 2003. TR81 covers all of the Turkish provinces but has been available since 2012. To match the two indexes, we assume the first quarter of 2012 is 100 and adjust the TR7 and CBT indexes accordingly. All values are real, except TR7 (Nominal).

Source: REIDIN for TR7, TR81, Istanbul, and Mardin, and Central Bank of the Republic of Turkey for CBT.

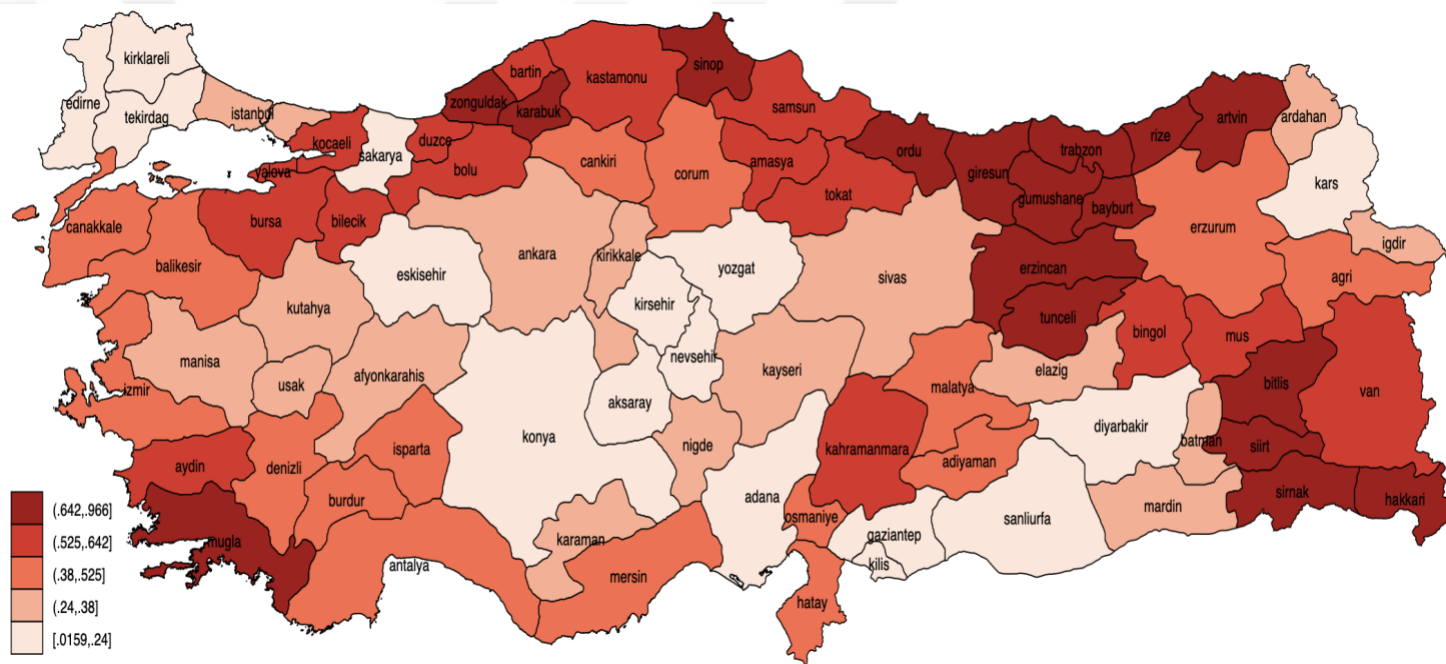


Figure 3.3: Map of Provinces in Turkey with their Unavailable Land Shares.

Source: Authors' own calculations.

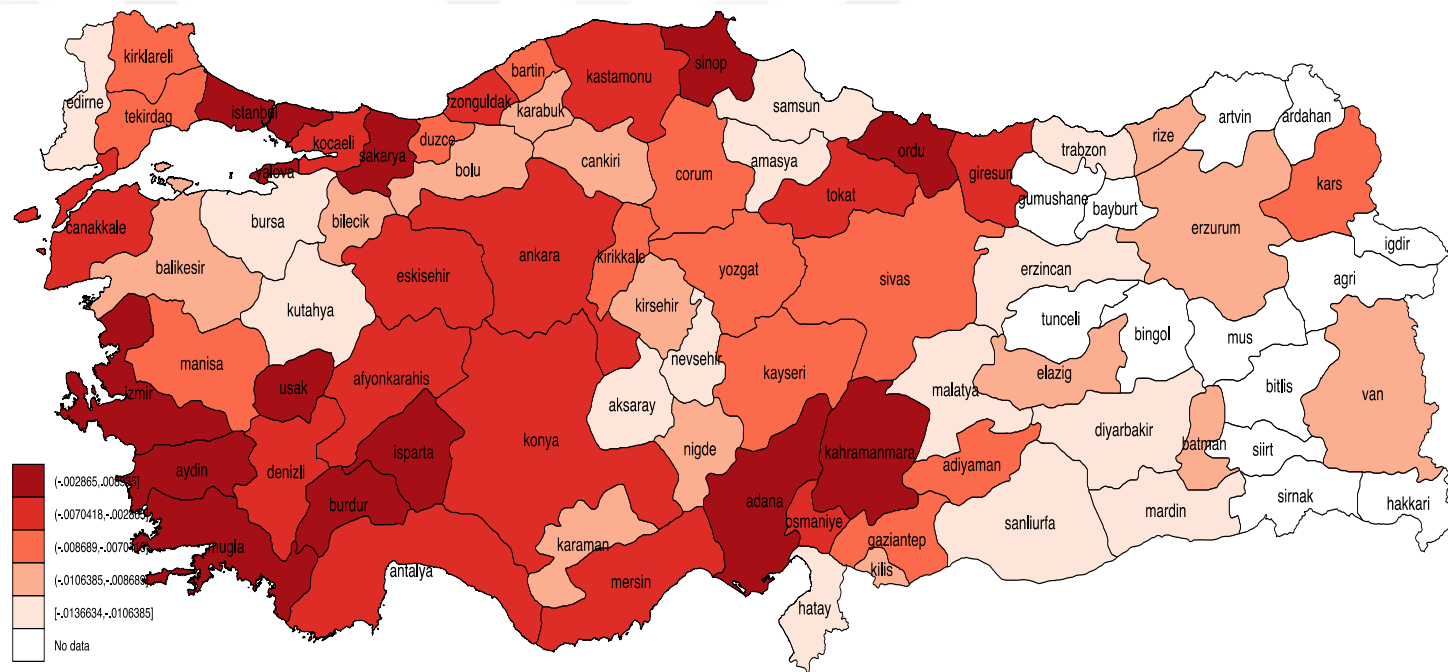


Figure 3.4: Map of Provinces in Turkey with Average Real Appreciation Rate in House Prices, 2007Q4–2015Q2.

Source: Authors' calculations using REIDIN house price values at the provincial level.

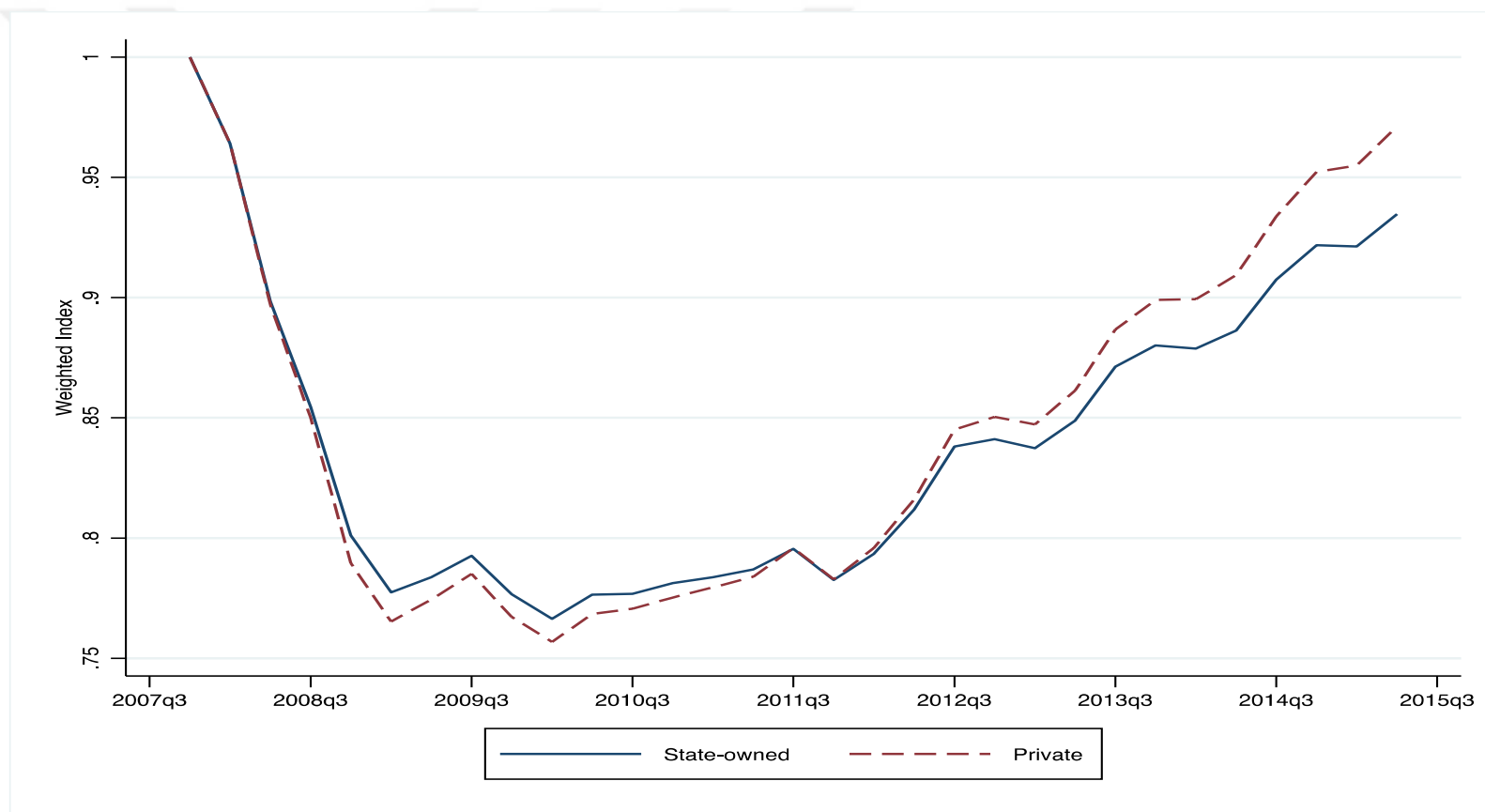


Figure 3.5: Mortgage Weighted House Price Index Faced by State-owned and Private banks, 2007Q4–2015Q2.

Notes: The weight of each province is the share of mortgage issued by each bank type. The weighted average of house prices faced by each bank type is the sum of the multiplication of the mortgage weight by the house prices at each province for each year-quarter.

Table 3.1: Some Characteristics of Deposit Collecting Banks in Turkey, 2007–2015.

	Private			State			Foreign			Islamic		
	2007	2015	Mean	2007	2015	Mean	2007	2015	Mean	2007	2015	Mean
<i>Panel A – General Characteristics</i>												
Number of banks	12	9	11	3	3	3	18	21	18	4	5	4
Number of branches	3,966	4,269	4,676	2,271	3,647	2,921	1,372	3,153	2,120	421	1,076	740
Total Asset Share (%)	52.13	37.82	50.17	29.30	30.07	29.68	12.79	26.77	15.44	3.46	5.34	4.71
Total Credit Share (%)	56.92	38.29	50.88	22.33	30.31	26.85	15.66	26.30	16.59	5.09	5.11	5.68
Non-performing Loans/Total Loans (%)	3.43	2.84	3.07	4.16	2.73	3.36	3.12	3.87	4.65	3.37	5.40	3.93
<i>Panel B – Loan Composition</i>												
Share of Mortgage Loans (%)	12.88	9.56	11.07	12.08	9.89	11.27	16.60	10.43	10.47	10.97	17.39	12.74
Share of Commercial Loans (%)	56.67	69.38	62.75	66.21	74.20	66.54	55.59	69.23	61.04	77.40	77.12	79.96
Share of Consumer Loans (%)	28.41	18.49	23.81	20.56	13.96	20.02	25.42	17.54	12.62	4.65	4.00	4.54

Notes: The data in Panel A are obtained from the Turkish Banking Association (TBA), and Participation Banks Association of Turkey (TKBB). The data in Panel B are obtained from the FINTURK. The annual mean values for the period between 2007–2015 are reported under the “Mean” column. Commercial loans do not include loans to financial institutions. Consumer loans do not include mortgage loans.

Table 3.2: Descriptive Statistics of Variables Used in the Estimations.

	Mean	Median	Standard Deviation	Minimum	Maximum	N
<i>Time-varying Province Characteristics</i>						
House price appreciation rate (% , real)	-0.67	-0.36	2.45	-9.33	8.71	2,040
House price appreciation rate (% , nominal)	1.29	1.39	2.43	-6.56	11.22	2,040
Growth rate in real GDP (%)	1.07	1.07	2.11	-21.76	9.55	1,972
Growth rate in total employment (%)	2.26	1.84	7.60	-71.49	119.83	1,972
<i>Time-varying Bank Characteristics</i>						
Growth rate in Mortgage Loans (%)	3.67	3.40	5.52	-21.10	23.38	4,080
Growth rate in Commercial Loans (%)	4.46	3.20	10.01	-13.36	108.80	4,080
Growth rate in Consumer Loans (%)	3.37	3.12	5.09	-14.34	21.19	4,080
Growth rate in Agriculture Loans (%)	3.90	2.69	11.63	-36.78	60.16	4,080
Growth rate in Loans to Textile Industry (%)	6.07	1.34	33.07	-49.44	458.20	4,059
Growth rate in Loans to Food Industry (%)	5.95	2.07	23.20	-34.44	246.70	4,080
Growth rate in Loans to Construction Industry (%)	5.92	3.99	13.46	-25.17	57.08	4,080
Growth rate in Total Loans (%)	4.22	3.34	6.07	-11.21	47.85	4,080
Growth rate in deposit (%)	1.65	1.35	6.84	-51.11	128.47	3,944
<i>Time-invariant Province Characteristics</i>						
Slope	18.85	17.91	8.68	4.09	45.64	68
Share of Unavailable Land (%)	41.4	42.03	22.01	1.58	93.13	68

Notes: All of the growth rates are quarterly growth rates. Loan growth rates are winsorized at 5% tails. They are obtained from real loan amounts, expressed in terms of 2015Q2 prices. Commercial loans do not include construction loans and loans to financial institutions. Consumer loans do not include mortgage loans and balances on consumer credit cards.

Table 3.3: Quarterly Growth Rates of Different Types of Loans Provided by Banks Classified by Their Ownership, 2007Q4-2015Q2.

	State-owned Banks				Private Banks			
	Mean	Standard Deviation	Median	N	Mean	Standard Deviation	Median	N
<i>Growth Rate in (%)</i>								
Mortgage Loans	3.941	5.38	3.757	2,040	3.406	5.636	3.058	2,040
Commercial Loans	4.912	9.651	3.378	2,040	3.999	10.340	3.025	2,040
Consumer Loans	3.286	4.911	2.279	2,040	3.463	5.262	3.942	2,040
Loans to Agriculture Industry	3.994	9.981	2.651	2,040	3.809	13.070	2.727	2,040
Loans to Textile Industry	6.236	31.870	1.523	2,022	5.903	34.220	1.194	2,037
Loans to Food Industry	6.599	21.960	3.033	2,040	5.306	24.360	1.170	2,040
Loans to Construction Industry	6.110	13.410	3.908	2,040	5.732	13.500	4.106	2,040
Total Loans	4.394	5.870	3.300	2,040	4.054	6.263	3.396	2,040

Notes: All variables are winsorized at 5% tails. All of the loan growth rates are obtained from real value, expressed in terms of 2015Q2 prices. Commercial loans do not include construction loans and loans to financial institutions. Consumer loans do not include mortgage loans and consumer credit cards.

Table 3.4: Relationship Between Appreciation Rate in House Prices and Growth Rate in Loan Provisions by State-owned and Private Banks.

