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HOUSING PRICE BUBBLES AND FACTORS AFFECTING THE FORMATION OF BUBBLES: THE TURKISH CASE*

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Abstract

Price bubbles may be a leading indicator for financial crises. In history, some of the important price bubble cases occurred in the real estate or housing market. In this study, the existence of a price bubbles, the periods of the existing bubbles, and the factors affecting the formation of bubbles in the housing sector for both Turkey and TR22 Region (Balıkesir-Çanakkale) are being investigated. Data covering 126 monthly housing price indices for the period between January 2010 and June 2020 were used. According to the SADF and GSADF test results, some evidence of housing bubbles for both Turkey and TR22 Region was reached. According to the results of the logit model applied in the study, increases in housing real interest rates, CPI and M2 money supply variables increase the possibility of housing price bubbles for overall Turkey. Additionally, housing real interest rates and CPI increases also increase the possibility of housing price bubbles for the TR22 Region (Balıkesir-Çanakkale). Considering those factors, the regulatory authorities in Turkey such as Banking Regulation and Supervision Agency (BRSA) and Central Bank of Turkey (CBRT) should take preventive measures to maintain price, financial and economic stability. In addition, the ones who consider investing or already invested in the housing sector as well as portfolio managers should take into account the existence of the bubble in housing prices in their investment decisions.

Keywords: *Economic Fundamentals, Housing Bubble, Housing Price Indices, SADF and GSADF Tests, Logit Model.*

Jel Classification Codes: C22, G12, R31.

KONUT FİYAT BALONLARI VE BALON OLUŞUMUNU ETKİLEYEN FAKTÖRLER: TÜRKİYE ÖRNEĞİ

Öz

Fiyat balonları finansal krizler için öncü bir gösterge olabilmektedir. Tarihte önemli fiyat balonu vakalarının bazıları gayrimenkul ya da konut piyasasında gerçekleşmiştir. Bu çalışmada Türkiye geneli ve TR22 Bölgesi (Balıkesir-Çanakkale) için konut sektöründe fiyat balonunun varlığı, balon dönemleri ve balon oluşumunu etkileyen faktörler araştırılmaktadır. Çalışmada Ocak 2010-Haziran 2020 dönemine ait 126 adet aylık konut fiyat endeks verisi kullanılmıştır. Çalışmada uygulanan SADF ve GSADF test sonuçlarına göre hem Türkiye geneli hem de TR22 Bölgesi konut fiyat endekslerinde fiyat balonlarının varlığına ilişkin kanıtlara ulaşılmıştır. Yine çalışmada uygulanan logit model tahmin sonuçlarına göre; konut reel faiz oranı, TÜFE ve M2 para arzındaki artışlar Türkiye için konut fiyat balonu oluşma olasılığını artırmaktadır. Diğer taraftan konut reel faiz oranı ve TÜFE artışları, TR22 Bölgesi (Balıkesir-Çanakkale) için konut fiyat balonu oluşma olasılığını artırmaktadır. Bu durumda Türkiye'de BDDK, TCMB gibi düzenleyici otoriteler söz konusu faktörleri göz önünde bulundurarak fiyat istikrarı, ekonomik istikrar ve finansal istikrarı koruyucu önlemler almalıdırlar. Ayrıca Türkiye'deki konut sektörüne yatırım yapanlar veya yapmayı düşünenler ile portföy yöneticileri, yatırım kararlarında konut fiyatlarındaki balonların varlığını dikkate almalıdırlar.

Anahtar Kelimeler: *Ekonomik Temeller, Konut Balonu, Konut Fiyat Endeksleri, SADF ve GSADF Testleri, Logit Model.*

Jel Kodları: C22, G12, R31

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1. INTRODUCTION

Since ancient times, the world financial markets have been prone to create bubbles in every aspect of life from tulips and artworks to stocks and residences. Therefore, it is very important for investors to understand the nature of bubbles (Biggs, 2006: 259). The term bubble is defined as "the part of the movement in asset prices that cannot be explained by economic fundamentals or the deviations in the basic value of an asset" (Atasever, 2016: 1). Implicit in the definition of asset bubble, there is the idea that the prices grow rapidly in a short period of time, this price increase overestimates the assets and thus carries the risk of a "correction" or a sharp decrease in price (Barlevy, 2007: 44). Phillips, Shi, and Yu (2015a) stated that before financial crises there is usually an asset market bubble or widespread credit growth. On the other hand, many economists and policy makers worry that asset bubbles may drop rapidly and cause economic recession (Ambrose, Eichholtz and Lindenthal, 2013: 477). While the term "boom" suggests that the increase in prices may be an opportunity for investors, the term "bubble" expresses a negative judgment about the phenomenon and the view that price levels cannot be sustained (Case and Shiller, 2003: 301-302).

Some of the significant bubble cases in asset prices in history have occurred in the real estate or housing market. Stock and real estate bubbles in Norway, Finland and Sweden in the 1980s, stock and real estate bubbles in Japan in the 1990s, and housing bubble in the USA in the 2000s, are examples of real estate or housing bubbles in history (Kansu, 2017: 15). Along with the stock market, housing market is one of the most important asset markets (Miao, 2014: 130). However, if the house prices are above the basic values, there is a positive housing bubble, while a negative housing bubble is mentioned if it is below the basic value (Barlevy, 2007: 57). In other words, deviations from the basic values in both directions can be expressed as a housing bubble. But, studies have generally focused on positive bubbles. Barlevy (2007) states that a bubble is described by most economists as "a situation where the asset exceeds its fundamental value".

Explaining the effects of the housing bubble can help to better understand the importance of the issue. Historical experience shows that housing price failures have a much stronger impact on the economy than the bursting of the stock market bubble. Housing market bubbles pose a significant threat to a country's financial stability, especially when mortgage loans make up a large part of total loans (Hlaváček and Komárek, 2009: 2). The transformation of the crisis that started in the housing market in the USA into a global crisis in 2008 is an important example of the damage that may be caused by the burst in the housing bubble.

The 2007-2009 crisis showed how costly bubbles could be. The burst of the asset bubble in the housing market seriously disrupted the financial system, leading to an economic downturn, increased unemployment, stressful societies and families who had to leave their homes after foreclosure (Mishkin and Eakins, 2018: 275). The mortgage credit crisis that started in 2005 after the housing bubble in the USA turned into a financial crisis in August 2007 and a global economic crisis in September 2008 (Kaya, 2012: 1). These negative effects reveal the importance of price and financial stability. Otherwise, the search for solutions after bubbles may be useless. However, Malkiel (2018) explains that it is more difficult to determine the date and extent of the collapse in the real estate market due to the fact that real estate rarely changes owners.

Understanding the causes of the housing bubble, which has important consequences in many ways, will be the basis for important steps to be taken in solving the problem. Malkiel (2018) points out both the cause and the inevitable end of price bubbles with the statement that "markets that leap into the sky almost by taking their power from spiritual support, invariably always obey the rule of gravity in finance". Mishkin and Eakins (2018) divide asset bubbles into two as "credit-driven bubbles" formed by credit boom and "irrational exuberance" formed by overly optimistic expectations and state that the bubbles formed by the credit boom are more dangerous than the bubbles formed by irrational exuberance. Kansu (2017) states that the reasons for the formation of all asset bubbles may be different, and the reasons for bubble formation are expansionary monetary policy, positive progress in economic sizes, abundant liquidity, new inventions, financial liberalization, financial innovations, ease of borrowing, increases in credit volume, changes in portfolio structure, and policies followed by governments. Gökçe and Güler (2020) explain that asset bubbles are affected by demand-side shocks, and

demand-side shocks are triggered by factors such as low loan interest, real increase in income, ease of use of credit, and tax incentives.

Housing prices are the main determinant of housing demand and there is a negative relationship between housing demand and housing prices (Taşdemir, 2013: 108). Öztürk and Fitöz (2009) explained factors affecting housing demand as i) house prices (and inflation expectation), ii) income, iii) credit conditions and loan interest rates, iv) income distribution, v) monetary aggregates, vi) social demand and vii) demographic characteristics (population growth, age distribution of the population, gender, marital status, educational status, etc.). The impact direction of these factors on housing demand is also important. Accordingly, it is expected that there will be a positive relationship between housing demand with inflation expectations, income, monetary aggregates (especially M2), and increase in population, migration and urbanization rate. However, it is expected that there will be a negative relationship between housing demand with housing prices, loan interest rates and income inequalities (Öztürk and Fitöz, 2009: 25-29). In addition, Taşdemir (2013) cited expectations regarding housing prices and the cost-purchase preferences of rented houses among other factors affecting the housing demand.

If the increase in interest rates arises solely from inflationary expectations, the housing demand may not be affected by this increase. That is, interest increases caused by other macroeconomic dynamics may have the potential to affect housing demand (Taşdemir, 2013: 114). Apart from this, the application of an expansionary monetary policy increases the lending opportunities of banks, which positively affects the total housing demand. On the other hand, banks create more loan opportunities to gain more profit, which eventually may lead to financial instability and bubbles (Darıcı, 2018: 221). The expectation of an increase in inflation also increases the demand for housing, while the expectation of a decrease in prices reduces the housing demand (Öztürk and Fitöz, 2009: 26). Darıcı (2018) explains that the expectation that the prices will increase in the future can lead to the transfer of future consumption to today and increase the house prices. In other words, there is a positive relationship between the expectation of an increase in the general level of prices and house prices.

