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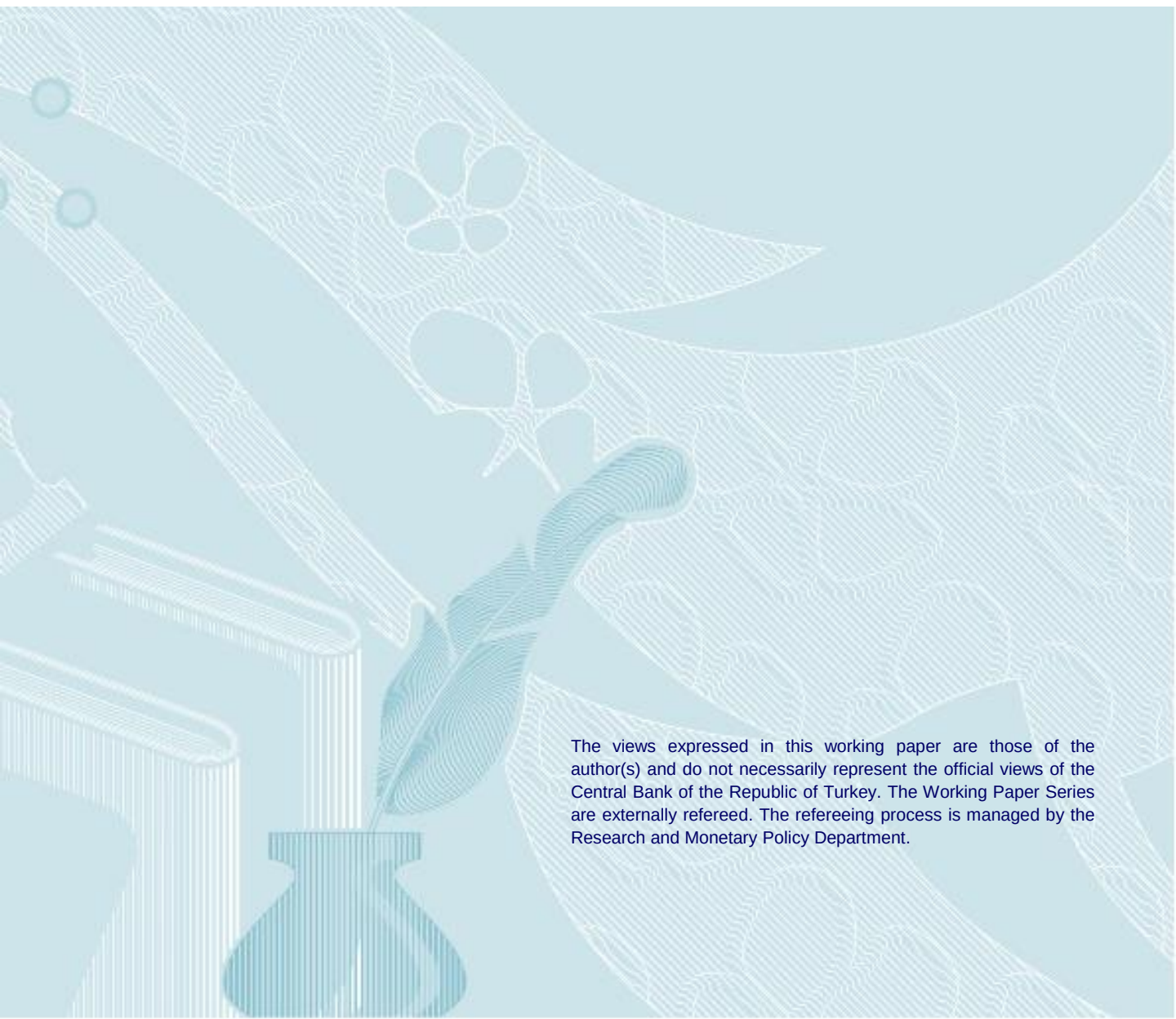

A Hedonic House Price Index for Turkey*

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Abstract

In the 2010Q1-2015Q1 period, housing prices increased 78.8 percent in Turkey, which raises a need to monitor the housing market dynamics carefully. This increase is widespread across the country where prices have even doubled in some regions. Our study performs a hedonic price adjustment for the housing market in Turkey, where we control for the price effects of improvements in observed house characteristics in time. Results show significant increases in the quality of houses sold, which in turn suggests that attributing all the price increase to a real appreciation may be misleading. In particular, we estimate that one fourth of nominal changes and one half of relative changes in house prices stem from quality improvements in general.

Keywords: House price index, Hedonic regression, Characteristic price approach, Quality adjusted price index.

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1 Introduction

Houses are the most important wealth component of most households and property prices influence economic dynamics. Therefore, it is crucial for authorities including central banks to have a reliable index for monitoring the fluctuations in house prices. However, many countries including Turkey did not have an official house price index until the recent global financial crisis. In an effort to fill this gap, the Central Bank of the Republic of Turkey (CBRT) started to publish a monthly house price index from January 2010 by using the median price method.[1] It measures nominal price changes for the whole Turkish housing market and according to this official statistic, nominal house prices in 2015Q1 are 78.8 percent higher on average than in 2010. When deflated by the consumer price index for Turkey (CPI), the increase is 25.0 percent in relative terms. This significant rise in house prices raises a need to monitor the housing market dynamics carefully.