	Growth Rate in Loans							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Mortgage	Commercial	Consumer	Agriculture	Textile	Food	Construction	First-Stage
Mortgage Rate								-0.227*** (0.024)
Mortgage Rate*Unavailable Land								0.039 (0.038)
Growth HP	2.359*** (0.260)	-1.618*** (0.440)	2.639*** (0.262)	0.592 (0.540)	-5.081** (2.109)	-2.088** (1.033)	3.803*** (0.691)	
Growth Deposit	0.066*** (0.017)	0.033 (0.023)	-0.005 (0.010)	0.005 (0.034)	0.089 (0.079)	0.070 (0.052)	0.013 (0.044)	0.000 (0.004)
Growth GDP	0.542*** (0.073)	0.857*** (0.134)	0.671*** (0.100)	0.192 (0.123)	0.974*** (0.281)	0.537*** (0.186)	0.120 (0.148)	-0.030 (0.016)
Growth Employment	-0.063*** (0.013)	0.005 (0.026)	-0.028* (0.017)	0.012 (0.009)	0.007 (0.018)	-0.054 (0.058)	0.012 (0.028)	0.001 (0.003)
State	0.003 (0.005)	0.013 (0.030)	-0.023*** (0.003)	0.016 (0.014)	0.115* (0.063)	0.061*** (0.020)	-0.066*** (0.022)	-0.002 (0.003)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944	3,944
Kleibergen-Paap rk Wald F	70.71	70.71	70.71	70.01	68.04	70.42	71.72	
Hansen J test (Sargan test) p-value	0.827	0.967	0.738	0.371	0.875	0.515	0.946	
Underidentification p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000	

Notes: Dependent variables are growth rates in loan provisions by state-owned and private banks in a province and winsorized at 5% tails. Commercial loans do not include construction loans and loans to financial institutions. Consumer loans do not include mortgage loans and balances on consumer credit cards. Growth HP is the real house price appreciation rate. Growth GDP is the real GDP growth rate. Growth Employment indicates the growth of private employment in a province. In columns (1)-(3), Growth Employment is employment in private firms excluding construction sector. In columns (4)-(7), Growth Employment is the employment in the corresponding industry, i.e., agriculture, textile, food, and construction. Growth Deposit is the real deposit growth. All of the control variables are lagged by one period. The instruments for the house price appreciation rate are the interaction variable between the quarterly mortgage rate and unavailable land share in the province and the mortgage rate. Robust standard errors are in parentheses and clustered at the province-bank level. Province-quarter, province-bank, bank-quarter, and year fixed effects are included in all models. ***, **and * denote statistical significance at 1%, 5% and 10%, respectively.

Table 3.5: Relationship Between Appreciation Rate in House Prices and Growth Rate in Loan Provisions: Interaction with State-owned banks.

	Growth Rate in Loans						
	(1) Mortgage	(2) Commercial	(3) Consumer	(4) Agriculture	(5) Textile	(6) Food	(7) Construction
Growth HP	2.437*** (0.277)	-1.054** (0.442)	3.658*** (0.284)	2.201*** (0.524)	-5.522*** (2.128)	-2.170** (1.031)	4.418*** (0.710)
State*Growth HP	-0.161 (0.149)	-1.171*** (0.170)	-2.116*** (0.148)	-3.346*** (0.298)	0.972 (0.630)	0.170 (0.436)	-1.277*** (0.363)
Growth Deposit	0.065*** (0.016)	0.021 (0.025)	-0.027** (0.011)	-0.031 (0.036)	0.099 (0.078)	0.071 (0.052)	-0.001 (0.044)
Growth GDP	0.542*** (0.072)	0.861*** (0.136)	0.678*** (0.107)	0.204* (0.122)	0.974*** (0.277)	0.537*** (0.186)	0.124 (0.152)
Growth Employment	-0.063*** (0.013)	0.005 (0.026)	-0.028* (0.017)	0.012 (0.010)	0.007 (0.017)	-0.054 (0.058)	0.012 (0.028)
State	0.004 (0.005)	0.016 (0.031)	-0.018*** (0.005)	0.024 (0.016)	0.113* (0.064)	0.061*** (0.020)	-0.063*** (0.021)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Kleibergen-Paap rk Wald F	35.34	35.34	35.34	34.98	34.01	35.19	35.84
Hansen J test (Sargan test) p-value	0.805	0.590	0.573	0.409	0.697	0.808	0.982
Underidentification p-value	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Total Effect							
Growth HP for State Banks	2.276	-2.225	1.542	-1.145	-4.550	-2.000	3.141
p-value	0.000	0.000	0.000	0.053	0.032	0.064	0.000

Notes: Dependent variables are growth rates in loan provisions and winsorized at 5% tails. State is a dummy variable indicating the state-owned banks. Commercial loans do not include construction loans and loans to financial institutions. Consumer loans do not include mortgage loans and balances on consumer credit cards. Growth HP is the real house price appreciation rate. Growth GDP is the real GDP growth rate. Growth Employment indicates the growth of private employment in a province. In columns (1)-(3), Growth Employment is employment in private firms excluding construction sector. In columns (4)-(7), Growth Employment is the employment in the corresponding industry, i.e., agriculture, textile, food, and construction. Growth Deposit is the real deposit growth. All of the control variables are lagged by one period. The instruments for the house price appreciation rate are the interaction variable between the quarterly mortgage rate and unavailable land share in the province and the mortgage rate. Robust standard errors are in parentheses and clustered at the province-bank level. Province-quarter, province-bank, bank-quarter, and year fixed effects are included in all models. ***, **and * denote statistical significance at 1%, 5% and 10%, respectively.

Table 3.6: Robustness Tests: Estimated Coefficients of Growth HP and Related Variables.

	Growth Rate in Loans						
	(1) Mortgage	(2) Commercial	(3) Consumer	(4) Agriculture	(5) Textile	(6) Food	(7) Construction
Panel A – Models include region (NUTS-2) fixed effects							
Growth HP	2.437*** (0.277)	-1.054** (0.442)	3.658*** (0.284)	2.201*** (0.524)	-5.522*** (2.128)	-2.170** (1.031)	4.418*** (0.710)
State *Growth HP	-0.161 (0.149)	-1.171*** (0.170)	-2.116*** (0.148)	-3.346*** (0.298)	0.972 (0.630)	0.170 (0.436)	-1.277*** (0.363)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Panel B – Sample excludes provinces with extreme growth rates							
Growth HP	2.476*** (0.309)	-0.791* (0.461)	3.699*** (0.292)	2.164*** (0.814)	1.936 (1.481)	0.082 (1.058)	4.031*** (0.961)
State*Growth HP	-0.125 (0.170)	-1.239*** (0.198)	-2.177*** (0.155)	-3.608*** (0.402)	0.993 (0.719)	0.676 (0.514)	-1.616*** (0.447)
N	3,944	3,942	3,944	3,911	3,797	3,918	3,937
Panel C – Dependent Variables are the logarithm growth rates							
Growth HP	2.350*** (0.296)	-0.141 (0.435)	3.662*** (0.290)	1.669* (0.881)	-0.102 (1.877)	-0.221 (1.014)	3.961*** (0.923)
State *Growth HP	-0.115 (0.160)	-1.250*** (0.181)	-2.163*** (0.152)	-3.498*** (0.375)	1.381 (0.861)	0.058 (0.465)	-1.254*** (0.409)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Panel D – Sample includes private, state-owned, foreign, and Islamic banks							
Growth HP	2.544*** (0.285)	3.001*** (0.521)	2.847*** (0.502)	9.687*** (1.376)	-6.662*** (2.254)	-4.952*** (1.234)	5.257*** (0.833)
State *Growth HP	-0.117 (0.168)	-1.217*** (0.212)	-2.167*** (0.128)	-3.589*** (0.501)	1.270* (0.730)	0.251 (0.512)	-1.394*** (0.427)
Foreign*Growth HP	-1.306*** (0.206)	-1.665*** (0.279)	-0.669*** (0.207)	-6.157*** (0.638)	-0.550 (0.700)	-1.250** (0.610)	-3.633*** (0.491)
Islamic*Growth HP	-3.057*** (0.387)	-3.261*** (0.328)	-5.820*** (0.687)	-2.447*** (0.772)	0.028 (0.809)	-0.835 (0.684)	-3.090*** (0.541)
N	7,763	7,773	7,768	7,656	7,311	7,712	7,759

Table 3.6 (cont'd)

	Growth Rate in Loans						
	(1) Mortgage	(2) Commercial	(3) Consumer	(4) Agriculture	(5) Textile	(6) Food	(7) Construction
Panel E – Control for bank risk (non-performing loans ratio of each bank type) in the province							
Growth HP	2.407*** (0.291)	-1.054** (0.471)	3.987*** (0.330)	2.827*** (0.561)	-5.515** (2.228)	-2.529** (1.079)	4.362*** (0.747)
State*Growth HP	-0.156 (0.149)	-1.170*** (0.174)	-2.174*** (0.163)	-3.433*** (0.313)	0.968 (0.630)	0.231 (0.450)	-1.267*** (0.365)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Panel F – Interaction with Non-performing Loans and Growth HP for only State-owned banks							
Growth HP	2.930*** (0.657)	-0.915 (0.878)	1.833*** (0.289)	1.044 (1.095)	0.773 (3.656)	0.465 (1.988)	6.674*** (1.686)
NPL *Growth HP	-4.278 (8.071)	-34.626*** (11.316)	-18.043*** (4.708)	-33.892** (14.367)	-102.169** (50.866)	-36.736 (27.583)	-67.870*** (24.282)
NPL	-0.036 (0.232)	-0.669** (0.284)	-0.254** (0.112)	-1.029*** (0.318)	-3.352*** (1.238)	-0.667 (0.563)	-1.928** (0.852)
N	1,972	1,972	1,972	1,957	1,917	1,971	1,972

Notes: Dependent variables are growth rates in mortgage, commercial, consumer loans, and loans to agriculture, textile, food, and construction industries. Only the coefficients of Growth HP and its interaction with state-owned banks are reported in the table. Panel A presents the results of the model controlling for regional fixed effects. Panel B provides the estimation results after dropping the observations whose growth is doubled between two consecutive quarters. Panel C provides estimation results using logarithmic growth rates. Panel D presents the estimated coefficients of Growth HP variable of the models for a sample of private, state-owned, Islamic, and foreign banks. Panel E presents the estimated coefficients of Growth HP variable when the bank risk in the province is controlled by the growth rate of non-performing loan ratio of each bank type in the province. Panel F presents the estimated coefficients of Growth HP variable and its interaction with non-performing loans only for the sample of state-owned banks. All of the models are estimated by using two-stage least squares and controlling for province-quarter, province-bank, bank-quarter, and year fixed effects. Robust standard errors are in parentheses and clustered at the province-bank level. ***, **and * denote statistical significance at 1%, 5% and 10%, respectively.

CHAPTER 4

NON-PERFORMING LOANS AND HOUSE PRICES: A COMPARISON OF DOMESTIC BANKS IN TURKEY

4.1. Introduction

In the aftermath of the global financial crisis, there has been growing attention to the relationship between banks' lending and house prices, as their interaction affects the banking industry's strength. Therefore, given the close link between the banking crisis and non-performing loans (NPLs) (Reinhart and Rogoff, 2010), it is critical to understand how rising housing prices affect NPLs. Studies in the literature have reported that bank characteristics (such as bank profitability, capitalization, inefficiency, mismanagement, bank size, and ownership) and macroeconomic conditions in the economy (such as real GDP, inflation rate, sovereign debt, exchange rate, economic policy uncertainty) are factors that significantly affect NPLs in both emerging and advanced economies using aggregated data either at the country or bank level (Quagliariello, 2007; Nkusu, 2011; Louzis et al., 2012; Beck et al., 2015; Ghosh, 2015; Tajik et al., 2015; Ghosh, 2016; Dimitrios et al., 2016; Nikolopoulos and Tsalas, 2017; Us, 2017; Wan, 2018; Ari et al., 2019; Karadima and Louri, 2021). However, the characteristics of local markets, such as the appreciation rate of local house prices, are generally ignored in the literature. Only a few studies document that house prices as regional characteristics affect NPLs in advanced economies.

For example, Ghosh (2015) shows that appreciation in house prices at the state level in the US reduces banks' NPLs. Koetter and Poshosyan (2010) document that house price deviations from fundamental values in German cities contribute to the probability of bank distress. Nkusu (2011) reports that the change in house prices is negatively associated with the NPLs in advanced economies at the aggregate level. In China, Zhang et al. (2016) provide evidence that the higher growth in real estate investment leads to a decline in regional commercial banks' NPLs ratio. In this study, we examine the association between growth in house prices and NPLs at the province level in an emerging market, Turkey, where the government has adopted a debt-fueled growth strategy (Acemoglu and Ucer, 2020), and the construction sector has been at the forefront of the country's economic growth. We first test the hypothesis that the NPLs are affected by house price growth at the province level, controlling for local and macroeconomic characteristics. Second, we analyze whether NPLs of different loan categories respond differently to the house price increase. Lastly, we investigate whether an appreciation in house prices has a different impact on the NPLs of state-owned and private banks.

Literature provides two views to explain the relationship between house prices and NPLs. The first one posits that an increase in house prices will result in the appreciation of collateral values pledged by the borrowers and reduce the probability of default on loans, improving bank stability. It is supported both theoretically (Niinimäki, 2009) and empirically for several countries (Ghosh, 2015; Tajik et al., 2015; Zhang et al., 2016; Wan, 2018). Alternatively, the second view contends that increasing collateral values will increase firms' and individuals' borrowing ability, encouraging them to demand more loans by betting on further price increases. However, the adverse selection of risky borrowers due to an improvement in their borrowing capacities may increase banks' credit risk (Dell'ariccia and Marques, 2006). In line with this argument, by estimating the fundamental value of house prices using the population growth rate and GDP per worker in German cities, Koetter and Poshosyan (2010) show

that deviations of house prices from their fundamental values, rather than the change or the level of house prices increase the likelihood of the banking distress.

A booster of the Turkish economy was the construction industry since the 2000s. Until 2017, the share of the construction sector in GDP reached 8.5%, which was ranked third in size, following the manufacturing, wholesale and trade industries. In line with the government's actions to stimulate the economy through construction, the share of state-owned banks' lending in mortgage and construction had an increasing trend (Figure 4.1). Based on the Banks Association of Turkey statistics, three of the four largest three banks in terms of asset size are state-owned as of 2021. Although state-owned banks were heavily involved in lending over this period, their NPLs remain low compared to private banks. However, the actions taken to reduce the financial burden on the corporate sector and households to boost the demand by easing the credit conditions might increase banks' vulnerability, especially the state-owned banks. More recently, according to the 2021 World Bank report (World Bank, 2021), the actual NPLs might be higher than the reported values due to forbearance measures due to COVID.

Several emerging economies in recent years, including China, Malaysia, Mexico, and Turkey, have pursued debt-based growth strategies driven by consumption, credit expansion, construction, and government spending, without sufficient investment (Acemoglu and Ucer, 2020).⁴² The banking system's stability and soundness are critical in this strategy because bank lending may be the only alternative for liquidity-constrained enterprises and individuals in emerging economies. Turkish economy had grown very fast following the crisis in the early 2000s by adopting policies to strengthen the institutional quality, such as ensuring the central bank's independence and tightening the fiscal

⁴² According to the World Bank Development Indicators, domestic credits provided to the private sector by banks to GDP ratio climbed up from 56.2% (30.9%) in 2008 to 94.3% (65.3%) in 2016 in middle-income countries to which Turkey belongs.

policy. In return, the Turkish economy enjoyed high growth and increased employment. Since the last decade, like other middle-income countries, Turkey has undergone a rapid credit expansion which is mostly driven by state-owned banks.⁴³ Hence, our findings from Turkey may be generalizable to other emerging markets that apply similar strategies for economic development.

Apart from the credit growth, Turkey witnessed rapid house price increases, especially in the major provinces such as Istanbul, Ankara, Izmir, and Adana. While the real house prices started to slow down around 2016, currently, in Turkey, the nominal house prices are rising due to several reasons, including the citizen by investment program first initiated in 2017 (Gunduz et al., 2022) and mortgage rate cuts offered by the state-owned banks to stimulate the economy in response to Covid-19 pandemic (Akgunduz et al., 2021). These developments in credit and housing markets imply that banks' exposure to house prices requires attention since the sudden decline in property prices might adversely affect the banks' financial stability.

We contribute to the existing literature in two ways by analyzing the relationship between appreciation in house prices and NPLs of domestic banks in Turkish provinces for the 2009Q1–2016Q4 period.⁴⁴ First, we examine this relationship for NPLs of different loan types as total, commercial, consumer, and mortgage loans separately in an emerging market. In general, the studies in the literature examine total NPLs; only a few investigate different loan categories (Tajik et al., 2015; Ghosh, 2017). Because an increase in house prices is not found to affect the provision of different types of loans in the same way (Flannery and Lin, 2017; Chakraborty et al., 2018; Cuñat et al., 2018; Martin et al., 2020), the credit risk of different loan borrowers might change with house price growth. We document that an appreciation in house prices at the local level reduces not only

⁴³ See, for instance (<https://www.ft.com/content/343eaf56-d850-11e9-8f9b-77216ebe1f17>).