Although Kansu (2017) explains that the reasons for the formation of all asset price bubbles are different, Taşdemir (2013) asserts that the formation mechanism of the housing bubble and the bubble formation mechanism in other markets are the same. Accordingly, primarily the demand for a good or service increases due to any factor. Thanks to this increase in demand, prices also increase in markets where supply is inelastic, and this raises expectations that prices will increase further. This increase in expectations also triggers speculative demand and increases demand further. In this way, price and demand increases affect each other and cause prices to move away from their fundamentals. When expectations are reversed, those who previously bought houses especially for investment quickly put their houses up for sale and potential housing investors delay their investments and cause the prices to decrease rapidly.

In this study, the existence, periods, and factors of asset bubbles in the housing sector at the national level Turkey and local level in TR22 Region (Balıkesir-Çanakkale) are being investigated. Balıkesir and Çanakkale are the cities that have received significant investments in recent years with projects such as the North Marmara Highway, Kınalı-Tekirdağ-Çanakkale-Savaştepe Highway and 1915 Çanakkale Bridge. Both provinces are located in the North West of Turkey and they have coasts to both Aegean and Marmara seas. In addition, Balıkesir has gained the "Metropolitan" qualification with the law numbered 6360 published in the Official Gazette dated 06.12.2012 and numbered 28489. Caspi (2016) emphasizes the importance of regional analysis because of the potential detection of bubbles that are regionally available but cannot be detected at national level due to the average nature of the total national data. Korkmaz (2020) states that geographical, economic, social and cultural differences between various regions of the country should be taken into account in studying housing. The research on the existence of the housing bubble and the determination of the periods is carried out with the help of the newly developed Supremum Augmented Dickey-Fuller (SADF) and generalized SADF (GSADF) unit root tests. Different from other studies, in this study, it is tried to determine the reasons of price bubbles with the logit model. In addition, the analyzes are carried out for the first time in the TR22 Region with real housing price data free of inflation effects and relatively more observations. As well as contributing to the literature, the findings to be obtained from this study will provide important information for investors who consider investing in the housing sector in Turkey, especially in South Marmara Region, Balıkesir and Çanakkale. In addition, the

results of this study will provide important valuable information for the regulatory authorities such as Banking Regulation and Supervision Agency (BRSA) and Central Bank of Turkey (CBRT) of for achieving price, economic and financial stability. Additionally, it will be possible to compare the results for Turkey and the TR22 Region (Balıkesir-Çanakkale).

In the second section of the study, economic fundamentals regarding housing prices are introduced. In the third section, information about housing market in Turkey and TR22 Region is given. In the fourth section, the literature review is presented. The fifth section includes the method, and the sixth section includes the data and descriptive statistics. While empirical findings are explained in the seventh section, the results are included in the eighth section of the study.

2. HOUSING PRICES AND ECONOMIC FUNDAMENTALS

Under normal circumstances, the prices of financial assets should be determined by economic fundamentals. For example, the current price of a stock should be equal to the present value of the dividends to be obtained by the shareholder during the period of holding this stock (Özatay, 2015: 151). Economic or market fundamentals of an asset refer to items that have a direct impact on the future income flows of securities (Mishkin and Eakins, 2018: 170). The price of a stock in an efficient market is determined according to the "discounted cash flow model", one of the valuation methods (Çağlı and Evrim Mandacı, 2017: 64). Gökçe and Güler (2020) define the housing bubble as the deviation of housing prices from basic values such as price-to-rent ratio, price-to-income ratio, housing affordability index, expectations, housing vacancy rates and state the fundamentals of housing prices. Eğilmez (2017) expressed that the basis of the debate on the existence of a bubble in real estate is based on the ratio of "house rent/house sales price" and that the clearer the difference between the sale price of the house and the rental income it will bring, the more real is the existence of the bubble. Thus, housing prices and rental income of the houses were associated with the existence of the bubble in the housing markets. Shi (2017) states that the commonly used tools to measure deviations from fundamentals are affordability ratios, including the price-rent and the price-income ratios.

Apart from the house price-rent criterion, different opinions are also put forward on the economic basis of housing prices. Ambrose, Eichholtz, and Lindenthal (2013) state that while the price-to-rent ratio is a measure of house prices relative to basic prices, it does not show the complete picture. Caspi (2016) expresses the main factors for house prices as rent and interest rates. In their assessment of whether housing prices are unsustainably high, Himmelberg, Mayer, and Sinai (2005) state that it is often focused on housing price growth as well as the tools such as price-to-rent ratio which measures the relative cost of owning and renting and price-to-income ratio which measures local housing costs relative to local solvency. However, they state that these three methods are insufficient in evaluating whether there is a speculative bubble or not. Instead of these three criteria, Himmelberg, Mayer, and Sinai (2005) offer the formula "annual cost of home ownership". In this context, it is not possible to correctly evaluate whether the houses are priced reasonably without taking into account the real long-term interest rates, expected inflation, the increase in the expected house price and the changes in taxes. For example, fluctuations in user costs resulting from changes in interest rates and taxes can lead to predictable changes in the price-to-rent ratio that reflect the fundamentals rather than bubbles.

3. HOUSING MARKETS OF TURKEY AND TR22 REGION (BALIKESIR-ÇANAKKALE)

Despite its illiquid and highly leveraged nature, housing, an important asset category, generally constitutes the largest component of household wealth. In many countries, the majority of households tend to keep wealth in the form of housing rather than financial assets (Coşkun, Seven, Ertuğrul and Alp, 2017: 1). Growth model based on construction has been adopted in Turkey in recent years. In this context, as a result of important legal changes in the structure of the Housing Development Administration (HDA), a housing finance institution, has been transformed into a housing producer (Karasu, 2019: 670). According to data of Turkish Statistical Institute (TSI), the average share of the construction industry in GDP in the last five years was 7,52%, while the average employment rate in the construction sector was 6,9% in the same period. While the average share of real estate activities in GNP in the last five years was 7,14%, the average employment rate of real estate activities in the same period was 0,95%. Despite obtaining different results for several sub-periods, Erol and Ünal (2015) found

that economic growth directed the construction sector for the 1998-2014 period, which was surprising. Due to this relationship between the housing sector and income, the total gross domestic product (GDP) and per capita as well as income growth rate are shown in the following table.

Table 1. Gross Domestic Product Growth of Turkey (2015-2019)

	GDP (Billion TL)	GDP (Billion USD)	GDP Growth (%)	Per Capita Income (TL)	Per Capita Income (USD)
2015	2.339	862	6,1	29.899	11.019
2016	2.609	863	3,2	32.904	10.883
2017	3.111	853	7,5	38.732	10.616
2018	3.724	789	2,8	45.750	9.632
2019	4.280	754	0,9	51.834	9.127

Source: Participation Banks Association of Turkey (2019: 32).

As shown in Table 1, according to the TSI data obtained by the Participation Banks Association of Turkey, despite the continuous increase in the total income of Turkey in TL for the 2015-2019 period, it decreased in dollar terms as of 2016. In the same period, per capita income decreased in dollar terms, even if it increased in TL compared to previous years.

In big cities of Turkey, demand, supply and prices of housing have increased significantly in recent years. This is due to the increase in the population and households, demographic changes, urbanization, internal/external migration, and structural factors such as the differentiation of housing consumption habits as well as considering housing as a high-yielding investment (Coşkun, 2016: 202). Evrim Mandacı and Çağlı (2018) stated that housing supply and demands can give a general information about the existence of a bubble in housing prices, and announced housing sales as an indicator of housing demand and a building permit with building license as an indicator of housing supply. Accordingly, information concerning the housing supply and demand, with annual housing price index changes across Turkey and TR22 Region is shown in Table 2.

Table 2. Annual Housing Price Index Changes, Housing Supply and Demand (2015-2019)

	Turkey				TR22 Region (Balıkesir-Çanakkale)	
	Housing Price Index Change (%)	Housing Sales (Number)	Building Permit Certificate (Number of Apartments)	Building License (Number of Apartments)	Housing Price Index Change (%)	Housing Sales (Number)
2015	15,60	1.289.320	732.948	897.230	13,58	38.368
2016	12,19	1.341.453	754.174	1.006.650	19,84	40.855
2017	9,07	1.409.314	833.517	1.405.447	15,13	41.309
2018	4,45	1.375.398	893.651	664.686	6,67	42.642
2019	10,00	1.348.729	735.325	313.173	15,36	41.074

Source: CBRT/EVDS/Housing and Construction Statistics, TSI/Basic Statistics/Construction and Housing.

In Table 3 below, the quantity of the total housing sales and mortgages and the rate of mortgages to the total housing sales have been shown separately for Turkey, Balıkesir and Çanakkale.

Table 3. Total Housing and Mortgage Sales in Turkey, Balıkesir and Çanakkale (2015-2019)

	Turkey			Balıkesir			Çanakkale		
	Total Housing Sales (Number)	Mortgage Sales (Number)	Mortgage Sales Rate (%)	Total Housing Sales (Number)	Mortgage Sales (Number)	Mortgage Sales Rate (%)	Total Housing Sales (Number)	Mortgage Sales (Number)	Mortgage Sales Rate (%)
2015	1.289.320	434.388	33,69	26.292	7.643	29,07	12.076	3.668	30,37
2016	1.341.453	449.508	33,51	27.666	8.082	29,21	13.189	3.975	30,14
2017	1.409.314	473.099	33,57	28.250	8.437	29,87	13.059	3.848	29,47
2018	1.375.398	276.820	20,13	28.917	5.080	17,57	13.725	2.613	19,04
2019	1.348.729	332.508	24,65	29.069	6.490	22,33	12.005	2.757	22,97

Source: TSI/Basic Statistics/Construction and Housing.