The housing market is inherently heterogeneous in terms of its characteristics such as location, number of bedrooms, age, size, etc. On the other hand, differences in quality across such properties may be challenging to control because of the high degree of heterogeneity. Therefore, changes in property prices can reflect pure price changes as well as changes in the quality of houses. Increase in a property price index might result from at least one of these two factors, hence identifying big changes as a bubble may be misleading if the main driver of the increase is the latter. Several approaches have been proposed in the literature to distinguish these two factors, such as the hedonic method, the repeat-sales method and hybrid methods. In an extensive literature survey paper, Hill (2013) discusses advantages and disadvantages of these methods and concludes that hedonic indices have been increasingly preferred due to the weaknesses of alternatives. The hedonic regression method makes it possible

[1] See Kaya et al. (2012) and the CBRT website, www.tcmb.gov.tr.

to control for many observed characteristics of a property and measures pure price changes as well as price effects of quality changes. In fact, hedonic regression is the only method that enables us to create an index, taking into account the characteristics of houses (Kunovac et al., 2008). Besides, the unavailability of unique identifiers of houses in Turkey makes the repeat-sales method inapplicable in our case. These considerations lead us to opt for the hedonic regression method.[2]

The hedonic regression method, on the other hand, includes time dummy and characteristic prices approaches, where the former performs a single regression for the full time horizon assuming that quality improves in time and is indifferent in characteristics while the latter uses sequential regressions and computes intertemporal differences in quality. The former has the advantage of pooling data and this leads to lower standard errors in estimation. On the other hand, one disadvantage of the former is that the assumption of no structural change in parameters over time might be too restrictive (Shimizu and Nishimura, 2006, 2007; and Shimizu et al., 2010). Moreover, official statistics providers prefer the characteristics prices approach mainly because of its simplicity as well as the fact that the former approach needs revisions in past data every time new data arrive (Eurostat, 2011). As a result, we propose a residential property price index in this study by using the hedonic method with characteristics prices approach. Our results show that the house prices increased 60.6 percent in nominal terms and 12.3 percent relative to consumer price index when we hold their characteristics fixed, and that an 11.3 percent increase is estimated to have stemmed from the quality changes from January 2010 to March

[2]There are some criticisms of the repeat-sales indices in the literature. For example, Clapp and Giaccotto (1992) provide evidences that houses sold repeatedly are mostly "lemons" and have different characteristics compared to other houses traded in the market. Since lemons dominate the transactions in the sample, the data used to produce the house price index may not represent all the transactions well enough, causing sample selection bias or the so-called "lemon bias" issue. Moreover, houses traded at least twice are in the scope in this approach and this leads to huge loss of information. Yet, the underlying assumption is constant quality, ignoring the quality improvements (or depreciation) which often occur for the exact same house.

2015. Equivalently, 18.2 percentage points of the 78.8 percent nominal increase and 12.7 of the 25.0 percent relative increase in property prices in Turkey can be attributed to quality improvements and the rest was caused by pure price changes. Although some discrepancies across regions are observed, one fourth of nominal price increases and one half of relative appreciation can be attributed to quality improvements in general.[3]

The hedonic method was first developed and applied to land characteristics by Waugh (1928) while the term "hedonic pricing method" was first used by Court (1939) in the context of developing price measures for automobiles. On the other hand, the method was popularized by Griliches (1961, 1971) and Rosen (1974). Following these seminal papers, several early studies discuss mainly location effects on house prices. Later, hedonic quality adjustments in house prices have been extensively used.[4] The first official hedonic house price index was US Census Bureau's "One-Family Houses Index" which was first published in 1968 (Triplett, 2004). In the Turkish case, Kaya (2012) employs the time dummy approach to the same dataset as we do in this paper and finds that pure property price changes contribute to 6.2 percent from December 2010 to June 2012 whereas we compute that figure as 14.5 percent for the same period by using the characteristic prices approach. There are also a few other papers applying hedonic adjustment to prices in the Turkish housing market.[5] However,

[3]Increases observed in the components of houses should not always be considered as quality improvements. For instance, it may not be correct to state that two bedroom apartments are certainly better in quality than one bedroom ones. As a matter of fact, it is very common these days that one bedroom apartments (and also smaller ones) are preferred more compared to two bedroom ones in some districts in Istanbul. Yet, it may not be correct to interpret this as a decrease in quality. Therefore, it could be better to use the term "composition change" rather than "quality change". However, we opt to use the term "quality" in this study to have the similar terminology with other studies in this field. See, for example, http://ec.europa.eu/eurostat/cache/metadata/en/prc_hps_esms.htm for the European Union Harmonised Indices of Housing Price Statistics.

[4]See, for example, Straszheim (1973, 1974). For more recent studies, see Wilhelmsson (2008) and Widlak and Tomczyk (2010). Hill (2013) documents a wide literature survey in this topic.

[5]An extensive list of studies for Turkey includes Üçdoğruk (2001), Yankaya and Çelik (2005), Cingöz (2010), Baldemir et al. (2008), Karagöl (2007), Mutluer (2008), Kördiş et al. (2014).

they mostly use regional or local data, or analyze cross sectional data to estimate the determinants of house prices (see Selim, 2008). Our paper, on the other hand, covers the whole country and uses the time dimension to construct a hedonic house price index. Nevertheless, our results are in line with the common findings in the literature analyzing the Turkish market regarding the importance of house characteristics.

The rest of the paper is organized as follows. Next, we explain our data source, scope and methodology of the hedonic price index model used in the study. Section 3 provides our estimation and index results and conclusions are drawn in section 4.

2 Data and Methodology

In this study, we use monthly House Price Index for Turkey (THPI) data compiled by the CBRT, which covers the period from January 2010 to March 2015. The THPI is compiled from valuation reports prepared by real estate appraisal companies at the stage of approval of individual housing loans extended by banks. The actual sale or utilization of the loan is not required and all appraised residential properties are included in the scope.[6] On the other hand, our dataset is rich in variety of observable property characteristics. In particular, it has information on properties, including location (city, sub-city, neighborhood and block information), the year of construction, build quality, availability of an elevator and whether the building resides in a gated community where security staff protect the site 24/7. Moreover, it also has information about the apartment such as gross area of use, heating type, and number of bedrooms, bathrooms and balconies. This rich dataset enables us to identify the shadow prices of each quality component and to compute pure price changes by keeping average characteristics constant.

[6]For detailed information, see the "Methodological Information on the House Price Index" at www.tcmb.gov.tr.

The THPI uses the (geographically) stratified median price method to measure price movements in the Turkish housing market. In the current THPI implementation, properties are grouped together to form homogenous strata and the median unit price for each stratum is weighted by the number of residential properties sold to reach the overall price index. Specifically, the previous year house sales statistics from the General Directorate of Land and Cadastre are used to determine the weights. In the geographical stratification, sub-cities with sufficient number of observations are determined as strata.[7] The THPI relies on the assumption that the median unit price of appraised properties is indicative of the median unit price of all properties sold. In that, a unit price is the appraisal value divided by its gross area of use and the median unit price is calculated -excluding extreme values- for each stratum.