⁴⁴ This sample period was chosen because house prices were appreciated in Turkey. The analysis of the national-level REIDIN price index covering seven big provinces in Turkey indicates a structural break in the real house price growth rate in 2016.

total NPLs but also decreases the commercial and consumer NPLs in Turkey, unlike Rinaldi and Sanchis-Arellano (2006), who report that house prices have an insignificant effect on non-performing household loans for a sample of seven Euro countries. Second, we examine whether state ownership of banks matters in this relationship. The literature provides evidence that state-owned banks provide credit with political incentives (Dinc, 2005; Imai, 2009; Carvalho, 2014), they are less profitable (Micco et al., 2007), take more risk (Dong et al., 2014), and have higher NPLs during economic upswings than private banks (Bertay et al., 2015). Our findings indicate that there is no statistical difference between the state-owned and private banks' NPLs in their response to the real house price increase over the sample period.

4.2. Methodology and Data

Using a similar model to Ghosh (2015) and Tajik et al. (2015), we investigate the association between house prices and NPLs by estimating the following model:

$$NPL_{i,b,t}^k = \alpha_1 NPL_{i,b,t-1}^k + \alpha_2 HP_{i,t-1} + \alpha_4 X_{i,b,t-1} + \gamma_i + \delta_t + \varepsilon_{i,b,t}. \quad (1)$$

The dependent variable is the logarithm of the NPL ratio of a bank type b (private or state-owned) in province i at time t for a loan type k . k stands for total, commercial, consumer, and mortgage loans. HP indicates a logarithm of real house prices. X denotes the vector of provincial and bank control variables included in the model. We include the logarithm of GDP per capita and the unemployment rate as local economic characteristics of provinces that are associated with the demand for loans. Bank control variables include a dummy variable indicating the state ownership of banks (*State*) and the logarithm of loans of the banks in a province. Due to a lack of data, we are not able to control for the other bank characteristics such as bank assets and profitability as in Ghosh (2015), Tajik et al. (2015), and Zhang et al. (2016) that are found to be an important determinant of NPLs. Instead, we use bank deposits to control

banks' local funding sources and the number of bank branches to control banks' penetration in a province. γ_i and δ_t are province, and time fixed effects, respectively. Robust standard errors are clustered at the province level.

Due to dynamic nature of the Equation (1), we follow the literature and apply the two-step system GMM estimation proposed by Arellano and Bover (1995) and Blundell and Bond (1998), which is a traditional approach in this literature with the assumption that NPLs are persistent. In the analyses, we treat the bank-related variables as endogenous and instrument them GMM-style; and treat province-level macroeconomic variables as exogenous and instrumented IV style. In all cases, the lags are determined such that the number of instruments is less than the number of groups.

In this chapter, we use several data sources to analyze the relation between the NPLs and house prices at the local level. We obtain our bank-related variables from the FINTURK database of Banking Regulation and Supervision of Agency (BRSA), macroeconomic variables such as GDP per capita, unemployment rate from the Turkish Statistical Institute (TURKSTAT), mortgage rate from the Central Bank of the Republic of Turkey (CBT), and house prices from the REIDIN. The definitions of the variables and how we constructed them are provided in Table 4.1.

Figure 4.2 plots the evaluation of NPLs across loan types and bank ownership over the sample period. Private banks have higher levels of NPLs for all loan types at the beginning of the sample period; it is reversed over the period except in the case of consumer loans. The average NPL ratios of state-owned and private banks are provided in Table 4.2 and suggest that the average NPL ratios of state-owned banks are lower than that of private banks, regardless of the loan type over the sample period. The summary statistics of the variables that we use in the analysis are presented in Table 4.3.

In the analysis, all variables are expressed in levels. Before the regression analyses, we perform Im et al. (2003) panel unit root test, which is suitable for our unbalanced data structure. Table 4.4 presents the panel unit root test results where the null hypothesis is that all panels contain a common unit root. Therefore, the variables that exhibit panel unit roots in their levels are first-differenced. Table 4.5 provides the correlation matrix of the variables that are used in this chapter.

4.2.1. Empirical Results

The estimation results of Equation (1) are presented in Table 4.6, where the odd-numbered columns provide OLS results, and even-numbered columns provide System GMM estimation results. We also provide the p-value of the Hansen test of overidentifying restrictions and the first and the second-order autocorrelation of the residuals at the bottom of Table 4.6 for the system GMM. The results of the Hansen test of overidentifying restrictions suggest that instruments that are used in all models are appropriate. For the autocorrelation tests, one should reject the null of first-order serial correlation and not reject the null of second-order serial correlation of the residuals. Except for the mortgage NPLs, the requirements are met.

Overall, our results indicate a negative relationship between NPLs and house prices at the province level in Turkey, except for mortgage loans. This finding is in line with the literature suggesting that a surge in house prices reduces the probability of default by increasing the financial health of the borrowers. The insignificant coefficient on house prices for mortgage loans might be the result of the endogeneity issue between mortgage lending and house prices.⁴⁵

Among the control variables, the coefficient on bank ownership suggests that state-owned banks significantly have lower total and commercial NPLs

⁴⁵ It should be noted that we cannot reject the hypothesis of no autocorrelation of order 2 for mortgage NPLs. Thus, our results should be interpreted cautiously for mortgages.

compared to private banks. The negative coefficient of branches in explaining NPLs suggests that bank branches mitigate the information asymmetry; thus, higher bank coverage in a province lowers default risk on loans, but it is only significant for the total loans. The coefficient on *Loan*, on the other hand, changes its sign based on the loan type. For the consumer loans, the coefficient is positive, suggesting that domestic banks adopted lax lending policies as they provided more consumer loans during the post-global financial crisis period in Turkey. For mortgage loans, however, it is negative and significant. Among the local economic control variables, an increase in GDP per capita in a province seems to increase the credit risk of loans significantly. Most of our sample period covers the economic recovery period; thus, a positive coefficient on GDP per capita might imply that banks take more risk at the province level in Turkey. Us (2017) documents an insignificant association between GDP growth and NPLs over the sample period of 2002Q1-2013Q3 in Turkey for the pooled sample of state-owned and private banks. Similarly, Danışman (2018) find a positive yet insignificant association between banks' NPL and GDP per capita growth for a sample of 27 Turkish banks over the 2007-2015 period. The unemployment rate is close to being significant in conventional levels for consumer NPLs (p-value close to 0.11) in Column (6) and significant for mortgage NPLs in Column (7).

In Table 4.7, we test the hypothesis of whether local house prices affect NPLs of state-owned banks and private banks differently. Our results indicate that state-owned banks do not provide riskier loans than private banks as house prices increase in a province. Moreover, the coefficient on the interaction terms changes their signs based on the estimation methodology we use. For the system GMM method, the coefficient is positive for total and consumer NPLs and negative for commercial and mortgage NPLs.⁴⁶

⁴⁶ Due to high correlation between house prices and GDP per capita, we dropped the GDP variable and run the same estimations. Our results and sign of the variables remain the same.

4.2.2. Robustness

As a first robustness check, we apply the logit transformation to the NPLs; in particular, the dependent variable is defined as $LN(NPL/(1 - NPL))$ as in Ghosh (2015). The logit transformation ensures that the dependent variable spans the interval $[-\infty, +\infty]$ instead of taking values on the $[0,1]$ interval and it is distributed symmetrically. The system GMM estimation results are provided in Table 4.7 when the NPLs are transformed. The coefficient on house price variables for all types of loan categories in Panel A of Table 4.8 supports our main result that the house prices and NPLs are negatively associated controlling for the economic and banking characteristics of provinces.

There are some changes in our findings about bank ownership structures when the dependent variable is transformed. In Panel B of Table 4.8, we report the estimated coefficients of house price variable and its interaction with State dummy variable. The insignificant coefficient on the interaction terms except for commercial NPLs in Table 4.8 suggests that there is no statistically significant difference between state-owned and private banks in terms of the effect of changes in house prices on their NPLs. The negative interaction term in Column (4) suggests that state-owned banks' commercial NPLs decline more than private banks' NPLs as house prices increase in a province.

As a second robustness check, we drop the lagged dependent variable and estimate a static model because of the insignificant coefficients of the lagged dependent variables in explaining total and commercial NPLs using System GMM methods indicating that NPLs are not persistent, as reported in Table 4.6. The estimated coefficients of house price related variables are reported in Table 4.9. In Panel A, the dependent variable is the logarithm of NPL ratios, whereas the dependent variable is their logit transformation in Panel B. The same variables are controlled in the models. While the coefficient on the house price variable is significant for the total and commercial NPLs (Columns (1) and (3)), it

is negative yet insignificant for consumer and mortgage loans (Columns (5) and (7)). Our results in Table 4.9 also confirm our main finding that NPLs of state-owned banks do not respond differently than private banks to house price increases, although the coefficients are positive.

As a third robustness check, we apply the instrumental variable (IV) approach. In analyzing the effect of house price growth on the riskiness of banks, endogeneity can be a concern because a large body of literature documents the relationship between house price fluctuations and credit conditions,⁴⁷ and NPLs increase with bank lending (Us, 2017). Similar to Chakraborty et al. (2018), we instrument house price growth rate with undevelopable land share⁴⁸ and its interaction with the real mortgage rate. It is based on the argument that as mortgage rates decline, house prices increase; however, provinces with a higher share of undevelopable land are expected to experience higher house price increases for a given decline in mortgage rates.⁴⁹ The estimated coefficients of house price related variables and the tests for the validity of the instruments are provided in Table 4.10.⁵⁰ In Panel A, the dependent variables are the logarithm of the NPL ratios, and in Panel B, the dependent variables are the logit transformations of the NPLs. While the coefficient on HP is negative for all loan

⁴⁷ For the recent evidence, see Cox and Ludvigson (2021) and the references cited in this study.

⁴⁸ Undevelopable land share for each province is calculated using an approach similar to Saiz (2010) as discussed in Chapter 2. The digital elevation map of Turkey is processed with ArcGIS. First, we determine the radius for each province by calculating the closest distance between the neighboring provinces and using half of the calculated distance as a radius. Next, we draw a circle around the province center and calculate the slope of each cell (30mx30m) within that circle. The cell with a slope greater than 15% is called undevelopable. The total area of cells classified as undevelopable gives the undevelopable land of a province. The ratio of undevelopable land to the total area of a circle (excluding water bodies) gives the undevelopable land share.

⁴⁹ Undevelopable land share is used as an instrument for house prices since it is not related to NPLs and loan demand. It affects house prices through its effect on the housing supply of that province. It will be costly to increase the housing supply in provinces with high undevelopable land share.

⁵⁰ First stage estimation results reveal that both mortgage rate and its interaction with undevelopable land share are negatively related to the house prices, though only the coefficient on the mortgage rate is significant.

types except for mortgages, it is found to be significant only for consumer NPLs. The significant coefficients on interaction terms with the State dummy variable suggest that as house prices increase, state-owned banks issue riskier total loans but less risky consumer loans than private banks. These results contradict with our earlier findings that there is no difference between state-owned and private banks in terms of the effect of house prices on their NPLs.

As a final robustness check, we assume that private and foreign banks act and respond in a similar way to changes in house prices and aggregate the data of foreign and private banks in Turkey and analyze the same hypotheses by comparing state-owned and private banks (i.e., we sum all the variables so that the private bank group also includes foreign banks). Table 4.11 provides the estimation results of the robustness checks using aggregated data over the same period. In Panels A and B in Table 4.11, we replicate the models that we use in Table 4.6 and Table 4.7, and in Panels C and D, we estimate the same model using logit transformation of NPLs. Finally, in Panels E and F, we estimate the static version of the model in Equation (1) as in Table 4.9. Our main findings remain robust when we aggregate the foreign and private banks; that is, the house price increase is negatively associated with NPLs (Panels A, C, E, and F). Moreover, in almost all cases, the coefficients on the house price variable for consumer NPLs are higher than other types of loans. On the other hand, the interaction term between the ownership variable and the house prices provides some evidence that the consumer NPLs of state-owned banks increase more than the consumer NPLs of private banks as house prices increase (Column (6) in Panel B, E, and F), suggesting that state-owned banks issue riskier consumer loans controlling for macroeconomic and bank variables.

4.3. Conclusion

We analyze the association between the house prices and domestic banks' NPLs and whether house price appreciation affects the credit risk of state-

owned and private banks differently in an emerging market. Our results suggest that house prices are negatively related to different loan categories of NPLs of all domestic banks in Turkey, controlling for macroeconomic and province characteristics and time-fixed effects. We then show that state-owned banks do not issue riskier loans than private banks as house prices increase at the province level in Turkey.

Our results offer some policy implications to enhance banks' financial stability. First, ensuring price stability in the housing market is essential in emerging markets as in developed economies since the banking sector in these economies is critical for borrowers' financing needs. Second, evaluating all loan categories, not only total NPLs, while monitoring banks' financial soundness is important because each loan category has a different sensitivity to house price fluctuations. Third, banks must be monitored closely, even in periods of house value appreciation. This became especially important in the post-Covid-19 pandemic period when banks experienced a significant increase in loan supply, state-owned banks reduced interest rates to accelerate the economy, and nominal house prices are overheating in Turkey.

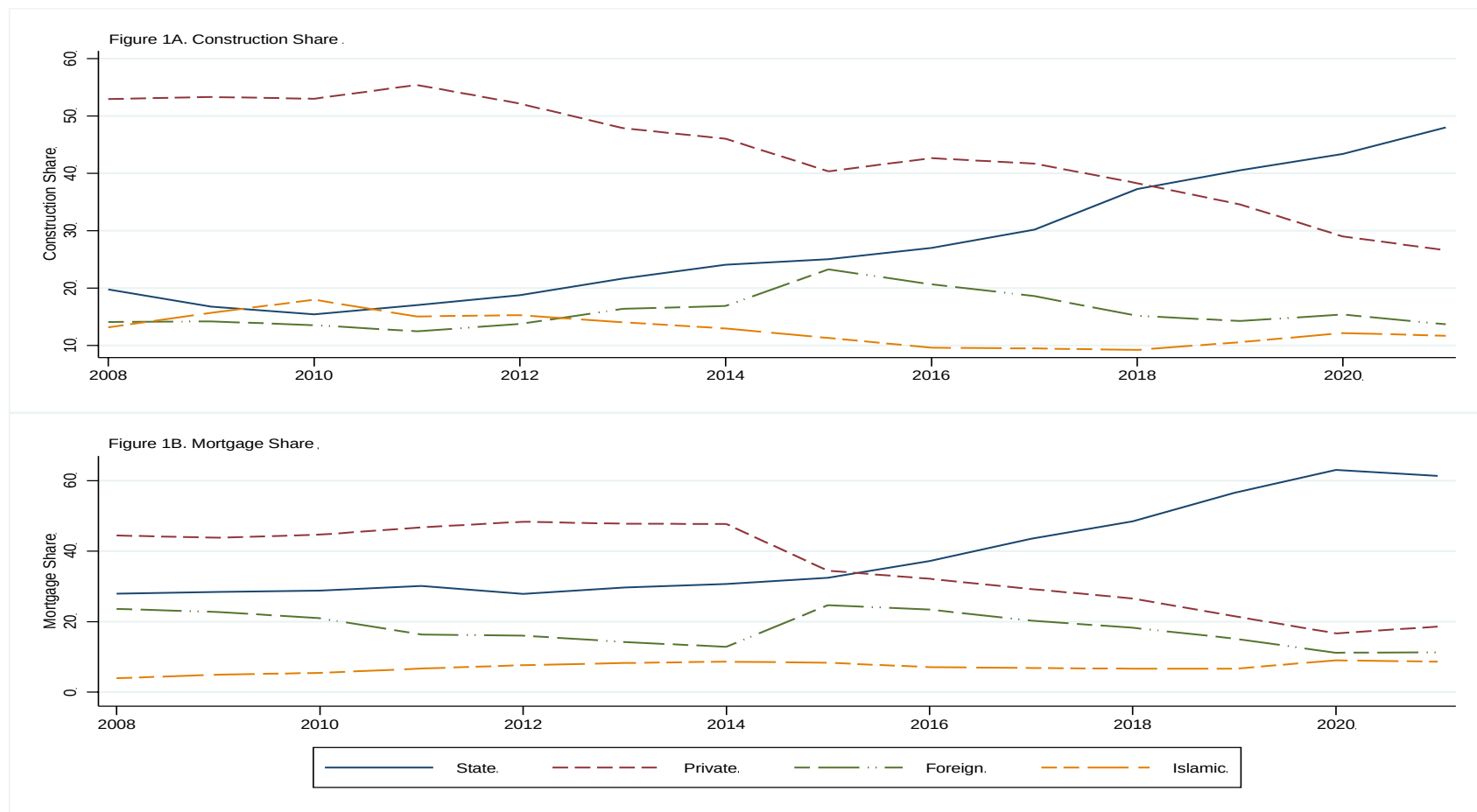


Figure 4.1: Share of State-owned, Private, Foreign, and Islamic Banks in Total Mortgage and Construction Loans, 2008-2021.