According to Table 3, 29,11% of total housing sales for the whole of Turkey, 25,61% for Balikesir and 26,40% for Canakkale consisted of the mortgage sales. While housing sales for Turkey decreased as of 2018, sales increased steadily in Balıkesir. As it is known, homeowners can gain capital from the increase in housing prices, as well as earning income by renting their houses. In Figure 1 below, hedonic housing price index (HHPI) and housing rent index (HRI) for overall Turkey and TR22 Region (Balıkesir-Çanakkale) are shown graphically[1].

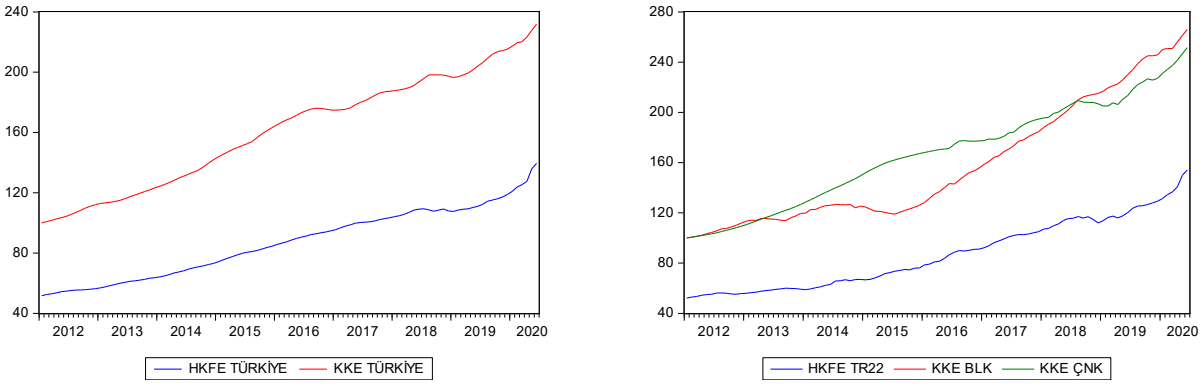

Figure 1. HHPI and HRI for Turkey and TR22 Region (Balıkesir-Çanakkale) (01.2012-06.2020)

Source: CBRT/EVDS/Housing and Construction Statistics, Reidin Data and Analytics.

Note: Blk represents Balıkesir and Çnk represents Çanakkale in Figure 1.

As seen in the left graphic in Figure 1, both indices had a similar development in the comparison between HHPI and HRI indices for Turkey. On the other hand, a similar development can be seen at first glance between the HHPI of TR22 Region and HRI of Çanakkale in the graphic on the right in Figure 1. In addition, HRI of Balıkesir had a value below the HRI of Çanakkale as of May 2013, whereas it had a value above as of August 2018.

4. LITERATURE REVIEW

There are many studies in the literature on asset bubbles in general and housing bubbles in particular. Studies conducted on the existence of price bubbles in the housing market in accordance with the subject of this study are explained below.

Case and Shiller (2003) examined state-level housing bubbles for the USA. In the study, house price changes were compared with various explanatory variables. According to the findings of the study, the variable of income per capita alone explained a significant part of the changes in housing prices, except for 8 states (states with the most volatile housing price) out of 51 states, while other fundamental variables increased the explanatory power of the model. In addition, the hypothesis that there was a bubble for some states with the most volatile housing prices in the 2000-2002 period could not be rejected, and according to the results of the survey conducted for

1 HRIs for Balıkesir and Çanakkale are published separately by Reidin Data and Analytics on a city basis.

4 metropolitan areas, it was determined that the general indicators regarding the descriptive characteristics of bubbles were quite strong in 2003. Black, Fraser and Hoesli (2006) investigated the housing bubble for the UK using the "time-varying present value approach". Two macroeconomic variables, real disposable income and retail price index, were used in the study. The study concluded that there are periods of strong divergence from market fundamentals for UK housing prices. Hlaváček and Komárek (2009) investigated the existence of bubbles in housing prices in the Czechia. As a result of three different analyzes used in the research, real estate price bubbles were detected in 2002/2003 and 2007/2008. In addition, it was determined that housing prices in the Czechia were mainly driven by demand factors, and these factors included wages, rents, unemployment and natural population growth and partially other factors (migration, divorce rate). Also surprisingly, it was found that mortgage loan growth and loan conditions represented by interest rates were not among the important factors in housing prices.

In their study investigating the existence of the bubbles in Istanbul, Izmir, and Ankara housing markets, Zeren and Ergüzel (2015) found that there was no housing bubble in Turkish housing markets. Price increases above the average are experienced only in the short term, not permanent in the long term. According to the findings, the efficient market hypothesis was found to be valid for Turkey, and 2008 mortgage crisis was experienced less than many other countries. In addition, it was interpreted that the stability of the housing pricing policy after the crisis was properly maintained in the housing market. Atasever (2016) conducted the ADF unit root test to the real housing prices and real rental income of 5 developing neighborhoods in Muğla. According to the test results, it was concluded that the relevant series were stationary and thus there was a cointegration relationship between the series, and there was no bubble in the Muğla housing market. On the other hand, it was stated that bubble could not be mentioned for the period of 2010-2013 in the Muğla housing market due to the fact that the annual return of housing prices which was approximately 7% was similar to the annual real return of government bonds which was 7,3%. Caspi (2016) examined the existence of a national and regional housing bubble for Israel. The study results showed that the recent home price valuations (increases) at national and regional level were consistent with developments in fundamentals such as supply and demand factors represented by rental payments and interest rates, not the housing bubble scenario. Pavlidis et al. (2016) investigated the existence of the bubble for housing price indices of 22 countries, for the price-rent ratio of 16 countries. The study also examined whether macroeconomic and financial variables helped predict exuberance periods in housing markets. As a result of the study, three different bubble periods were determined for most of the countries concerned, especially according to the GSADF test findings. In addition, variables such as long-term interest rates, private loan growth, current account growth, real disposable income growth per capita, unemployment rate, real GDP growth and Kilian (2009) global economic condition measure was found to have predictive power for exuberance in housing.

Coşkun and Jadevicious (2017) performed a three-step bubble analysis of the housing market in the Turkish housing market. The results showed that there was no bubble in the relevant period for Turkey housing sector and the regional series. Although housing prices showed no bubble formation in Turkey, it was stated that there was a considerable increase in the number of potential over-valuation during the 2010-2014 period. Coşkun et al. (2017) examined the existence of housing bubbles in Turkey for two different periods and two different housing price indices. Several variables were used to explain the price changes for the Turkish housing market in the study. The bound test results of the study showed that there was a long-term cointegration relationship between the price indices with rental prices, construction costs and real mortgage interest rates. According to the results of the study, it was seen that although there were some cases of overvaluation in the Turkish housing market, no bubble formation was observed. Shi (2017) proposed a new method exploring information beyond the housing market and considering total economic conditions to monitor speculative bubbles in the US housing markets in real time. As a result of the study, it was determined that there was a housing bubble for each sample (USA in general and 21 metropolitan regions) with the PSY procedure, whereas a bubble was detected with the new method in the USA in general and 16 of 21 regions.

Afşar and Dogan (2018), investigated the existence of bubbles for the real housing price index and real rental index in Turkey. According to the findings of the study, although it was implied that there would be a future bubble risk in housing prices, housing bubbles did not emerge empirically in the period examined. Accordingly, the correction performed with the internal dynamics of Turkey blocked the formation of the housing bubble in

the relevant period. Evrim Mandacı and Çağlı (2018) examined the existence of housing bubbles in Turkey in general and 26 regional units for different housing indices. Results showed strong evidence for the existence of the bubble in housing prices in overall Turkey and in 17 regional units (often in the western and coastal regions). In addition, there were no significant differences between different types of housing indices calculated for the same geographical region or provinces. The existence of the housing price bubble was found to be significant at the 1% level for the TR22 Region. Çağlı (2019) investigated the potential presence of explosive behavior in the housing market for both Turkey general and 26 regions. According to the empirical results of the study, the presence of explosive behavior in regional price indices as well as the country's housing price index was determined. In addition, as a result of the examination of the relationship between the countrywide housing price index and regional housing price indices, it was understood that some regions in the real estate market have a more aggressive feature than the whole market. It was determined that housing prices of the TR22 region have explosive behavior. İskenderoğlu and Akdağ (2019) examined whether real hedonic price bubble in the housing price index occurred in Turkey overall and İstanbul, İzmir and Ankara. Both tests (SADF and GSADF) used in the study showed that the existence of housing bubbles in Turkey, İstanbul and İzmir, while it was found that there was a bubble formation in housing prices for Ankara only in the SADF test result. Korkmaz (2019) examined the asset price bubble in the housing market in Turkey with 26 regional units using different unit root tests basis. According to PANKPSS, Fourier KSS and KPSS stationarity test with sharp and smooth breaks test results, no housing price bubble was detected in any region; according to CADF, SURADF, SADF and GSADF test results, housing price bubble was detected in some regions. According to CADF, SADF and GSADF test results, there were housing price bubbles in the TR22 Region. Gökçe and Güler (2020) investigated the existence of rational bubbles for Ankara using the seasonally adjusted real housing price index. The results showed the existence of a housing bubble in the Ankara real house price index in the relevant period.

The literature explained in this study on the housing bubble is presented in Table 4 with additional information.