The THPI is calculated by using the Chain Laspeyres Index method:

$$I^{ty} = \frac{\sum_i w_i^y p_i^{ty}}{\sum_i w_i^y p_i^{12(y-1)}} I^{12(y-1)}, \tag{1}$$

where I^{ty} is the price index for the reference month t in year y, w_i^y is the weight for stratum i, p_i^{ty} is the median price of all properties in i. We denote the reference month as ty while $12(y-1)$ denotes 12th month of the previous year.[8]

In this paper, we use characteristic-prices-based hedonic regression method. The basis of the hedonic hypothesis is that a good is characterized by the set of all its characteristics. The high heterogeneity of the housing market necessitates this approach. In this context, regression methods can be used to estimate shadow prices of the features of a property.[9]

[7] In case of insufficient number of observations for sub-cities, NUTS-Level 2 regions constitute one stratum. If any stratum has a sample size smaller than 50 appraisal reports in a period, this stratum is excluded and its weight is distributed to other strata in the geographical region.

[8] In fact, THPI uses quarterly data where one quarter data consist of valuation reports of the reference, preceding and succeeding months. We adopt the same approach in our hedonic index.

[9] According to the "Residential Property Price Index Handbook" (Eurostat, 2011), the hedonic prices approach can be used to obtain estimates of willingness to pay the different characteristics

In particular, our log-linear regression model is as follows:

$$lnp_n^t = \beta_0^t + \sum_k \beta_k^t z_{nk}^t + \varepsilon_n^t, \tag{2}$$

where p_n^t is the price of property n and z_{nk}^t is the characteristic k of the property.

In order to avoid adverse effects of potentially problematic initial data points on the whole index, we carefully choose January 2012 as the base period ($t = 0$) to construct our Hedonic House Price Index for Turkey (THHPI).[10] Then, we run separate regressions for each period and compute the estimates of regression coefficients, $\widehat{\beta}_k^t$. To compute fixed-characteristics prices, we use $\widehat{\beta}_k^t$ along with the average characteristics for the base period, $\overline{z_{nk}^0}$. From this perspective, average characteristics for the base period resembles "standardized property with fixed characteristics". Our Laspeyres-type index for each stratum i is as following:

$$P_i^t = \frac{exp(\widehat{\beta}_0^t) exp[\sum_k \widehat{\beta}_k^t \overline{z_{nk}^0}]}{exp(\widehat{\beta_0^0}) exp[\sum_k \widehat{\beta_k^0 z_{nk}^0}]}, \tag{3}$$

where P_i^t is the hedonic house price index.[11] Equation (3) gives the quality adjusted property price index because characteristics are kept constant in time.

2.1 Model selection

By its nature, the hedonic regression, which considers the price of each good as a bundle of characteristics, may suffer from two different and interrelated statistical problems, namely the omitted variable bias and multicollinearity. The former is a

and to construct quality-adjusted price indices.

[10] As a robustness check, we also computed a similar index with 2012=100 but differences are negligible.

[11] Since the THPI is a Laspeyres index, we also follow the same methodology. However, for a robustness check, we compute Paasche and Fisher indices -as in Eurostat (2011)- but they show no significant differences. Results are available from the authors upon request.

common problem in such studies because all characteristics that have an effect on house prices could not be included in the regression model due to data limitations. In general, characteristics of a house can be divided into three categories; structural, neighborhood and location characteristics (see, for example, Chin and Chau, 2003). In our dataset, we do not have neighborhood characteristics such as the income level of residents or the air quality in the region, but we have observable structural features as well as location information of an appraised house. However, using location information itself can not provide fully homogeneous data on the market because even houses in the same building have different values. Moreover, there is a trade-off in stratifying the market with respect to location, i.e. the more you homogenize the less data you will have in each strata. On top of these, obtaining the full set of structural characteristics in practice is almost impossible. Therefore, we can say that, similar to other studies using hedonic regression, our model may also be subject to omitted variable bias to some extent. While hedonic price indices potentially suffer from this problem, well-constructed models that use the characteristic prices approach or double imputation indices significantly reduce the sensitivity to omitted variable bias (Triplett, 2004; Hill and Melser, 2008; and Hill, 2011).

A second potential statistical problem is the existence of multicollinearity among explanatory variables. This is a common issue in applying hedonic methods to houses because there can be statistical dependencies among characteristics of a house. For example, a larger house probably has more bedrooms and a regression might suffer from multicollinearity if it has both variables on the right hand side. In this case, high correlation among these variables makes coefficient estimates unstable and complicates the interpretation of variable importance in price determination. However, according to Eurostat (2011), indices created with this method will not suffer too much from this issue. In particular, multicollinearity does not interfere with the

characteristics price interpretation in the sense that the value of an estimated coefficient will converge on the true characteristics price in repeated samples. Thus, the estimates are consistent in econometric terms and the hedonic index is still valid under the presence of multicollinearity. Furthermore, there is a trade-off between the omitted variable bias and the multicollinearity issues, i.e. excluding a relevant variable due to high correlation with other might increase the former bias. As a result, we opt to include such highly correlated variables in our regression models.