Source: BRSA.

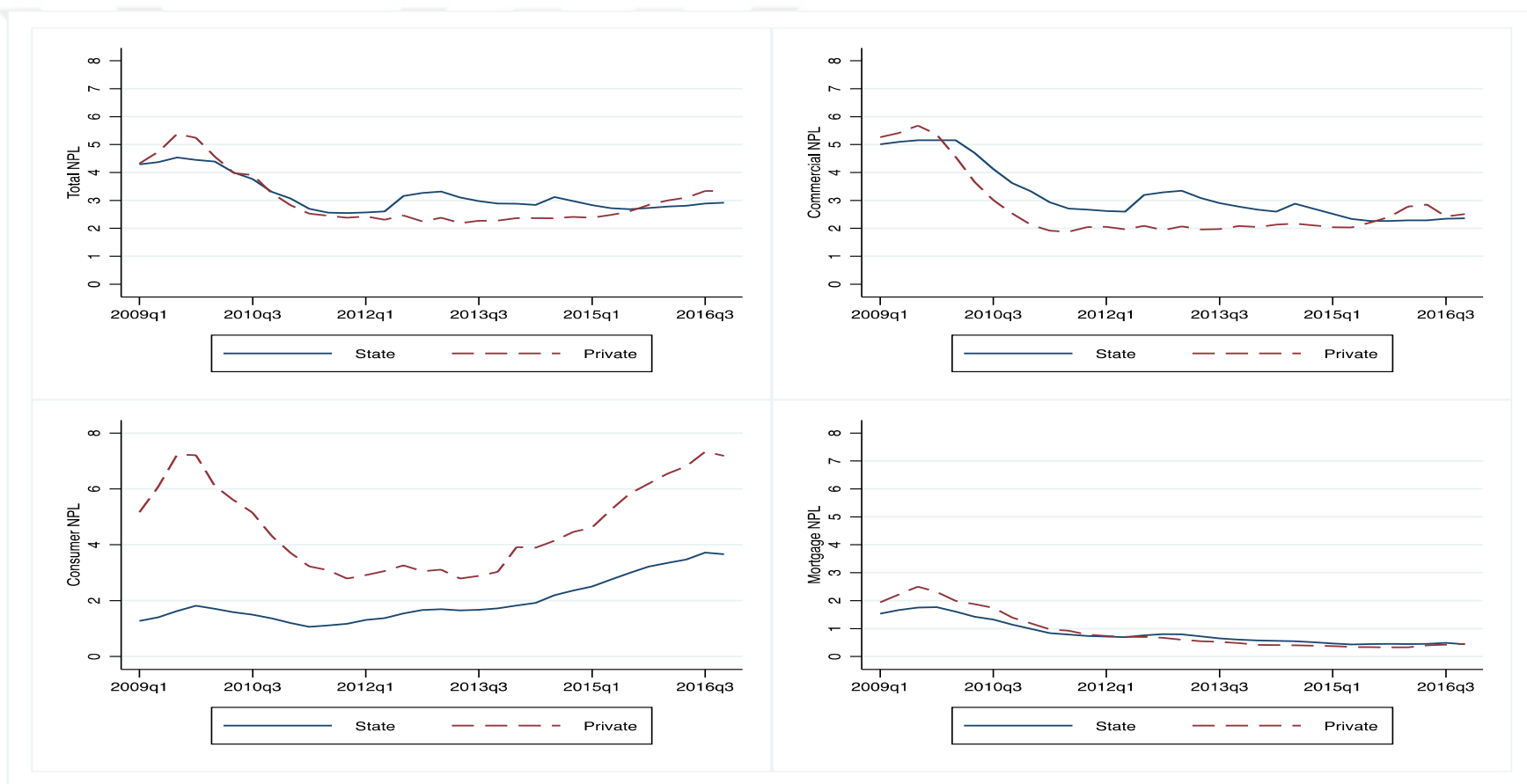


Figure 4.2: NPLs of Private and State-owned Banks over the Sample Period by Loan Type, 2009Q1–2016Q4.

Source: BRSA (top left panel) and FINTURK.

Table 4.1: Definitions of Variables and Data Sources.

Variable	Source	Explanation
Total NPL	FINTURK	The logarithm of the ratio of non-performing loans to total loans in a province. Loans to financial institutions are excluded.
Commercial NPL	FINTURK	The logarithm of the non-performing commercial loans to total commercial loans in a province. Total commercial loans are obtained by subtracting consumer, automobile, mortgage loans, and loans to financial institutions from total loans. Non-performing commercial loans are obtained in a similar way.
Consumer NPL	FINTURK	The logarithm of the ratio of non-performing consumer loans to total consumer loans in a province. Consumer loans do not include mortgage and automobile loans and balances on consumer credit cards.
Mortgage NPL	FINTURK	The logarithm of the ratio of non-performing mortgage loans to total mortgage loans in a province.
Total Loan	FINTURK	Natural logarithm of total loans, excluding loans to financial institutions in a province.
Commercial Loan	FINTURK	The natural logarithm of commercial loans in a province. Commercial loans are obtained by subtracting all consumer loans from total loans.
Consumer Loan	FINTURK	The natural logarithm of consumer loans in a province.
Mortgage Loan	FINTURK	The natural logarithm of mortgage loans in a province.
Deposit	FINTURK	The natural logarithm of bank deposits in a province.
Branch	FINTURK	The natural logarithm of the number of bank branches in a province.
111 GDP	TURKSTAT	The natural logarithm of GDP per capita in a province. The quarterly GDP per capita is obtained by extrapolating the annual GDP per capita.
Unemp. Rate	TURKSTAT	The unemployment rate at the NUTS-2 levels. The yearly rate is extrapolated to get the quarterly unemployment rate. Provinces located at the same NUTS-2 level are assumed to have the same unemployment rate.
Mortgage Rate	CBT	The weighted average interest rate on residential mortgage loans is available at the national level.
HP	REIDIN	The natural logarithm of house prices is calculated by using the house price at the end of each quarter. Provincial house price data are available for 68 provinces out of 81 provinces in Turkey.

Notes: FINTURK is a database maintained by the Banking Regulation and Supervision of Agency (BRSA). TURKSTAT and CBT are abbreviations for the Turkish Statistical Institute and the Central Bank of the Republic of Turkey, respectively.

Table 4.2: Descriptive Statistics of NPL Ratios of State-owned and Private Banks, (%).

	Mean	Median	Sd	p25	p75	N
State-owned						
Total NPL	2.800	2.540	1.297	1.939	3.360	2,040
Commercial NPL	2.998	2.666	1.727	1.867	3.659	2,040
Consumer NPL	1.734	1.493	0.912	1.079	2.201	2,040
Mortgage NPL	0.854	0.622	0.768	0.393	1.037	2,040
Private						
Total NPL	3.864	3.352	1.798	2.554	4.825	1,972
Commercial NPL	3.265	2.654	2.035	1.913	4.103	1,972
Consumer NPL	4.143	3.675	1.780	2.805	5.312	1,972
Mortgage NPL	0.955	0.598	0.956	0.359	1.185	1,972

Notes: All figures are ratios of non-performing loans. The 25th, 50th, and 75th percentile values of the variables are reported in columns p25, p50, and p75, respectively. N represents the number of observations. Even though both private and state-owned banks operate in all of the provinces in Turkey, the difference in the number of observations is due to the exclusion of the 2015Q3 values from the sample of private banks, as one private bank was acquired by a foreign bank in that quarter.

Table 4.3: Summary Statistics of Variables Used in the Estimations, 2009Q1–2016Q4.

		Mean	p50	Sd	p25	p75	N
Bank-Related Variables							
State-owned	Total NPL	-3.669	-3.673	0.429	-3.943	-3.393	2,040
	Commercial NPL	-3.645	-3.625	0.525	-3.981	-3.308	2,040
	Consumer NPL	-4.181	-4.205	0.501	-4.529	-3.816	2,040
	Mortgage NPL	-5.036	-5.081	0.720	-5.540	-4.569	2,040
	Total Loan	13.458	13.284	1.066	12.759	14.003	2,040
	Commercial Loan	12.956	12.75	1.154	12.200	13.532	2,040
	Consumer Loan	11.921	11.842	0.882	11.277	12.439	2,040
	Mortgage Loan	11.223	11.031	1.087	10.512	11.782	2,040
	Branch	3.281	3.219	0.832	2.708	3.714	2,040
	Deposit	13.332	13.172	1.072	12.613	13.924	2,040
Private	Total NPL	-3.351	-3.396	0.436	-3.667	-3.031	1,972
	Commercial NPL	-3.591	-3.629	0.585	-3.957	-3.193	1,972
	Consumer NPL	-3.271	-3.304	0.420	-3.574	-2.935	1,972
	Mortgage NPL	-5.045	-5.117	0.909	-5.627	-4.434	1,967
	Total Loan	13.426	13.155	1.298	12.592	14.163	1,972
	Commercial Loan	12.721	12.496	1.457	11.796	13.521	1,972
	Consumer Loan	11.639	11.454	1.111	10.887	12.288	1,972
	Mortgage Loan	11.336	11.056	1.247	10.461	12.146	1,967
	Branch	3.382	3.091	1.095	2.639	4.060	1,836
	Deposit	13.007	12.658	1.355	12.057	13.856	1,836
Province Characteristics							
	HP	6.103	6.093	0.186	5.979	6.204	4,012
	GDP	8.969	8.959	0.322	8.765	9.169	4,012
	Unemp. Rate	9.387	8.425	3.774	6.600	11.300	4,012

Notes: The definitions of all variables are provided in Table 4.1. Even though both private and state-owned banks operate in all of the provinces in Turkey, the difference in the number of observations is due to the exclusion of the 2015Q3 values from the sample of private banks, as one private bank was acquired by a foreign bank in that quarter. All monetary values are real. The 25th, 50th, and 75th percentile values of the variables are reported in columns p25, p50, and p75, respectively.

Table 4.4: Panel Unit Test Results.

	Im, Pesaran and Shin Test Statistics	Prob
Total NPL	3.041	0.999
Commercial NPL	1.227	0.890
Consumer NPL	9.661	1.000
Mortgage NPL	2.407	0.992
Total Loan	-1.738	0.041
Commercial Loan	3.232	0.999
Consumer Loan	-12.717	0.000
Mortgage Loan	0.197	0.578
Branch	14.143	1.000
Deposit	3.932	1.000
GDP	4.967	1.000
Unemp. Rate	1.267	0.897
HP	16.238	1.000

Notes: The definitions of all variables are provided in Table 4.1. All monetary values are real. Null hypothesis is all panels contain unit roots and the alternative is some panels are stationary.

Table 4.5: Correlation Matrix of the Variables.

	NPL	Loan	Branch	Deposit	HP	GDP
Panel A. Total NPL						
NPL	1.000					
Loan	-0.103	1.000				
Branch	0.046	0.952	1.000			
Deposit	-0.033	0.939	0.947	1.000		
HP	-0.017	0.418	0.437	0.452	1.000	
GDP	-0.161	0.546	0.495	0.556	0.498	1.000
Unemp. Rate	0.271	0.060	0.076	0.071	-0.074	-0.218
Panel B. Commercial NPL						
NPL	1.000					
Loan	-0.173	1.000				
Branch	0.013	0.924	1.000			
Deposit	-0.009	0.928	0.947	1.000		
HP	-0.029	0.405	0.437	0.452	1.000	
GDP	-0.161	0.537	0.495	0.556	0.498	1.000
Unemp. Rate	0.216	0.074	0.076	0.071	-0.074	-0.218
Panel C. Consumer NPL						
NPL	1.000					
Loan	0.049	1.000				
Branch	0.203	0.932	1.000			
Deposit	0.064	0.936	0.947	1.000		
HP	0.107	0.417	0.437	0.452	1.000	
GDP	0.121	0.558	0.495	0.556	0.498	1.000
Unemp. Rate	0.168	-0.018	0.076	0.071	-0.074	-0.218
Panel D. Mortgage NPL						
NPL	1.000					
Loan	-0.133	1.000				
Branch	0.027	0.948	1.000			
Deposit	0.009	0.927	0.947	1.000		
HP	-0.041	0.402	0.437	0.452	1.000	
GDP	-0.214	0.580	0.494	0.556	0.498	1.000
Unemp. Rate	0.210	0.032	0.077	0.072	-0.074	-0.218

Notes: The definitions of all variables are provided in Table 4.1. NPL and Loan indicate the loan types as total, commercial, consumer and mortgage loans in Panels A, B, C and D, respectively.

Table 4.6: Effect of House Price Appreciation on NPLs, 2009Q1–2016Q4.

	(1) OLS Total	(2) GMM Total	(3) OLS Commercial	(4) GMM Commercial	(5) OLS Consumer	(6) GMM Consumer	(7) OLS Mortgage	(8) GMM Mortgage
HP _{t-1}	-0.273* (0.142)	-0.558** (0.221)	-0.492** (0.237)	-0.589*** (0.215)	-0.047 (0.099)	-1.221** (0.528)	-0.107 (0.302)	-1.198 (2.535)
Loan _{t-1}	0.016** (0.008)	0.022 (0.029)	-0.016 (0.059)	-0.034 (0.050)	0.050*** (0.011)	0.184*** (0.061)	-0.631*** (0.113)	-0.443*** (0.156)
State	-0.010*** (0.003)	-0.011*** (0.003)	-0.007** (0.003)	-0.008** (0.004)	0.015*** (0.004)	-0.021 (0.017)	0.002 (0.005)	0.002 (0.006)
Branch _{t-1}	-0.136*** (0.051)	-0.143** (0.068)	-0.279*** (0.097)	-0.193 (0.126)	-0.041 (0.057)	-0.002 (0.078)	0.191 (0.211)	0.450** (0.211)
Deposit _{t-1}	-0.010 (0.034)	0.028 (0.042)	-0.025 (0.058)	-0.005 (0.057)	-0.048 (0.033)	-0.063 (0.039)	-0.005 (0.065)	0.152 (0.098)
GDP _{t-1}	0.502*** (0.195)	0.184 (1.606)	0.707** (0.312)	0.710** (0.305)	0.328** (0.166)	1.363*** (0.475)	0.545 (0.372)	0.713 (0.634)
Unemp. Rate _{t-1}	-0.005 (0.006)	0.006 (0.008)	-0.008 (0.010)	-0.000 (0.008)	-0.002 (0.005)	0.019 (0.012)	0.022** (0.011)	0.014 (0.012)
NPL _{t-1}	-0.017 (0.069)	0.055 (0.069)	-0.034 (0.048)	-0.019 (0.050)	-0.336*** (0.025)	-0.335*** (0.026)	-0.142*** (0.026)	-0.113*** (0.030)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,007	4,007
AR(1)		0.000		0.000		0.000		0.000
AR(2)		0.626		0.653		0.093		0.005
Hansen		0.112		0.890		0.414		0.172

Notes: Dependent variables are logarithm of NPL ratios of state-owned and private banks in a province. The definitions of all variables are provided in Table 4.1. The base group is private banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 4.7: Effect of House Price Appreciation on NPLs by Ownership, 2009Q1-2016Q4.

	(1) OLS Total	(2) GMM Total	(3) OLS Commercial	(4) GMM Commercial	(5) OLS Consumer	(6) GMM Consumer	(7) OLS Mortgage	(8) GMM Mortgage
HP _{t-1}	-0.311* (0.167)	-1.182* (0.720)	-0.546* (0.317)	0.923 (1.373)	-0.066 (0.094)	-1.260** (0.615)	0.465 (0.454)	-0.295 (3.273)
HP _{t-1} *State	0.075 (0.160)	1.067 (1.147)	0.106 (0.260)	-2.948 (2.630)	0.038 (0.155)	0.133 (0.253)	-1.119** (0.464)	-1.436 (2.833)
Loan _{t-1}	0.017** (0.008)	0.018 (0.030)	-0.016 (0.059)	-0.039 (0.049)	0.050*** (0.011)	0.184*** (0.060)	-0.625*** (0.111)	-0.475*** (0.158)
State	-0.011*** (0.003)	-0.013*** (0.004)	-0.007** (0.003)	-0.003 (0.006)	0.015*** (0.004)	-0.022 (0.017)	0.004 (0.005)	0.005 (0.009)
Branch _{t-1}	-0.138*** (0.050)	-0.148** (0.067)	-0.281*** (0.097)	-0.154 (0.124)	-0.042 (0.057)	-0.008 (0.079)	0.213 (0.213)	0.517** (0.231)
Deposit _{t-1}	-0.010 (0.033)	0.017 (0.045)	-0.026 (0.058)	0.014 (0.057)	-0.048 (0.033)	-0.061 (0.038)	-0.004 (0.064)	0.154 (0.097)
GDP _{t-1}	0.501*** (0.195)	0.954 (1.608)	0.707** (0.312)	0.704** (0.291)	0.328** (0.166)	1.252** (0.475)	0.545 (0.372)	0.728 (0.632)
Unemp. Rate _{t-1}	-0.005 (0.006)	0.008 (0.008)	-0.008 (0.010)	-0.000 (0.007)	-0.002 (0.005)	0.019* (0.011)	0.022** (0.011)	0.015 (0.012)
NPL _{t-1}	-0.018 (0.069)	0.067 (0.074)	-0.034 (0.048)	-0.025 (0.049)	-0.336*** (0.025)	-0.330*** (0.026)	-0.144*** (0.026)	-0.114*** (0.031)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,007	4,007
AR(1)		0.000		0.000		0.000		0.000
AR(2)		0.555		0.562		0.125		0.004
Hansen		0.106		0.931		0.452		0.176

Notes: Dependent variables are logarithm of NPL ratios of state-owned and private banks in a province. The definitions of all variables are provided in Table 4.1. The base group is private banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 4.8: Effect of House Price Appreciation on Logit Transformed NPLs, 2009Q1-2016Q4.