Table 4. Literature Review

Reference	Country/ Region	Data (Frequency)	Econometric Method	Findings
Case and Shiller (2003)	The USA	Q1:1985-Q3:2002 (Quarterly)	1. Price/income analysis 2. Panel regression model 3. Survey research	√ (For some States)
Black, Fraser and Hoesli (2006)	The UK	Q4:1973-Q3:2004 (Quarterly)	1. ADF unit root test 2. Johansen cointegration test 3. VAR model	√
Hlaváček and Komárek (2009)	Czechia and Prague	Q1:1998-Q2:2009 (Quarterly) 1998–2008 (Annually)	1. Price/income and price/rent analysis 2. Regression models with supply and demand variables 3. Panel regression model	√ (For Czechia)
Zeren and Ergüzel (2015)	İstanbul, İzmir and Ankara	01.2010-06.2014 (Monthly)	1. SADF and GSADF tests	×
Atasever (2016)	Muğla (for 5 neighborhood)	2000-2013 (Yearly four data)	1. ADF unit root test 2. Correlation test	×
Caspi (2016)	Israel and 9 regions in Israel	01.1999-07.2013 (Monthly) Q1:1998-Q2:2013 (Quarterly)	1. ADF, SADF and GSADF tests 2. CUSUM test	×
Pavlidis et al. (2016)	22 countries	Q1:1975-Q2:2013 (Quarterly)	1. SADF, GSADF and Panel GSADF tests 2. Pooled probit model	√ (For most countries)

Coşkun and Jadevicious (2017)	Turkey, İstanbul, İzmir and Ankara	01.2010-12.2014 (Monthly and Annually)	1. Affordability ratios (price/income and price/rent) analysis 2. Regression models with Case-Shiller (2003) and extended Case-Shiller (2003) frameworks 3. ADF, RADF, SADF and GSADF tests	×
Coşkun et al. (2017)	Turkey	01.2010-12.2014 06.2007-12.2014 (Monthly)	1. ADF, PP and NG-Perron unit root tests 2. Bound test 3. OLS, FMOLS, DOLS and Kalman filter models 4. ARIMA model	×
Shi (2017)	The USA and 21 metropolitan regions in the USA	1978-2015 (Six months)	1. VAR model 2. Phillips et al. (2015a, 2015b) procedure	√ (For 17 regions)
Afşar and Doğan (2018)	Turkey	01.2010-11.2017 (Monthly)	1. SADF and GSADF tests	×
Evrim Mandacı and Çağlı (2018)	Turkey and 26 regional units in Turkey	01.2010-04.2017 (Monthly)	1. GSADF test	√ (For Turkey and 16 regions)
Çağlı (2019)	Turkey and 26 regional units in Turkey	01.2010-12.2017 (Monthly)	1. Chen et al. (2017) continuous time framework	√ (For Turkey and 16 regions)
İskenderoğlu and Akdağ (2019)	Turkey, İstanbul, İzmir and Ankara	01.2010-12.2018 (Monthly)	1. SADF and GSADF tests	√
Korkmaz (2019)	26 regional units in Turkey	01.2010-12.2018 (Monthly)	1. CADF, SURADF, PANKPSS, Fourier KSS, SADF ve GSADF unit root tests 2. KPSS stationarity test with sharp and smooth breaks	√ (For some tests and some regions)
Gökçe and Güler (2020)	Ankara	01.2010-08.2019 (Monthly)	1. GSADF test	√

NOTE: The sign "√" indicates the findings regarding the existence of a bubble in house prices, and the sign "×" indicates the findings regarding the absence of a bubble in house prices.

According to studies in the literature described above, it was seen that the studies on housing bubbles were conducted for Turkey overall, İstanbul, Ankara, and İzmir. This study investigates the reasons of the existence of the bubble in housing prices in Turkey in general and TR22 Region, which is different from other studies in the literature. It can be seen from the literature table that the newly developed SADF and GSADF tests are generally used in current studies on the detection of the existence of the housing bubble. In this study, newly developed tests mentioned above were conducted. Another issue pointed out in literature reviews, while the housing price index data covering a long period have existed in countries other than Turkey, the housing price index data in Turkey has started to be published by the CBRT as of the beginning of 2010.

Korkmaz, Erer and Erer (2016) and Akkaya (2018) have conducted studies on the reasons for price bubbles and their causes. However, these studies focused on credit bubbles, and no empirical studies were found on the causes of housing price bubbles. In the introduction explanations, Gökçe and Güler (2020) and Taşdemir (2013) pointed out that demand factors were effective in the formation of price bubbles. Studies on the demand side determinants of the housing market are explained below.

Painter and Redfearn (2002) investigated the role of interest rates on home ownership rates and housing stock. The study found that interest rates play little direct role in changing home ownership rates, explaining that changes in interest rates can affect the timing of changes in tenant-to-owner tenure and that the long-term ownership rate is independent of interest rates. Halicioglu (2005) explored new housing demand functions for the 1964-2004 period in Turkey. Empirical research results indicated that income is the most important variable in explaining the demand for new housing revenue in Turkey and housing prices and the level of urbanization follow it. There is a positive relationship between housing demand with real disposable income and urbanization rate, and a negative relationship between housing demand and housing prices. Öztürk and Fitöz (2009) investigated

the supply and demand determinants of housing market in Turkey. According to the stepwise regression method, it was determined that among many variables, the variables that best explain the housing demand are per capita income, CPI and interest rates. According to the model results performed on these three variables; a statistically significant and positive relationship was found between housing demand with per capita income, CPI and interest rates. In other words, per capita income, the increase in the CPI and interest rates explain the increase in demand for housing in Turkey.

Lebe and Akbaş (2014) carried out an analysis of the demand for housing in Turkey for the period 1970-2011. As a result of the analysis performed in this study, it was found that per capita income, marital status and industrialization affect the demand for housing in a positive direction, whereas housing prices, interest rates and employment in the agricultural sector have a negative impact. As a result of bootstrap analysis, one-way causality relationship from per capita income, house prices, interest rate and industrialization to housing demand was determined. Uysal and Yigit (2016) investigated the determinants of demand for housing in Turkey. The results showed a positive relationship between housing demand with per capita income, urbanization rate, and interest rates. In addition, a negative relationship was found between housing demand with M2 money supply and CPI. Darıcı (2018) investigated the impact of monetary policy on housing prices for the economy of Turkey. As a result of the study, it was found that the expansionary monetary policy exerted a pressure to increase housing prices.

According to the results of the study conducted on the determinants of housing demand, consistent results were obtained for the per capita income variable. However, results on interest rates, CPI, and M2 money supply differ. In the literature, there are significant number of studies on housing prices and their determinants (see Çankaya, 2013; Darıcı, 2018; Kolcu and Yamak, 2018; Karadaş and Salihoğlu, 2020).

5. METHOD

In this study, SADF and GSADF tests, which are among the newly developed tests, are used to determine the housing bubbles and the bubble periods. Pavlidis et al. (2016) stated that SADF and GSADF tests are better in the detection of slightly explosive behaviors in time series data than unit root/cointegration tests (e.g. Diba and Grossman, 1988), variance bounds tests (e.g. LeRoy and Porter, 1981; Shiller, 1981), specification tests (e.g. West, 1987), Chow and CUSUM-type tests (e.g. Homm and Breitung, 2012). Gürkaynak (2008) asserted that the mentioned variance bounds tests, West's two-step test, integration/cointegration-based tests and intrinsic bubbles test (Froot and Obstfeld, 1991) do not yield consistent results in distinguishing between incorrectly defined fundamentals and bubbles. He noted that the tests were only strong against certain types of bubbles. In addition, SADF and GSADF tests are used in exuberance indicator analyzes published by the Federal Reserve Bank of Dallas for 23 countries (www.dallasfed.org). In the study, the reasons of these bubbles are investigated with the logit model, based on the periods when the housing price bubble formation is determined.

5.1. SADF and GSADF Tests

SADF and GSADF tests are bubble tests that take into account the right-tailed variations of the standard ADF unit root test. Right-tailed unit root tests provide information about the slightly explosive or sub-martingale behavior in the data and are therefore useful as a market diagnosis or warning sign (Phillips et al., 2015a: 1047). Phillips, Wu, and Yu (2011) developed the SADF test by using forward recursive right-tailed ADF unit root tests; Phillips et al. (2015a, 2015b) developed the GSADF test using the backward recursive right-tailed ADF unit root tests to test the existence of a bubble, determine the bubble's formation and expiration dates. For this reason, these tests are also referred to as PWY method for SADF test and PSY method for GSADF test. The hypotheses of the SADF test are shown below (Phillips et al., 2011: 207):

$\mathbf{H_0}$: $\delta = 1$ (no bubble)

$\mathbf{H_1}$: $\delta > 1$ (at least one bubble)

When the sample period includes two bubbles, especially when the duration of the first bubble is longer, the PWY strategy usually fails to identify the second bubble or performing date-stamping consistently (Phillips et al. 2015a: 1057). Since the SADF test can present an inconsistent dating strategy in multiple bubble formations, the

alternative hypothesis was formed as "at least one bubble exists". The hypotheses of the GSADF test are shown below.