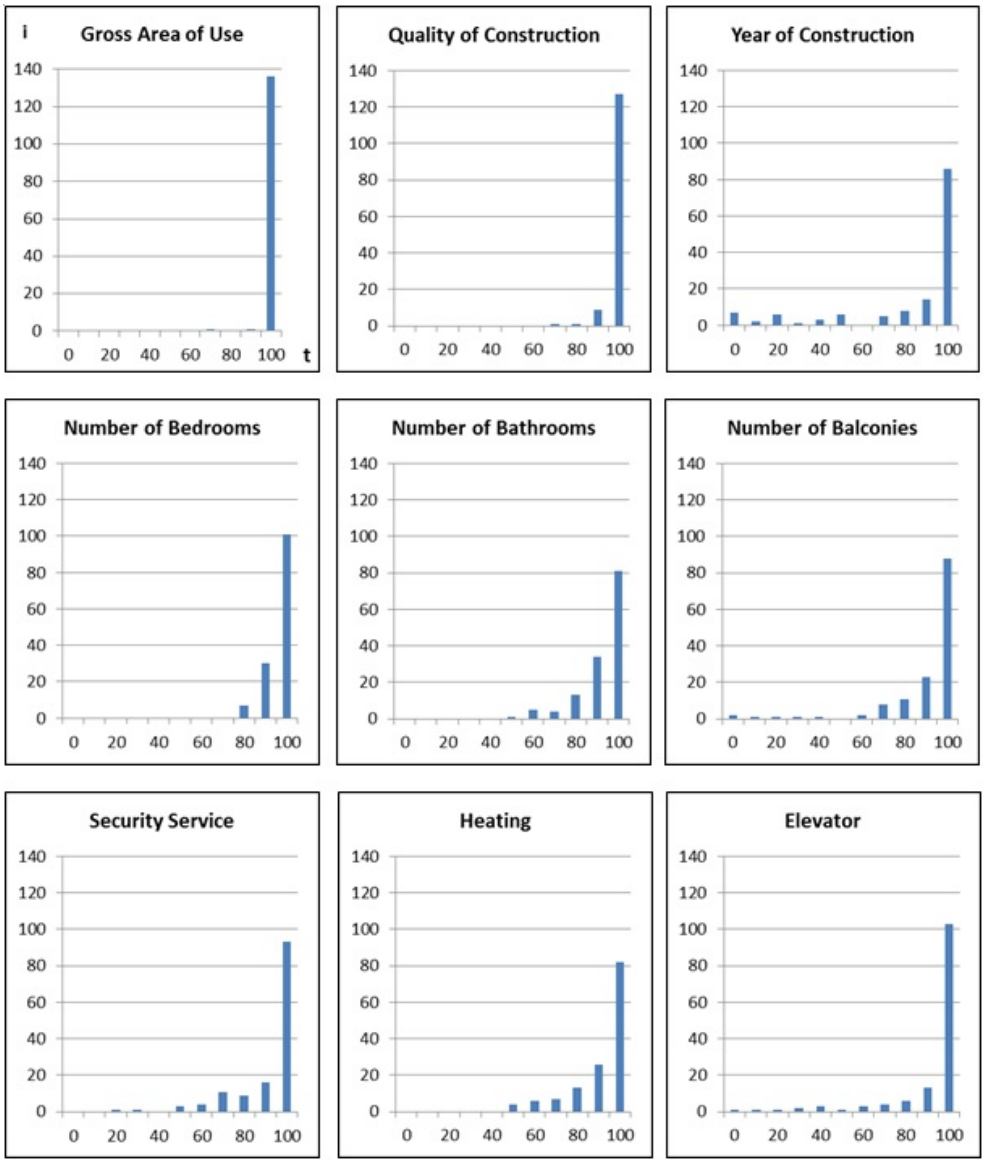
There are more than 130 strata in our study.[12] Since we run regressions for each period and each stratum in the characteristics prices approach, it is almost impossible to have significance of the same variables in all regressions.[13] Therefore, we first regress all independent variables for each stratum for the first 36 periods (2010-2012). Then, the p-values of each variable are computed and a suitable model is chosen for each stratum accordingly. To illustrate how significance changes in time and by stratum, Figure 1 depicts histograms for each variable, in which rows represent the rate of significance (according to 5 percent level) in time and columns represent the number of stratum. For example, as we see from the upper left histogram, the gross area of use is a significant variable for almost all strata. Some variables have less significance rate for some strata; heating, for instance, is significant 90 percent of the time for 26 strata and 80 percent of the time for 12 strata. Here we determine an ad hoc limit for the significance rate: if a variable is significant less than 70 percent of the time for a stratum then we exclude this variable for that stratum. Based on the outcomes and this strategy, we determine seven different regression models and assign one to each stratum. Table 1 lists our 7 regression models.[14]

[12]To be exact, 137, 153, 175 and 191 strata for 2010-2012, 2013, 2014 and 2015 periods, respectively.

[13]We have enough observations for each strata by construction. In particular, 50 observations in a period is a requirement to form a stratum, as explained in a previous footnote.

[14]In general, how old a house is important in determining its price. The exact age (equivalently, the year of construction) or a categorical classification of age groups can be used, where the latter

Figure 1: Histogram of Variable Significance



Note: Histograms show the number of strata (on y-axis) that the variable (each histogram) is significant -at 5 percent level- while x-axis represents the percentage of times the variable is significant for the stratum.

covers nonlinearity effects of age in price. We computed both alternatives and observed negligible differences. Therefore, for simplicity purposes, we prefer using the year of construction.

Table 1: Regression Models

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Gross area of use	✓	✓	✓	✓	✓	✓	✓
Quality of construction	✓	✓	✓	✓	✓	✓	✓
Year of construction	✓	✓	✓	✓	✓	✓	✓
Number of bedrooms	✓	✓	✓	✓	✓	✓	✓
Number of bathrooms	✓	✗	✓	✓	✓	✓	✗
Number of balconies	✓	✓	✗	✓	✓	✓	✗
Security service	✓	✓	✓	✗	✓	✓	✗
Heating	✓	✓	✓	✓	✗	✓	✗
Elevator	✓	✓	✓	✓	✓	✗	✗

Notes: (1) See the appendix for variable explanations. (2) Checkmarks show inclusion of the variable in the respective model while crossmarks represent exclusion.

3 Results

According to a sample regression result given in Table 2, all independent variables used in this regression are statistically significant and signs of all coefficients are consistent with economic theory. In other words, all shadow prices, i.e. the additional contribution of a coefficient to appraisal value, result in increasing the house price. For example, keeping other physical characteristics constant, a 100 square-meter larger house is 50 percent more expensive than average. Higher quality houses are valued at a 10.9 percent higher price on average while an elevator in the building adds 13.3 percent to its value. Security is another important characteristic for this stratum, meaning that if a house receives a 24/7 security service within a gated community then one would expect its price to be 33.3 percent higher on average.[15]

Following the methodology described above, we first compute regional indices and then aggregate them to reach the index for Turkey. The THHPI shows an increasing trend starting from the first period, similar to the THPI. Figure 2 shows that, the THHPI increased by 60.6 percent in nominal terms (and 12.3 percent in relative terms) while the THPI increased nominally by 78.8 percent (25.0 percent in relative terms)

[15] Average R-squared values across all strata and all months for each year are 0.511, 0.586, 0.637, 0.629 and 0.667 for 2010-2014, respectively.