	(1) OLS Total	(2) GMM Total	(3) OLS Commercial	(4) GMM Commercial	(5) OLS Consumer	(6) GMM Consumer	(7) OLS Mortgage	(8) GMM Mortgage
Panel A. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-0.280* (0.146)	-0.574** (0.229)	-0.503** (0.243)	-0.611*** (0.222)	-0.048 (0.101)	-1.313** (0.559)	-0.107 (0.303)	-1.204 (2.544)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,007	4,007
AR(1)		0.001		0.000		0.000		0.000
AR(2)		0.622		0.647		0.114		0.004
Hansen		0.110		0.889		0.458		0.175
Panel B. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-0.319* (0.173)	-0.428 (0.267)	-0.559* (0.325)	1.676 (1.673)	-0.071 (0.096)	-1.370** (0.647)	0.470 (0.456)	-0.293 (3.293)
HP _{t-1} *State	0.077 (0.166)	-0.185 (0.224)	0.110 (0.268)	-4.965* (2.940)	0.044 (0.159)	0.159 (0.261)	-1.129** (0.466)	-1.450 (2.852)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,007	4,007
AR(1)		0.001		0.000		0.000		0.000
AR(2)		0.641		0.509		0.124		0.004
Hansen		0.199		0.931		0.426		0.179

Notes: Dependent variables are the logit transformation of NPL ratios of state-owned and private banks in a province. The base group is private banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 4.9: Effect of House Price Appreciation NPLs Using Static Model, 2009Q1-2016Q4.

	(1) OLS Total	(2) OLS Total	(3) OLS Commercial	(4) OLS Commercial	(5) OLS Consumer	(6) OLS Consumer	(7) OLS Mortgage	(8) OLS Mortgage
Panel A. Dependent variables are the logarithm of NPLs.								
HP _{t-1}	-0.271* (0.141)	-0.307* (0.166)	-0.486** (0.236)	-0.534* (0.316)	-0.023 (0.094)	-0.029 (0.090)	-0.095 (0.290)	0.387 (0.438)
HP _{t-1} *State		0.070 (0.157)		0.095 (0.259)		0.011 (0.153)		-0.944** (0.467)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,008	4,008
Panel B. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-0.277* (0.146)	-0.313* (0.172)	-0.497** (0.242)	-0.546* (0.324)	-0.024 (0.096)	-0.031 (0.092)	-0.095 (0.291)	0.391 (0.440)
HP _{t-1} *State		0.071 (0.163)		0.096 (0.267)		0.013 (0.156)		-0.951** (0.470)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,008	4,008

Notes: Dependent variables are the logarithm of NPL ratios (Panel A) and logit transformation of NPL ratios (Panel B) of state-owned and private banks in a province. The base group is private banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 4.10: Effect of House Price Appreciation NPLs Using IV, 2009Q1-2016Q4.

	(1) Total	(2) Total	(3) Commercial	(4) Commercial	(5) Consumer	(6) Consumer	(7) Mortgage	(8) Mortgage
Panel A. Dependent variables are the logarithm of NPLs.								
HP _{t-1}	-1.238 (0.878)	-3.865*** (1.230)	-0.368 (1.275)	0.673 (1.738)	-1.915* (1.155)	3.553* (1.841)	3.121 (2.172)	2.419 (2.688)
HP _{t-1} *State		5.319*** (1.991)		-2.050 (2.203)		-11.078*** (2.719)		1.406 (3.716)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,008	4,008
Kleibergen-Paap rk Wald F	17.11	8.675	17.36	10.09	17.46	7.527	17.31	8.613
Overidentification p-value	0.845	0.978	0.710	0.778	0.124	0.302	0.328	0.509
Panel B. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-1.285 (0.911)	-4.197*** (1.290)	-0.399 (1.317)	0.592 (1.794)	-1.994* (1.187)	3.424* (1.855)	3.122 (2.192)	2.432 (2.711)
HP _{t-1} *State		5.896*** (2.124)		-1.949 (2.305)		-10.978*** (2.715)		1.382 (3.758)
N	4,012	4,012	4,012	4,012	4,012	4,012	4,008	4,008
Kleibergen-Paap rk Wald F	17.11	8.675	17.36	10.09	17.46	7.527	17.31	8.613
Overidentification p-value	0.879	0.977	0.732	0.792	0.118	0.295	0.329	0.515

Notes: Dependent variables are the logarithm of NPL ratios (Panel A) and logit transformation of NPL ratios (Panel B) ratios of state-owned and private banks in a province. Instruments for the house price variable are the mortgage rate and its interaction with undevelopable land share. The base group is private banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table 4.11: Effect of House Price Appreciation NPLs Using Aggregated Data, 2009Q1-2016Q4.

	(1) OLS Total	(2) GMM Total	(3) OLS Commercial	(4) GMM Commercial	(5) OLS Consumer	(6) GMM Consumer	(7) OLS Mortgage	(8) GMM Mortgage
Panel A. Dependent variables are the logarithm of NPLs.								
HP _{t-1}	-0.257** (0.123)	-0.338* (0.190)	-0.387* (0.211)	-0.386* (0.202)	-0.045 (0.088)	-0.670* (0.393)	-0.204 (0.231)	-0.262 (0.313)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080
AR(1)		0.002		0.000		0.000		0.000
AR(2)		0.653		0.785		0.262		0.010
Hansen		0.216		0.508		0.142		0.016
Panel B. Dependent variables are the logarithm of NPLs.								
HP _{t-1}	-0.343** (0.138)	-0.360 (0.230)	-0.400 (0.276)	-0.308 (0.289)	-0.200** (0.079)	-0.866** (0.430)	0.086 (0.313)	0.125 (0.298)
HP _{t-1} *State	0.173 (0.159)	0.097 (0.199)	0.026 (0.248)	-0.172 (0.262)	0.312** (0.138)	0.363** (0.174)	-0.493 (0.401)	-0.483 (0.447)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080
AR(1)		0.002		0.000		0.000		0.000
AR(2)		0.641		0.796		0.248		0.010
Hansen		0.184		0.461		0.125		0.175
Panel C. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-0.264** (0.128)	-0.347* (0.196)	-0.396* (0.217)	-0.398* (0.210)	-0.047 (0.090)	-0.757* (0.432)	-0.160 (0.230)	-0.186 (0.207)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080
AR(1)		0.003		0.000		0.000		0.000
AR(2)		0.651		0.775		0.296		0.007
Hansen		0.200		0.494		0.135		0.194

Table 4.11 (cont'd)

	(1) OLS Total	(2) GMM Total	(3) OLS Commercial	(4) GMM Commercial	(5) OLS Consumer	(6) GMM Consumer	(7) OLS Mortgage	(8) GMM Mortgage
Panel D. Dependent variables are the logit transformed NPLs.								
HP _{t-1}	-0.353** (0.144)	-0.371 (0.238)	-0.411 (0.284)	0.300 (0.956)	-0.211*** (0.082)	-0.926 (0.787)	0.089 (0.315)	0.128 (0.300)
HP _{t-1} *State	0.181 (0.166)	0.108 (0.208)	0.029 (0.257)	-1.405 (1.834)	0.329** (0.142)	0.332 (1.512)	-0.499 (0.403)	-0.490 (0.449)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080
AR(1)		0.003		0.000		0.000		0.000
AR(2)		0.640		0.837		0.285		0.009
Hansen		0.170		0.346		0.117		0.176
	(1) Total	(2) Total	(3) Commercial	(4) Commercial	(5) Consumer	(6) Consumer	(7) Mortgage	(8) Mortgage
Panel E. Dependent variables are the logarithm of NPLs, static model.								
HP _{t-1}	-0.256** (0.123)	-0.341** (0.136)	-0.386* (0.210)	-0.400 (0.274)	-0.034 (0.084)	-0.200*** (0.072)	-0.182 (0.218)	0.048 (0.307)
HP _{t-1} *State		0.172 (0.157)		0.028 (0.247)		0.332** (0.139)		-0.388 (0.418)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080
Panel F. Dependent variables are the logit transformed NPLs, static model.								
HP _{t-1}	-0.262** (0.127)	-0.351** (0.142)	-0.395* (0.215)	-0.410 (0.282)	-0.035 (0.086)	-0.207*** (0.075)	-0.183 (0.219)	0.049 (0.309)
HP _{t-1} *State		0.178 (0.163)		0.031 (0.256)		0.346** (0.143)		-0.393 (0.420)
N	4,080	4,080	4,080	4,080	4,080	4,080	4,080	4,080

Notes: The dependent variables are the logarithm of NPL ratios in Panels A, B, and E and logit transformation of NPL ratios in Panels C, D, and E of state-owned and private banks in a province. Foreign banks are assumed to behave like private banks and their loan and deposit amounts and branches are combined with those of private. The base group is private banks, including foreign banks. Clustered robust standard errors are reported in parentheses. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

CHAPTER 5

CONCLUSIONS

This dissertation explores the impact of house prices on the supply side of the housing market as well as the banks' lending decisions and financial stability in Turkey.

In the second chapter of the thesis, we estimate the price elasticity of housing supply and identify the factors that drive the differences across provinces in a less-regulated emerging market, Turkey. First, using both OLS and IV specifications, we show that the average housing supply elasticity is low in Turkey. Second, we document that the tighter the geographical constraints of a province, the smaller the expansion in building for a given increase in house price growth. Finally, by estimating the price elasticity of housing supply for each province, we show that population, undevelopable land share and average steepness of a province are significant factors in explaining cross-sectional variations of the housing supply elasticities among provinces in Turkey.

In the third chapter, we examine how house price growth affects banks' loan allocation decisions by their ownership types at the provincial level in Turkey. To analyze this relationship, we focus on the mortgage, consumer, construction, and commercial loans; and loans made to several industries where firms might have difficulty accessing financing, such as agriculture, textile, and food. Our

findings suggest that banks reduce the provision of commercial loans and increase consumer loans as house prices appreciate. We also show that banks with different ownership structures respond differently to house price increases; the state-owned banks reduce their commercial loans more than private banks as house prices appreciate, and among the selected industrial loans, state-owned banks reduce their provision of agricultural loans more than private banks.

In the final chapter, we examine the impact of house price growth on domestic banks' NPLs in Turkey using the provincial data for the 2009Q1–2016Q4 period and test whether house price appreciation affects the credit risk of state-owned and private banks differently. We find that house price growth negatively affects the NPLs of all domestic banks in Turkey, controlling for macroeconomic and province characteristics. We observe that state-owned banks do not issue riskier loans than private banks as house prices increase at the province level.

Our findings in this thesis offer some policy implications. First, because supply conditions in Turkish provinces vary widely and local characteristics matter, we highlight the function of the local governments in urban planning. Second, increasing the housing supply would help stabilize the housing market because the low estimated housing supply elasticities suggest that provinces, particularly those that are geographically constrained and more populated, might experience further price increases. Third, policymakers should consider the possible unfavorable consequences of the rising prices in the housing market since a decline in commercial loans, especially the loans provided by state-owned banks, might wipe away the positive effects of a strong housing market. Fourth, state-owned banks should be more careful in expanding mortgage lending since any reversal in house prices might amplify the impact of any downturn through deterioration in households' balance sheets. Fifth, policymakers should ensure price stability in the housing market since any policies that cool down the house prices might cause an increase in NPLs. Finally, policymakers should evaluate

all loan categories while monitoring banks' financial soundness since each loan category has a different sensitivity to house price fluctuations.

There are a few limitations in this thesis. First, housing supply elasticities are calculated using construction permits because of the unavailability of the actual housing stock. In addition, we could not include vacancy and demolition rates into our housing stock calculations due to the lack of these variables. In addition, because we have a limited time series available in Turkey, further studies are needed to fully understand the housing market dynamics in the long run as more data become available. Moreover, the lack of spatially disaggregated construction costs might be preventing us from estimating the supply elasticities more precisely by neglecting the regional heterogeneity in the construction sector. Another shortcoming of this study is the lack of the appropriate regulatory index that measures how man-made constraints on residential construction can affect housing supply. Second, when analyzing the bank loans and NPLs, we use aggregated data by the bank ownership due to the lack of data availability at the firm-bank pair. Therefore, we fail to control the borrower characteristics that might affect the banks' lending decisions or their risk. Also, local bank characteristics such as size, profitability, and liquidity might play a role in their decision to lend that we fail to control.

Given these limitations, future work could broaden this dissertation. For the second chapter, the undevelopable land share measure can be improved by incorporating already developed urban areas into the calculations. Moreover, constructing regulatory measures that capture, for instance, the perception of the contractors or the land allocation decisions by the central or local government might also help us to increase our understanding of the market. Finally, for the third and fourth chapters, more granular data at the bank and firm level might increase our estimates' precisions and help us quantify the real effects of the loan allocation due to changes in house prices.

REFERENCES

- Aastveit, K. A., Albuquerque, B., and Anundsen, A. K. (2020). Changing supply elasticities and regional housing booms. Bank of England Working Paper No. 844. <http://dx.doi.org/10.2139/ssrn.3520650>
- Accetturo, A., Lamorgese, A. R., Mocetti, S., and Pellegrino, D. (2021). Housing supply elasticity and growth: Evidence from Italian cities. *Journal of Economic Geography*, 21(3), 367-396. <https://doi.org/10.1093/jeg/lbaa034>
- Acemoglu, D. and Ucer, M. (2020). High-quality versus low-quality growth in Turkey – Causes and consequences, in: Akat, A.S., Gursel, S. (Eds.), *Facing the Challenges Ahead: Turkish Economy at the Crossroads*. World Scientific Publishing Co. Pte. Ltd., Singapore, pp. 37-89.
- Adelino, M., Schoar, A. and Severino, F. (2015). House prices collateral and self-employment. *Journal of Financial Economics*, 117(2): 288-306. <https://doi.org/10.1016/j.jfineco.2015.03.005>
- Akgunduz, Y. E., Dursun-de Neef, H. Ö., Hacıhasanoglu, Y., and Yilmaz, F. (2021). Cost of Credit and House Prices. Available at SSRN 3803383. <http://dx.doi.org/10.2139/ssrn.3803383>
- Allen, F., Krzysztof, J., Kowalewskic, O. and Kozlowski, L. (2017). Bank lending, crises, and changing ownership structure in Central and Eastern European countries. *Journal of Corporate Finance*, 42: 494-515. <https://doi.org/10.1016/j.jcorpfin.2015.05.001>

- Ari, A., Chen, S., and Ratnovski, L. (2019). The Dynamics of Non-performing Loans During Banking Crises: A New Database. IMF WP no.272.
- Arellano, M., and Bover, O. (1995). Another look at the instrumental variable estimation of error- components models, *Journal of Econometrics*, 68(1), 29-51.
[https://doi.org/10.1016/0304-4076\(94\)01642-D](https://doi.org/10.1016/0304-4076(94)01642-D)
- Aysan, A. F., Disli, M., Ng, A., and Ozturk, H. (2016). Is small the new big? Islamic banking for smes in Turkey. *Economic Modelling*, 54, 187-194.
<https://doi.org/10.1016/j.econmod.2015.12.031>
- Ayberk, İ., and Önder, Z. (2022). House prices and bank loan portfolios in an emerging market: The role of bank ownership. *Economic Modelling*, 106.
<https://doi.org/10.1016/j.econmod.2021.105683>
- Bahadir, B. and Gumus, I. (2016). Credit decomposition and business cycles in emerging market economies. *Journal of International Economics*, 103 (2016), 250-262.
<https://doi.org/10.1016/j.jinteco.2016.10.003>
- Balkan, B., Tok, E., Torun, H., and Tumen, S. (2018). Immigration, housing rents, and residential segregation: Evidence from Syrian refugees in Turkey.
<http://dx.doi.org/10.2139/ssrn.3205899>
- Beck, R., Jakubik, P., and PiloIU, A. (2015). Key determinants of non-performing loans: new evidence from a global sample. *Open Economies Review*, 26(3), 525–550.
<https://doi.org/10.1007/s11079-015-9358-8>
- Beck, T., Büyükkarabacak, B., Rioja, F. K., and Valev, N. T. (2012). Who gets the credit? And does it matter? Household vs. firm lending across countries. *The BE Journal of Macroeconomics*, 12(1).

