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Explosive housing price dynamics in Türkiye: a city and district-level analysis before and during the COVID-19 pandemic

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Abstract
This study investigates house price dynamics in Türkiye using monthly data for 55 cities and 87 districts over the period 2010–2022. Employing a three-stage empirical framework, we first detect exuberant episodes using Generalized Sup Augmented Dickey-Fuller (GSADF) and backward Sup ADF (BSADF) right-tailed unit root tests at both the city and district levels. We then analyze co-explosivity among the five largest cities (Istanbul, Ankara, Izmir, Bursa, and Antalya) using logistic regression models. Finally, we explore the drivers of bubble formation across 55 cities using panel logistic regression models. The results indicate that most cities and districts experienced synchronized explosive house price increases across three periods: 2013–2015, 2017–2018, and 2020–2022. The 2021–2022 period saw the most widespread bubbles, particularly in the western and Marmara regions than in the eastern part of the country, indicating a clear regional asymmetry in housing market dynamics. The evidence suggests that housing price exuberance was more synchronized in the largest urban markets. The panel logistic regression analysis revealed that new house sales were associated with bubble formation. In contrast, mortgage-financed sales and higher mortgage rates reduced the likelihood of bubbles, highlighting the stabilizing role of credit costs. Macroeconomic shocks from the COVID-19 pandemic and low interest rates were key drivers of bubble dynamics. These findings suggest that housing market stability requires locally targeted macroprudential and credit policies to prevent local and global shocks.

Keywords GSADF/BSADF test · House prices · Bubble formation · Regional analysis · Türkiye

JEL Classification C33 · O18 · R31

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1 Introduction

Over the past two decades, especially after the Global Financial Crisis (GFC), house prices worldwide have increased rapidly. During this period, Türkiye recorded the highest annual increase, with a growth rate of 46.4%, making it the fastest-growing annual house price market globally (Knight 2024). This growth in Türkiye has been supported by limited housing supply and a prolonged period of low mortgage rates (Cevik and Naik 2023; Yang and Zhou 2023; Vogiazas and Alexiou 2017). In addition, among many other factors, the COVID-19 pandemic, supply shortages (Doruk 2024), demographic changes, and policy interventions (Ceritoğlu et al. 2019; Genç et al. 2024; Gunduz et al. 2022) accelerated house prices. These increases in house prices are widely linked to episodes of house price bubble formation across many countries (e.g., Engsted et al. 2016; Martínez-García and Grossman 2020; Petris et al. 2022; Yang and Zhou 2023; Bangura and Lee 2022).

Housing bubbles are defined as deviations in house prices from their fundamental values, caused by speculative behavior and irrational expectations (Stiglitz 1990). Another definition states that house price bubbles are characterized by buyers paying high prices in anticipation of future gains, leading prices to exceed their fundamental values, such as rent and interest rates (Himmelberg et al. 2005). In addition, price increase expectations characterize housing bubbles (Case and Shiller 2003). Early studies on housing price bubbles have mainly focused on advanced economies such as the US, the UK, and other OECD countries (Phillips et al. 2015a; Greenaway-McGrevy and Phillips 2016; Engsted et al. 2016; Pavlidis 2016; Balcilar et al. 2018; Hu and Oxley 2018). In Türkiye, despite the recent increase in research on the explosive behavior of house prices, most existing empirical evidence either looks at the national level (Coşkun et al. 2017; Doruk 2024) or focuses on a few metropolitan cities, most often Istanbul, Ankara, and Izmir (Cagli 2019; Ceritoğlu et al. 2019). District-level analyses are even fewer and largely focus on house price dynamics within Istanbul districts (Ayan and Eken 2021; Gunduz et al. 2025). As a result, there is still a lack of a comprehensive analysis on the explosive behavior of house prices across Türkiye at both the city and district levels. To fill this gap, this study uses a monthly dataset covering 55 cities and 87 districts in Türkiye from 2010 to March 2022. The empirical analysis follows a two-step procedure designed to answer the following three research questions. First, which cities and districts exhibit explosive or bubble behavior in house prices? Second, to what extent are these bubble episodes synchronized across cities? Third, how do local market activity, credit conditions, and global shocks affect the probability of bubble formation? In the first stage, we applied the Generalized Sup Augmented Dickey-Fuller (GSADF) test, developed by Phillips et al. (2015a, b), along with its associated backward sup ADF (BSADF) statistics to detect multiple episodes of explosive behaviors of house prices. In the second stage, we employed logistic regression models to explore contagion-like synchronization effects across Türkiye's major urban markets. Finally, we applied a panel logit model to examine the drivers of housing bubbles. To our knowledge, this study is the first to expand the existing literature examining explosive behavior in house prices by providing more extensive geographic coverage across Türkiye and by jointly assessing both local and macroeconomic drivers of housing bubbles.

The paper is structured as follows: Sect. 2 reviews the literature on house prices, house price bubbles, and their determinants. Section 3 outlines the methodology employed in this study. Section 4 discusses the empirical findings, while Sect. 5 provides the conclusions and policy recommendations.

2 Literature review

Many recent studies on house prices and their explosive behavior (Petris et al. 2022; Yang and Zhou 2023; Zhang et al. 2024) use the recursive right-tailed unit root tests (Phillips et al. 2015a, b). Using this test, Zhang et al. (2024) found multiple house price bubbles across the G7 countries. They also found that total population, size of private debt, GDP per capita, and urbanization are among the common drivers of the G7 countries. Martínez-García and Grossman (2020) analyzed the widespread international pattern of explosive behavior of house prices in a panel of 23 countries. They found that interest rate spreads and stock market growth are among the key drivers of bubble formations. Combining right-tailed unit root tests with a dynamic panel probit model, Chiang and Chen (2025) found that G7 countries experienced two phases of housing bubbles, namely 2003–2008 and post-2016. They also found that low interest rates and money supply are certain macroeconomic variables associated with bubble formations. Evidence from city-level analysis extends research on house price dynamics. Petris et al. (2022) applied a recursive right-tailed test to 32 London boroughs and detected explosive behavior in only three of 32 boroughs in London's housing market. Bangura and Lee (2022) found strong evidence of house price bubbles across Sydney's sub-regions and identified that investment is the main driver of those bubbles, particularly in Western Sydney. Cevik and Naik (2024) also found strong evidence of multiple, long periods of explosive behavior in the housing markets of all major cities of Lithuania.

Research during the COVID-19 pandemic period further extends these findings. For instance, Hansen et al. (2024) investigated the house price bubbles across 382 U.S. metropolitan areas during the COVID-19 pandemic. Their findings revealed that housing price bubbles differ between low- and high-density metro areas. Yang and Zhou (2023) analyzed house price bubbles in major Australian cities during pandemic and found evidence of bubbles in all major cities, namely Sydney, Melbourne, and Brisbane. Huang and Shen (2017) analyzed Hong Kong's housing market by applying the GSADF test and dynamic probit models. They found that speculative demand and an increased money supply were the main bubble drivers, especially in the mass market segment rather than in the luxury segment. Using a difference-in-differences hedonic framework for Shanghai, Du et al. (2025) found that the COVID-19 pandemic reduced house prices in smaller, lower-valued communities and in urban locations.

