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Asymmetries across regional housing markets in Turkey

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ABSTRACT

In the literature on real estate prices, two main groups of determinants are primarily considered; *speculative* and *fundamental variables*. Empirical literature in the areas has, however, several shortcomings. First, although existing studies have analysed the role played by speculative factors, none of the studies, have measured precisely the relative importance of speculative and fundamental variables. We aim at doing this. Moreover, the literature has measured the speculation only by analysing backward-looking behavior. We improve this analysis by considering also forward-looking expectations. Second, in terms of cross-regional determinants, the literature has largely considered economic and demographic variables whereas geographical and cultural variables have been ignored. We intend to incorporate them. Hence, aim of this paper is to understand the dynamics behind the housing prices in 26 Turkish regions between 2010:1–2016:9. We employ range of econometric methods such as Vector-Autoregressions, Unit Root Analysis, Cholesky Forecast Error Variance Decompositions, Impulse-Response Functions, Panel Regressions, Lagrange Multiplier Spatial Dependence Tests and Granger Causality Tests. As an outcome, three results emerge. First, housing price appreciations are so heterogeneous across regions. Second, role of speculative behaviour is quite significant. Third, regions which have high urbanization, population, crime rate, trade openness, seaside and cultural density experience faster housing appreciations.

1. Introduction

The literature on determinants of regional housing prices goes back to 1940s. Over the decades, a number of studies have tried to understand why some regions in a country experience faster increase in housing prices. Primarily, two main groups of determinants are put forward which are *fundamental* and *speculative* factors (Himmelberg et al., 2005; Mallick & Mahalik, 2015).[1]

Fundamental determinants represent the changes in housing prices due to *demand-side* and *supply-side* variables.

On the one hand, regional housing demand is affected both by aggregate variables (i.e. changes in mortgage interest rates, credit availability, money supply) and region specific variables such as income level of regions, wealth, employment growth, inflation, population, city size, net migration, household size, life expectancy, urbanization rate and trade openness of regions (Abraham & Hendershott, 1996; Apergis & Rezitis, 2003; Baffoe-Bonnie, 1998; Blumenfeld, 1944; Eaton & Eckstein, 1997; Goetzmann & Valaitis, 2006; Hausman & Wise, 1980; Kearl, 1979; Lee, 1963; Mallick & Mahalik, 2015; Mankiw & Weil, 1989; Poterba, 1991; Smith & Tesarek, 1991; Wang et al., 2011; Öztürk & Fitöz, 2009).

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Housing supply, on the other hand, is mostly affected by the changes in interest rate, construction cost, regional inflation rate, land availability, credit volume and financial return of alternative investment options (gold, stock prices etc.) (Chan, 1999; Dipasquale, 1999; Poterba, 1991; Topel & Rosen, 1988).

It has been argued that housing prices can also increase due to *speculative reasons,* such as bubbles (Case & Shiller, 1988, 1989). For instance, once housing prices start increasing in a region, it causes further appreciation in that area. This herding behaviour occurs because individuals prefer more buying the properties in these regions since they expect a higher value increase in the future (Capozza et al., 2002; Levin & Wright, 1997; Mallick & Mahalik, 2015). This behaviour is termed *backward-looking expectation* as individuals decide buying the properties by analysing the former changes in housing prices (Capozza & Seguin, 1996; Capozza et al., 2002).

However, the empirical literature in this area has various shortcomings. First, although existing studies have analysed the role played by speculative factors, none of the studies (to our knowledge) have measured precisely the relative importance of speculative and fundamental variables in percentages. We aim at doing this. Moreover, the literature has measured the speculation only by analysing backward-looking behaviour. We intend to improve this analysis by considering also *forward looking expectations.* We think that this contribution is precious not only for research but also from a policy standpoint. Such that if one understands better the severity of speculative dimension, it is politically easier to assess and cure the risk of possible housing bubbles and thereby triggered financial crisis.

The second shortcoming of the literature is related to the inadequacy of cross-regional determinants used in existing studies. The literature has largely considered economic and demographic variables whereas geographical; climate and cultural variables have largely been ignored. We intend to incorporate them as well and follow a more comprehensive approach.

Hence, aim of this paper is to understand the dynamics of regional housing prices in Turkey. Specifically, our target is twofold. The first one is to estimate and measure the relative (%) importance of fundamental and speculative variables in regional housing appreciation. The second one is to analyse comprehensively the reasons for cross-regional variation in housing price increases.

In terms of methodology, we adopt a panel dataset which covers 26 Turkish NUTS-2 regions and a period between the periods of 2010:1–2016:9. We employ a wide range of time series and panel data methodologies such as VAR (Vector Auto-regressions), Unit Root Analysis, Cholesky Forecast Error Variance Decompositions, Impulse-Response Functions, Fixed Effect Panel Regressions, Kernel Distributions, Lagrange Multiplier Spatial Dependence Tests and Granger Causality Tests.

With regard to paper's structure, in the second part, we summarize the theoretical and empirical literature in this field. In part 3, we start our empirical analysis by providing descriptive statistics on housing prices in Turkey (in part 3.1). In part 3.2, we pursue a time series and panel VAR analysis and analyse in this way the impact of aggregate macroeconomic variables on regional housing prices. In part 3.3, we implement a fixed effect panel regression to analyse the cross-regional determinants of housing prices. In part 3.4, we perform a robustness analysis to check the validity of our results. Finally, in section 4, conclusion part takes place.

2. Literature review

The asymmetries across housing markets, the extend of the asymmetries and underlying reasons have been discussed in various empirical and theoretical studies. (see for some examples, McDonald, 2020; Lee & Choi, 2011; Tommaso et al., 2019; Bahmani-Oskooee & Ghodsi, 2018; Larraz-Iribas et al., 2008).

To provide a brief overview of these examples, Larraz-Iribas et al. (2008) have analysed the asymmetries across Spanish regional housing markets. They found some co-integrating relationships among the groups of regions. These relationships are mostly driven by physical proximity and economic similarities. McDonald (2020) has analysed the asymmetries in housing market (in the Northeastern U.S) between 1970 and 2010 and found that in centres occupancy rate is related to population change and housing stock. However, in the suburbs, there are far lower movements in housing markets. Tommaso et al. (2019) have investigated the drivers of convergence to long-run equilibrium in housing markets across the pairs of Bejing's districts between 2006:1–2014:12. They found that convergence across pairs of districts tend to become less likely with high differentials in income as well as in demographic and supply-side variables. Bahmani-Oskooee and Ghodsi (2018) have analysed the relationship between stock and house prices for US states and found quite asymmetric relationships. While in some of the states, an impact from stock prices to house prices is evident while in others vice versa is true.

A detailed literature discussion on the asymmetric impact of fundamental and speculative variables on house prices are provided in the next sections.

2.1. Fundamental determinants

2.1.1. Demand-side variables

Mortgage interest rate (Aggregate variable): Long-run interest rate has an inverse impact on real estate demand. High mortgage rate increases the cost of financing the property, hence, lowers the demand (Baffoe-Bonnie, 1998). Furthermore, high interest rate increases the return of risk-free investment. Thus, households prefer investing in more bonds and bank deposits rather than real estate products.

On empirical grounds, the inverse relationship between mortgage rates and housing prices is confirmed by many existing studies (Adams & Füss, 2010). These studies used mainly time series techniques (such as VAR, Impulse-Responses and Co-integration analysis) to measure such an impact. Some examples are Baffoe-Bonnie (1998) who focused on 4 big regions in US for a period between the period of 1973–1994 and Apergis and Rezitis (2003) who analysed Greek housing market for a period between the periods of 1981–1999. Both studies have reached to a similar result that change in interest rate accounts for about 35–40% of the changes in housing prices which represents a quite important impact.