H_0: $\delta = 1$ (no bubble)

H_1: $\delta > 1$ (multiple bubbles)

The GSADF test is more successful than the SADF test in detecting multiple bubbles and determining bubble periods. The following recursive regression equations are used to determine the existence of price bubbles in the SADF test (Phillips et al., 2011: 206):

$$x_t = \mu_x + \delta x_{t-1} + \sum_{j=1}^{j} \phi_j \Delta x_{t-j} + \varepsilon_{x,t}, \qquad \varepsilon_{x,t} \sim NID\ (0, \sigma_x^2) \tag{1}$$

In Equation 1, j refers to the delay parameter and NID refers to the independent and normal distribution. The rolling recursive regression equations are used to detect the existence of price bubbles in GSADF tests (Phillips et al., 2015a: 1047):

$$\Delta y_t = \hat{\alpha}_{r1,r2} + \hat{\beta}_{r1,r2} y_{t-1} + \sum_{i=1}^{k} \hat{\psi}_{r1,r2}^{i} \Delta y_{t-i} + \hat{\varepsilon}_t, \tag{2}$$

In Equation 2, k is the lag length, r_1 is the starting point for recursive regression estimation and r_2 is the end point for recursive regression estimation. SADF and GSADF statistics calculated based on Equation 1 and Equation 2 are shown in Equation 3 and Equation 4 below, respectively (Phillips et al., 2015a: 1048-1049):

$$SADF(r_0) = \sup_{r_2 \in [r_0, 1]} ADF_0^{r_2} \tag{3}$$

$$\sup_{\substack{r_2 \in [r_0, 1] \\ r_1 \in [0, r_2 - r_0]}} \{ADF_{r_1}^{r_2}\} \tag{4}$$

The SADF test in Equation 3 is based on the recursive estimation of the ADF model over a series of samples expanding forward. Here, the window size (rw) expands from r_0 to 1, r_0 is the smallest sample window width (and the starting point of the test statistic), and 1 is the largest window width (and total sample size). In the SADF test, the starting point (r_1) of the sample series is fixed at 0. Therefore, the end point (r2) of each sample varies from r0 to 1. The ADF statistics of a sample ranging from 0 to r_2 are shown with .

In the GSADF test in Equation 4, the sub-samples used in recursive are much more extensive than those in the SADF test. In the GSADF test, the starting point (r_1) is allowed to vary within a suitable range. Phillips et al. (2015a) proposed the $r_0 = 0{,}01 + 1{,}8 / \sqrt{T}$ rule based on comprehensive simulation findings for r_0 selection in SADF and GSADF tests. The recursive SADF and GSADF processes described in Equation 3 and Equation 4 above are shown comparatively in Figure 2 below (Phillips et al., 2015a: 1049):

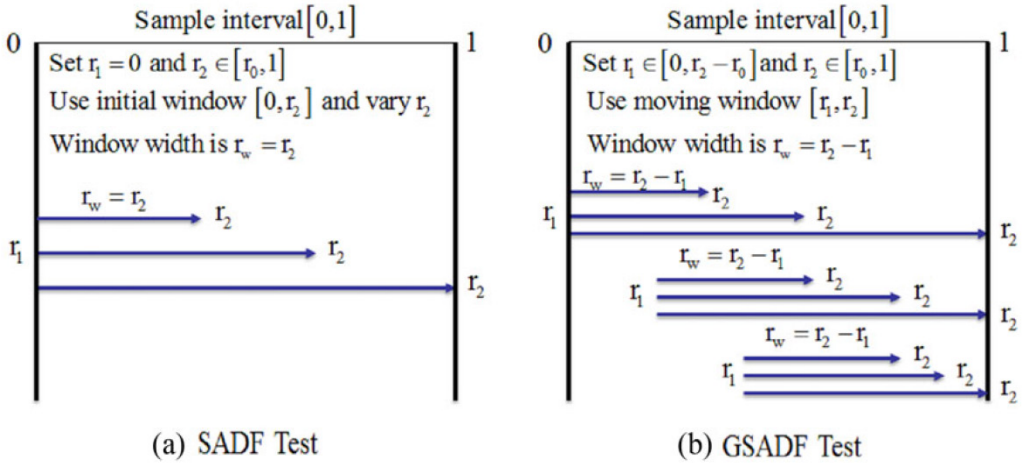

Figure 2. Sampling Ranges for SADF and GSADF Tests

Source: Phillips et al. (2015a: 1049).

The test statistics calculated with the Equation 3 and Equation 4 above are compared with the critical values calculated as a result of Monte Carlo simulations. If the test statistics are greater than the critical values, the zero hypothesis is rejected and the alternative hypothesis is accepted as "there is a bubble".

Finally, while determining the start and end dates of the bubble periods, the backward SADF (BSADF) statistics series for the GSADF test from the last observations of the sample to the first observations are formed (Çağlı and Evrim Mandacı, 2017: 66). The upper value of the test statistics series is called the BSADF statistic and is shown as in Equation 5 (Phillips et al. 2015a: 1051):

$$BSADF_{r2}(r_0) = \sup_{r_1 \in [0, r2 - r_0]} \{ADF_{r_1}^{r_2}\} \quad (5)$$

The BSADF statistics in Equation 5 are then compared with a series of right-tailed critical values for each statistic calculated by Monte Carlo simulations (Çağlı and Evrim Mandacı, 2017: 66). The starting point of a bubble formation is completed by the BSADF sequence cutting the critical value upwards and cutting it downwards (Gökçe and Güler, 2020: 110). The PWY procedure for bubble detection (i.e. recursive ADF test) is a special case of the backward ADF test with r1 = 0, and in that case, the sup operation is unnecessary (Phillips et al., 2015a: 1051).

5.2. Logit Model

In econometric models, dummy variables that can take values of 0 and 1 can be used to show the effect of qualitative factors as well as various quantitative factors. While dummy variables are mostly used as independent variables, there may be situations where the dependent variables are also dummy variables in some cases. Such models are called dummy dependent variable models (Tarı, 2014: 213). Dummy dependent variable models can be used as two or multi-state. Such models are called binary choice models if the dependent variable is binary, such as the presence or absence of a certain state. One of the binary choice models is the logit (logistics) model (Tarı, 2014: 245).

Logit model is a binary choice model whose prediction probability is always in the range of 0-1 and which has a nonlinear relationship between the dependent variable and the independent variable (Gujarati, 2016: 233). In the linear probability model, other binary choice model, the dependent variable D_i, which reflects the probability of P_i, can take any real value and is not limited to the correct probability range (0-1 interval). There is a simple two-step solution to this problem (Asteriou and Hall, 2016: 258): The first step is to transform the dependent variable D_i as in Equation 6 and define it with the concept of "odds".

$$Odds_i = \frac{P_i}{1 - P_i} \tag{6}$$

Here $odds_i$ is defined as the ratio of probability of success to its complement (i.e, failure rate). The second step involves taking the natural logarithm of the odds ratio and calculating the logit L_i as in Equation 7. In addition, using Equation 7 in linear regression, the logit model in Equation 8 is obtained (Asteriou and Hall, 2016: 258):[2]

$$L_i = Ln\left(\frac{P_i}{1 - P_i}\right) \tag{7}$$

$$L_i = \beta_1 + \beta_2 X_{2i} + u_i \tag{8}$$

Logit model is estimated with the maximum likelihood method (Asteriou and Hall, 2016: 259; Gujarati, 2016: 237).

6. DATA AND DESCRIPTIVE STATISTICS

In the study, housing prices are analyzed for overall Turkey (TR) and TR22 Region. Housing Price Index, Housing Price Index for New Dwellings, Housing Price Index for Existing Dwellings, and Housing Unit Prices have been published by the CBRT as of January 2010. However, the data except for Housing Price Index could not been included in the study as they have been published for overall Turkey, İstanbul, Ankara and İzmir. In the statement made by the CBRT regarding Housing Price Index, the expression "the price index created by using the hedonic regression method in order to monitor the price changes adjusted for the quality effect depending on the observable properties of the houses" was included. In this case, the index mentioned is the hedonic housing price index. In this study, 126 months of observations for the period January 2010-June 2020 were used. As described in the literature review section, housing price index in Turkey have been published by the CBRT on a monthly frequency since the beginning of 2010. For this reason, the analysis period was chosen as of January 2010 until today. In addition, the index data is freed of the inflation effect by using the monthly CPI rate by using the formula in Equation 9.

$$Real\ HPI_t = \frac{Nominal\ HPI_t}{CPI_t} \times 100 \tag{9}$$

The variables used in the analysis performed on the causes of bubble formation in house prices are given below. Due to the lack of data on monthly frequency of income or per capita income variables, which are factors affecting housing demand, could not included in the study. Turkey real estate sector confidence index, price expectations index and housing rent index are calculated by Reidin Data and Analytics. While confidence index and the expectations index are calculated as three months, housing rent index is calculated for overall Turkey or on a city basis not regional. Other factors affecting the housing demand could not be included in the study because they were not at the appropriate frequency with the housing price index data. For this reason, only the variables which can explain housing bubbles such as the housing real interest rate (HRINT), the consumer price index change (CPI), an indicator of inflation, and the money supply percentage change (M2) could be included as their data were found to be suitable for the study. As the inflation data is calculated separately for both across Turkey (TR) and TR22 Region, they were included in the study. In addition, inflation adjusted housing interest rate, i.e. housing real interest rate is calculated separately for overall Turkey and TR22 Region. The data were obtained from the official websites of BRSA, CBRT and TSI. Descriptive statistics of all variables used in analysis are shown in Table 5 below.