In contrast, Zhang et al. (2023) found that house prices increased by about 2.5% during the COVID-19 pandemic in MSAs in North Dakota and Minnesota. Using daily REIT data from twelve major countries, Lesame et al. (2021) investigated the transmission of shocks across Real Estate Investment Trusts (REITs) markets. They found that cross-market interdependence increases during high-uncertainty periods, such as the COVID-19 pandemic, with the U.S. and major European REITs serving as key shock transmitters to Asia-Pacific markets. Further, Lesame et al. (2024) examined 27 international REIT markets and found strong evidence of both static and time-varying herding during the COVID-19 pandemic.

Admittedly, there are limited studies on emerging markets, including Türkiye. However, recent studies have begun to fill this gap. For example, Coşkun et al. (2017) analyzed the formation of house price bubbles and their determinants in the Türkiye's housing market. Despite some cases of overvaluation, they found no evidence of bubble formation. They also found long-term cointegration between house price indexes, housing rents, construction costs, and real mortgage interest rates. Recently, Yıldırım and Yıldırım (2025) examined the determinants of housing prices in Türkiye using the Bayesian sign and zero-constrained Structural Vector Autoregression (SVAR). They found that housing supply shocks were the key factor in housing prices before 2018, while mortgage rates and credit conditions became the primary determinants after 2018. Moreover, Cagli (2019) observed explosive behavior in house prices nationwide, particularly in Istanbul and Izmir. The main drivers of the real estate market could be the urban transformation projects, large-scale public investments in Istanbul, and net internal migration to Izmir during the period 2014–2016. In a related study, Ceritoğlu et al. (2019) examined exuberant behavior in house prices across 26 geographic regions in Türkiye. They found multiple periods of bubble in house prices, with Istanbul being the main contributor. They also found that explosive price behavior turned into an implosion in many regions from 2018 onwards. Another related study was conducted by Doruk (2024), who investigated the probability of a housing bubble and its drivers in the Turkish economy during the pandemic. The study found that housing bubbles emerged during the pandemic, driven by mortgage credit expansion, mortgage credit rates, and the depreciation of the Turkish lira.

Few studies investigated house price dynamics at the city and district level in Türkiye (Ayan and Eken 2021; Gunduz et al. 2025). For example, Gunduz et al. (2025) investigated house prices across Istanbul's districts and found multiple bubbles driven by low mortgage rates and stock prices in two periods, especially 2014–2015 and during COVID-19. Similarly, Ayan and Eken (2021) examined housing price bubbles in Istanbul and its districts and found multiple periods of house price bubbles that vary across districts and over time. They also observed that mortgage interest rate cuts increased demand in Istanbul. Only a few papers analyzed the effect of demographic factors on house prices. Genç et al. (2024) investigated the short-run impact of Syrian refugee inflows on house prices in Istanbul districts. The comparison of price changes before and after the arrival of refugees found that house prices in refugee receiving districts declined by 3.5% compared to other districts. Another study by Gunduz et al. (2022) analyzed the impact of Türkiye's Citizenship by Investment (CBI) program on house prices in Istanbul's districts. Their results indicated that the influx of foreign buyers increased house prices by about 2% in districts most favored by foreign investors. The study also found that foreigners' share of total house sales exceeds 10%, highlighting the impact of the CBI program. In sum, previous studies have mainly focused on a few major cities, while largely overlooking the interactions among housing markets across different cities.

3 Methodology

Recent empirical studies generally employ the Generalized Sup Augmented Dickey-Fuller (GSADF) procedure developed by Phillips et al. (2015a), which is designed to detect explosive behavior and date-stamp the origination and termination of explosive episodes. In this paper, we also applied SADF and GSADF right-tailed unit root tests to detect explosive behavior in housing markets in Türkiye. The GSADF test is preferred because it allows both the start and end points of the recursive estimation window to vary, making it more effective at detecting multiple or recurring bubbles within the same sample. This is particularly important in housing markets, where price booms may occur repeatedly and be interrupted by temporary corrections or policy shocks. Our dataset consists of monthly real house prices[1] for 55 cities and 87 districts in Türkiye from January 2010 to March 2022 (end of pandemic).[2] Table 1 presents the definitions and sources of variables used in the analysis.

We adapt the SADF and GSADF unit root tests that rely on the ADF regression defined as follows:

Table 1 Variable definitions and sources

Variable	Definition	Data Source
House prices	Housing prices per square meter deflated by respected regional consumer price indices (CPI)	Central Bank of the Republic of Türkiye
New house sales	Number of houses sold for the first time by a developer to an initial buyer.	Turkish Statistical Institute
Second-hand house sales	Number of houses resold by a prior owner to a subsequent buyer.	Turkish Statistical Institute
Mortgage-financed house sales	Number of houses purchased through a loan collateralized by the acquired property.	Turkish Statistical Institute
Real effective exchange rate	U.S. Dollar to Turkish Lira exchange rate, deflated by the consumer price index.	Central Bank of the Republic of Türkiye
Mortgage interest rate	Mortgage interest rate deflated by the consumer price index	Central Bank of the Republic of Türkiye
Stock market return	BIST100 stock market index deflated by the consumer price index	Central Bank of the Republic of Türkiye
Pandemic dummy	Take the value of one during pandemic period (2020m4-2022m3), otherwise zero	Republic of Türkiye Ministry of Health

Natural logarithms are applied to the data in levels to address any scaling effects. All variables are expressed in growth (differenced) terms to ensure stationarity, except for mortgage interest rates

[1] In this study, nominal house prices are deflated using regional consumer price indices (CPI) to construct real price series. The CPI in Türkiye incorporates rent and owner-occupier housing cost components, and rental price indices tend to co-move with general inflation over long horizons given that rent adjustments in lease contracts are typically indexed to the 12-month CPI average, implying that the CPI serves as a reasonable proxy for rent inflation when constructing real variables. Gunduz et al. (2025) find that bubble detection results for Istanbul are not sensitive to whether house prices are deflated using CPI or rental price indices, and our results for Istanbul are visually consistent with theirs. The primary reason for not employing rental price indices as an alternative deflator is the absence of city-level rental price data outside large metropolises such as Istanbul, precluding a systematic province-level comparison. Accordingly, we base our analysis on regional CPIs, which represents the most comprehensive and consistently available price deflator across all provinces in our sample.