Money supply and credit availability (Aggregate variable): An increase in money supply is argued to induce the housing prices. When

money supply is raised by the Central Bank, an excess supply occurs in money market which causes interest rates to decline (Baffoe-Bonnie, 1998). Therefore, the cost of financing the real estate lowers. Hence, the demand for properties increases.

This proposition has been investigated by several papers. Baffoe-Bonnie (1998) has found, for instance, that only 2–14% of the changes in US housing prices are due to changes in money supply. A similar finding is reported by Apergis and Rezitis (2003) that in Greek housing market only a small fraction (1–7%) of housing prices changes is attributed to money supply. Consistent with these studies, Öztürk and Fitöz (2009) have found insignificant effect of money supply on housing demand.

Income and economic variables (Region-specific variable): One of the most often emphasized variables is the income level of regions. The claim is that a rise in regional income directly creates an additional demand for properties. Hence, real estate prices tend to increase (Hausman & Wise, 1980; Hendershott & Thibodaux, 1990; Ozanne & Thibodeau, 1983). Moreover, when income level increases, the rate of marriages increase as well, which cause more demand for housing (Blumenfeld, 1944; Kartman, 1972).

Empirically, the impact of income has been tested in a number studies. Majority of the studies have found positive and significant effect. For instance, La Paz(2000) who analysed this issue for 71 Spanish provinces between 1987 and 1999, Wang et al. (2011) for 35 Chinese cities between 1998 and 2006 and Jud and Winkler (2002) for 130 Metropolitan Statistical Areas (MSA) in US between 1984 and 1998 have found positive and significant impact of income on housing prices. In contrast, Mallick and Mahalik (2015) have found insignificant effect in their analysis on Indian cities for a period 2010–2013.

Employment growth, unemployment and labor participation rate are other critical variables. As the more jobs available and people are more occupied, the more opportunities they will have for housing affordability (Hyclak & Johnes, 1999). Hence, it will create more demand for housing.

Regional inflation rate (Region-specific variable): Two different views exist on the impact of inflation. The first one claims that inflation has a decreasing effect on house prices. When expected inflation is high, mortgage rate also increases in the money market, which lowers the demand for properties (Baffoe-Bonnie, 1998; Kearl, 1979). Moreover, inflation reduces the purchasing power of individuals which decreases households' incentives to buy properties under high inflation, nominal mortgage payments become more expensive which prevents households from buying the properties more (Kearl, 1979; Öztürk & Fitöz, 2009).

An opposite view argues that under inflation, people perceive real estate as a safe investment tool which causes a rise in demand for properties (Goetzmann & Valaitis, 2006).

Empirically, there are mixed results in the literature. While, Mallick and Mahalik (2015) have found supporting evidence for the first view, Öztürk and Fitöz (2009) and Apergis and Rezitis (2003) have found supporting evidence for the second view.

Demographic variables (Region-specific variable): Demographic characteristics of the regions are critical for housing demand and prices. To start with, population is one of the most crucial determinants. It is argued that in highly populated metropolitan cities housing demand and prices grow faster as there is a superior quality of life, diverse set of consumption goods, well established infrastructure and facilities (Eaton & Eckstein, 1997; Ermisch, 1990; Mankiw & Weil, 1989; Paz, 2000).

There are some other variables related to age and household structure of the region. Younger age profile, for instance, is supposed to induce housing demand as these people are more willing to demand housing for both consumption and investment purposes (Galati et al., 2011). Small household size, marriage rates and life expectancy are the other important determinants that indicate the extent to which individuals need housing (Li, 2013; Martin, 1966).

Quality of education, education level (bachelor rate) and density of students in the region are the variables related to human capital. The increase in the level and quality of education is likely to make the region more attractive for housing and, thus, the prices should increase faster (Eaton & Eckstein, 1997).

Urbanization (Region-specific variable): This group of variable has been less emphasized in the literature. Urbanization has often been considered as a factor that accelerates the housing values. Population density, net immigration, vehicle density and urbanization rate are the important variables which are considered to induce housing demand (Gök & Keçeli, 2015; Martin, 1966; Öztürk & Fitöz, 2009).

Economic openness (Region-specific variable): Trade and financial openness of the cities are argued to increase the housing demand and prices. This proposition has been discussed in detail by Wang et al. (2011). In their study, they emphasize two main channels through which openness can affect the housing prices. The first one is the quality of life channel according to which "open" cities have greater amenities in consumption and product diversity, hence, a superior quality of life (Roback, 1982). Thus, the demand for properties is higher in these places. The second one is called Balassa (1964) and Samuelson (1964) effect. The rationale behind this effect is that trade openness brings higher productivity in tradable goods sector that rises the wages in both tradable and non-tradable sectors. Increases in wages imply higher affordability and demand for real estate products. Hence, property prices tend to increase.

In their study on 35 Chinese cities between the periods of 1998–2006, Wang et al. (2011) have reported a positive and significant impact of trade openness on regional housing prices.

2.2. Supply-side variables

Land supply (Region-specific variable): The availability of land within the region automatically affects the housing supply (Dipasquale, 1999). Within the cities which large sites for construction are available, housing supply is expected to be higher. Thus, lower increase in housing price is expected. In other words, the cities which have intensively protected zones are likely to have less housing supply and higher prices.

Construction costs and inflation (Region-specific variable): It is one of the mostly cited supply-side variables which are considered to have an inductive effect on housing prices. As the cost of raw materials and price of intermediate goods increase, it becomes more costly and less profitable to invest in new construction projects (Potepan, 1996). Hence, housing supply tends to lower which causes prices to increase.

This has been tested empirically and confirmed by Adams and Füss (2010)'s study on 15 countries for a period between 1975 and 2007 and by Jud and Winkler (2002)'s study on 130 MSAs in US between the periods of 1984–1998. Construction costs are best measured by Production Price Index (PPI) inflation.

Interest rate (Aggregate variable): Changes in interest rate might affect the housing prices through the supply channel. High interest rates increase the cost of financing the construction projects which prevents companies from starting new projects. These lower the housing supply and increase the property prices (Topel & Rosen, 1988).

Similarly, money supply and credit availability can be argued as other important supply-side variables. They indicate the fact that, during the periods of tight monetary policy, credit availability falls sharply. This forces small firms to invest less as they can hardly finance their construction projects. Hence, property prices tend to increase as new housing construction becomes limited (Chan, 1999).

2.3. Speculative determinants

In recent years, a growing strand of researchers has emphasized the role played by speculative factors in housing markets (Levin & Wright, 1997; Mallick & Mahalik, 2015). The best example of this was experienced in 2008–2009 global financial crises when an unsustainable growth of sub-prime lending and credits created an artificial housing price bubble in US which, in turn, caused a worldwide economic recession.

There are various researchers belong to this stream who defends the significant role of speculative decisions on housing markets (Clark & Coggin, 2011). The proponents claim that once housing prices start increasing in an area, this will further (cumulatively) appreciate the prices. Individuals will intensively prefer buying the properties in these places since they expect a higher increase in values. This behaviour relies on backward-looking expectations as people analyses the past values of the properties (Capozza & Seguin, 1996; Case & Shiller, 1989). Mathematically, this behaviour can be expressed in a following way;

$HPI_t = f(HPI_{t-1}, HPI_{t-2}, \ldots HPI_{t-n})$ where *HPI* represents the housing prices in a region. According to the expression, housing prices is a function of its past values.