Table 2: House Price Estimation Results

Characteristic	Estimates
Gross area of use (Sq. m.)	0.005
	(0.000)***
Quality of construction	0.109
	(0.022)***
Year of construction	0.003
	(0.001)**
Number of bedrooms	0.033
	(0.017)**
Number of bathrooms	0.084
	(0.029)***
Number of balconies	0.071
	(0.017)***
Security service	0.333
	(0.032)***
Heating	0.118
	(0.045)***
Elevator	0.133
	(0.028)***
Constant	5.655
	(2.040)***
Number of observations	621
R-squared	0.641

Notes: (1) Dependent variable lnP_i^t is the logarithm of total appraisal value of the house in Turkish Liras. (2) The numbers in parenthesis are standard errors while (**) and (***) denotes significance at 5% and 1% level, respectively. (3) Quality of construction is a dummy variable equal to 1 for higher quality houses and 0 for lower. (4) Security service is a dummy variable equal to 1 if the house resides in a gated community. (5) Heating denotes central heating and wall hung gas boiler systems. (6) Elevator denotes whether the building has an elevator or not. (7) Sample regression covers one of the sub-cities of Istanbul with one quarter data. More regression results are available upon request.

in almost five years.[16] These findings suggest that, an 11.3 percent increase was due to quality improvements in housing characteristics in the given period.[17] In order to analyze what form these improvements are taking, one can see from Table 3 that there are more than one house characteristic which improved over time. Particularly, on average, houses sold in 2015 have better quality of construction, more bathrooms, elevators and security service compared to houses sold in 2010. On the other hand, we can see that smaller houses with less number of rooms and balconies are generally sold recently but their diminishing effects are dominated. Although there exist some

[16]The THHPI is rebased into 2010 from January 2012 to make a comparison with the THPI.

[17]This figure can be found by dividing the THPI (178.8) by THHPI (160.6), or similarly relative increases in these two indices (dividing 125.0 by 112.3).

Figure 2: Comparison of THPI and Hedonic Price Index for Turkey

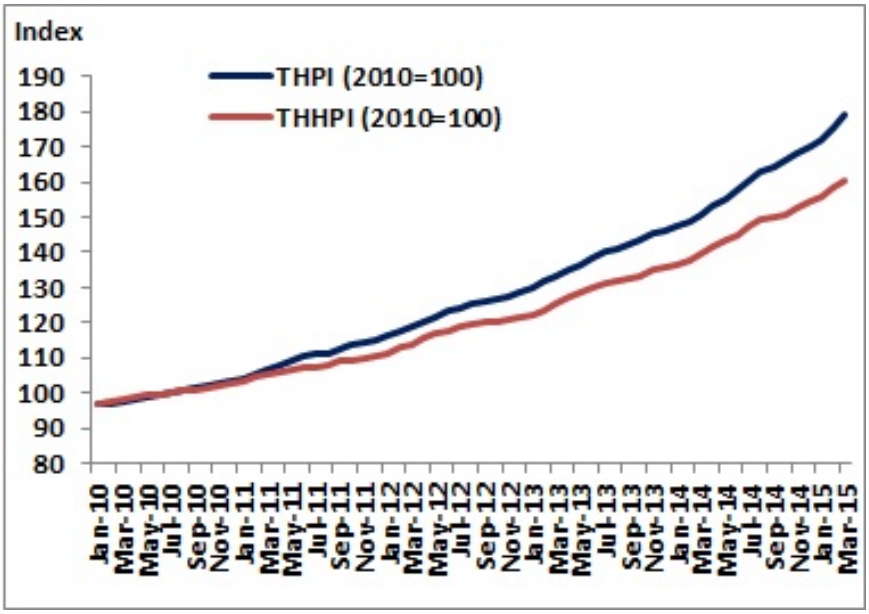
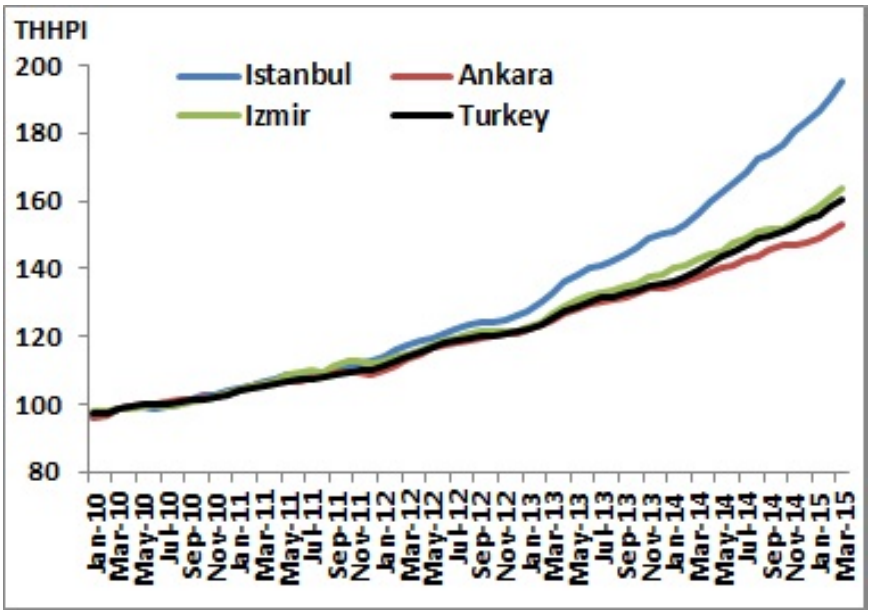


Figure 3: Hedonic Price Indices for Three Large Cities



discrepancies in these results across different sub-cities, findings are valid for almost all regions.

The general tendency of hedonic prices in the three largest cities in Turkey, i.e. Istanbul, Ankara and Izmir, followed the same pattern until late 2012 and diverged

after. Following a period of similar inflation rates, hedonic prices in Istanbul showed a faster pace and dissociated from the others as shown in Figure 3. In particular, the highest nominal increase in five years is seen in Istanbul by 95.3 percent, while the increase in Ankara is 53.2 percent and in Izmir is 63.6 percent (respective CPI-deflated increases are 36.5, 7.0 and 14.4 percent). The respective official THPI increases are 116.7, 57.2 and 72.5 percent in nominal terms (and 51.5, 9.9 and 20.6 percent in relative terms). One can see that the lowest quality change is observed in Ankara with only 2.7 percent (less than one tenth of total change) whereas average house quality increase observed in Istanbul is 11.0 (almost one fifth of total price increase).