[2] The cities, along with their geographical regions and respective districts, are presented in the Appendix Tables 5 and 6.

$$\Delta y_t = c + \theta y_{t-1} + \sum_{i=1}^{k} \varphi_t \Delta y_{t-i} + \epsilon_i \tag{1}$$

where y_t is the real house prices, k is the lag length, θ represents the coefficient on y_{t-1}, Δ denotes the first-difference operator, and ϵ_t is the error term. Based on Eq. (1), the null hypothesis of a unit root assumes $H_0 : \theta = 1$ in the SADF test against the explosive alternative hypothesis $H_1 : \theta > 1$, which refers to explosive behavior in the time series. The GSADF procedure allows for constructing a timeline of explosive periods in house prices by identifying when the null hypothesis of a unit root is rejected (Phillips et al. 2015a, b). The SADF test divides the sample into forward-expanding subsamples and standard ADF test statistics. They are estimated recursively to detect episodes of explosive behavior in house prices. This recursive approach involves repeated regressions on increasing window sizes to identify right-tailed deviations consistent with bubble formation. Since our test equation is run on the first difference of the dependent variable, we do not include a trend variable in the estimations.

Both the SADF and GSADF tests are based on the general regression model presented in Eq. (1). The minimum window size is selected using the Phillips et al. (2015a) rule of thumb $r_0 = 0.01 + 1.8/\sqrt{T}$. Given our monthly sample of 147 observations, this yields a minimum window size of 23 observations. This rule has also been adopted in previous housing-market applications for Türkiye. (Ceritoğlu et al. 2019). The lag order is 1 in the auxiliary regressions to reduce the risk of size distortion.[3] Larger lag orders may introduce size distortions in GSADF testing because the procedure repeatedly estimates ADF regressions over relatively short moving windows. For this reason, a parsimonious fixed-lag specification is preferred. As a robustness check, we also estimated the GSADF/BSADF procedure with zero lag and the results of exuberant episodes remained unchanged. Based on this, a dummy variable, $EXU_{i,t}$, is defined for a given time series i that takes the value of 1 if a bubble is detected at time t and 0 otherwise. In other words, $EXU_{i,t} = 1$ indicates an episode of explosive price behavior defined as follows:

$$EXU_{i,t} = \begin{cases} 1, & if\ \mathrm{BSADF}_{i.t}(r_0) > \mathrm{cv}_t^{\propto}, \\ 0, & if\ \mathrm{BSADF}_{\mathrm{r}_2}(r_0) < \mathrm{cv}_t^{\propto}. \end{cases} \tag{2}$$

An explosive period begins when the BSADF test statistic exceeds its critical value and ends when it falls below that value. This method helps detect one or multiple explosive periods, as shown by Phillips et al. (2015a, b).

Thus, in this study, we follow the two-step procedure to conduct our econometric analysis. In the first step, we apply a special version of unit root tests of Eq. 1 to detect the likely bubbles in house prices. Equation 2, on the other hand, guides us in classifying explosive house prices (versus not). Then, we adopt a multivariate panel data estimation method to explore the determinants of bubbles (or lack thereof). This is because some explanatory variables used in model estimation can cause endogeneity if not carefully handled. There are several reasons why endogeneity could be a

[3] For a broader discussion of GSADF and alternative specifications, see Phillips et al. (2015a).

problem in house price estimations. While some of the factors causing endogeneity are observable, such as co-movement between prices and credits, others are difficult to observe directly. These may include local policy changes, attitudes toward migration, speculative behaviors, or unmeasured economic shocks. Therefore, we use the GSADF recursive unit root tests to directly detect explosive behavior in house price series, without explicitly modeling fundamentals. After detecting explosive behavior in house prices, we employ panel data estimations to examine the fundamental factors associated with house price dynamics in Türkiye. The literature on asset price dynamics suggests that past price changes have had a strong influence on expectations of current prices. This highlights the need to incorporate dynamic effects into the empirical specification. Accordingly, we estimate a dynamic panel fixed effects model that controls for time-invariant city-specific characteristics, while including time fixed effects and lagged values of the dependent variable.

4 Empirical findings

Table 2 presents the GSADF test statistics for 55 cities in Türkiye and identifies evidence of explosive house price behavior at various significance levels. The results indicate strong evidence of housing bubbles at the 1% significance level in 53 out of 55 cities during the sample period. For the remaining cities, like Sakarya, Elazığ, and Rize, the bubbles are supported at the 5% and 10% significance levels, respectively. These findings suggest that explosive house price behavior was widespread across Türkiye's housing markets rather than being confined to a small number of major metropolitan areas.

Figures 1 and 2 (Fig. 1 at the city level, Fig. 2 at the district level) provide graphical representations of explosive periods in real house prices across Türkiye. Following Phillips et al. (2015a), we account for the minimum duration condition, that is $L_T = log(T)$, which is intended to exclude short-lived fluctuations in the fitted autoregressive coefficient. This condition can also be adjusted based on the data frequency. In line with Phillips et al. (2015a) and related housing-market applications such as Gunduz et al. (2025), we define sustained bubble episodes for visualization purposes as periods of at least six consecutive months of explosivity. In the empirical analysis, however, each month is still treated as explosive whenever the BSADF statistic exceeds its corresponding critical value, irrespective of duration.

We can summarize the findings as follows. First, there is synchronicity in house price bubbles across Türkiye during three periods: 2013–2015, 2017–2018, and, in particular, 2020–2022. Furthermore, the pandemic period stands out as the most widespread and synchronized, mainly driven by common factors, including the COVID-19 pandemic and monetary policies (Gunduz et al. 2025; Doruk 2024), supply shortages, shifts in housing preferences (Ayan and Eken 2021), construction costs, and housing demand (Ceritoğlu et al. 2019; Coşkun et al. 2017).

Second, house price bubbles have been observed in both metropolitan and Anatolian cities. Western and southern cities such as Izmir, Antalya, and Muğla experienced prolonged bubble periods, which may be driven by tourism and investment. By contrast, southeastern cities such as Gaziantep and Şanlıurfa displayed frequent bub-

Table 2 GSADF test results

City	Test statistics
İstanbul	9.0228***
İzmir	7.2224***
Aydın	5.8067***
Denizli	5.0838***
Muğla	2.8432***
Manisa	7.7872***
Afyonkarahisar	4.8879***
Kütahya	6.0239***
Uşak	6.448***
Antalya	12.7149***
Isparta	3.1875***
Adana	6.6625***
Mersin	7.7701***
Hatay	10.0056***
K.Maraş	7.4612***
Osmaniye	6.569***
Trabzon	3.7084***
Ordu	5.7779***
Giresun	4.180***
Rize	1.8346*
Zonguldak	3.0482***
Karabük	3.1111***
Samsun	8.4834***
Tokat	6.1287***
Çorum	5.1543***
Amasya	3.7993***
Malatya	5.3489***
Elazığ	2.4746**
Tekirdağ	7.1903***
Edirne	3.1032***
Kırklareli	5.2589***
Balıkesir	6.2693***
Çanakkale	5.2506***
Bursa	8.1212***
Eskişehir	8.0923***
Bilecik	5.2175***
Kocaeli	9.0017***
Sakarya	6.3405**
Bolu	7.0765***
Yalova	6.3974***
Kırıkkale	3.0609***
Aksaray	5.5958***
Niğde	8.0158***
Nevşehir	5.2102***
Kırşehir	3.936***
Kayseri	8.8526***
Sivas	5.459***