- Bernanke, B. and Gertler, M. (1989). Agency costs, net worth, and business fluctuations. *American Economic Review*, 79: 14–31.
- Bertay, A. C., Demirgüç-Kunt, A., and Huizinga, H. (2015). Bank ownership and credit over the business cycle: Is lending by state banks less procyclical? *Journal of Banking & Finance*, 50, 326–339. <https://doi.org/10.1016/j.jbankfin.2014.03.012>
- Bezemer, D., Grydak, M. and Zhang, L. (2016). More mortgages, lower growth?. *Economic Inquiry*, 54: 652-674. <https://doi.org/10.1111/ecin.12254>
- Bircan, C. and Saka, O. (2021). Lending cycles and real outcomes: costs of political misalignment. *The Economic Journal*. <https://doi.org/10.1093/ej/ueab020>
- Blundell, R. and Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115-143. [https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/10.1016/S0304-4076(98)00009-8)
- Caldera, A., and Johansson, Å. (2013). The price responsiveness of housing supply in OECD countries. *Journal of Housing Economics*, 22(3), 231-249. <https://doi.org/10.1016/j.jhe.2013.05.002>
- Carvalho, D. (2014). The real effects of government-owned banks: evidence from an emerging market. *The Journal of Finance*, 69(2): 577-609. <https://doi.org/10.1111/jofi.12130>
- Ceritoğlu, E. (2020). Homeownership, housing demand, and household wealth distribution in Turkey. *Emerging Markets Finance and Trade*, 56(5), 1146-1165. <https://doi.org/10.1080/1540496X.2018.1555461>

- Chakraborty I., Goldstein I. and MacKinlay A. (2018). Housing price booms and crowding-out effects in bank lending. *The Review of Financial Studies*, 31(7): 2806-53. <https://doi.org/10.1093/rfs/hhy033>
- Claessens, S., Feyen, E. and Laeven, L. (2008). Political connections and preferential access to finance: The role of campaign contributions. *Journal of Financial Economics*, 88(3): 554-580. <https://doi.org/10.1016/j.jfineco.2006.11.003>
- Coleman, N. and Feler, L. (2015). Bank ownership, lending, and local economic performance during the 2008-2009 financial crisis. *Journal of Monetary Economics*, 71: 50-66. <https://doi.org/10.1016/j.jmoneco.2014.11.001>
- Cooray, A. (2011). The role of the government in financial sector development. *Economic Modelling*, 28(3): 928-938. <https://doi.org/10.1016/j.econmod.2010.11.001>
- Coskun, Y., Seven, U., Ertugrul, H., M. and Alp, A. (2017). Housing price dynamics and bubble risk: the case of Turkey. *Housing Studies*, 35(1): 1-37. <https://doi.org/10.1080/02673037.2017.1363378>
- Cox, J., and Ludvigson, S. C. (2021). Drivers of the great housing boom-bust: Credit conditions, beliefs, or both?. *Real Estate Economics*, 49(3), 843–875. <https://doi.org/10.1111/1540-6229.12303>
- Cull, R., Peria, M.S.M. and Verrier, J. (2018). Bank ownership: trends and implications, IMF Working Paper, No. 17/60. <https://doi.org/10.1596/1813-9450-8297>
- Cuñat V., Cvijanović, D. and Yuan, K. (2018). Within-bank spillovers of real estate shocks. *The Review of Corporate Finance Studies*, 7(2): 157-93. <https://doi.org/10.1093/rcfs/cfy001>

- Danişman, G. (2018). Determinants of bank stability: A financial statement analysis of Turkish banks. *Sosyoekonomi*, 26(38), 87-103.
<https://doi.org/10.17233/sosyoekonomi.2018.04.06>
- De Haas, R., and Van Lelyveld, I. (2014). Multinational banks and the global financial crisis: Weathering the perfect storm?. *Journal of Money, Credit and Banking*, 46(s1), 333-364. <https://doi.org/10.1111/jmcb.12094>
- De Haas, R., Ferreira, D. and Taci, A. (2010). What determines the composition of banks' loan portfolios? Evidence from transition countries. *Journal of Banking & Finance*, 34(2): 388-398. <https://doi.org/10.1016/j.jbankfin.2009.08.005>
- Dell'Ariccia, G., and Marquez, R. (2006). Lending booms and lending standards. *The Journal of Finance*, 61(5), 2511-2546.
<https://doi.org/10.1111/j.1540-6261.2006.01065.x>
- Demiralp, S., Demiralp, S, and Gumus, I. (2016). The state of property development in Turkey: facts and comparison. *New Perspectives on Turkey*, 55: 85-106.
<https://doi.org/10.1017/npt.2016.3>
- Deng, Y., Zeng, Y., and Li, Z. (2019). Real estate prices and systemic banking crises. *Economic Modelling*, 80, 111-120.
<https://doi.org/10.1016/j.econmod.2018.09.032>
- Dimitrios, A., Helen L., and Mike T. (2016). Determinants of non-performing loans: Evidence from Euro- area countries. *Finance Research Letters*, 18, 116-119. <https://doi.org/10.1016/j.frl.2016.04.008>.
- Dinc, I.S. (2005). Politicians and banks: Political influences on government-owned banks in emerging markets. *Journal of Financial Economics*, 77(2): 453-479.
<https://doi.org/10.1016/j.jfineco.2004.06.011>

- DiPasquale, D. (1999). Why don't we know more about housing supply?. *The Journal of Real Estate Finance and Economics*, 18(1), 9-23.
<https://doi.org/10.1023/A:1007729227419>
- Dong, Y. (2016). A note on geographical constraints and housing markets in China. *Journal of Housing Economics*, 33, 15-21.
<https://doi.org/10.1016/j.jhe.2016.06.003>
- Dong, Y., Meng, C., Firth, M., and Hou, W. (2014). Ownership structure and risk-taking: Comparative evidence from private and state-controlled banks in China. *International Review of Financial Analysis*, 36, 120–130.
<https://doi.org/10.1016/j.irfa.2014.03.009>
- Ergenc, C., and Yuksekkaya, O. (2022). Institutionalizing authoritarian urbanism and the centralization of urban decision-making. *Territory, Politics, Governance*, 1-20.
<https://doi.org/10.1080/21622671.2021.2020156>
- Flannery, J. M., and Lin, L. (2017). House prices, bank balance sheets, and bank credit supply, Working Paper.
- Follain, J. R. (1979). The price elasticity of the long-run supply of new housing construction. *Land Economics*, 55(2), 190-199. <https://doi.org/10.2307/2330451>
- Gan, J., 2007. The real effects of asset market bubbles: Loan-and firm-level evidence of a lending channel. *The Review of Financial Studies*, 20(6), 1941-1973.
<https://doi.org/10.1093/rfs/hhm045>
- Garber, G., Mian, A., Ponticelli, J., and Sufi, A. (2019). Household debt and recession in Brazil. *Handbook of U.S. Consumer Economics*. <https://doi.org/10.1016/B978-0-12-813524-2.00004-4>

- Ghosh, A. (2015). Banking-industry specific and regional economic determinants of non-performing loans: Evidence from US states. *Journal of Financial Stability*, 20, 93–104. <https://doi.org/10.1016/j.jfs.2015.08.004>
- Ghosh, A. (2017). Sector-specific analysis of non-performing loans in the US banking system and their macroeconomic impact. *Journal of Economics and Business*, 93, 29-45. <https://doi.org/10.1016/j.jeconbus.2017.06.002>
- Gitelman, E., and Otto, G. (2012). Supply elasticity estimates for the Sydney housing market. *Australian Economic Review*, 45(2), 176-190. <https://doi.org/10.1111/j.1467-8462.2012.00679.x>
- Glaeser, E. L., and Gyourko, J. (2005). Urban decline and durable housing. *Journal of Political Economy*, 113(2), 345-375. <https://doi.org/10.1086/427465>
- Glaeser, E. L., Gyourko, J., and Saks, R. E. (2006). Urban growth and housing supply. *Journal of Economic Geography*, 6(1), 71-89. <https://doi.org/10.1093/jeg/lbi003>
- Green, R. K., Malpezzi, S., and Mayo, S. K. (2005). Metropolitan-specific estimates of the price elasticity of supply of housing, and their sources. *American Economic Review*, 95(2), 334-339. <https://doi.org/10.1257/000282805774670077>
- Gunduz, L., Genc, I. H., and Aysan, A. F. (2022). Buying citizenship: A boon to district-level house prices in Istanbul. *Housing Policy Debate*, 1-16. <https://doi.org/10.1080/10511482.2021.2013283>
- Guren, A. M., McKay, A., Nakamura, E., and Steinsson, J. (2021). Housing wealth effects: The long view. *The Review of Economic Studies*, 88(2), 669-707. <https://doi.org/10.1093/restud/rdaa018>

- Gyourko, J., Saiz, A., and Summers, A. (2008). A new measure of the local regulatory environment for housing markets: The Wharton Residential Land Use Regulatory Index. *Urban Studies*, 45(3), 693-729.
<https://doi.org/10.1177/0042098007087341>
- Harter-Dreiman, M. (2004). Drawing inferences about housing supply elasticity from house price responses to income shocks. *Journal of Urban Economics*, 55(2), 316-337. <https://doi.org/10.1016/j.jue.2003.10.002>
- Hilber, C. A. L., and Vermeulen, W. (2016). The impact of supply constraints on house prices in england. *The Economic Journal*, 126(591):358–405.
<https://doi.org/10.1111/ecoj.12213>
- Im, K. S., Pesaran, M. H., and Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of econometrics*, 115(1), 53-74. [https://doi.org/10.1016/S0304-4076\(03\)00092-7](https://doi.org/10.1016/S0304-4076(03)00092-7)
- Imai, M. (2009). Political determinants of government loans in Japan. *The Journal of Law and Economics*, 52(1), 41–70. <https://doi.org/10.1086/595697>
- Jackson, K. K. (2018). Regulation, land constraints, and California's boom and bust. *Regional Science and Urban Economics*, 68, 130-147.
<https://doi.org/10.1016/j.regsciurbeco.2017.10.005>
- Karadima, M., and Louri, H. (2021). Economic policy uncertainty and non-performing loans: The moderating role of bank concentration. *Finance Research Letters*, 38, 101458. <https://doi.org/10.1016/j.frl.2020.101458>
- Kim, B.H. and Min H. (2011). Household lending, interest rates and housing price bubbles in Korea: Regime switching model and Kalman filter approach. *Economic Modelling*, 28(3): 1415-1423. <https://doi.org/10.1016/j.econmod.2011.02.001>

- Kim, K., Phang, S. Y., and Wachter, S. (2012). Supply Elasticity of Housing. *International Encyclopedia of Housing and Home*, 66-74. <https://doi.org/10.1016/B978-0-08-047163-1.00181-8>
- Kiyotaki, N. and Moore, J. (1997). Credit cycles. *Journal of Political Economy*. 105(2): 211-248. <https://doi.org/10.1086/262072>
- Koetter, M., and Poghosyan, T. (2010). Real estate prices and bank stability. *Journal of Banking & Finance*, 34(6), 1129–1138. <https://doi.org/10.1016/j.jbankfin.2009.11.010>
- Kumar, N. (2020). Political interference and crowding out in bank lending. *Journal of Financial Intermediation*, 43: 1042-9573. <https://doi.org/10.1016/j.jfi.2019.02.001>
- La Porta, R., Lopez-De-Silanes, F., and Shleifer, A. (2002). Government ownership of banks. *The Journal of Finance*, 57(1):265–301. <https://doi.org/10.1111/1540-6261.00422>
- Lerbs, O. W. (2014). House prices, housing development costs, and the supply of new single-family housing in German counties and cities. *Journal of Property Research*, 31(3), 183-210. <https://doi.org/10.1080/09599916.2014.893249>
- Li, S.M., Suardi, S. and Wee, B. (2019). Bank lending behavior and housing market booms: the Australian evidence, University of Wollongong, Working Paper.
- Lim, T. (2018). Growth, financial development, and housing booms. *Economic Modelling*, 69, 91-102. <http://dx.doi.org/10.1016/j.econmod.2017.09.008>
- Liu, X., and Otto, G. (2017). Housing supply elasticity in local government areas of Sydney. *Applied Economics*, 49(53), 5441-5461. <https://doi.org/10.1080/00036846.2017.1307936>

- Loutschina, E. and Strahan, P.E. (2015). Financial integration, housing, and economic volatility. *Journal of Financial Economics*, 115: 25-41.
<https://doi.org/10.1016/j.jfineco.2014.09.009>
- Louzis, D. P., Vouldis, A. T., and Metaxas, V. L. (2012). Macroeconomic and bank-specific determinants of non-performing loans in Greece: A comparative study of mortgage, business and consumer loan portfolios. *Journal of Banking & Finance*, 36(4), 1012–1027. <https://doi.org/10.1016/j.jbankfin.2011.10.012>
- Malpezzi, S., and Maclennan, D. (2001). The long-run price elasticity of supply of new residential construction in the United States and the United Kingdom. *Journal of Housing Economics*, 10(3), 278-306. <https://doi.org/10.1006/jhec.2001.0288>
- Malpezzi, S., and Mayo, S. K. (1997). Getting housing incentives right: a case study of the effects of regulation, taxes, and subsidies on housing supply in Malaysia. *Land Economics*, 372-391. <https://doi.org/10.2307/3147174>
- Martin, A., Moral-Beniito, E. and Schmitz T. (2021). The financial transmission of housing booms: evidence from Spain. *American Economic Review*, 111(3): 1013-53.
<https://doi.org/10.1257/aer.20191410>
- Mayer, C. J., and Somerville, C. T. (2000). Residential construction: Using the urban growth model to estimate housing supply. *Journal of Urban Economics*, 48(1), 85-109. <https://doi.org/10.1006/juec.1999.2158>
- Meghana, A., Demirguc-Kunt, A., and Maksimovic, V. (2012). Financing of firms in developing countries: Lessons from research. Policy Research Working Paper Series No. 6036. The World Bank. <https://doi.org/10.1596/1813-9450-6036>

- Micco, A., Panizza, U., and Yanez, M. (2007). Bank ownership and performance. Does politics matter? *Journal of Banking & Finance*, 31(1), 219–241.
<https://doi.org/10.1016/j.jbankfin.2006.02.007>
- Muth, R. F. (1960). The demand for non-farm housing. *The demand for durable goods*, 29-96.
- Niinimäki, J. P. (2009). Does collateral fuel moral hazard in banking? *Journal of Banking & Finance*, 33(3), 514–521. <https://doi.org/10.1016/j.jbankfin.2008.09.008>
- Nikolopoulos K.I., and Tsalas A.I. (2017). Non-performing Loans: A Review of the Literature and the International Experience. In: Monokroussos P., Gortsos C. (Eds.) *Non-Performing Loans and Resolving Private Sector Insolvency*. Palgrave Macmillan Studies in Banking and Financial Institutions. Palgrave Macmillan, Cham. https://doi.org/10.1007/978-3-319-50313-4_3
- Nkusu, M. M. (2011). Non-performing loans and macrofinancial vulnerabilities in advanced economies. International Monetary Fund.
- Oikarinen, E., Peltola, R., and Valtonen, E. (2015). Regional variation in the elasticity of supply of housing, and its determinants: The case of a small sparsely populated country. *Regional Science and Urban Economics*, 50, 18-30.
<https://doi.org/10.1016/j.regsciurbeco.2014.10.004>
- Onder, Z., and Ozyildirim, S. (2011). Political connection, bank credits and growth: Evidence from Turkey. *The World Economy*, 34(6): 1042-65.
<https://doi.org/10.1111/j.1467-9701.2011.01342.x>
- Onder, Z., and Ozyildirim, S. (2013). Role of bank credit on local growth: do politics and crisis matter? *Journal of Financial Stability*, 9(1): 13-25.
<https://doi.org/10.1016/j.jfs.2012.12.002>

- Ongena, S., and Sendeniz-Yuncu, I. (2011). Which firms engage small, foreign, or state banks? and who goes islamic? Evidence from Turkey. *Journal of Banking & Finance*, 35(12): 3213-3224. <https://doi.org/10.1016/j.jbankfin.2011.05.001>
- Orhangazi, O., and Yeldan, E. (2020). Re-making of the Turkish Crisis. PERI Working Paper Series No.5, The University of Massachusetts Amherst.
- Özdemir Sarı, Ö. B., and Aksoy Khurami, E. (2018). Housing affordability trends and challenges in the Turkish case. *Journal of Housing and the Built Environment*, 1-20. <https://doi.org/10.1007/s10901-018-9617-2>
- Paciorek, A. (2013). Supply constraints and housing market dynamics. *Journal of Urban Economics*, 77, 11-26. <https://doi.org/10.1016/j.jue.2013.04.001>
- Polidi, T. D. (2016). Multifamily housing construction in Russia: supply elasticity and competition. *Area Development and Policy*, 1(2), 238-265. <https://doi.org/10.1080/23792949.2016.1161492>
- Quagliariello, M. (2007). Banks' riskiness over the business cycle: a panel analysis on Italian intermediaries. *Applied Financial Economics*, 17(2), 119–138. <https://doi.org/10.1080/09603100500486501>
- Quigley, J. M., and Raphael, S. (2005). Regulation and the high cost of housing in California. *American Economic Review*, 95(2), 323-328. <https://doi.org/10.1257/000282805774670293>
- Reinhart, C. M., and Rogoff, K. S. (2011). From financial crash to debt crisis. *American Economic Review*, 101(5), 1676–1706. <https://doi.org/10.1257/aer.101.5.1676>
- Rinaldi, L., and Sanchis-Arellano, A. (2006). Household debt sustainability: What explains household non-performing loans? An empirical analysis. ECB Working Paper No. 570.