4 Conclusion

Excessive property price movements can be a threat to financial stability because houses are considered as the largest part of household wealth. Therefore, price movements in housing markets have a major role in policymaking and need to be monitored using a reliable statistic. Due to potential quality changes in residential properties, house prices can reflect these effects and might result in misinterpretation of a large increase as a -false- relative appreciation.

Since the Turkish house price index computed by the CBRT is prone to above-mentioned effects, we construct a quality adjusted property price index by using the hedonic regression method. In other words, we distinguish quality changes and pure price increases in the index. According to our results, one fourth of the nominal and one half of the relative property price increase can be attributed to quality improvements in general.

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A Data Appendix

Real estate appraisal companies prepare valuation reports at the stage of approval of individual housing loans extended by banks.[18] In this study, we use the exact same database which the CBRT forms to compile the house price index using such valuation reports.

The final sample used in our study covers valuation reports observed over the 2010-March 2015 period. The dependent variable in our regressions is the log of appraised value of the house in Turkish liras, $logP_i^t$. Other variables, which are used as explanatory variables in our study, are listed below.[19] We also give summary statistics of these characteristics by year in Table 3, and their latest statistics by region in Figure 4.

- Gross area of use (in square meters).
- Quality of construction. Luxury or good (higher quality)=1, bad or others (lower quality)=0.
- Year of construction.
- Number of bedrooms.
- Number of bathrooms.
- Number of balconies.
- Security service. House resides in a gated community=1, otherwise=0.
- Heating. Central heating or wall-hung gas boiler=1, others=0.
- Elevator. If the building has an elevator=1, otherwise=0.

[18] The actual sale of the property and utilization of the loan is not required and all houses appraised are included in our scope.

[19] Appraisal reports include other variables such as type of dwelling, construction level of the dwelling, parking lot, swimming pool, number of total floors, structure of the construction, number of living rooms and kitchens. These variables show no or little significance in the determination of the appraised value.

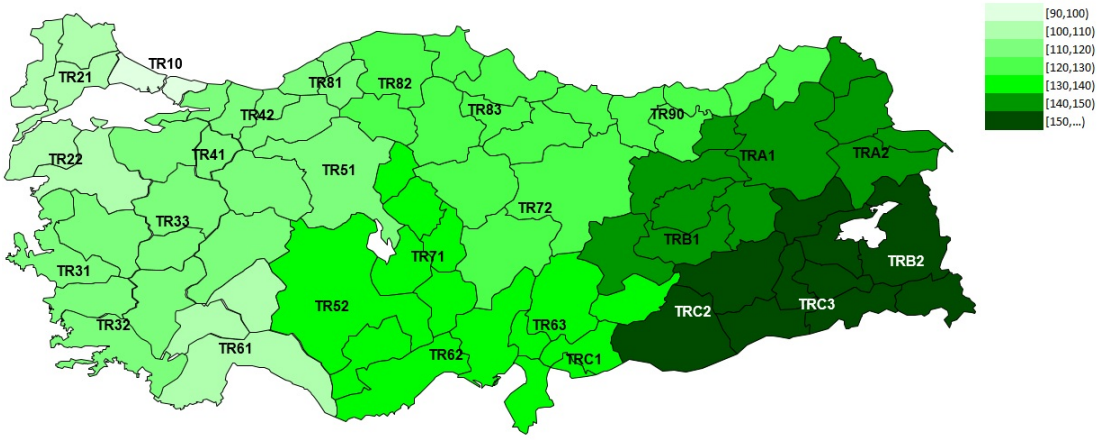
Table 3: Summary Statistics of House Price and Characteristics

	2010		2011		2012		2013		2014		2015	
Variables	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Price	100,124	95,000	106,054	100,000	115,981	110,000	127,426	120,000	141,081	135,000	151,579	145,000
Gross area of use	123.00	110.00	117.60	110.00	113.95	108.00	114.33	109.00	112.14	106.00	111.48	106.00
Quality of construction	0.59	1.00	0.60	1.00	0.60	1.00	0.61	1.00	0.62	1.00	0.61	1.00
Year of construction	2000.86	2006.00	2001.68	2007.00	2002.89	2008.00	2004.21	2010.00	2005.62	2011.00	2005.95	2011.00
Number of bedrooms	2.81	3.00	2.79	3.00	2.74	3.00	2.77	3.00	2.73	3.00	2.72	3.00
Number of bathrooms	1.22	1.00	1.22	1.00	1.23	1.00	1.24	1.00	1.25	1.00	1.25	1.00
Number of balconies	1.59	2.00	1.61	2.00	1.60	2.00	1.59	2.00	1.55	2.00	1.54	2.00
Security service	0.09	0.00	0.08	0.00	0.09	0.00	0.09	0.00	0.10	0.00	0.10	0.00
Heating	0.73	1.00	0.74	1.00	0.76	1.00	0.74	1.00	0.72	1.00	0.72	1.00
Elevator	0.38	0.00	0.40	0.00	0.46	0.00	0.47	0.00	0.47	0.00	0.49	0.00

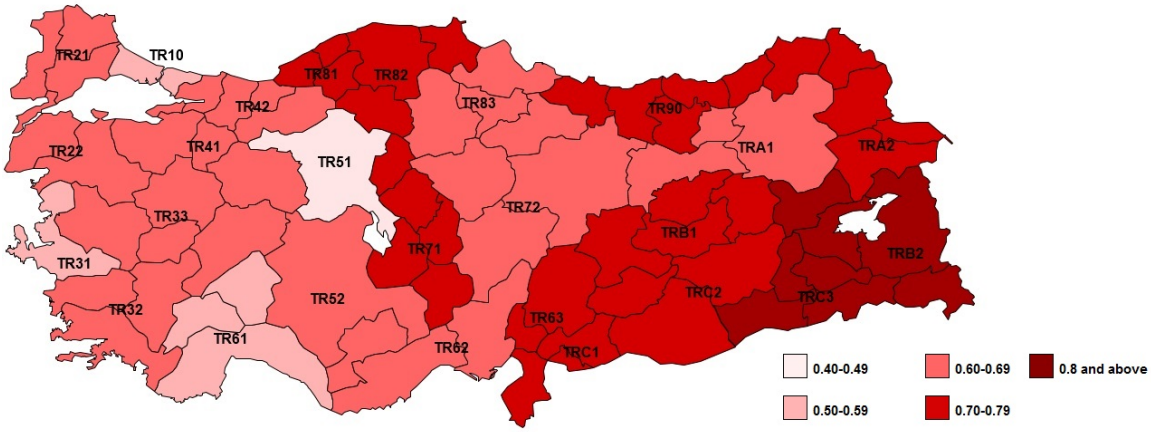
Notes: (1) 2015 data cover January-March months.