To test this proposition, empirical studies have adopted autoregressive time series regressions. Mallick and Mahalik (2015) have found a quite significant speculative component in Indian housing market. A similar finding is also reported by Capozza et al. (2002) and Clark and Coggin (2011) for US market.

In short, although speculation variable is quite severe, a very limited attention has been paid to this issue as mentioned also in the introduction part.

2.4. Literature on Turkey

There are a very limited number of studies that address the housing price dynamics at the regional/macro-level in Turkey. This section is devoted to, first, summarizing some examples of the existing research studies in this context and, secondly, to explaining (with graphs) the increasing importance of this sector in Turkish economy.

Öztürk and Fitöz (2009) is one of the most striking studies. They analyse the dynamics of housing prices in Turkey for a period 1968–2006. They analyse the housing demand and supply dynamics separately. As a result of their empirical analysis, income per capita, inflation and credit interest rate are found as significant factors behind the housing demand. In terms of supply factors, income per capita, producer inflation and money supply are found significant.

Gök and Keçeli (2015) have analysed the same issue for 26 Turkish regions in 2014. As an outcome their research, demand variables (such as income per capita and net in migration) are found to be most critical dynamics behind housing prices.

There are other very valuable studies on Turkish real estate market and housing price dynamics. They adopt more micro approaches

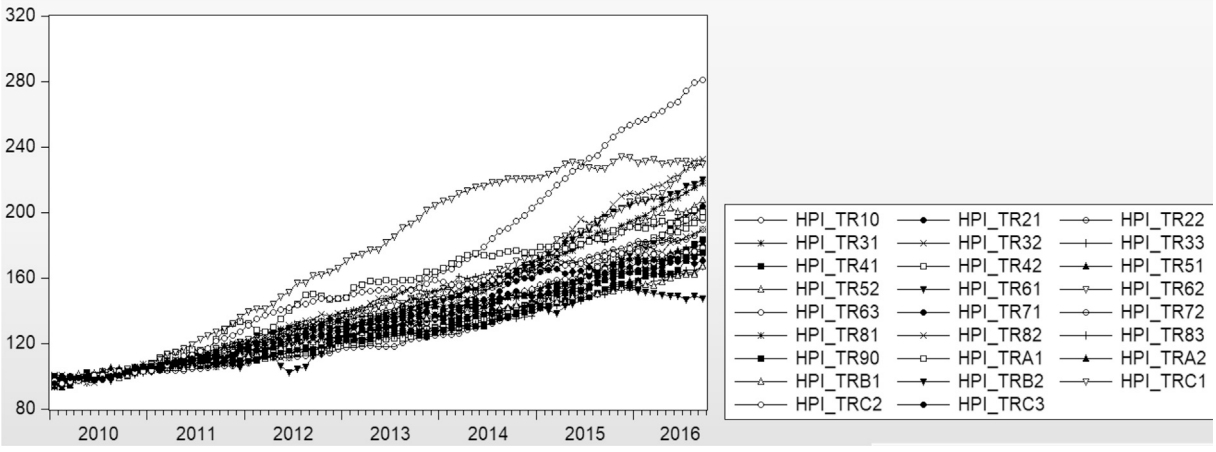

Fig. 1. Evolution of regional housing prices in Turkey, 2010:1–2016:9. Source: CBRT (Central bank of the Republic of Turkey).

at the metropolitan or district level (Ebru & Eban, 2011; Koramaz & Dökmeci, 2012; Ozus, Dökmeci, Kiroğlu, & –Eğdemir, 2007; Selim, 2009; Özsoy & Şahin, 2009).

3. Empirical analysis

3.1. Descriptive statistics

Hereby, we begin our empirical investigation by providing basic descriptive statistics on regional housing markets in Turkey. Initially, we illustrate below (in Fig. 1) the evolution of monthly housing price indexes for 26 regions (assuming 2010 = 100).

It is clearly observed that for all regions it appears a tendency to increase. However, the pace of appreciations is quite mixed and heterogeneous across regions. Such that while some regions reach to an index number of 280 which corresponds to 180% price increase in 6 years, some other regions can only reach to 140 which corresponds to 40% increase in 6 years. Hence, the extent of imbalances in the housing market makes our study area more interesting per se.

Descriptive statistics that summarize the main characteristics of regional housing prices are shown in Table 1. In this table, HPI_ 2011 (%) represents the percentage increase in housing prices between January-2011 and January-2010. Similarly, HPI_2015 (%) denotes the percentage increase between January-2015 and January-2014.

At a glance, we observe that cross regional mean of annual appreciation has increased from 8.3% to 12.4% whereas standard deviation has increased more rapidly (from 3.5% to 6.2%). Skewedness and kurtosis of the distribution have also increased considerably. In none of the years the distributions are found to follow a normal distribution as indicated by Jarque Bera test statistics (Jarque & Bera, 1980).

Moreover, a display of Kernel probability distribution function is shown in Fig. 2. While in 2011 the distribution exhibits a high mode around median values, in 2015 it appears rather a more dispersed distribution with much less probability around the median values.

All these findings point to a common result: housing markets in Turkey show a tendency to become more heterogeneous over time and housing price appreciations across regions tend to diverge from each other.

Finally, the geographical distributions of appreciations are illustrated in a map below (Fig. 3). Specifically, it shows average annual percentage increase during the 2011–2015 periods. The dark red colour represents the most rapidly appreciating regions whereas light pink coloured regions are the ones which exhibit slowest appreciation.

The regions that we analyse are the Nuts-2 level regions. They are seen as statistical and socio-economic regions with quite different characteristics. To speak briefly about their economic structure, regions placed around North-western Istanbul port (TR21, TR41, TR33, TR42), around Western Izmir port (TR31, TR33) and around Southern Iskenderun Port (TR63, TR72) represents several manufacturing belts. Big metropolitan areas (Istanbul (TR10), Ankara (TR51), Izmir(TR10), TRC2 (Diyarbakir-Şanlıurfa) are characterized with services sector and trade. The capital city Ankara has an intense Public sector. Southern Mediterranean/Aegean coastal regions (TR32, TR61, TR62) represents the tourism belt. Northern part, Black Sea coast is generally an agriculture zone (TR90). The remaining regions are mostly characterized by agriculture trade and mixture of these sectors (TRA1, TRA2, TRB1, TRB2; TR22, TR52, TR71, TR81, TR82, TR83, TRC2, TRC3). Western regions are known to be more developed and prosperous compared to the Eastern ones.

Two main features seem to exist from the map about the geographical distribution of house price appreciations. First, house prices in South Western, Aegean and Mediterranean coastal regions (such as TR31, TR32, TR61, TR62) display a very rapid appreciation. This makes us consider the importance of climate, natural amenities and cultural determinants which are the variables largely ignored by the existing literature. Intensity of trade and tourism related activities might trigger the demand for houses by foreigners as another cause of high increase. Second, industrial belt of Turkey seems to display a very quick appreciation (such as Istanbul (TR10) and Kocaeli (TR42) or TR62, TR63). Third, Northeast coast and Eastern part of Turkey seem to have modest appreciations, possibly, due to a lack of demand for houses driven by migration from these areas to developed Western parts.

Overall, we understood from this explanatory analysis that our study place is a complicated one since it contains large regional asymmetries and it needs more formal examination of the determinants.

3.2. Current state of real estate sector in Turkey

Real estate is really a crucial sector in Turkey, however, a limited attention has been paid to the analysis of this market. It deserves more words on its characteristics and importance. It is a sector that has been getting even more important over time. To illustrate this, it is useful to compare the evolution of house prices in Turkey with the corresponding evolutions in OECD countries and Euro Area.