- Saiz, A. (2010). The geographic determinants of housing supply. *The Quarterly Journal of Economics*, 125(3), 1253–1296. <https://doi.org/10.1162/qjec.2010.125.3.1253>
- Saks, R. E. (2008). Job creation and housing construction: Constraints on metropolitan area employment growth. *Journal of Urban Economics*, 64(1), 178-195. <https://doi.org/10.1016/j.jue.2007.12.003>
- Sapienza, P. (2004). The effects of government ownership on bank lending. *Journal of Financial Economics*, 72(2): 357-384. <https://doi.org/10.1016/j.jfineco.2002.10.002>
- Sarıoğlu-Erdogdu, G. P. (2014). Housing development and policy change: what has changed in Turkey in the last decade in the owner-occupied and rented sectors?. *Journal of Housing and the Built Environment*, 29(1), 155-175. <https://doi.org/10.1007/s10901-013-9368-z>
- Tai, M. (2017). House prices and the allocation of consumer credit, Harvard University, Department of Economics, Working Paper.
- Tajik, M., Aliakbari, S., Ghalia, T., and Kaffash, S. (2015). House prices and credit risk: Evidence from the United States. *Economic Modelling*, 51, 123–135. <https://doi.org/10.1016/j.econmod.2015.08.006>
- Tumen, S. (2016). The economic impact of Syrian refugees on host countries: Quasi-experimental evidence from Turkey. *American Economic Review*, 106(5), 456-60. <https://doi.org/10.1257/aer.p20161065>
- Tunc, C. (2019). The effect of credit supply on house prices: Evidence from Turkey. *Housing Policy Debate*, 30(2): 228-242. <https://doi.org/10.1080/10511482.2019.1661266>

- Türel, A., and Koç, H. (2015). Housing production under less-regulated market conditions in Turkey. *Journal of Housing and the Built Environment*, 30(1), 53-68. <https://doi.org/10.1007/s10901-014-9393-6>
- Us, V. (2017). Dynamics of non-performing loans in the Turkish banking sector by an ownership breakdown: The impact of the global financial crisis. *Finance Research Letters*, 20, 109-117. <https://doi.org/10.1016/j.frl.2016.09.016>.
- Vermeulen, W., and Rouwendal, J. (2007). Housing supply and land use regulation in the Netherlands. Tinbergen Institute Discussion Paper No. 07-058/3. <http://dx.doi.org/10.2139/ssrn.1003955>
- Vo, X., V. (2018). Bank lending behavior in emerging markets. *Finance Research Letters*, 27: 129-134. <https://doi.org/10.1016/j.frl.2018.02.011>
- Wan, J. (2018). Non-performing loans and housing prices in China. *International Review of Economics & Finance*, 57, 26–42. <https://doi.org/10.1016/j.iref.2018.02.011>
- Wang, S., Chan, S. H., and Xu, B. (2012). The estimation and determinants of the price elasticity of housing supply: Evidence from China. *Journal of Real Estate Research*, 34(3), 311-344. <https://doi.org/10.1080/10835547.2012.12091336>
- World Bank and Islamic Development Bank Group, (2016). Global Report on Islamic Finance: Islamic Finance: A Catalyst for Shared Prosperity, World Bank, Washington, DC.
- World Bank, (2015). Rise of the Anatolian Tigers: Turkey Urbanization Review, Main Report. Policy brief; Washington, DC.
- World Bank, (2021). Turkey Economic Monitor, April 2021: Navigating the Waves, World Bank, Washington, DC.

Zhang, D., Cai, J., Liu, J., and Kutan, A. M. (2018). Real estate investments and financial stability: evidence from regional commercial banks in China. *The European Journal of Finance*, 24(16),1388-1408.

<https://doi.org/10.1080/1351847X.2016.1154083>



APPENDICES



APPENDIX A : ADDITIONAL MATERIALS FOR CALCULATING HOUSING SUPPLY ELASTICITY



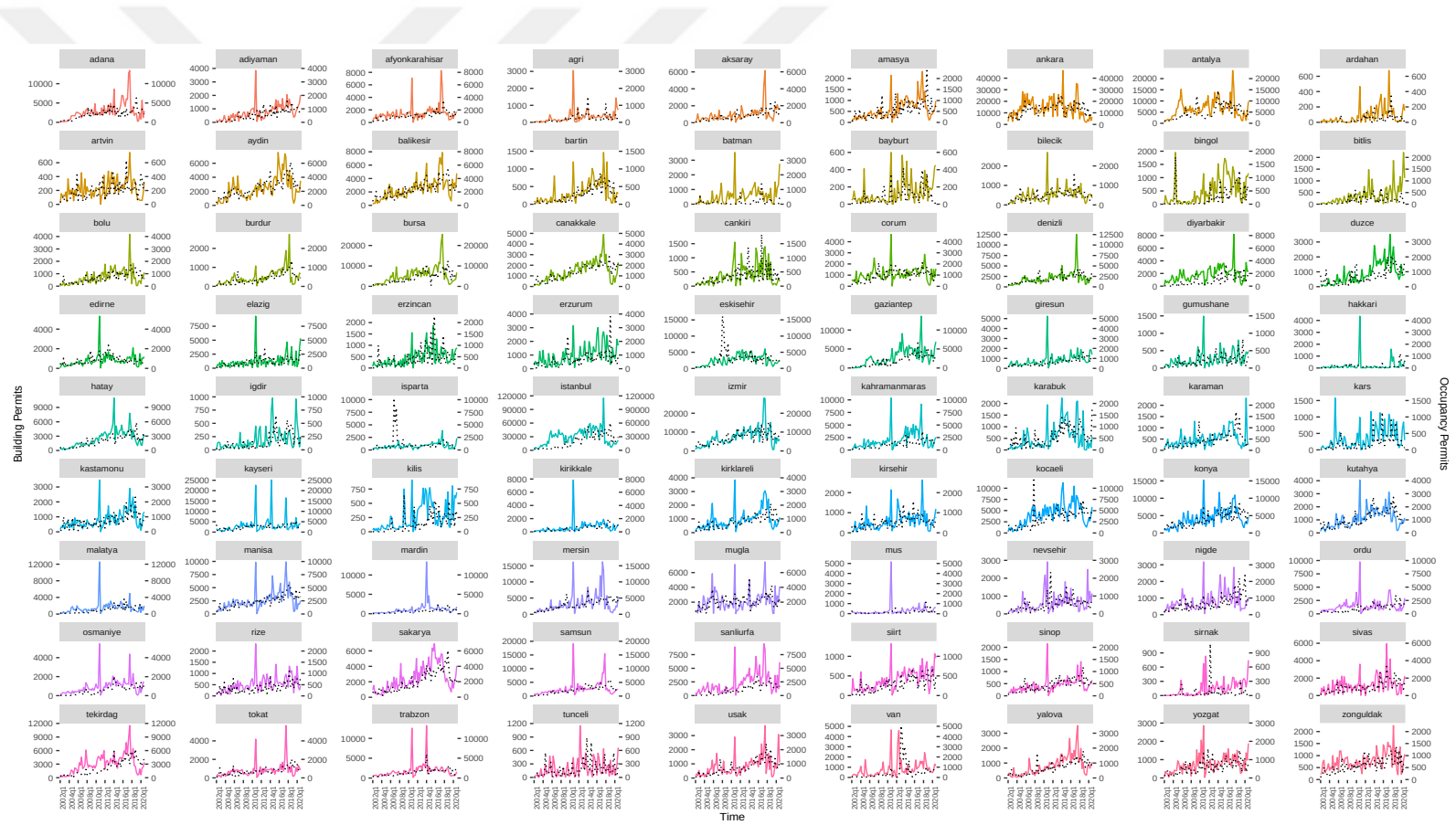


Figure A.1: Residential Construction Permits (solid, left axis) and Residential Occupancy Permits at the Province Level (dotted, right axis), 2002Q1-2017Q4.

Notes: Dotted line plots the occupancy permits, and colored solid line plots the construction permits.

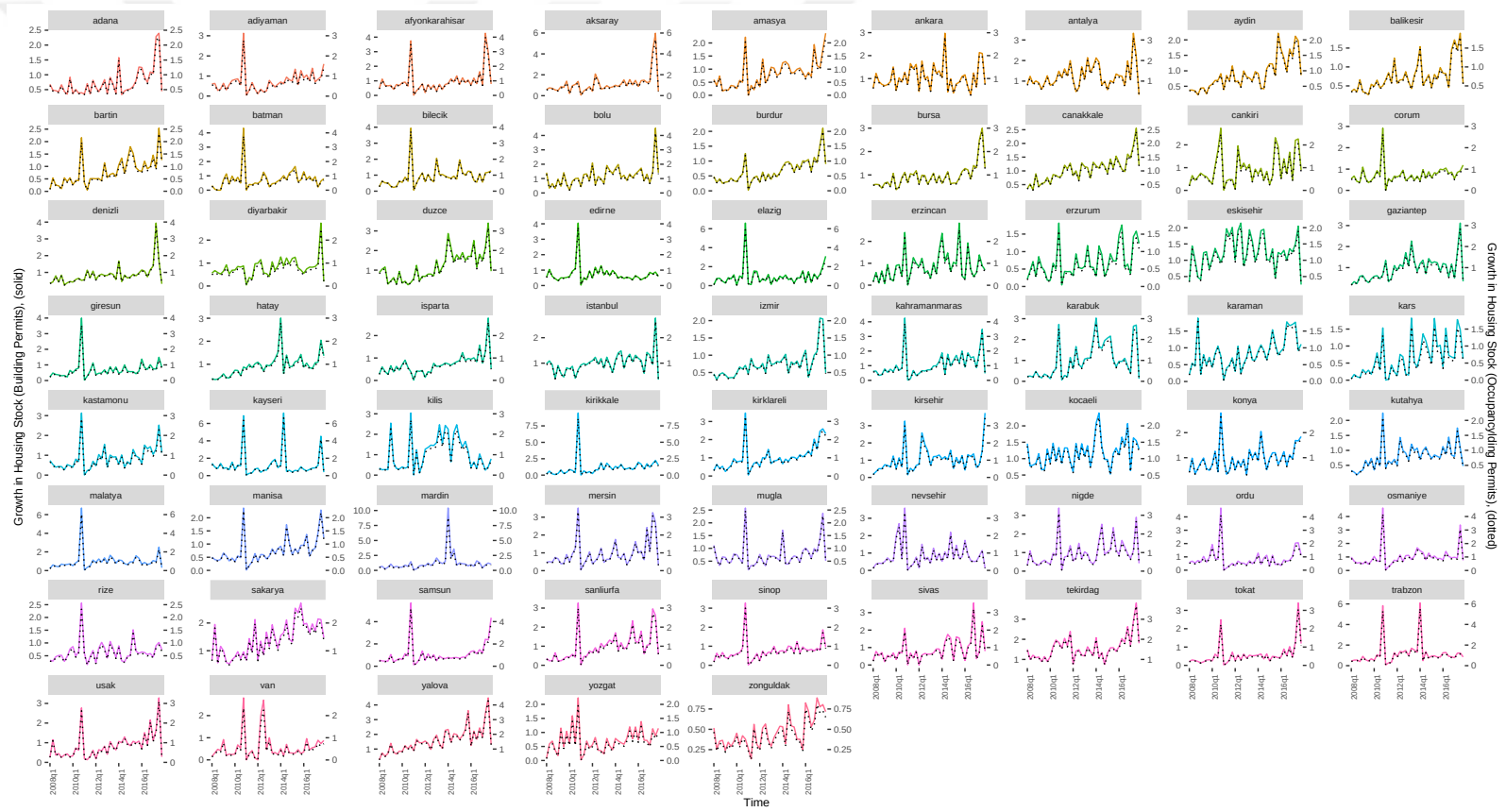


Figure A.2: Growth in Housing Stock at the Province Level.

Notes: Dotted line plots the growth in housing stock using the occupancy permits, and colored solid line plots the growth in housing stock using the construction permits.

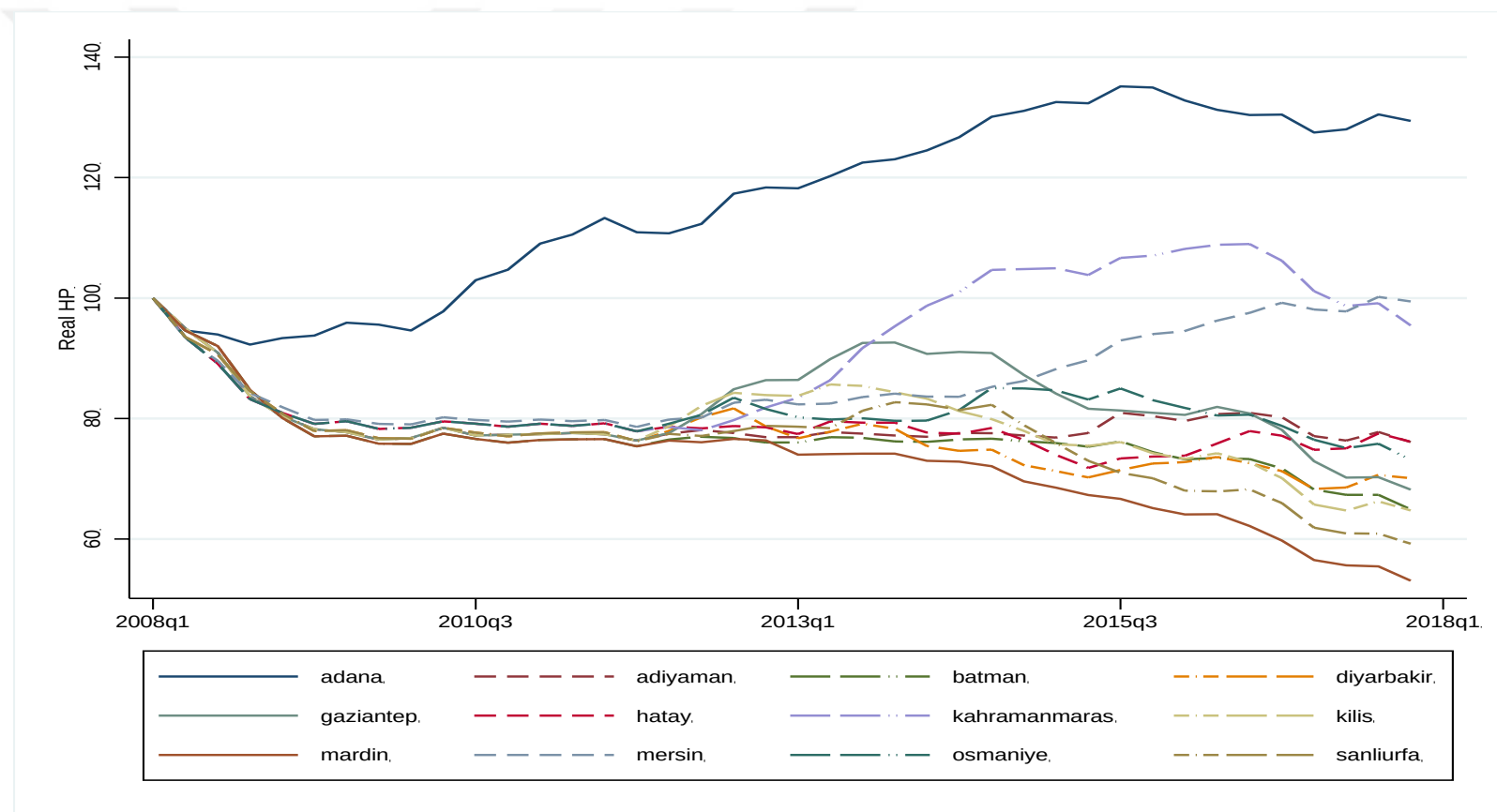


Figure A.3: The Evolution of Real House Prices in Provinces with High Syrian Immigrant Influx, 2008Q1-2017Q4.