2 For more detailed mathematical explanations, see Asteriou and Hall (2016: 261-262).

Table 5. Descriptive Statistics

	RHPI_TR	RHPI_ TR22	HRINT_ TR	HRINT_ TR22	CPI_TR	CPI_TR22	M2
Mean	28,57695	28,60305	12,15303	12,11603	0,803415	0,839149	1,465122
Median	27,62028	28,03325	11,51553	11,56242	0,664286	0,666566	1,297854
Maximum	32,87632	33,10149	30,51320	30,13836	6,304738	6,268937	12,03844
Minimum	25,49166	25,22052	7,477027	6,398981	-1,442919	-2,063412	-4,706333
Std. Dev.	2,343143	2,228740	3,778535	3,805411	0,954750	1,100395	2,032746
Skewness	0,484474	0,527753	2,547119	2,358139	1,583497	1,228239	1,388715
Kurtosis	1,668789	2,068430	10,85993	10,00138	10,71060	7,301222	9,757697
J. B.	14,23267	10,40505	460,5814	374,1288	364,7871	128,8076	280,2480
Prob.	0,000812	0,005503	0,000000	0,000000	0,000000	0,000000	0,000000
N. of Obs.	126	126	126	126	126	126	126

As seen in Table 5, the descriptive statistics of the real house price index for overall Turkey and TR22 Region were close to each other. A similar situation was valid for housing real interest rates and inflation indicators. In this case, it can be said that the data calculated for overall Turkey and TR22 Region did not vary much. Interest rates data had more distinct standard deviation than that of the others. Skewness values were positive for all series. Kurtosis values of all series except real housing price indices were quite high. Jargue-Bera (J. B.) statistics indicates that all series used in the study did not show normal distribution feature.

The graphs regarding the time series of the data used in the study are shown in Figure 3 below.

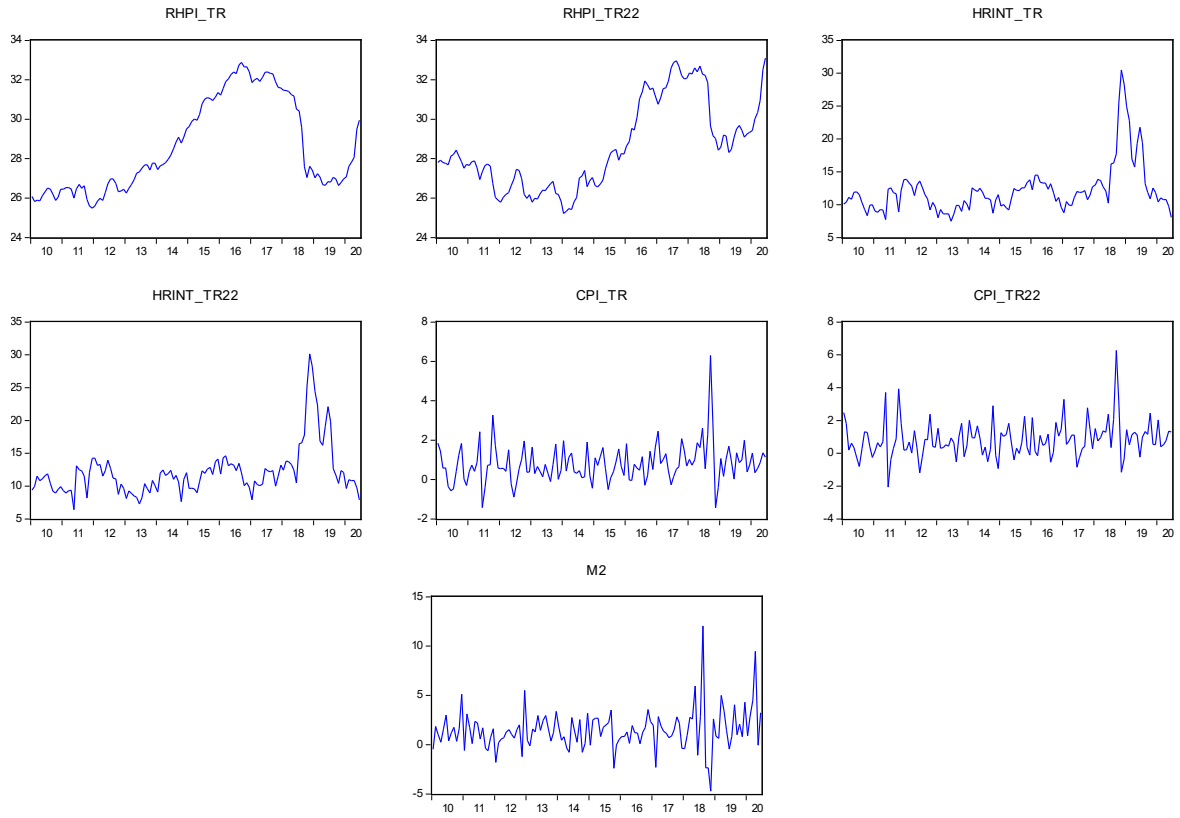

Figure 3. Time Series Graphs for Variables

When Figure 3 is examined, it can be seen that there were significant price increases and decreases for both real housing price indices. There were significant decreases in real housing price indices in 2018. Additionally, important changes in housing real interest rates, inflation rates and M2 money supply levels were observed.

7. EMPIRICAL FINDINGS

7.1. SADF and GSADF Test Results

The SADF and GSADF test results performed to detect the existence of the bubble in Turkey general and TR22 Region are shown in Table 6 below.

Table 6. SADF and GSADF Test Results

Variables	Test Statistics	
	SADF	**GSADF**
Real Housing Price Index for Turkey	2,676217*** (0,0000)	4,421184*** (0,0000)
Real Housing Price Index for TR22 Region (Balıkesir-Çanakkale)	0,782773** (0,0175)	1,360635** (0,0223)
	Critical Values	
%99	0,988019	1,623947
%95	0,436292	1,096919
%90	0,177529	0,834064

Note: *** and ** signs indicate 1% and 5% significance, respectively. Critical values were obtained from 10.000-replicated Monte Carlo simulation results. The initial window size is taken as 25. Values in parentheses are probability values.

According to the SADF test results in Table 6 above, test statistic obtained in RHPI for Turkey overall, the confidence interval was found to be 99% while it was 95% for TR22 Region. Since these values were greater than the critical values, the null hypothesis was rejected and the alternative hypothesis was accepted. It was concluded that there was at least one bubble in the relevant housing prices. Again according to GSADF test results in Table 6, evidence for the existence of multiple bubbles was reached in RHPI for Turkey overall in the 99% confidence interval and for TR22 Region in 95% confidence interval. In Figure 4 below, bubble formation periods are shown graphically according to SADF and GSADF test results.

Figure 4. Graphical Display of House Bubble Formation Periods according to SADF and GSADF Test Results

As mentioned earlier, GSADF test is more successful in detecting multiple bubbles and determining bubble periods. According to GSADF test results, the start and end periods of the bubbles are shown in Table 7 below. It can be seen in Table 7 that long-term housing bubble periods were experienced in Turkey while short term housing bubbles were experienced in TR22 Region.

Table 7. Bubble Periods According to GSADF Test Results

TURKEY		TR22 REGION (BALIKESİR-ÇANAKKALE)	
Start - End	**Period**	**Start - End**	**Period**
01.2017-01.2017	1 month	06.2016-09.2016	4 months
04.2017-04.2017	1 month	09.2018-01.2019	5 months
10.2017-01.2020	28 months	04.2019-05.2019	2 months
04.2020-06.2020	3 months	05.2020-06.2020	2 months

Table 7 shows the four bubble period for Turkey in general and TR22 Region. It is noteworthy that the analyzed data consisted of real housing price indices adjusted for inflation. The periods of bubbles are relatively shorter for the TR22 Region. In this case, it can be said that even though bubbles were detected in real housing prices, the prices would stabilize again in a certain period. When the results regarding overall Turkey were considered, there was a 28-month bubble period between October 2017 and January 2020. As can be seen from the time series graphs regarding the data above, significant changes occurred in housing real interest rates, CPI and M2 money supply in the relevant period.

The results obtained in this study are consistent with the studies conducted by Evrim Mandacı and Çağlı (2018), Çağlı (2019), İskenderoğlu and Akdağ (2019), Korkmaz (2019), Gökçe and Güler (2020) on housing bubbles in Turkey. The studies on the recent housing price bubbles that described in the literature review of this study resulted in similar findings for Turkey. In addition, the results obtained from the study are consistent with the studies conducted by Case and Shiller (2003), Black, Fraser and Hoesli (2006), Hlaváček and Komárek (2009), Pavlidis et al. (2016) and Shi (2017). But the results are not consistent with the studies conducted by Zeren and Ergüzel (2015), Atasever (2016), Caspi (2016), Coşkun and Jadevicious (2017), Coşkun et al. (2017), Afşar and Doğan (2018).

7.2. Logit Model Results

The housing price bubble periods obtained as a result of SADF and GSADF test results were determined above. In the next step, various financial and economic variables that affect the formation of these bubbles are investigated with the logit model. Dummy variables were created by giving the number 1 for the bubble periods and 0 to other periods to be determined as a result of GSADF analysis for Turkey. The dummy variables created in this way were included in the analysis as dependent variables. The same process was applied for the TR22 Region. The model including variables that were used to describe housing price bubbles for overall Turkey and TR22 Region is shown in Equation 10 and Equation 11, respectively.

$$BUBBLES_{TR}=\beta_1+\beta_2 HRINT\_TR_t+\beta_3\ CPI\_TR_t+\beta_4 M2_t+u_t \quad (10)$$

$$BUBBLES_{TR22}=\beta_1+\beta_2 HRINT\_TR22_t+\beta_3 CPI\_TR22_t+\beta_4\ M2_t+u_t \quad (11)$$

Whether the independent variables to be included in the logit model were stationary or not was investigated with the Zivot-Andrews (1992) Unit Root Test, which takes into account a break in the series. Zivot-Andrews (1992) test results are shown in Table 8 below.