Table 1
Descriptive statistics on regional housing price increases in Turkey, Source: Own calculation.

Measure	HPI_ 2011 (%)	HPI_2015 (%)
Mean	8,31	12,46
SD	3,52	6,28
SD/Mean	0,42	0,50
Skewness	0,45	0,57
Kurtosis	1,94	2,35
Jarque-Bera	2,10	1,86
Jarque-Bera (Probability)	0,35	0,40

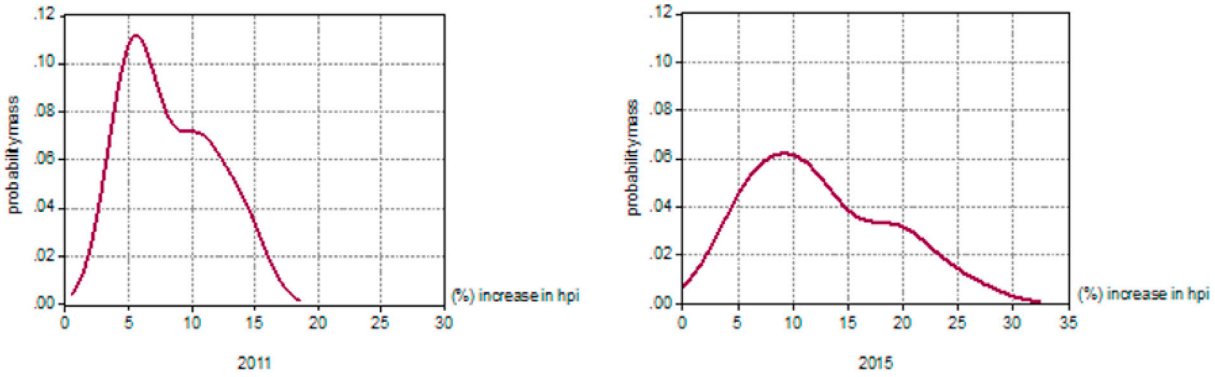

Fig. 2. Kernel Probability Distribution of regional housing price increases (%). Source: Own Estimation.

Therefore, Fig. 4 displays such a graph from 2010 to 2015. While the housing price index declines for Euro Area and increases very slightly for OECD countries, it has been rising quite rapidly in Turkey, almost at a rate of 40% in 5 years. One reason why such a particular increase is observed is the fact that real estate is seen as a profitable investment in Turkey which rises the demand for houses and, hence, prices.

In order to understand better the significance of real estate sector, we focus on 2 more indicators (1) share of real estate sector in GDP (Gross Domestic Product), (2) share of real estate sector in employment.[2] Fig. 5 illustrates the first one according to which the share of construction sector tend to rise in recent years. While it is only 12% in 1998, it reaches to 18% in 2015. Hence, we can argue that roughly about 1/5 of the economic activities in Turkey is related to the real estate market. These activities include construction and real estate agency services. Moreover, any increase in production and income in real estate sector stimulates banking and manufacturing industry as well. Secondly, Fig. 6 indicates also an increasing importance of this sector. Such that while the employment share is 5.5% in 2005; it rises up to about 7.2% in 2010 and, after this period, it ranges between 7.2% and 7.4%.

Finally, significance of the housing sector in total household expenditures is also a useful indicator. Hence, we show below in Fig. 7 the evolution of the share of housing or rent expenditures of households in their total expenditure. It seems that while housing/rent expenditures are about 28% in 2003, it becomes 26% in 2015 which represents a significant share in household expenditures.

Overall, it has been understood that real estate sector has an important share in Turkish economy not only for construction but also other related sectors (services, manufacturing, banking).

3.3. Macroeconomic determinants of regional housing prices: Time series analysis

In order to understand the importance of the role played by speculative and fundamental variables, we pursue a time series (VAR) analysis on the regional housing market by controlling also the impact of macroeconomic determinants on the regional housing prices. We use monthly data in current part.

In terms of adopted variables, we use 2 regional variables (each for 26 regions) and 6 aggregate variables. The definition of variables is summarized in the table below.

All our variables are seasonally adjusted by using the multiplicative ratio to moving average technique.[3] An initial step in our analysis is to understand the time series properties of our variables. To do so, we implement a unit root analysis by applying an Augmented Dickey Fuller test the series (Dickey & Fuller, 1979). It appeared that almost all our series follow a non-stationary process since the ADF statistics is not significant. Only consumer confidence and construction permissions variables are found to be stationary. Hence, in order to proceed with our analysis, we calculate the percentage increase in series (at the annual rate) from 2011:1–2016:9 and make our series stationary in this way. The results of the ADF test is available upon request and we do not report it here to save space.

In order to estimate the effect of speculative and fundamental variables, we employ a Panel Vector Auto-regression model (PVAR) in equation (1) (Holtz-Eakin et al., 1988). It covers a dataset that includes 26 regions and 68 months (from 2011:1 to 2016:9). In total, there are 26 × 68 (1768) observations.

$$x_{i,t} = c + \sum_{j=1}^{J} A_j x_{i,t-j} + \vartheta_{i,t}$$

$$x_{i,t} = \left\{ \Delta cci_t, \Delta emp_t, \Delta cpi_{i,t}, \Delta conscost_t, \Delta m2_t, \Delta int_t, \Delta hpi_{i,t} \right\} \quad (1)$$

where i represents the regions, t denotes months and x represents a set of endogenous variables which are already defined in Table 2. All

[2] Real estate sector is composed of construction activities and real estate services.

[3] The empirical analyses are implemented in Eviews and R softwares ("SPLM" (Millo & Piras, 2012) and SPDEP packages (Bivand et al., 2019)).

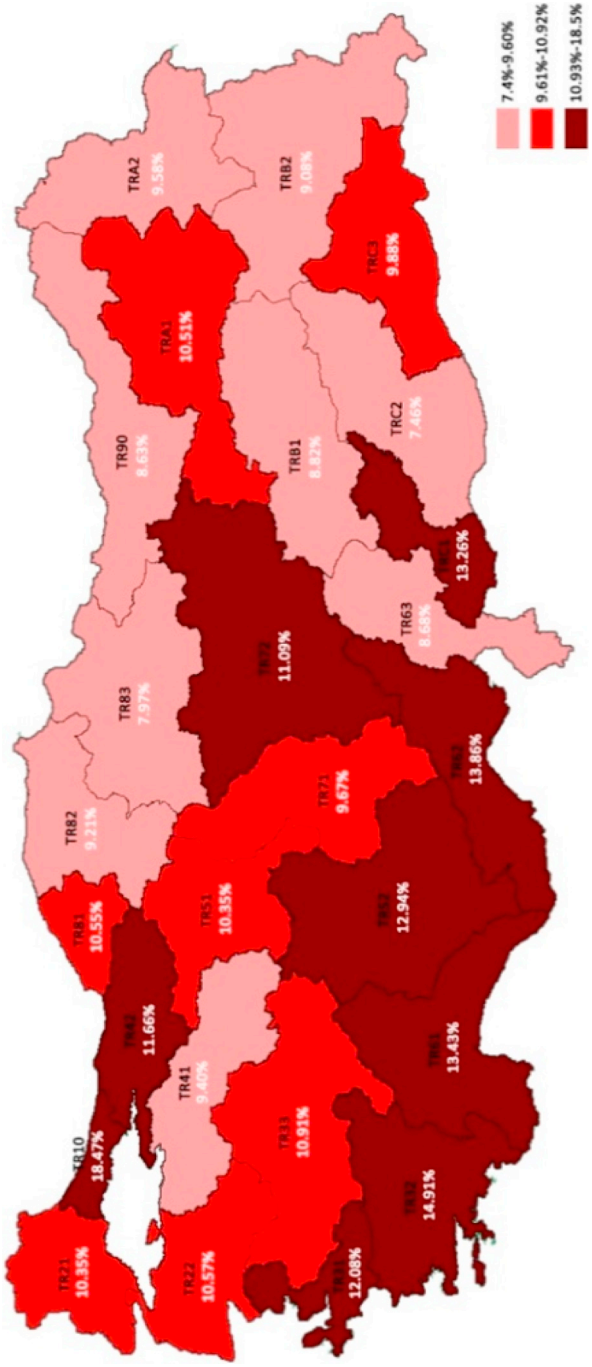

Fig. 3. Geographical distribution of housing prices. Source: Central bank of Turkish Republic.