Table 2 (continued)

City	Test statistics
Yozgat	4.1913***
Gaziantep	6.4161***
Adıyaman	3.731***
Şanlıurfa	8.4363***
Diyarbakır	9.0357***
Ankara	11.0937***
Konya	6.9349***
Karaman	3.6961***

*** $p<0.01$, ** $p<0.05$, * $p<0.10$. The statistical significance is according to the asymptotic one-sided p-values of Phillips et al. (2015a). GSADF critical values are 2.63, 2.10, and 1.80 for 90, 95, 99 confidence levels

bles that may be influenced by demographic factors (Ceritoğlu et al. 2019; Genç et al. 2024; Gunduz et al. 2022) as well as migration and refugee pressures (Cagli 2019; Cevik and Naik 2023; Genç et al. 2024). The earliest house price bubble emerged in Istanbul and Antalya during 2012–2014, while a significant price rise was observed during 2015–2016 in key districts such as Pendik, Bağcılar, and Kadıköy (Istanbul), Çankaya (Ankara), Kepez and Manavgat (Antalya), and Nilüfer, Mudanya, and Osmangazi (Bursa), reflecting growing housing demand beyond Istanbul. In contrast, some historically expensive and commercial central districts, such as Beşiktaş and Beyoğlu in Istanbul and Konak in Izmir, did not exhibit sustained bubbles. These findings are consistent with previous findings suggesting that price explosiveness tends to be lower in more expensive districts (Gunduz et al. 2025; Ayan and Eken 2021).

Third, the timing and duration of price bubbles varied across cities and districts. For instance, between 2012 and 2015, housing bubbles were initially observed in major cities such as Ankara, Istanbul, and Gaziantep, before spreading to 20 cities and 62 districts during 2014–2015. Price bubbles were more limited during 2018–2020, appearing in only nine cities and five districts. By contrast, in 2021–2022, housing bubbles became widespread across all 55 cities and 87 districts. These findings highlight the heterogeneity of housing bubbles in Türkiye and reveal that common factors can affect local house price dynamics differently. They also underline the importance of district-level analysis, since national or city-level indicators may hide substantial local variation. For instance, in Istanbul, house price bubbles during 2014–2016 were concentrated in central districts (e.g., Ataşehir, Kadıköy, Maltepe, Fatih) before spreading to more peripheral districts (Pendik, Gaziosmanpaşa, Beylikdüzü, Büyükçekmece). However, expensive commercial hubs such as Beşiktaş and Beyoğlu did not show signs of a bubble. In Izmir, the bubbles first appeared in coastal districts such as Karşıyaka and Konak (2012–2013), before extending to Bornova, Buca, and Bayraklı. By contrast, Bursa displayed very frequent bubbles in central districts such as Nilüfer and Yıldırım. These differences between coastal and inland areas, as well as between central and peripheral districts, would be difficult to identify using national-level data. This is one of the main contributions of this study.

Finally, regional explosive house price behaviors revealed considerable heterogeneity, with some regions showing more persistent and synchronized bubbles than

Fig. 1 Results of the date-stamp procedure at the city level. Shaded areas indicate a minimum of six months of explosive periods per GSADF exceeding 95% wild bootstrapped critical values. The smallest window size is 23 observations, and the lag order is 1 in auxiliary regressions to reduce size distortion risk. The results are similar to the case with zero lag

others. Figure 3 shows that the economically dynamic western and Marmara regions experienced more persistent, recurrent, and frequent bubble behavior than others, such as Istanbul, Bursa, Çanakkale, and Izmir. Specifically, in Istanbul, housing price bubbles were concentrated in both central and peripheral districts, including Ataşehir, Kadıköy, Maltepe, and Fatih. Many of these districts are primarily located on the Anatolian side and near the shores of the Bosporus Strait (Fig. 4). A more synchronized and extended bubble period occurred between 2014 and 2016, spreading across Pendik, Gaziosmanpaşa, Beylikdüzü, and Büyükçekmece. Notably, almost all districts experienced price bubbles during 2021–2022, marking this period one of the

Fig. 2 Results of the date-stamp procedure at the district level. *Notes*: Shaded areas indicate a minimum of six months of price exuberance per GSADF exceeding 95% wild bootstrapped critical values. The smallest window size is 23 observations, and the lag order is 1 in auxiliary regressions to reduce size distortion risk. The results are similar to the case with zero lag

Fig. 3 Classification of explosive house prices in Türkiye's cities. *Notes*: The intervals showing the relative frequency of explosive price behavior are constructed based on standardized GSADF test statistics. We first compute the cross-city mean and standard deviation of bubble incidence and then calculate each city's z-score. After obtaining z-scores for all cities, we classify them into discrete categories, from high positive frequency (many bubble months) to negative frequency (rare bubbles) based on these standardized values

most widespread episodes in Istanbul's housing market. Similarly, the Aegean region experienced explosive dynamics, with all nine cities showing evidence of price bubbles, led by Izmir, Denizli, and Manisa. In Izmir, bubble episodes first appeared in coastal districts such as Karşıyaka and Konak during 2012–2013, then extended to Bornova, Buca, and Bayraklı. These bubbles were generally short-lived and geographically confined to the city's more established neighborhoods (Fig. 4). In Bursa, persistent bubbles were observed in central districts such as Nilüfer, Osmangazi, and Yıldırım, which may be associated with sustained investment and industrial expansion. Kocaeli's housing market also displayed frequent explosive behavior, especially in Gebze and Körfez, possibly influenced by spillovers from Istanbul. Central Anatolia had synchronized bubbles, particularly in Ankara, Eskişehir, and districts like Çankaya, Etimesgut, and Sincan.