Notes: The price level in 2008Q1 is set to 100 for all provinces.

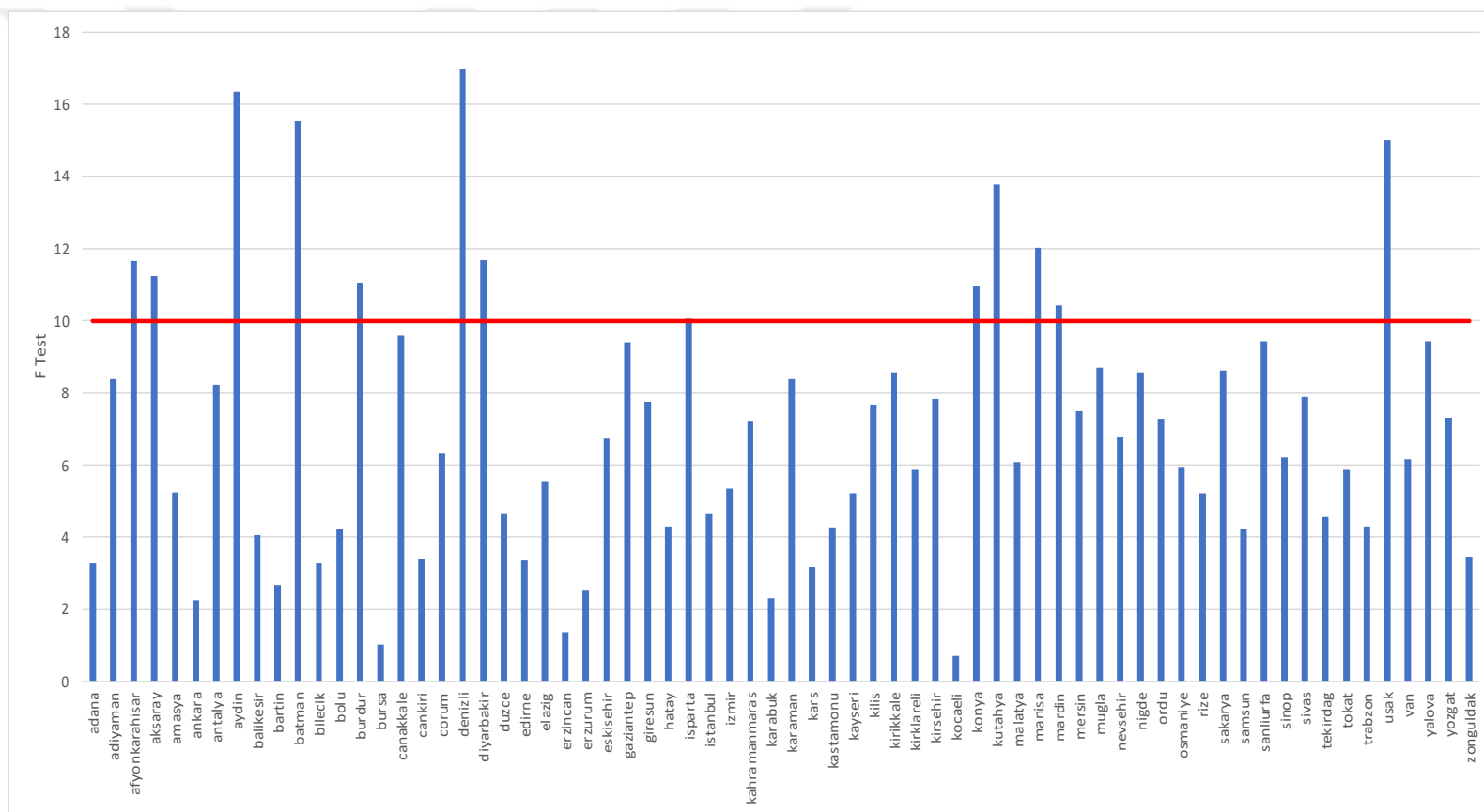


Figure A.4: First-stage F Values for the Elasticity Estimates for each Province.

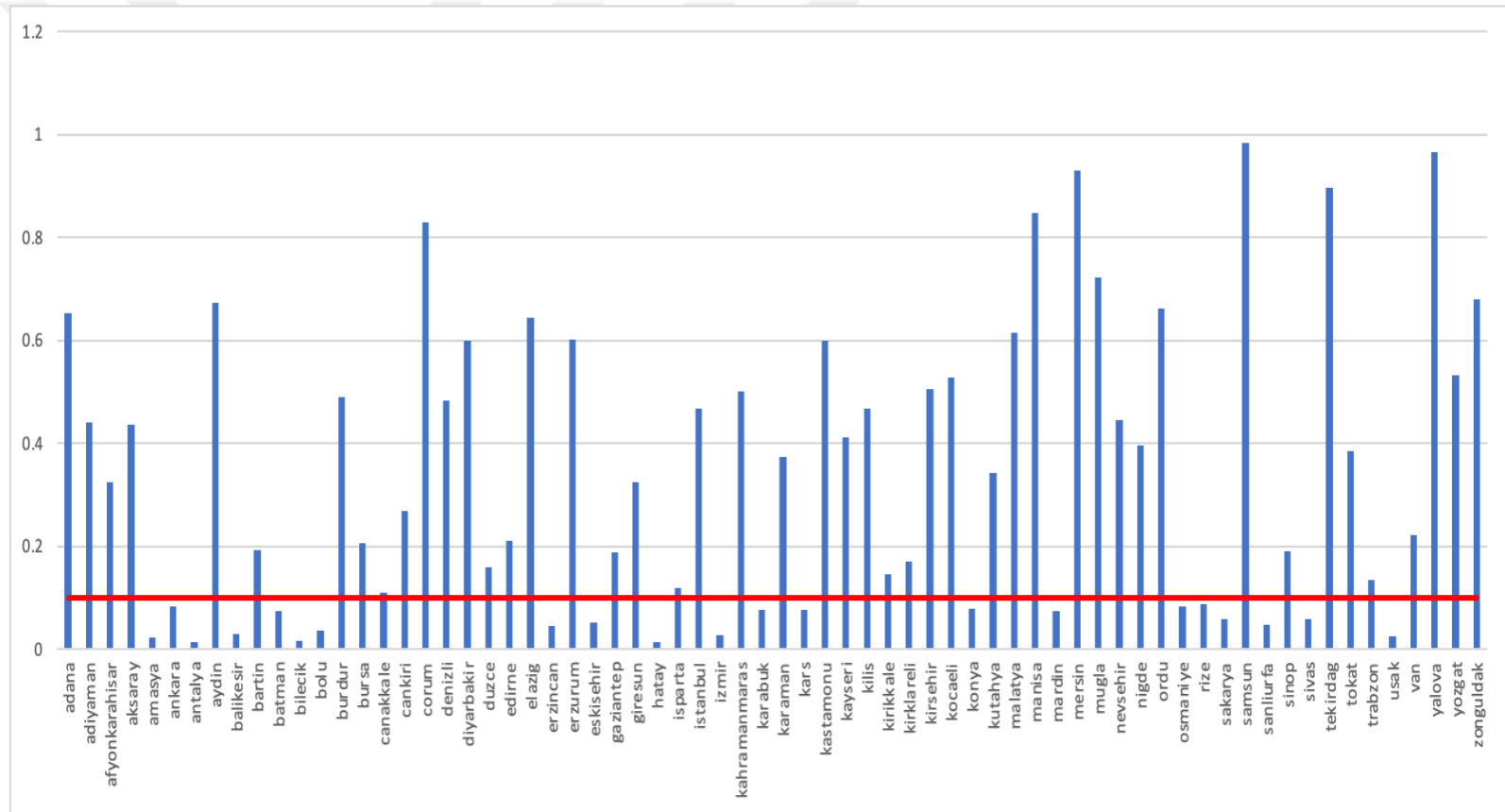


Figure A.5: Hausman Test Results for each Province.

Table A.1: UTM Projections of the Turkish Provinces.

Zone 35	Zone 36	Zone 37	Zone 38
aydin	adana	adiyaman	agri
balikesir	afyonkarahisar	artvin	ardahan
bilecik	aksaray	batman	bitlis
bursa	amasya	bayburt	hakkari
canakkale	ankara	bingol	igdir
denizli	antalya	diyarbakir	kars
edirne	bartin	elazig	sirnak
istanbul	bolu	erzincan	van
izmir	burdur	erzurum	
kirklareli	cankiri	gaziantep	
kocaeli	corum	giresun	
kutahya	duzce	gümüşhane	
manisa	eskisehir	hatay	
mugla	isparta	kahramanmaras	
tekirdag	karabuk	kilis	
usak	karaman	malatya	
yalova	kastamonu	mardin	
	kayseri	mus	
	kirikkale	ordu	
	kirsehir	osmaniye	
	konya	rize	
	mersin	samsun	
	nevsehir	siirt	
	nigde	sivas	
	sakarya	sanliurfa	
	sinop	tokat	
	yozgat	trabzon	
	zonguldak	tunceli	

Table A.2: Housing Supply Elasticity Estimates, 2008-2017.

	(1) OLS	(2) OLS	(3) IV	(4) IV	(5) OLS	(6) OLS	(7) IV	(8) IV
$\Delta \ln(HP)$	0.053*** (0.017)	0.052*** (0.017)	0.462 (0.297)	0.547* (0.330)	0.090*** (0.025)	0.095*** (0.025)	0.342 (0.213)	0.417* (0.233)
$\Delta \ln(HP) * Undev$					-0.089** (0.039)	-0.105*** (0.040)	-0.076 (0.146)	-0.106 (0.167)
N	612	612	612	612	612	612	612	612
R-squared	0.574	0.577	0.073	-0.148	0.577	0.582	0.379	0.274
Control Vars.	No	Yes	No	Yes	No	Yes	No	Yes
Kleibergen-Paap rk Wald F			1.712	1.768			1.320	1.156
Overidentification p-value			0.755	0.915			0.550	0.587

Notes: The dependent variable is the ratio of construction permits to population, multiplied by the average household size. $\Delta \ln(HP)$ is the real house price growth for each province, $\ln(Cost)$ is the logarithm of the real construction cost index, $\ln(GDP)$ is the logarithm of real GDP per capita, and $Undev$ is the undevelopable land share. The model includes province and year fixed effects. Robust standard errors are reported in parenthesis. *** Significance level at %1, ** Significance level at %5, and * Significance level at %10.

Table A.3: Correlation Coefficients of Elasticities Estimated using Different Models.

	Model 1	Model 2	Model 3	Model 4
Model 1	1.000			
Model 2	0.943	1.000		
Model 3	0.875	0.827	1.000	
Model 4	0.791	0.842	0.934	1.000

Notes: The dependent variable is the ratio of construction permits to population, multiplied by the average household size. Model 1 includes only $\Delta \ln(HP)$, Model 2 includes $\Delta \ln(HP)$ and quarter fixed effects, Model 3 includes $\Delta \ln(HP)$ and construction cost, and Model 4 includes $\Delta \ln(HP)$, construction cost and quarter fixed effects.

Table A.4: Regulatory Classification of Provinces based on 2/B Forest Areas.

Province	Regulatory Environment	Sold/Applied (Cumulative, 2012-2017)
adana	less strict	0.916
adiyaman	less strict	0.804
afyonkarahisar	less strict	0.921
amasya	strict	0.650
ankara	strict	0.703
antalya	strict	0.730
artvin	strict	0.115
aydin	less strict	0.944
balikesir	less strict	0.887
bartin	less strict	0.796
bilecik	less strict	0.818
bingol	less strict	0.887
bitlis	less strict	0.973
bolu	less strict	0.769
burdur	less strict	0.925
bursa	less strict	0.895
canakkale	less strict	0.838
cankiri	strict	0.721
corum	less strict	0.905
denizli	less strict	0.881
duzce	less strict	0.873
edirne	less strict	0.908
elazig	strict	0.362
erzurum	less strict	0.985
eskisehir	less strict	0.884
gaziantep	less strict	0.903
giresun	strict	0.701

Table A.4 (cont'd)

Province	Regulatory Environment	Sold/Applied (Cumulative, 2012-2017)
gumushane	strict	0.684
hatay	strict	0.617
isparta	strict	0.632
istanbul	strict	0.113
izmir	strict	0.749
kahramanmaras	less strict	0.790
karabuk	strict	0.666
karaman	less strict	0.793
kastamonu	less strict	0.796
kayseri	less strict	0.822
kirikkale	less strict	0.898
kirklareli	strict	0.597
kirsehir	strict	0.075
kilis	less strict	0.984
kocaeli	strict	0.707
konya	strict	0.688
kutahya	less strict	0.910
manisa	less strict	0.943
mersin	strict	0.608
mugla	strict	0.434
nevsehir	less strict	0.974
nigde	less strict	0.900
ordu	strict	0.310
osmaniye	less strict	0.825
rize	less strict	0.883
sakarya	less strict	0.936
samsun	less strict	0.799
sinop	less strict	0.765

Table A.4 (cont'd)

Province	Regulatory Environment	Sold/Applied (Cumulative, 2012-2017)
sivas	strict	0.458
tekirdag	less strict	0.835
tokat	less strict	0.861
trabzon	less strict	0.851
usak	less strict	0.936
yalova	strict	0.547
yozygat	strict	0.736
zonguldak	strict	0.732
	average	0.755

Source: The Ministry of Agriculture and Forestry.

APPENDIX B : ROBUSTNESS CHECK FOR HOUSE PRICES
AND BANK LOAN PORTFOLIOS IN AN EMERGING
MARKET: THE ROLE OF BANK OWNERSHIP



Table B.1: Weighted Regression Results.

	(1) Mortgage	(2) Commercial	(3) Consumer	(4) Agriculture	(5) Textile	(6) Food	(7) Construction
Growth HP	2.460*** (0.775)	-0.274 (0.440)	3.167*** (0.943)	3.693*** (1.215)	-1.630 (1.339)	0.168 (1.941)	1.819 (1.750)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Kleibergen-Paap rk Wald F	6.400	6.400	6.400	6.781	6.690	6.162	7.756
Hansen J test (Sargan test) p-value	0.0171	0.273	0.0278	0.113	0.664	0.863	0.0263
Growth Rate in Loans							
	(1) Mortgage	(2) Commercial	(3) Consumer	(4) Agriculture	(5) Textile	(6) Food	(7) Construction
Growth HP	2.367*** (0.803)	-0.186 (0.357)	3.251*** (0.889)	3.487*** (1.253)	-1.724 (1.350)	-0.040 (1.821)	1.612 (1.835)
State *Growth HP	0.160 (0.475)	-0.737*** (0.146)	-1.645*** (0.462)	-1.576** (0.744)	0.234 (0.405)	0.474 (0.429)	0.178 (0.732)
N	3,944	3,944	3,944	3,914	3,848	3,942	3,944
Kleibergen-Paap rk Wald F	3.445	3.445	3.445	3.631	3.574	3.327	4.174
Hansen J test (Sargan test) p-value	0.0496	0.440	0.0467	0.154	0.845	0.617	0.0257

Notes: Weight variable is the number of bank branches in each province and each bank type. Dependent variables are growth rates in loan provisions and winsorized at 5% tails. State is a dummy variable indicating the state-owned banks. Commercial loans do not include construction loans and loans to financial institutions. Consumer loans do not include mortgage loans and balances on consumer credit cards. Growth HP is the real house price appreciation rate. Growth GDP is the real GDP growth rate. Growth Employment indicates the growth of private employment in a province. In columns (1)-(3), Growth Employment is employment in private firms excluding construction sector. In columns (4)-(7), Growth Employment is the employment in the corresponding industry, i.e., agriculture, textile, food, and construction. Growth Deposit is the real deposit growth. All of the control variables are lagged by one period. The instruments for the house price appreciation rate are the interaction variable between the quarterly mortgage rate and unavailable land share in the province and the mortgage rate. Robust standard errors are in parentheses and clustered at the province-bank level. Province-quarter, province-bank, bank-quarter, and year fixed effects are included in all models. ***, ** and * denote statistical significance at 1%, 5% and 10%, respectively.