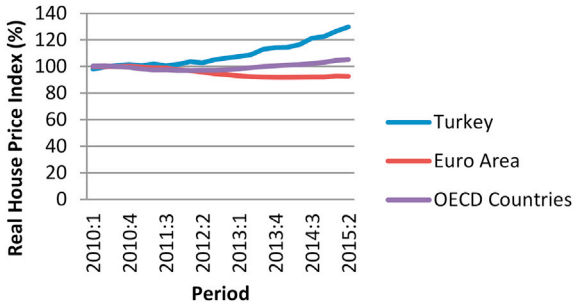

Fig. 4. Real house price index of OECD countries, Turkey and Euro area, Q1, 2010-Q1, 2015, Source: OECD analytical house price database (OECD, 2017).

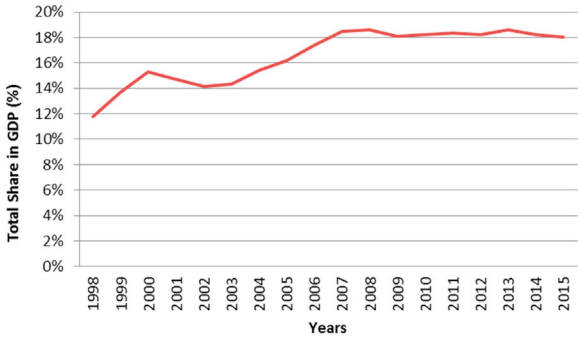

Fig. 5. Total share of real estate sector in GDP, 1998–2015, Source: (Turkey statistical institution) TURKSTAT.

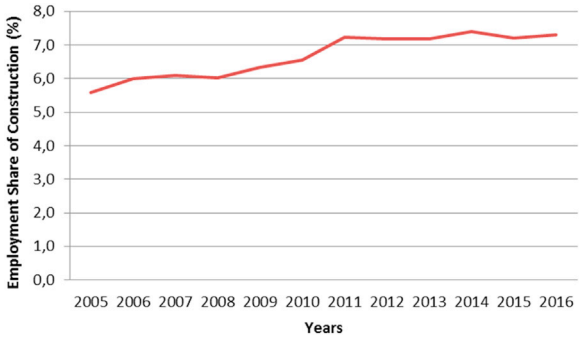

Fig. 6. Employment share of real estate sector, 2005–2016, Source:TURKSTAT.

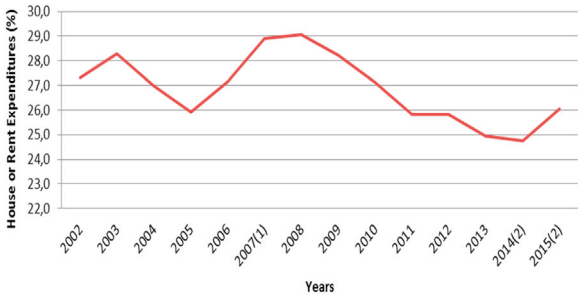

Fig. 7. Share of house or rent expenditures in household consumption, 2002–2015 Source: TURKSTAT.

aggregate and region specific variables are used in a form of percentage change (at the annual rate) in order to ensure the stationary property. The lag length has been determined by using a Schwarz (1978) criterion.

The first result obtained from the estimation is related to Cholesky Forecast Error Variance Decomposition of housing price indexes (Lütkepohl, 2007). It specifically shows the percentage of regional housing price movements due to different variables.

The outcome is shown in Fig. 8 from which we note several important results. First, it clearly shows the importance of speculative movements that about 40% of the changes in housing prices are due to the former changes in housing prices *(hpi)*. This variable represents the backward-speculative component. Second, in terms of forward-looking speculation, only about 0–5% of the changes in housing prices is attributed to changes in *cci* (consumer confidence index). Third, among the fundamental variables, the following ones have respectively higher impact on the property price dynamics: construction permissions (17–18%), interest rate (15%), regional consumer price inflation (12%), employment (10%), construction cost (2–3%) and money supply (2–3%).

To be able to provide more insights on how fundamental variables affect the housing prices, we calculate the impulse-response functions for each endogenous variable (Watson, 2001; Lütkepohl, 2008). These functions show how housing prices respond to a change in macro-variable. The results are shown in below graphics (Fig. 9):

As observed, the most influential variable is the construction permissions variable that has a negative impact on the prices as more permissions increase the housing supply that causes prices to decline. Second, an increase in interest rate clearly decreases the housing prices. Third, an acceleration in inflation causes a decline in housing prices since it lowers purchasing power of individuals. The other variables are either weakly or not important in explaining the regional housing prices.

Finally, as a last analysis in current section, we concentrate more on speculative behaivor of regions. We estimate the model in Equation (1) for each (26) region and calculate the forecast error variance decompositions due to backward *(hpi's past values)* and forward speculation variable *(cci)* and summarize the results in the Table 3 below.

At a glance, backward speculation's role ranges between 57% and 3.6% among regions. Forward speculation's role ranges between 1.3% and 22.5% and fundamental variables' role ranges between 27% and 88%. On average, backward speculation accounts for about 30%, forward speculation accounts for about 8% and fundamental variables account for about 62% of the changes in regional housing prices.

As seen in Table 3, in some regions, real estate prices are determined through backward expectations and in some others by forward looking expectations. It is understood from this Table 3 that the regions in which backward looking speculation is dominant mostly concentrate around Istanbul port (TR41, TR22, TR10, TR21 particular ones). They represent the developed, prosperous and industrialized places. The property prices are relatively much higher in these places. Hence, it is plausible to expect big investors to analyse the past values of real estates before purchasing. So, it may be relevant to observe backward looking speculation also due to the fact that real estate prices in these areas appreciates so fast which creates path dependence in backward looking manner. Controversially, forward looking behaviour is more dominant in rural Anatolian regions (TR33, TR52, TRC1, TR62 particular ones). In these regions real estate prices are relatively modest. Hence, the role of speculation is also low and individuals may behave in a forward looking manner as the future earnings are relatively more important for them.

Overall, the lesson we get from this section is that, first, speculation is an unignorably important behaviour in Turkish real estate markets that is approximately responsible for about 38–40% of the housing price movements. Second, interest rate, construction permissions and regional inflation rate are the important fundamental variables which have a detrimental impact on housing price appreciations.

3.4. Regional determinants of housing prices (Cross-sectional analysis)

Our other important aim is to understand the reasons of why some regions experience faster real estate appreciations. Therefore, we devote this section to the implementation of such a cross sectional analysis. To do so, we employ the following panel data regression that

Table 2
The definition of macroeconomic variables.