Figure 4: Average House Characteristics by Region (as of March 2015)

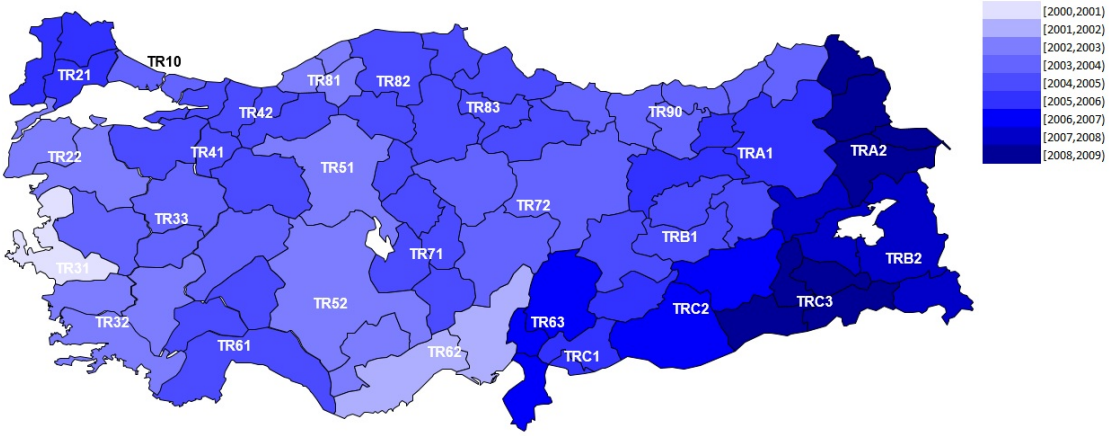
(a) Gross Area of Use (in square meters)