The Mediterranean region also had frequent house price bubbles and strong synchronization. Cities like Antalya and Mersin led this trend, particularly districts such as City Center (Merkez), Manavgat, and Kepez in Antalya. In Southeast Anatolia, cities such as Gaziantep, Adana, and Şanlıurfa experienced frequent bubble behavior, which might be driven by population growth, housing demand, and significant pressure from the post-2012 Syrian refugee inflows (Genç et al. 2024; Akgunduz et al. 2015). By contrast, the Black Sea and Central Anatolian regions generally expe-

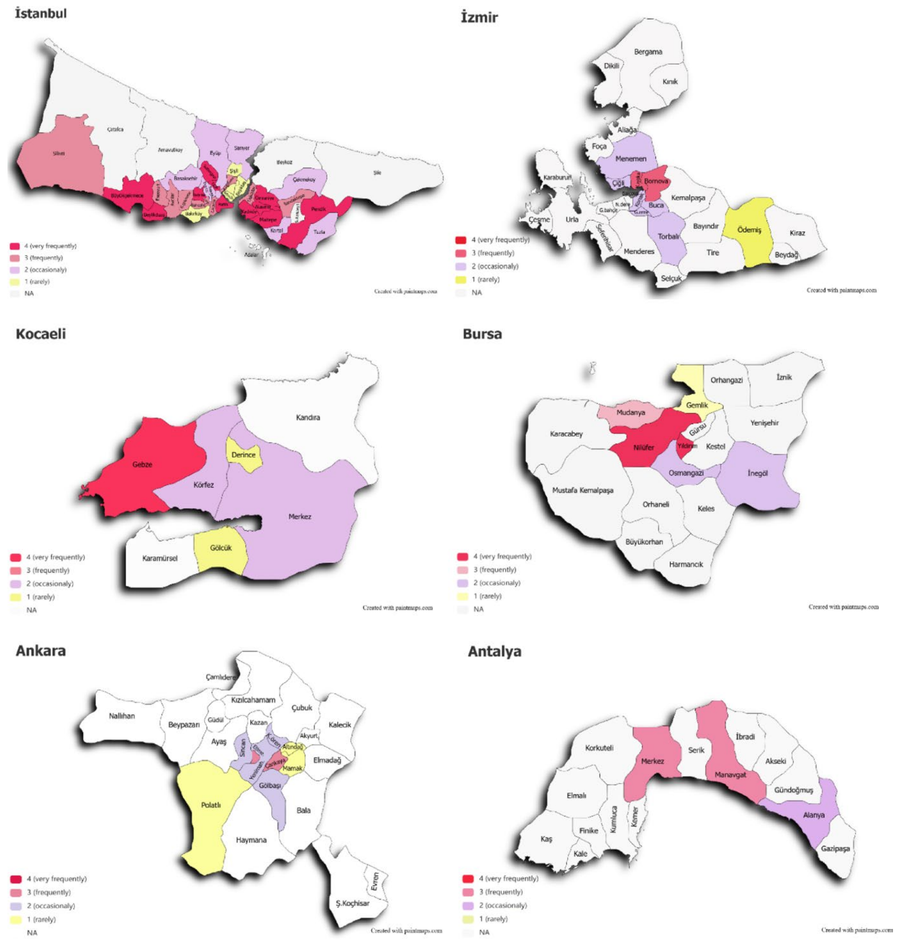

Fig. 4 Classification of explosive house prices in major capitals' districts. *Notes*: The intervals showing the relative frequency of explosive price behavior are constructed based on standardized GSADF test statistics

rienced only rare or occasional bubble behavior. At the same time, the eastern and northeastern provinces show limited or no bubble periods, reflecting regional disparities in Türkiye's housing market dynamics.

As a next step, we examine synchronization more formally across Türkiye's largest metropolitan housing markets. Following Bouri et al. (2019) and Chowdhury et al. (2022), we estimate a logistic regression model (Eq. 3) to examine co-explosivity among Istanbul, Ankara, Izmir, Bursa, and Antalya. These cities were selected because they account for a substantial share of national housing transactions and mortgage activity and constitute the core of Türkiye's housing market in terms of population size, construction volume, and market liquidity. As such, they are the most relevant cities for examining systemic co-explosivity patterns.[4] Moreover, according to the SEGE (2025), all five cities are located in the highest development tier (Level 1). However, the overall index still shows a strong hierarchy, with Istanbul having the highest value (4,419) followed by Ankara (2,837), Izmir (1.808), Antalya (1.716), and Bursa (1.360).

$$log\left(\frac{P(Y = 1|X}{1 - P(Y = 1|X}\right) = \beta_0 + \beta_i X_{i,t} + \epsilon_t \tag{3}$$

Here, the dependent variable Y is a dummy equal to 1 when the BSADF sequence for city i exceeds the corresponding critical value, $\mathrm{BSADF}_{i.t}(r_0) > \mathrm{cv}_t^{\propto}$, indicating an explosive price or boom episode and 0 otherwise. $X_{i,t}$ denotes a set of remaining dummy variables indicating the existence of price for the five largest metropolitan areas in Türkiye. β_0 is the intercept term and ϵ_t is the error term. The model is estimated for each of the five cities interchangeably. As the bubble indicators enter the regressions at the same time (i.e., at time t), the estimates capture the synchronisation of this explosive behavior across cities within the same period. Thus, this specification cannot identify lead–lag relationships. So, it does not allow us to determine which city leads and which follows, nor to make directional (causal) contagion and it is beyond the aim of this paper.

Table 3 Logistic regression results using housing bubble dummies as dependent/independent variables

	Istanbul	Ankara	Izmir	Bursa	Antalya
Istanbul		– 0.550	1.395***	-0.319	1.803***
Ankara	– 0.467		2.881***	0.974	4.200***
Izmir	1.371***	2.775***		0.997**	– 0.858
Bursa	– 0.335	0.602	1.018**		0.035
Antalya	1.816***	4.158***	– 0.868	0.035	
Constant	– 1.356***	– 4.924***	– 1.974***	– 0.949***	– 2.391***
McFadden R-squared	0.165***	0.566***	0.264***	0.088***	0.414***

Variables (cities) are dummy variables that take the value of one during periods of price exuberance, and zero otherwise. The sample period is from 2012m2 to 2022m3, covering 122 monthly observations. *** $p<0.01$, ** $p<0.05$, * $p<0.10$

[4] Furthermore, from an econometric perspective, reliable estimation of binary response models requires sufficient time-series variation in bubble episodes within each city. In many smaller cities and regional clusters (e.g., coastal tourism areas or industrial centres), explosive episodes are either infrequent or exhibit limited variation over the sample period. Including such cities would substantially reduce effective degrees of freedom and increase the risk of multicollinearity and perfect-prediction problems in the logistic framework, particularly given the relatively short time dimension of the panel. For these reasons, the co-explosivity analysis is restricted to the five largest metropolitan markets.

Table 3 presents the logistic regression results for the five largest metropolitan housing markets in Türkiye. The results indicate that the likelihood of observing explosive price behavior in one housing market is often higher when explosive episodes occur contemporaneously in other major markets, suggesting substantial synchronization among large urban housing markets. However, given the contemporaneous specification of the model, the findings should be interpreted as evidence of co-movement rather than directional causal spillovers.