Variable	Definition	Period	Spatial Units	Source
HPI	Housing Price Index	2010:1–2016:9	For 26 regions	CBRT (Central Bank of The Republic of Turkey)
CPI	Consumer Price Index	2010:1–2016:9	For 26 regions	CBRT (Central Bank of The Republic of Turkey)
CCI	Consumer Confidence Index	2010:1–2016:9	Aggregate Variable	TURKSTAT (Turkish Statistical Institute)
CONSCOST	Building Construction Cost Index	2010:1–2016:9	Aggregate Variable	TURKSTAT (Turkish Statistical Institute)
EMP	Employment	2010:1–2016:9	Aggregate Variable	TURKSTAT (Turkish Statistical Institute)
INT	Weighted Mean of Housing Loans Interest Rate Given by Banks	2010:1–2016:9	Aggregate Variable	CBRT (Central Bank of The Republic of Turkey)
M2	Money Supply (M2)	2010:1–2016:9	Aggregate Variable	CBRT (Central Bank of The Republic of Turkey)
PERMIS	Permissions Given to the Construction of All Buildings (M2)	2010:1–2016:9	Aggregate Variable	TURKSTAT (Turkish Statistical Institute)

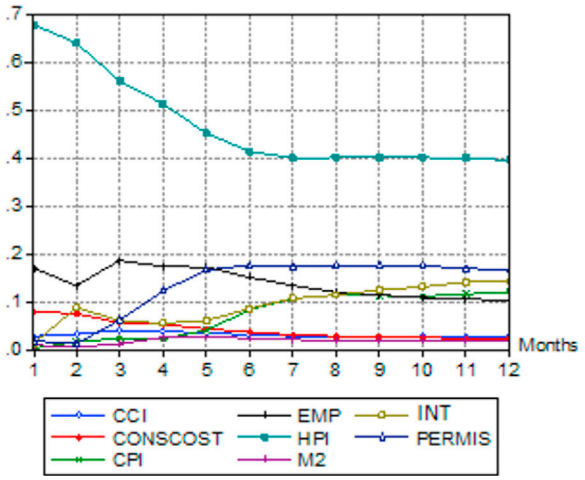

Fig. 8. Cholesky forecast error variance decomposition of regional housing price increases, 12 months horizon, Source: Own Estimation.

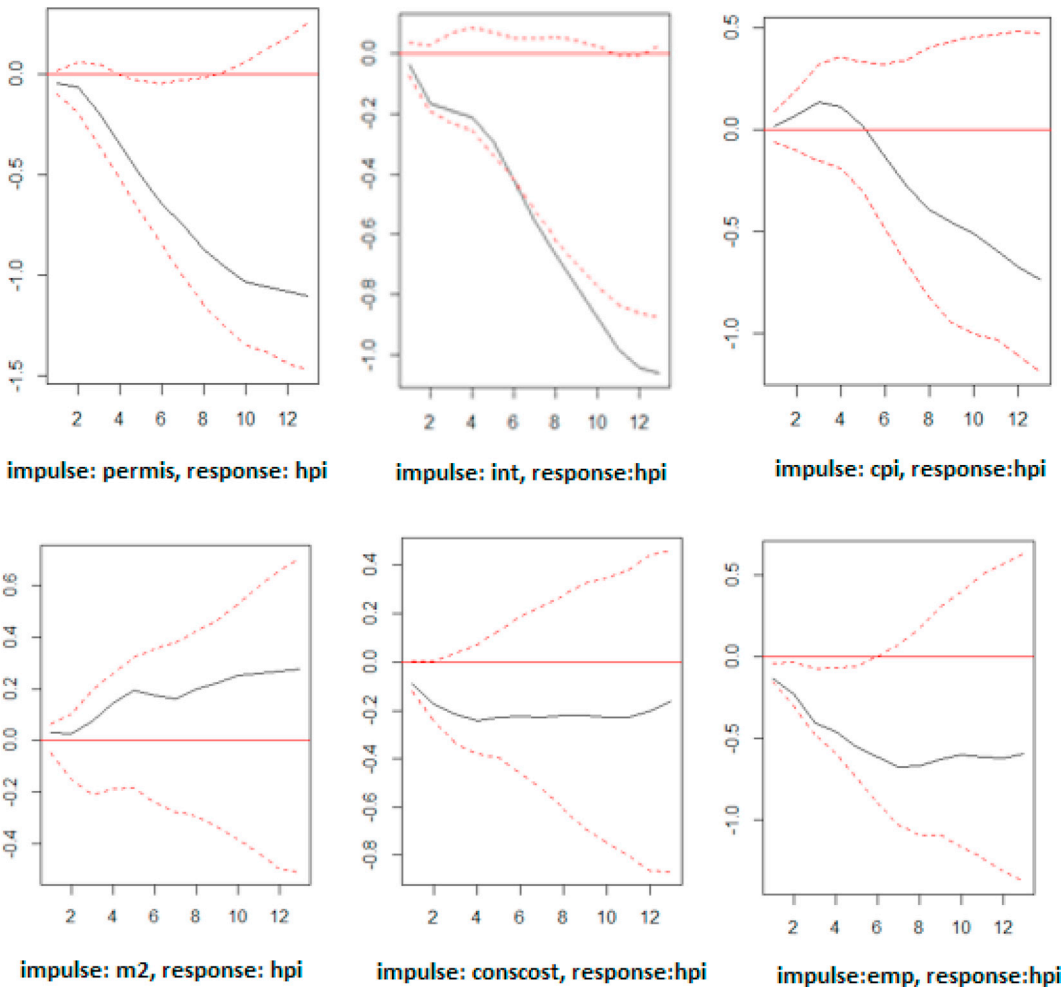

Fig. 9. Impulse-response functions, impulse: macro-economic variables, response: regional housing prices, Source: Own Estimation.

Table 3
Forecast error variance decomposition of housing prices, 12 months horizon, Source: Own calculation.

Regions	Forward-Looking Expectations(CCI)	Backward-Looking Expectations (HPI)	Fundamental Variables
TR10	7,96%	38,23%	53,81%
TR21	3,82%	29,06%	67,11%
TR22	6,64%	39,00%	54,37%
TR31	5,58%	37,73%	56,69%
TR32	5,94%	31,51%	62,55%
TR33	19,06%	21,38%	59,57%
TR41	2,53%	44,64%	52,83%
TR42	4,31%	32,11%	63,58%
TR51	13,48%	3,60%	82,92%
TR52	17,13%	34,77%	48,10%
TR61	1,39%	16,77%	81,84%
TR62	14,50%	12,27%	73,23%
TR63	1,51%	10,23%	88,26%
TR71	3,52%	35,84%	60,64%
TR72	7,07%	43,32%	49,60%
TR81	5,39%	51,00%	43,62%
TR82	5,39%	43,42%	51,19%
TR83	6,70%	24,84%	68,46%
TR90	5,42%	26,13%	68,46%
TRA1	4,40%	54,99%	40,61%
TRA2	4,26%	25,58%	70,16%
TRB1	16,07%	57,01%	26,92%
TRB2	6,93%	23,57%	69,51%
TRC1	22,57%	5,08%	72,36%
TRC2	10,94%	11,80%	77,26%
TRC3	5,78%	36,38%	57,84%
Mean	8,01%	30,39%	61,60%
Max	22,57%	57,01%	88,26%
Min	1,39%	3,60%	26,92%
SD	5,65%	14,67%	14,10%

incorporates a large set of variables:

$$\Delta hpi_{i,t} = \gamma + \rho \Delta hpi_{i,t-1} + \delta E_{i,t-1} + \theta D_{i,t-1} + \phi U_{i,t-1} + \partial CL_{it-1} + \omega CU_{i,t-1} + d_{1i,t} Reg + d_{2i,t} Years + \varepsilon_{i,t} \quad i = 1, \ldots\ldots\ldots\ldots, 26, \; t = 2011, \ldots\ldots, 2015 \tag{2}$$

There are 130 observations in this model. The dependent variable, Δhpi, represents the annual percentage increase in regional housing price indexes. The first independent variable is the lagged value of the dependent variable. So, ρ captures the degree of backward speculation behaivor. E represents the group of economic variables, D denotes demographic variables, U includes the variables related to urbanization, CL represents the climate and geographical variables and CU represents cultural variables. All these determinants are region specific variables. These groups contain the fundamental variables which are mostly the demand-side and to a less extent the supply side variables. d1 and d2 represent respectively the regional and time specific dummies.[4] The full documentation of variables, their definition and other details are documented in Table 4.