Table 8. Zivot-Andrews (1992) Unit Root Test Results

Variables	t-Statistic	Lags	Breakpoint
HRINT_TR	-6,25***	4	09.2018
HRINT_TR22	-5,89***	4	10.2018
CPI_TR	-8,26***	3	04.2018
CPI_TR22	-8,53***	3	08.2018
M2	-12,45***	0	10.2018
	Critical values for %1, %5 ve %10 significance levels are -5,57; -5,08; -4,82, respectively.		

Note: *** indicates the 1% significance levels. In the level values, "constant and trend" models were used.

According to the Zivot-Andrews (1992) test results in Table 8, all variables were found to be stationary at the level. The estimation results regarding the logit model are shown in Table 9 and Table 10 below. In Table 9, the dependent variable is the bubble dummy variable for overall Turkey, while the dependent variable is the bubble dummy variable for the TR22 Region in Table 10.

Table 9. Logit Model Estimation Results for Turkey

Dependent Variable: House bubble dummy variable for Turkey				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	-13,35371	2,626596	-5,08406	**0,0000**
HRINT_TR	0,761156	0,173052	4,398417	**0,0000**
CPI_TR	2,705995	0,507146	5,335733	**0,0000**
M2	0,508611	0,159012	3,198574	**0,0014**
McFadden R-squared: 0,499690 **LR statistic:** 64,16930 **Prob. (LR statistic):** 0,000000				

According to the estimation results in Table 9, the probability values of the variables HRINT_TR, CPI_TR and M2 were found to be statistically significant. In addition, the coefficients of all explanatory variables were positive. Accordingly, increases in HRINT_TR, CPI_TR and M2 variables increase the possibility of housing price bubbles for overall Turkey.

Our findings for housing real interest rates are consistent with the results of Öztürk and Fitöz (2009), Uysal and Yiğit (2016). Both studies were conducted on the housing market in Turkey which is the main area of interest in this study. Theoretically, while a negative relationship is expected between housing demand and interest rates, the results contrary to expectation were reached in the studies of Painter and Redfearn (2002), which is explained in the literature review section.

The findings obtained for the consumer price index are in line with the study of Öztürk and Fitöz (2009). The findings for the M2 money supply are also consistent with the study of Darıcı (2018). As explained in the introduction, a positive relationship between housing demand with CPI expectations and M2 money supply are theoretically expected.

Table 10. Logit Model Estimation Results for TR22 Region (Balıkesir-Çanakkale)

Dependent Variable: Housing bubble dummy variable for TR22 Region (Balıkesir-Çanakkale)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	-5,873761	1,181105	-4,973105	**0,0000**
HRINT_TR22	0,267135	0,065054	4,106367	**0,0000**
CPI_TR22	0,423415	0,233861	1,810544	**0,0702**
M2	-0,108034	0,102173	-1,057365	0,2903
McFadden R-squared: 0,267146 **LR statistic:** 20,79160 **Prob. (LR statistic):** 0,000116				

According to the estimation results in Table 10, the probability values of the variables HRINT_TR22 and CPI_TR22 were statistically significant, whereas the probability value of the M2 variable was not statistically significant. In addition, the coefficients of the variables HRINT_TR22 and CPI_TR22 were positive. Accordingly, increases in HRINT_TR22 and CPI_TR22 variables increase the possibility of housing price bubbles for the TR22 Region.

The study allows a comparison with the results obtained for Turkey overall and the TR22 Region. The findings obtained for Turkey overall and the TR22 Region are similar in terms of housing real interest rate and the inflation rate variables. However, while the findings concerning the money supply are statistically significant for Turkey overall, they are not statistically significant for the TR22 Region.

8. CONCLUSION

Price bubbles that can be defined as the part of the movement in asset prices that cannot be explained by economic fundamentals or the deviations in the basic value of an asset can be a leading indicator of financial crises. Significant price bubble events have occurred in the world financial markets since ancient times. Some of these price bubbles also appeared in the housing sector. In this study, the existence of bubbles in the housing sector in Turkey and TR22 Region (Balıkesir-Çanakkale), periods of bubbles and factors affecting bubble formations are investigated. Adopting a growth model based on construction in Turkey in recent years has increased the interest in the housing sector. However, first of all, the economic fundamentals of housing prices were explained in the study. In the second part analysis of the study, the factors affecting the formation of bubbles based on the mentioned bubble periods are investigated. Monthly data from January 2010 to June 2020 are used in this study as the housing price index data of Turkey has been published by the CBRT as of January 2010.

To detect bubbles the SADF test developed by Phillips et al. (2011) and the GSADF test developed by Phillips et al (2015a, 2015b) are used. These tests are bubble tests that take into account the right tailed variations of the standard ADF unit root test. Especially the GSADF test is more successful than the SADF test in detecting multiple bubbles and determining the periods. In the study, the reasons of these bubbles are investigated with the logit model, based on the periods when the housing bubble formation is determined.

According to the SADF and GSADF test results, evidences regarding the existence of price bubbles in the housing price index for both overall Turkey and TR22 Region (Balıkesir-Çanakkale) have been reached. Additionally, the logit model estimation results indicate that increases in housing real interest rate, CPI and M2 money supply also increase the possibility of housing bubbles for overall Turkey. In addition, housing real interest rate and CPI increases also increase the possibility of housing price bubbles for the TR22 Region (Balıkesir-Çanakkale).

According to the results obtained from the study, regulatory authorities such as the BRSA and CBRT should take preventive measures for price stability, financial stability and economic stability. Similar to the bursts in other asset price bubbles, the bursts in the housing bubbles can seriously disrupt the financial system and cause great problems. In addition, the ones who consider investing in the housing sector in Turkey and portfolio managers should take into account the existence of the bubble in housing prices in their investment decisions. According to TSI data, the total share of the construction and real estate sectors in the gross domestic product is

approximately 15% and the total share in employment rates is approximately 8%. Therefore, when these rates are considered, any instability in the housing market will unquestionably have a significant impact on Turkey's economy.

There are important limitations in terms of data set in the study. Although the housing price index data are published monthly, some important variables such as income, per capita income, population, marital status, migration, Turkey real estate sector confidence index and price expectations index that are thought to affect the housing price index are not published monthly. For this reason, variables that were incompatible with the frequency period of housing price indices could not included in the study. In addition, the housing rent index variable could not be included in the analysis since it is published not by region but by province and overall Turkey.

In future studies, it will be possible to investigate the existence of housing bubbles by using real house prices for the analyzed countries or regions, disregarding the effect of inflation. In addition, if data are available, more extensive research can be conducted on the factors affecting housing bubbles.

REFERENCES

Afşar, A. and Doğan, E. (2018). Analyzing Asset of Bubbles in the Housing Market with Right-Tailed Unit Root Tests: The Case of Turkey. Journal of Business Economics and Finance, 7(2), 139-147.

Akkaya, M. (2018). Türk Bankacılık Sektörü Yurtiçi Kredi Hacminde Balon Oluşumunu Etkileyen Faktörlerin Analizi. Yönetim ve Ekonomi Araştırmaları Dergisi, 16(2), 58-70.

Ambrose, B. W., Eichholtz, P. and Lindenthal, T. (2013). House Prices and Fundamentals: 355 Years of Evidence. Journal of Money, Credit and Banking, 45(2–3), 477-491.

Asteriou, D. and Hall, S. G. (2016). Applied Econometrics (Third Edition). London: Palgrave Macmillan.

Atasever, G. (2016). Varlık Fiyatları Köpüğü: Muğla Konut Piyasası Üzerine Bir Değerlendirme. Akdeniz Üniversitesi İİBF Dergisi, 16(34), 1-17.

Barlevy, G. (2007). Economic Theory and Asset Bubbles. Economic Perspectives, Federal Reserve Bank of Chicago, 44-59.

Biggs, B. (2006). Hedge Hogging. New Jersey: John Wiley & Sons.

Black, A., Fraser, P. and Hoesli, M. (2006). House Prices, Fundamentals and Bubbles. Journal of Business Finance & Accounting, 33(9), 1535-1555

Çağlı, E. Ç. and Evrim Mandacı, P. (2017). Borsa İstanbul'da Rasyonel Balon Varlığı: Sektör Endeksleri Üzerine Bir Analiz. Finans Politik & Ekonomik Yorumlar Dergisi, 54(629), 63-76.

Çağlı, E. Ç. (2019). Explosive Behavior in the Real Estate Market of Turkey. Borsa İstanbul Review, 19(3), 258-263.

Çankaya, S. (2013). Konut Fiyatları ve Makroekonomik Faktörler Arası İlişkiye Global Bakış. Maliye Finans Yazıları, 27(100), 143-154.

Case, K. E. and Shiller, R. J. (2003). Is There a Bubble in the Housing Market? Brookings Papers on Economic Activity, 2, 299-342.

Caspi, I. (2016). Testing for A Housing Bubble at the National and Regional Level: The Case of Israel. Federal Reserve Bank of Dallas, Working Paper No. 246.

Coşkun, Y. (2016). Konut Fiyatları ve Yatırımı: Türkiye İçin Bir Analiz. Niğde Üniversitesi İİBF Dergisi, 9(2), 201-217.