Interestingly, Istanbul and Ankara, the two largest cities, did not co-explode simultaneously. Instead, there was a negative association between them, similar to the relationship between Istanbul and Bursa. Housing explosivity in Istanbul increased with contemporaneous explosivity in Antalya and Izmir. Ankara also became a hot housing market when Antalya and Izmir did. The formation of house price exuberance in Izmir was positively associated with the presence of explosivity in Istanbul, Ankara, and Bursa. In addition, explosivity in Antalya's housing market was more likely when explosivity occurred in Istanbul and Ankara. Bursa appeared to be the least dependent market, as reflected in its relatively low McFadden R^2, followed by Istanbul. All constants in the regressions were significantly negative, indicating that in the absence of explosivity in other cities, the baseline probability of a city entering an explosive regime was relatively low. [5] Overall, the co-explosivity results suggest contagion-like synchronization effects across Türkiye's major urban housing markets. However, the evidence does not support directional contagion or lead-lag dynamics.[6]

We further extend the analysis by estimating panel logistic regression models to examine the effects of multiple independent variables on the drivers of house price bubbles across 55 cities, with the dependent variable referring to the presence of a housing bubble. Based on the literature and the available data, the independent variables (X_{ij}) include new house sales, second-hand house sales, mortgage-financed house sales, mortgage interest rates, stock market returns, and the real effective exchange rate. A COVID-19 pandemic dummy is also included. The form of the panel logistic regression model is defined as:

$$\text{logit}\ (P\,(y_{it}\ =\ 1)) = \alpha_{\,i} + \sum\nolimits_{j=1}^{J} \beta_{\,j} X_{ijt} + \beta_{\,pandemic} PandemicDummy_{it} + \epsilon_{\,it} \quad (4)$$

[5] The results change slightly after the pandemic episode is removed from the sample. For instance, Istanbul and Bursa are still related, but there is a significant negative relationship between the two, indicating a substitution effect. Results are available upon request.

[6] Following one of the referees' suggestions, we estimated two additional specifications: one including only lagged cross-city bubble indicators, and a dynamic specification incorporating both the lagged dependent variable and lagged cross-city indicators. Comparing these models with the baseline contemporaneous specification shows that lagged cross-city effects appear statistically significant when own persistence is not controlled for. However, once the lagged dependent variable is included, most cross-city effects lose statistical significance, while the own lag remains strongly significant. This pattern suggests that the observed inter-city associations largely reflect synchronised national housing cycles and strong local persistence, rather than clear directional spillover or transmission mechanisms. The overall evidence therefore supports co-explosivity and persistence, with limited support for lead–lag dynamics. Detailed results are available upon request.

where logit $(P) = log\left(\frac{P}{1-P}\right)$ is the log-odds of the probability. $P\left(y_{it} = 1\right)$ is the probability of the binary outcome (housing bubble) in city i at time t. X_{ijt} represents the set of independent variables (which include various predictors like new house sales and mortgage-financed sales, etc.). β_{j} is the coefficient corresponding to the $j-th$ independent variable and ϵ_{it} is the error term. $\beta_{pandemic}$ is the coefficient corresponding to the pandemic dummy, which is a binary variable that equals 1 during the pandemic period (March 2020–March 2022) and 0 otherwise.

Table 4 presents the panel logistic regression results, including static fixed effects and random effects as well as dynamic random effects models. The dependent variable, the presence of a housing bubble, is binary, and all coefficients are reported in log-odds units. Static models capture overall conditional associations among housing market activity, macro-financial factors, and bubble episodes, while dynamic models incorporate a lagged dependent variable to account for the persistence of housing bubbles.

In the static models, new house sales enter positively and are statistically significant, suggesting that periods of elevated primary market activity are associated with a higher likelihood of bubble episodes. Given that the official homeownership statistics have declined from about 60% to 56% between 2010 and 2024 in Türkiye, it is more likely that the increase in new house sales is related to rising property prices. In other words, new house sales will likely be driven by investment purposes for those who already own homes. Simply put, real estate is likely to be viewed as an investment asset rather than a means of providing housing, particularly for wealthier individuals in an economy expecting capital appreciation or rental income. Additionally, in rapidly urbanizing countries, homeownership may remain relatively low, while new house sales may be high due to rising demand for housing in urban areas.[7] Ceritoğlu et al. (2019) and Coşkun et al. (2017) found that speculative activity and urban transformation projects in Türkiye (especially in Istanbul) contributed to the formation of bubbles. Second-hand sales are not significant, suggesting that resale market activity is less closely linked to bubble dynamics.

Mortgage-financed sales and mortgage interest rates are negative and statistically significant, suggesting that higher mortgage interest rates are negatively associated with bubble probability. Mortgage-financed sales at the city level, which reflect the extent of financing used to purchase homes, can indicate how accessible the market is and whether buyers rely on credit. This could act as a counterbalance to speculative buying, reducing the risk of a bubble. These suggest that, at the city level, as more mortgages are sold (indicating a more stable and long-term financing environment) and mortgage rates are higher (which cools demand), the likelihood of a housing bubble decreases. This indicates that the credit market is crucial in stabilizing housing prices. These findings align with both local and international

[7] There is certainly a need to explore the dynamics of declining home ownership ratio which might be affected by different factors, including rising property prices, high mortgage rates, economic instability, changing demographics, and a growing preference for renting. Also see: PwC Turkey (2022), *Emerging areas of real estate investment in Turkey*, Retrieved from https://www.pwc.com.tr/tr/sektorler/gayrimenkul/yayinlar/emerging-areas-of-real-estate-investment-in-turkey.pdf.

literature. For instance, Cevik and Naik (2023) emphasized that lower borrowing costs lead to higher real house prices in emerging European countries, including Türkiye. Likewise, Bangura and Lee (2022) documented that low interest rates in Sydney contributed to sustained bubble pressures. The Turkish evidence reinforces this pattern. Yıldırım and Yıldırım (2025) found that house prices in Türkiye are predominantly shaped by credit conditions, mortgage rates, and sentiment shocks, particularly after 2018. They also found that mortgage rates, credit conditions, and sentiment shocks became more prominent in shaping house prices in the post-COVID period. At a more localized level, Ayan and Eken (2021) found that mortgage interest rate cuts increased housing demand in the Ataşehir and Kadıköy districts of Istanbul.

The COVID-19 pandemic dummy is positively associated with the probability of a bubble, which suggests that the pandemic period coincided with a higher likelihood of explosive episodes across cities. These findings align with those of Yang and Zhou (2023), who found that the housing markets in Sydney, Melbourne, and Brisbane experienced sharp overvaluation during the pandemic. They also reflect evidence from Türkiye, such as Gunduz et al. (2025), who identified significant bubble periods in Istanbul's districts during the pandemic driven by low mortgage rates and increased demand. Additionally, Doruk (2024) confirmed the presence of a house price bubble during the pandemic period in Türkiye. These findings support the view that the COVID-19 pandemic accelerated speculative behavior both globally and domestically. Other macroeconomic variables, such as the real effective exchange rate and stock market returns, do not show robust associations. This finding is also supported by Cevik and Naik (2023) for emerging European countries. These static models provide a baseline understanding of conditional correlations, rather than identified causal relationships.