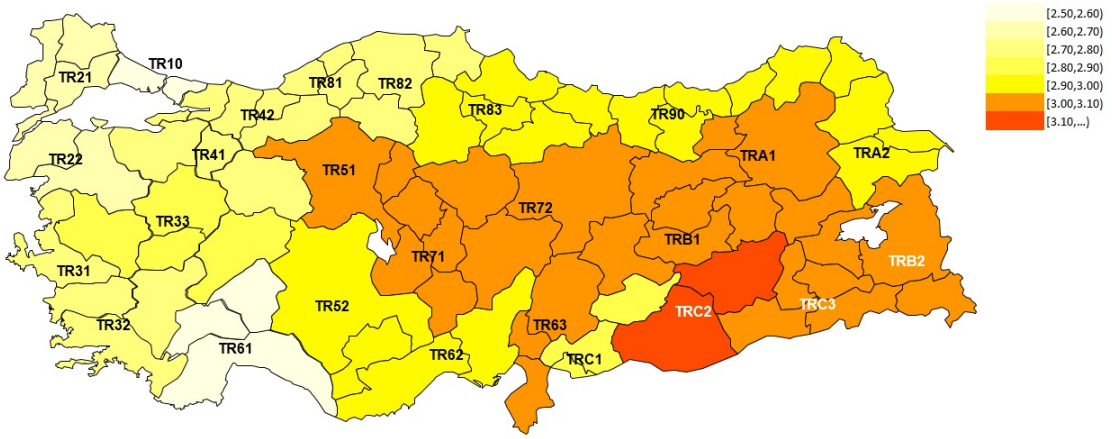
(b) Quality of Construction



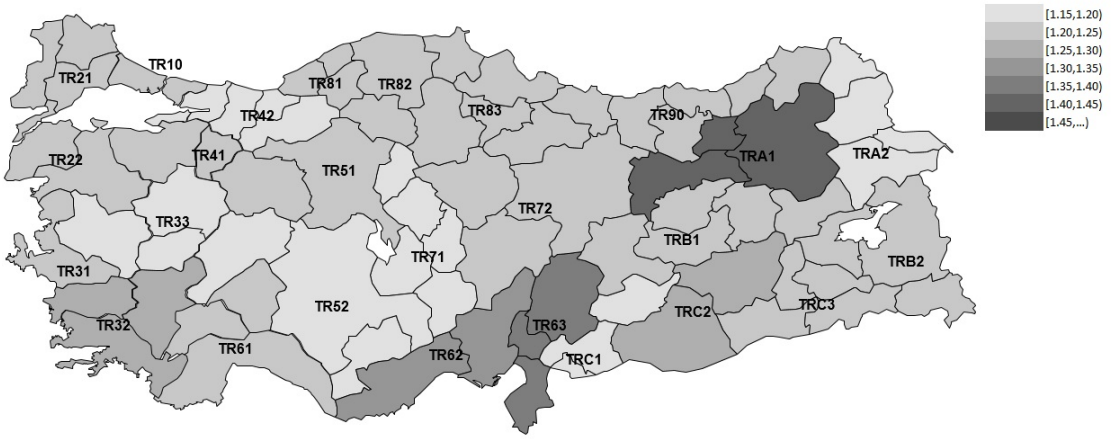
(c) Year of Construction



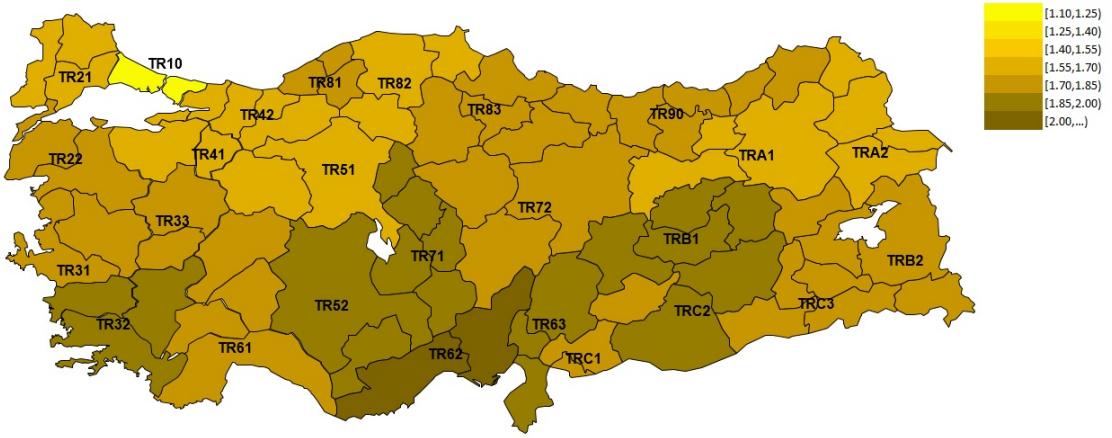
(d) Number of Bedrooms



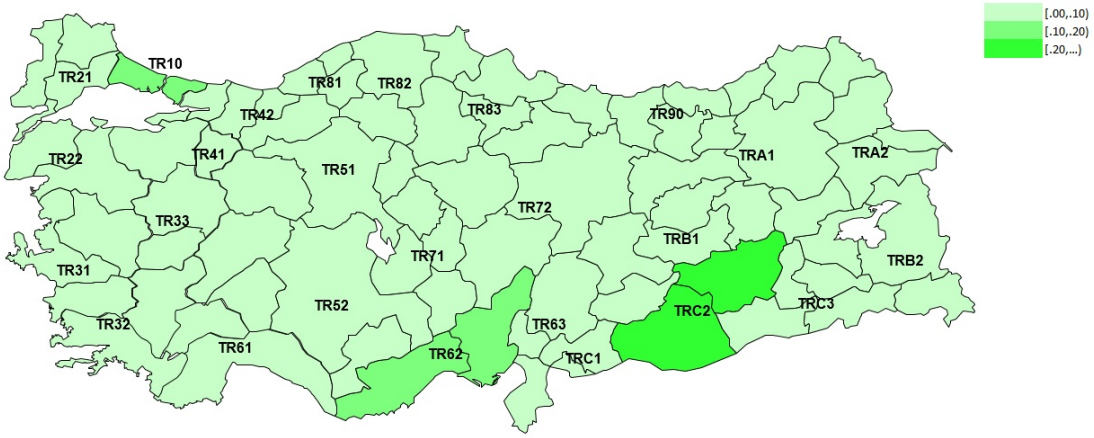
(e) Number of Bathrooms



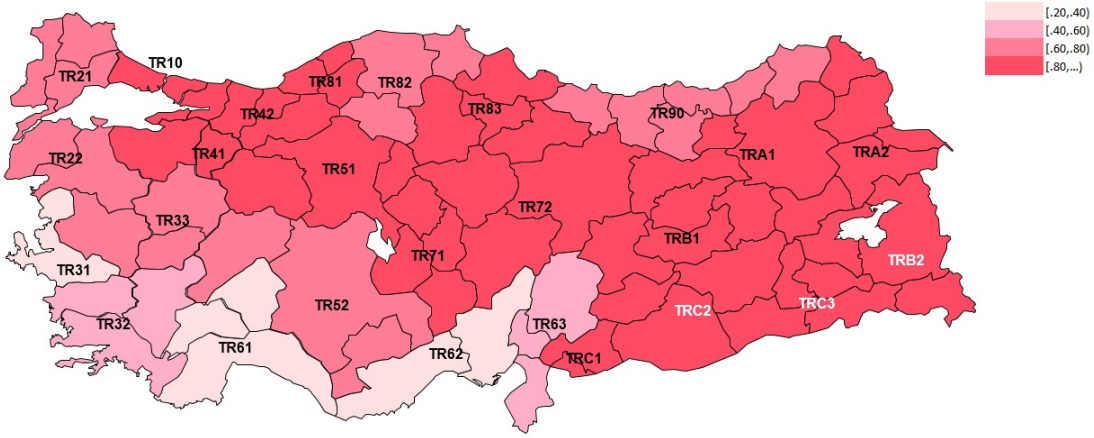
(f) Number of Balconies



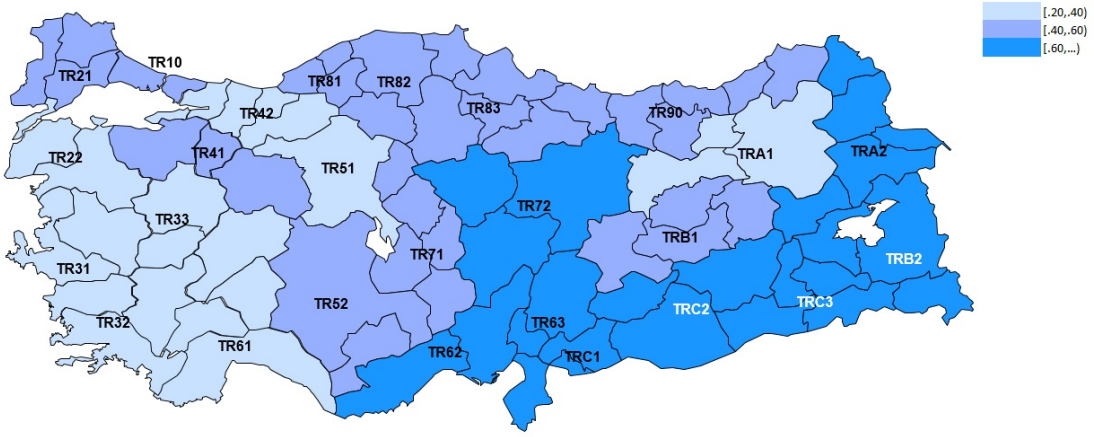
(g) Security Service



(h) Heating



(i) Elevator



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