Coşkun, Y. and Jadevicious, A. (2017). Is there a Housing Bubble in Turkey? Real Estate Management and Valuation, 25(1), 48-73.

Coşkun, Y., Seven, Ü., Ertuğrul, H. M. and Alp, A. (2017). Housing Price Dynamics and Bubble Risk: The Case of Turkey. Housing Studies, 35(1), 1-37.

Darıcı, B. (2018). Para Politikası ve Konut Fiyatları İlişkisi: Türkiye Ekonomisi için Ampirik Bir Analiz. Journal of Social Sciences of Mus Alparslan University, Special Issue on International Conference on Empirical Economics and Social Science (ICEESS' 18), 221-228.

Diba, B. T. and Grossman, H. I. (1988). Explosive Rational Bubbles in Stock Prices? American Economic Review, 78(3), 520–530.

Eğilmez, M. (2017). Konut ve Balon Meselesinin Analizi. Retrieved July 20, 2020, from http://www.mahfiegilmez.com/2017/05/konut-ve-balon-meselesi.html.

Erol, I. and Ünal, U. (2015). Role of Construction Sector in Economic Growth: New Evidence from Turkey. Munich Personal RePEc Archive, Paper No. 68263.

Evrim Mandacı, P. E. and Çağlı, E. Ç. (2018). Türkiye Konut Piyasasında Balon Var Mı? İstatistiki Bölge Birimleri Üzerine Bir Analiz. Finans Politik & Ekonomik Yorumlar Dergisi, 55(646), 85-113.

Froot, K. and Obstfeld, M. (1991) Intrinsic Bubbles: The Case of Stock Prices. American Economic Review, 81(5), 1189-1214.

Gökçe, A. and Güler, İ. (2020). Sağ-Yönlü ADF Sınamaları ile Ankara İlinde Konut Balonu Araştırması. Ankara Hacı Bayram Veli Üniversitesi İİBF Dergisi, Özel Sayı, 94-116.

Gujarati, D. (2016). Örneklerle Ekonometri (Translated by N. Bolatoğlu). Ankara: BB101 Yayınları.

Gürkaynak, R. S. (2008). Econometric Tests of Asset Price Bubbles: Taking Stock. Journal of Economic Surveys, 22(1), 166–186.

Halicioglu, F. (2005). The Demand for New Housing in Turkey: An Application of ARDL Model. 2005 Business and Economics Society International Conference, July 22-25 2005, Grand Canyon, Arizona, USA.

Himmelberg, C., Mayer, C. and Sinai, T. (2005). Assessing High House Prices: Bubbles, Fundamentals and Misperceptions. Journal of Economic Perspectives, 19(4), 67-92.

Hlaváček, M. and Komárek, L. (2009). Housing Price Bubbles and their Determinants in the Czech Republic and its Regions. Czech National Bank, Working Paper Series 12.

Homm, U. and Breitung, J. (2012). Testing for Speculative Bubbles in Stock Markets: A Comparison of Alternative Methods. Journal of Financial Econometrics, 10(1), 198-231.

İskenderoğlu, Ö. and Akdağ, S. (2019). Türkiye'de Reel Konut Fiyatlarında Balonların Varlığı Üzerine Uygulamalı Bir Analiz. Business and Economics Research Journal, 10(5), 1085-1093.

Kansu, A. (2017). Konut Balonundan Finansal Krize: ABD Mortgage Krizi. Ankara: Astana Yayınları.

Karadaş, H. A. ve Salihoğlu, E. (2020). Seçili Makroekonomik Değişkenlerin Konut Fiyatlarına Etkisi: Türkiye Örneği. Ekonomik ve Sosyal Araştırmalar Dergisi, 16(1), 63-80.

Karasu, M. A. (2019). İnşaata Dayalı Büyüme Ekseninde Türkiye'de Konut Sorunu. in Kırsal Kalkınma ve Kooperatifçilik (Editors: A. Mengi and D. İşçioğlu). Ankara Üniversitesi Yayınları No: 658, A. Ü. Siyasal Bilgiler Fakültesi Yayınları No: 62, pp. 669-693.

Kaya, A. (2012). Türkiye'de Konut Fiyatlarını Etkileyen Faktörlerin Hedonik Fiyat Modeli İle Belirlenmesi. TCMB Uzmanlık Yeterlilik Tezi.

Kilian, L. (2009). Not All Oil Price Shocks Are Alike: Disentangling Demand and Supply Shocks in the Crude Oil Market. American Economic Review, 99(3), 1053–1069.

Kolcu, F. and Yamak, N. (2018). Gelir ve Faiz Oranlarının Konut Fiyatları Üzerindeki Kısa ve Uzun Dönem Etkileri. International Journal of Economic and Administrative Studies, Prof. Dr. Harun Terzi Özel Sayısı, 141-152.

Korkmaz, Ö. (2019). Detecting Housing Price Bubbles Using Panel Unit Roots Tests. In Selected Topics in Applied Econometrics (Editors: E. Ç. Akay and Ö. Korkmaz). Berlin: Peter Lang GmbH, pp. 87-115.

Korkmaz, Ö. (2020). The Relationship between Housing Prices and Inflation Rate in Turkey: Evidence from Panel Konya Causality Test. International Journal of Housing Markets and Analysis, 13(3), 427-452.

Korkmaz, Ö., Erer, E. and Erer, D. (2016). The Factors Affecting Credit Bubbles: The Case of Turkey. Financial Studies, 20(1), 37-51.

Lebe, F. and Akbaş, Y. E. (2014). Türkiye'nin Konut Talebinin Analizi: 1970-2011. Atatürk Üniversitesi İktisadi ve İdari Bilimler Dergisi, 28(1), 57-83.

LeRoy, S. F. and Porter, R. D. (1981). The Present-Value Relation: Tests Based on Implied Variance Bounds. Econometrica, 49(3), 555–574.

Malkiel, B. G. (2018). Borsada Rastgele Seyir (Translated by A. Perşembe). İstanbul: Scala Yayıncılık.

Miao, J. (2014). Introduction to Economic Theory of Bubbles. Journal of Mathematical Economics, 53, 130-136.

Mishkin, F. S. and Eakins, S. G. (2018). Financial Markets and Institutions. United Kingdom: Pearson Education Limited.

Özatay, F. (2015). Parasal İktisat: Kuram ve Politika. Ankara: Efil Yayınevi.

Öztürk, N. and Fitöz, E. (2009). Türkiye'de Konut Piyasasının Belirleyicileri: Ampirik Bir Uygulama. ZKÜ Sosyal Bilimler Dergisi, 5(10), 21-46.

Painter, G. and Redfearn, C. L. (2002), The Role of Interest Rates in Influencing Long-Run Homeownership Rates. Journal of Real Estate Finance and Economics, 25(2-3), 243-267.

Pavlidis, E., Yusupova, A., Paya, I., Peel, D., Martinez-Garcia, E., Mack, A. and Grossman, V. (2016). Episodes of Exuberance in Housing Markets. The Journal of Real Estate Finance and Economics, 53(4), 419-449.

Phillips, P. C. B., Shi, S. and Yu, J. (2015a). Testing for Multiple Bubbles: Historical Episode of Exuberance and Collapse in the S&P 500. International Economic Review, 56(4), 1043-1077.

Phillips, P. C. B., Shi, S. and Yu, J. (2015b). Testing for Multiple Bubbles: Limit Theory of Real-Time Detectors. International Economic Review, 56(4), 1079-1133.

Phillips, P. C. B., Wu, Y. and Yu, J. (2011). Explosive Behavior in the 1990s Nasdaq: When Did Exuberance Escalate Asset Values? International Economic Review, 52(1), 201-226.

Shi, S. (2017). Speculative Bubbles or Market Fundamentals? An Investigation of US Regional Housing Markets. Economic Modelling, 66, 101-111.

Shiller, R. J. (1981). Do Stock Prices Move Too Much to be Justified by Subsequent Changes in Dividends? The American Economic Review, 71(3), 421-436.

Tarı, R. (2014). Ekonometri. Kocaeli: Umuttepe Yayınları.

Taşdemir, M. (2013). Konut Piyasası. In Gayrimenkul Ekonomisi (Editors: C. N. Berberoğlu and L. Erdoğan). T.C. Anadolu Üniversitesi Yayını No: 2766, Açıköğretim Fakültesi Yayını No: 1724, pp. 104-131.

Türkiye Katılım Bankaları Birliği (2019). Katılım Bankaları 2019. Retrieved September 29, 2020, from https://www.tkbb.org.tr/Documents/Yonetmelikler/Katilim-Bankalari-2019.pdf.

Uysal, D. and Yiğit, M. (2016). Türkiye'de Konut Talebinin Belirleyicileri (1970-2015): Ampirik Bir Çalışma. Selçuk Üniversitesi Sosyal Bilimler Meslek Yüksekokulu Dergisi, 19(1), 185-209.

West, K. D. (1987). A Specification Test for Speculative Bubbles. The Quarterly Journal of Economics, 102(3), 553-580.

Zeren, F. and Ergüzel, O. Ş. (2015). Testing For Bubbles in the Housing Market: Further Evidence from Turkey. Financial Studies, 19(1), 40-52.

Zivot, E. and Andrews, D. W. K. (1992). Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit Root Hypothesis. Journal of Business & Economic Statistics, 10(3), 251-270.

www.bddk.org.tr

www.dallasfed.org

www.reidin.com.en

www.tcmb.gov.tr

www.tuik.gov.tr

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