The dynamic random-effects models extend this framework by including the lagged bubble variable.[8] The coefficient on the lagged dependent variable is positive and highly significant, confirming strong persistence and self-reinforcing dynamics. Cities that experienced an explosive episode in the previous month are substantially more likely to remain one in the current month. Conditional on past bubble status, the positive association of new house sales, the negative association of mortgage interest rates and the positive effect of the pandemic dummy remain qualitatively similar to the static specifications. This pattern is consistent with low interest rates, credit expansion, and shifts in housing demand (e.g., housing as a perceived safe asset) during that episode. Importantly, while including the lagged

[8] As a robustness check to address potential simultaneity concerns, we re-estimated all models replacing contemporaneous housing market regressors with their one-period lagged values. The dynamic specification additionally includes the lagged bubble indicator to account for state dependence in bubble formation. The results reveal that all housing transaction variables — new house sales, second-hand house sales, and mortgage-financed sales — lose statistical significance when lagged, suggesting their significance in the baseline model partly reflects simultaneity bias rather than genuine predictive content. By contrast, the mortgage interest rate and pandemic dummy retain strong significance, confirming the robustness of our core findings. The lagged bubble indicator enters positively and significantly. While lagging mitigates the most immediate simultaneity concerns, we acknowledge that time-persistent unobservables may limit the strict exogeneity of lagged regressors. Full dynamic model results are available from the authors upon request.

Table 4 Determinants of housing bubbles at the city level: Panel logistic regression results

Variables	Static model			Dynamic model	
	Fixed effects	Random effects	Random effects (with robust standard effects)	Random effects	Random effects (with robust standard errors)
$\mathrm{Bubble}_{i,\ t-1}$				0.685058***	0.685058***
				(0.082674)	(0.094024)
New house sales	0.000290***	0.000182***	0.000182*	0.000169**	0.000169*
	(0.000088)	(0.000067)	(0.000095)	(0.000068)	(0.000101)
Second-hand house sales	0.000019	– 0.000009	– 0.000009	-0.000013	-0.000013
	(0.000055)	(0.000046)	(0.000021)	(0.000046)	(0.000020)
Mortgage-financed house sales	– 0.000195***	– 0.000169**	– 0.000169	– 0.000151**	– 0.000151
	(0.000074)	(0.000073)	(0.000104)	(0.000074)	(0.000098)
Pandemic dummy	1.134886***	1.124043***	1.124043***	1.02272***	1.02272***
	(0.088018)	(0.087676)	(0.085854)	(0.089562)	(0.088006)
Real effective exchange rate	– 1.010878	– 1.116181	– 1.116181	– 0.956655	– 0.956655
	(0.987739)	(0.989053)	(0.708389)	(1.002762)	(0.697763)
Mortgage interest rate	– 10.92670***	– 11.10482***	– 11.10482***	– 9.88443***	– 9.88443***
	(0.921417)	(0.926742)	(0.644206)	(0.944964)	(0.612083)
Stock market return	0.710595	0.697248	0.697248*	0.658232	0.658232*
	(0.539096)	(0.539812)	(0.385489)	(0.548098)	(0.384840)
Constant		– 1.570560***	– 1.570560***	– 1.711256***	– 1.711256***
		(0.055372)	(0.052474)	(0.059141)	(0.058193)
Observations	6050	6050	6050	6050	6050
Number of provinces	55	55	55	55	55
Log likelihood	– 2501.25	– 2646.86		-2614.195	
Log pseudolikelihood			– 2646.86		– 2614.195
Wald chi-square	978.51	572.95	966.64	618.12	1175.36
Prob > chi-square	0.000000	0.000000	0.000000	0.000000	0.000000

Table 4 (continued)

Variables	Static model			Dynamic model	
	Fixed effects	Random effects	Random effects (with robust standard effects)	Random effects	Random effects (with robust standard errors)
Province-level std. dev. (σ ?)		0.001073	0.001073	0.001545	0.001545
Share of variance due to provinces (ρ)		0.000000	0.000000	0.000001	0.000001

In all models, the dependent variable is the city-level housing bubble ($\mathrm{Bubble}_{i,\ t}$) indicator. All independent variables are presented in real growth rates, except for the mortgage interest rate. Standard errors are reported in parentheses for all specifications. Robust specifications use robust standard errors. Static fixed effect is estimated using conditional fixed-effects logit. Dynamic models include the lagged dependent variable. σ ? denotes the province-level random-effects standard deviation, while ρ measures the share of total variance attributable to province-level heterogeneity. All models are estimated using monthly city-level data from January 2013 to March 2022. ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels, respectively dependent variable improves model fit and better captures bubble persistence, it does not fully resolve potential endogeneity or reverse causality between housing market activity and bubble episodes. As such, the estimated coefficients should be interpreted as conditional associations rather than structural causal effects. Overall, the results suggest that city level housing bubbles are characterized by temporal persistence, sensitivity to primary housing market activity, and responsiveness to macro-financial conditions, particularly during the pandemic period. The dynamic random-effects specification, by explicitly capturing state dependence, provides the most informative framework for understanding these conditional relationships, while static models support these findings by showing qualitatively similar patterns across cities.

Our findings point to several key mechanisms that may help explain the underlying housing bubble episodes in Türkiye. First, the dominance of housing's role as a store of value may have become more prominent during periods of high and volatile inflation (see, among others, Muckenhaupt et al. 2025). When real interest rates turn deeply negative and exchange rate volatility intensifies, housing may become more attractive as a financial asset. Under such conditions, demand may be increasingly driven by price expectations and wealth-preservation motives rather than by household formation or housing service needs. This mechanism helps explain why the pandemic-era bubble episodes were both widespread and highly synchronized across cities.

Second, the negative association between low mortgage rates and bubble formation points to an important policy trade-off. Low mortgage rates may increase housing affordability in the short run, but they can also stimulate demand, accelerating price increases and, over time, exacerbating wealth inequality. Price increases in the housing market during bubble periods are likely to concentrate gains among existing property owners, while raising the income threshold required for new entrants. As house prices rise, low-income households are increasingly excluded from the housing market, thereby reinforcing a self-perpetuating cycle of asset-based inequality (see Zhang et al. 2021; Yang et al. 2023). This suggests that housing-market exuberance may reinforce wealth and regional inequalities, particularly when explosive episodes are concentrated in economically dynamic regions such as Istanbul, Izmir, Bursa, and Antalya. Although Türkiye maintains relatively high aggregate homeownership rates, despite a recent decline and substantial cross-city variation, these averages may mask growing disparities in housing wealth across regions and socioeconomic groups.

Third, the synchronization of bubble episodes across major metropolitan cities suggests that common macroeconomic shocks and nationwide shifts in expectations are important in Türkiye's housing market. While a detailed temporal sequencing analysis is left for future research, our results indicate substantial contemporaneous correlation among major cities during several periods. At the same time, the heterogeneity between economically dynamic western regions and eastern or northeastern regions suggests that substitution may operate within specific tiers of cities. Large metropolitan areas, particularly Istanbul, Ankara, Izmir, and Bursa, appear to form a more integrated market tier in which households may substitute across cities based on relative prices, employment opportunities, and amenities. In contrast, smaller eastern cities seem to function in more segmented markets with limited cross-regional substitution. Coastal migration dynamics, especially in Antalya, may reflect an additional lifestyle-driven mechanism (see Gunduz and Yilmaz 2023).