We estimate the model in equation (2) by using a Least Squares Dummy Variable (*LSDV)* method and control in this way the impact of possible time and region specific fixed effects. One year lagged version of independent variables are used so to avoid the simultaneity problem.

To be able to follow an appropriate empirical strategy, we first define a base model that includes control variables which are the most frequently referred variables in the literature. These are *population, employment, inverse land supply, inflation* and lagged value of the *hpi* variables. All these variables are uncorrelated with each other.

Afterwards, other independent variables are added to the base model one-by-one. Hence, in total 20 models are created. Each model includes control variables and a different independent variable of interest. In order to avoid multicollinearity, when an independent variable is correlated with one of the control variables (when correlation coefficient >0.2), that control variable is discarded only for the estimation of that specific model. The results are summarized in Table 5.

To start with economic variables, only *trade* variable has a significant coefficient (with positive sign). In other words, economically more open regions are likely to have faster appreciation in housing prices. This result is plausible as open regions attract people more as they are likely to have a better quality of life and high diversity in consumption goods. In terms of demographic variables, only *population* has a significant and positive impact on housing prices.

[4] Regional dummies are created by adding dummy variables for 7 geographical regions in Turkey. Time fixed effects are controlled by adding time dummies for 2012, 2013, 2014 years.

Table 4
Definition of regional independent variables.

Groups	Variable Name	Definition	Demand/ Supply Side	Source
E (Economic Variables)	Employment	Regional Employment Rates (For +15 Years Old)	Demand Side	TURKSTAT
	Inflation	Regional Inflation Rates	Demand and Supply Side	CBRT
	Trade	Trade Openness of the Region (Export + Import Volume)/Population	Demand Side	TURKSTAT
	Labor Participation Rate	Active Population (15–64 Years Old)/Total Population	Demand Side	TURKSTAT
D(Demographic Variables)	Population	Population	Demand Side	TURKSTAT
	Student Density	Number of University Students/Population	Demand Side	TURKSTAT
	Education Quality	Number of University Students/Number of Teachers	Demand Side	TURKSTAT
	Net Migration Rate	Net Migration Rate	Demand Side	TURKSTAT
	Bachelor Rate	Number of People Holding a University Diploma/ Population	Demand Side	TURKSTAT
	Age Dependency	Number of People (Between 0 and 14 or Above 64 Years) Who Must Be Looked After by a Person (15–64 Years)	Demand Side	TURKSTAT
	Household Size	Number of Person per-household	Demand Side	TURKSTAT
	Health Services Quality	Number of Doctors/Population	Demand Side	TURKSTAT
U(Urbanization Variables)	Urbanization Rate	Percentage of People Living in Urban Areas	Demand Side	TURKSTAT
	Crime Rate	Number of Convicted People/Population	Demand Side	TURKSTAT
	Population Density	Number of People per- square kilometer	Demand Side	TURKSTAT
	Vehicle Density	Number of Vehicle/Population	Demand Side	TURKSTAT
	Inverse Land Supply	Area of Protected Zones in the Region (Km Square)/ Total Area of the Region(Km Square) (This is a Time Invariant Variable)	Supply Side	Ministry of Culture and Tourism, Republic of Turkey
	Road Density	Length of Roads in the Region/Total Area of the Region	Demand Side	TURKSTAT
CL (Climate and Geographical Variables)	Seaside Density	Length of Sea Shores in Region/Total Area of the Region (This is a Time Invariant Variable)	Demand Side	TURKSTAT and own calculations (for shore length)
	Temperature	Average Temperature of the Cities in the Region (Average of the Period Between 1950 and 2015 Used) (This is a Time Invariant Variable)	Demand Side	Meteorological Service, Republic of Turkey
	Earthquake	Average of The Degree of Earthquake of Cities In the Region (Ranging From 1 To 4) (This is a Time Invariant Variable)	Demand Side	TURKSTAT, Republic of Turkey Prime Ministry Disaster & Emergency Management Authority.
	Sunshine duration	Average duration of sun (hours) perday	Demand Side	Meteorological Service, Republic of Turkey
CU (Cultural Variables)	Cultural Density	Number of People Participated in Cinema, Theater and Libraries/Population	Demand Side	TURKSTAT

Note: TURKSTAT (Turkish Statistical Institute), CBRT: Central Bank Republic of Turkey.

In contrast to the first two groups, urbanization group of variables contain more promising effects. Population density, urbanization rate and crime rate have positive and significant impacts which actually mean that urbanization brings faster valuation in real estate products.

Moreover, two valuable variables which are not yet adequately mentioned in the literature are found significant. The first one is the *seaside density* variable which is included in climate and geographical variables group. It has a positive and significant coefficient. So, within the regions that there is sea, lighter climate conditions are present that attract people to live there. Hence, housing prices tend to increase faster in these regions. Second important variable is the *cultural density*. The intensity of participation in cultural activities such as cinema, theater and utilization of libraries have a positive impact on housing prices as these regions become increasingly attractive residential places for people.

Finally, lagged value of Δhpi has also been found positive and significant in all models. It, thus, confirms once more the importance of speculative behaviour in housing markets.

In almost all regression models, normality of errors is confirmed by a Jarque-Bera test statistics (presented in the last raw of Table 5.)

Overall, one may argue that urbanization, climate and cultural characteristics matter for real estate markets in Turkey. A typical region that experience fast housing appreciation can be defined in a following way: Metropolitan regions that include high population, density, seaside, economic openness and dense cultural activities are likely to experience faster increase in housing prices.

Table 5
Regression results, fixed effect LSDV method, Source: Own Estimation.

Variables	model1	model2	model3	model4	model5	model6	model7	model8	model9	model10
Hpi(t-1)	0,292**	0,292**	0,383***	0,316***	0,269**	0,277**	0,264**	0,313***	0,387***	0,309***
population(t-1)	0,000001**	0,000001**		0,000001**		0,000001***				0,000001**
employment(t-1)	0,181	0171	0,085		0,165		0,177	0125	0,094	
inverse land supply (t-1)	−1713	19,051	−1392	−1560	−3666					
inflation(t-1)	−0,125	−0,234	−0,130	−0,057	−0,118	−0,076	−0,142	−0,108	−0,147	−0,099
C	−1045	0,742	2738	8069	0,484	4748	0,346	1866	3875	10,589
student density(t-1)		−4305								
earthquake(t-1)			0,507							
education quality(t-1)				−0,071						
population density(t-1)					0,003***					
vehicle density(t-1)						22,416				
seaside density(t-1)							68,393***			
trade (t-1)								0,00035*		
Net migration rate(t-1)									0,045	
household size(t-1)										−0,735
R_Squared	0,36	0,36	0,31	0,34	0,36	0,38	0,38	0,33	0,31	0,35
Jarque Bera Normality Test	3,44	2,97	1,7	3,61	2,95	3,94	2,87	1,45	1,57	3,86

Variables	model11	model12	model13	model14	model15	model16	model17	model18	model19	model20
Hpi(t-1)	0,360***	0,329***	0,396***	0,267**	0,403***	0,286***	0,388	0395***	0,387***	0,400***
population(t-1)						0,000001***				
employment(-1)	0,148									
inverse land supply (t-1)		−47,190								
inflation(t-1)	−0,154	0023	−0,152	−0,107	−0,113		−0,144	−0,155	−0,088	
C	−3520	3397	−2636	7763	6877	4155**	5969	11,703	8119	6504***
urbanization rate(t-1)	0,080**									
cultural density (t-1)		5191**								
labor participation rate(t-1)			16,396							
sunshine duration(t-1)				0,086						
temperature(t-1)					0,023					
crime rate(t-1)						1400,234**				
bachelor rate(t-1)							30,825			
Age dependency(t-1)								−0,067		
road density(t-1)									−2651	
health services quality (t-1)										−85511,5
R_Squared	0,34	0,34	0,31	0,24	0,3	0,37	0,32	0,31	0,31	0,3
Jarque Bera Normality Test	2,18	2,81	1,7	4,07	1,43	6,37**	1,99	1,69	1,57	1,59

Note: *** denotes significance at 1%, ** at 5%, *** at 10%.

3.5. Robustness of results

A final step in our empirical investigation is to check the robustness of our results. We perform two types of controls.

The first one is related to reverse causality. If present, reverse causality indicates misleading results in case the dependent variable causes the independent variable but not the other way around.

To understand this, we apply a bi-variate Panel Granger Causality tests (Granger, 1969). We concentrate only on the variables that are found significant in the regression analysis. The results are shown below in Table 6.

Hence, 7 tests are performed (see Table 7). In all of them, the independent variables cause the dependent variable significantly but not vice versa. Therefore, we can safely argue that the relationships are uni-directional (from independent ones to the dependent variable) and there exists no reverse causality.

Second type of robustness check is related to possibility of spatial dependence in panel regression (equation (2)). If spatial dependence is present but not incorporated in the regression, the estimations will be misleading and coefficients will be biased (Anselin, 1988).

So, we apply 5 different types of spatial autocorrelation tests to our base model. These tests are respectively *Lagrange Multiplier Error (LMerr), Lagrange Multiplier Lag (LMlag), Robust Lagrange Multiplier Error (RLMerr), Robust Lagrange Multiplier Lag (RLMlag) and Spatial Autoregressive Moving Average (Sarma*) tests (Anselin, 1988; Anselin et al., 1996; Anselin & Florax, 1995; Bivand et al., 2019).

Their test statistics are presented in:iil below. As seen, none of the test statistics are significant. Although some continuity effects may be seen in Fig. 3, (especially in rapid house price increases in South-western regions and low increases in Eastern/North-eastern regions), these spatial effects are not found as statistically significant. The absence of significance might have arisen due to some regions (TRC1, TRA1 and TR41) that shows controversial effects and masks spatial dependence.

Hence, we may argue that to our analysis is robust against spatial dependence in the estimation of our regression model.

Thus, our results seem robust against spatial autocorrelation.

4. Conclusions

In this paper, we empirically investigated the dynamics behind the regional housing prices in Turkey over a period 2010–2016.

Our results can be summarized in three groups. First, housing price appreciations are so heterogeneous across regions. Moreover, the dispersion is getting even more pronounced over time. Similar findings have been found in the literature as well that in various country examples regional asymmetries are shown to belarge as well (see for example on Spain Paz (2000), for India Mallick and Mahalik (2015), for Turkey (Gök & Keçeli, 2015). Hence, our paper contributes to this stream.

Second, we found that speculative increase in housing prices is quite important. Such as about 38–40% of the housing appreciation is attributed to this factor whereas fundamental determinants account for about 60–62% of the price changes. In a similar manner, Capozza et al. (2002) and Clark and Coggin (2011), Kim and Seong (1993) Malpezzi and Wachter (2005), Mallick and Mahalik (2015) found significant role of speculative movements on house prices, respectively, for US, Korea and Japan, Italy and India. However, the role of speculation should be emphasized more as there are quite few studies focusing on such a perspective.

Among the fundamental variables, construction permissions, long-run interest rate and regional inflation rates are among the most important ones that are found to decline the property appreciation.

Third, in terms of cross-sectional determinants, urbanization rate, population, crime rate, trade openness, seaside density and

Table 6
Granger causality test results, Source: Own Estimation.

Test Number	Null Hypothesis	F-Stat	P-Value	Decision
1.	POPULATION does not Granger Cause HPI	14,67***	0,00	Reject
	HPI does not Granger Cause POPULATION	0,08	0,78	Accept
2.	POPULATIONDENSITY does not Granger Cause HPI	12,35***	0,00	Reject
	HPI does not Granger Cause POPULATIONDENSITY	0,13	0,72	Accept
3.	URBANIZATIONRATE does not Granger Cause HPI	13,08***	0,00	Reject
	HPI does not Granger Cause URBANIZATIONRATE	3,39*	0,07	Reject
4.	CRIMERATE does not Granger Cause HPI	5,58**	0,02	Reject
	HPI does not Granger Cause CRIMERATE	0,49	0,49	Accept
5.	SEASIDEDENSITY does not Granger Cause HPI	21,47***	0,00	Reject
	HPI does not Granger Cause SEASIDEDENSITY	−101,00	1,00	Accept
6.	CULTURALDENSITY does not Granger Cause HPI	7,72***	0,01	Reject
	HPI does not Granger Cause CULTURALDENSITY	0,65	0,42	Accept
7.	TRADE does not Granger Cause HPI	13,09***	0,00	Reject
	HPI does not Granger Cause TRADE	1,62	0,21	Accept

Note: *** denotes significance at 1%, ** at 5%, *** at 10%.

Table 7
Spatial dependence tests, Source: Own Estimation.

Test	2012	2013	2014	2015
LMerr	2,23	1,17	1,02	1,06
LMlag	2,18	0,79	0,13	0,07
RlMerr	0,08	0,49	2,14	1,41
RlMlag	0,02	0,12	1,25	0,43
Sarma	2,26	1,29	2,27	1,48

cultural activity density of the regions are found to increase significantly the housing prices which are consistent with the findings of existing studies. For instance, Wang et al. (2011) have found similar role of trade openness and Gök and Keçeli (2015), Martin (1966), Öztürk and Fitöz (2009) have found similar impact of urbanization/population on house prices.

Differently, seaside density and cultural activity density are the significant climate and cultural variables which are not yet well discovered in the literature. Similarly, the impact of crime rate which we found as significant has not yet been adequately analysed in the literature.

Overall, our results indicate an important policy suggestion. A very special attention needs to be paid on the significance of the speculation factor. In order to avoid the credit bubbles driven by speculative herding behaviour of investors, new regulations on housing and credit market should be introduced. The unsafe and inefficient credits should be hampered so to overcome the possibility of an artificial housing price bubble and its destructive impact on macro-economy.

Author contribution

Hasan Engin Duran; Conceptualization; Methodology Development, Literature Review Software and Codes; Resources; Writing - Original Draft, Writing - Review & Editing; Supervision; Project Administration, Hilal Özdoğan Data Collection, Literature Review, Formal Data Analysis, Visualization; Validation Writing - Review & Editing.

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