Fourth, Türkiye's housing market combines features of both advanced and emerging economies. It shows sensitivity to credit conditions and synchronization across metropolitan markets, which are commonly observed in advanced economies. At the same time, rapid urbanization, developer-driven expansion, and vulnerability to external shocks resemble dynamics observed in emerging markets. However, the combination of high inflation and currency depreciation makes Türkiye a particularly informative case for analyzing the formation of a housing bubble under sustained macroeconomic stress.

Taken together, the results suggest that explosive house price behavior in Türkiye reflects deeper structural characteristics of the economy rather than purely temporary price misalignments. The findings suggest that housing has increasingly become both a consumption good and a financial asset, especially during periods of high inflation. Therefore, policy responses may need to go beyond short-term demand management and also address the deeper factors such as monetary instability, limited alternative investment instruments, and the geographic concentration of economic opportunity.

5 Conclusion

This study explores the dynamics of explosive house price behavior at the city and district levels in Türkiye. Using monthly real house price data for 55 cities and 87 districts from January 2010 to the end of the pandemic episode (March 2022), we apply the GSADF and BSADF tests to identify and date-stamp periods of exuberance. The results reveal three main episodes of explosive house price behavior, particularly 2013–2015, 2017–2018, and the post-pandemic phase of 2020–2022. Notably, the pandemic period represents the most widespread and synchronized price bubbles across cities and districts. The study also showed significant regional heterogeneity. Economically dynamic regions such as Istanbul, Izmir, Bursa, and Antalya experienced more volatile price dynamics than the less developed eastern and northeastern regions.

The panel logistic regression results provide further evidence on the factors associated with bubble formation. Firstly, new house sales were associated with a higher likelihood of bubble episodes, while mortgage-financed sales were associated with a lower likelihood. The COVID-19 pandemic significantly increased the likelihood of housing bubbles forming in every city and district, suggesting the pandemic's persistent impact on house prices across Türkiye. Moreover, real mortgage interest rates were negatively associated with bubble formation, indicating that loose credit conditions may have played a crucial role in driving housing market instability. Overall, the results suggest that the interplay between low interest rates, housing demand, and the COVID-19 shock emerged as a key factor in fueling prices.

Taken together, the findings confirm that house price bubbles in Türkiye were not uniform across regions. It was more pronounced and more synchronized in larger and economically dynamic urban markets. The results also underscore the stabilizing role of mortgage-financed sales and higher mortgage rates in mitigating bubble formation. In this respect, the study contributes to the literature by showing how regional differences, credit conditions, and external shocks jointly influence the formation of house price bubbles in Türkiye.

This study offers several policy recommendations. First, given the significant heterogeneity of housing bubbles across cities and districts, the housing market should be considered at the disaggregate level. Targeted interventions in major regional hubs like Istanbul, Izmir, and Antalya may help stabilize these markets more effectively. Second, prudential lending and credit policies should be implemented to curb speculative behavior in the housing market. These may include limiting loan-to-value ratios, carefully managing interest rates, and ensuring that central bank policies adopt a balanced approach that avoids excessively low interest rates during episodes of macroeconomic instability. Third, regional disparities in the formation of house price bubbles highlight the need for investment in less developed regions. Therefore, policies that encourage investment in the eastern and northeastern Türkiye through targeted development incentives and infrastructure projects are essential to mitigate regional house price disparities. Overall, the main challenge for policymakers is to maintain housing market stability by balancing between broad macroeconomic policies and region-specific interventions.

Appendix

See Tables 5 and 6.

Table 5 Cities with their geographical regions

Region	City
İstanbul	İstanbul
Aegean	İzmir
	Aydın
	Denizli
	Muğla
	Manisa
	Afyonkarahisar
	Kütahya
	Uşak
West Anatolia	Ankara
	Konya
	Karaman
Mediterranean	Antalya
	Isparta
	Adana
	Mersin
	Hatay
	K.Maraş
	Osmaniye
West Black Sea	Zonguldak
	Karabük
	Samsun
	Tokat
	Çorum
	Amasya
Middle East Anatolia	Malatya
	Elazığ
West Marmara	Tekirdağ
	Edirne
	Kırklareli
	Balıkesir
	Çanakkale
East Marmara	Bursa
	Eskişehir
	Bilecik
	Kocaeli
	Sakarya
	Bolu
	Yalova
Middle Anatolia	Kırıkkale
	Aksaray
	Niğde
	Nevşehir
	Kırşehir
	Kayseri
	Sivas
	Yozgat

Table 5 (continued)

Region	City
East Black Sea	Trabzon
	Ordu
	Giresun
	Rize
South East Anatolia	Gaziantep
	Adıyaman
	Şanlıurfa
	Diyarbakır

Table 6 Districts of cities

City	Districts
İstanbul	Ataşehir
	Avcılar
	Bağcılar
	Bahçelievler
	Başakşehir
	Bayrampaşa
	Beşiktaş
	Beylikdüzü
	Beyoğlu
	Büyükçekmece
	Çekmeköy
	Esenler
	Esenyurt
	EyüpSultan
	Fatih
	Gaziosmanpaşa
	Güngören
	Kadıköy
	Kâğıthane
	Kartal
	Küçükçekmece
	Maltepe
	Pendik
	Sancaktepe
	Sarıyer
	Silivri
	Sisli
	Sultangazi
	Tuzla
	Ümraniye
	Üsküdar
	Zeytinburnu
İzmir	Bornova
	Karşıyaka
	Buca
	Menemen
	Gaziemir
	Çiğli
	Konak
	Torbalı
	Bayraklı
	Karabağlar
	Ödemiş

Table 6 (continued)

City	Districts
Ankara	Çankaya
	Etimesgut
	Sincan
	Keçiören
	Gölbaşı
	Pursaklar
	Yenimahalle
	Altındağ
	Mamak
	Polatlı
Antalya	Muratpaşa
	Manavgat
	Kepez
	Konyaaltı
	Alanya
Bursa	Nilüfer
	Yıldırım
	Mudanya
	Osmangazi
	İnegöl
	Gemlik
Eskişehir	Odunpazarı
	Tepebaşı
Gaziantep	Şehitkâmil
	Şahinbey
Kayseri	Talas
	Melikgazi
	Kocasinan
Kocaeli	Gebze
	Darıca
	İzmit
	Körfez
	Gölcük
	Derince
Tekirdağ	Çorlu
	Çerkezköy
	Süleymanpaşa
Mersin	Yenişehir
	Mezitli
	Toroslar
	Tarsus
	Akdeniz
	Erdemli

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