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DETERMINATION OF THE FACTORS THAT AFFECT HOUSE PRICES IN TURKEY BY USING HEDONIC PRICING MODEL[1]

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ABSTRACT

The primary purpose of this paper is to analyze the marginal effects of various features of the houses on the prices to observe the price changes in the Turkish housing market which follows a heterogeneous pattern. As the second concern, it is aimed to declare the results and additionally to define Turkish housing market and its submarkets which affect the market itself and to calculate the pure price changes of the houses with constant features. Hedonic pricing model is applied on the data obtained via the house price index study performed at the Central Bank of Turkey. For the period between December 2010 and June 2012, under the constant housing features, hedonic price indexes are calculated as 6.21% for Turkey, 5.93% for İstanbul, and 5.05% and 2.83% for Ankara and İzmir respectively.

1. INTRODUCTION

The traditional Index method which takes into account quality changes is known as "matched model" method (Nair, 2004). However, using matched model method is not appropriate for the construction of house price indexes for three reasons. First, since houses have heterogeneous structure, they cannot be matched exactly. Second, the relation between the number of transactions and housing stock is considerably low. Third, a house price is only determined when the transaction takes place.

[1] This article is an abridged version of the thesis entitled "Türkiye'de Konut Fiyatlarını Etkileyen Faktörlerin Hedonik Fiyat Modeli İle Belirlenmesi". See full version at http://www.tcmb.gov.tr/kutuphane/TURKCE/tezler/ aslikaya.pdf for all the regional analysis results and other detailed information. The views expressed in the paper belong to the authors and do not represent those of the authorities/institutions in interest.

Due to these characteristics of the housing market, particular housing index methods have been developed. These methods are repeated sales, median or mean price model, sale price appraisal ratio model, representative property model, mix adjustments model, hybrid model and hedonic pricing model.

Each of these methods has certain advantages and disadvantages. In addition, each of them may require data sets differing in terms of both sample size and content of the data (Eurostat Handbook on Residential Property Price Indices, 2011).
In this paper we use hedonic pricing model. Our aim is to define Turkish housing market and its submarkets which affect the market itself and calculate the pure price changes of the houses with constant features by using the adjacent-period time dummy variable approach.

2. LITERATURE REVIEW

In the related literature Haas (1922) is the first to apply hedonic price model in agriculture and the first to use the term hedonic. Haas made an attempt to put an explanation through independent variables distance to city and size of the city and dependent variable field of the farm.

However, the first authors to apply hedonic price model in housing market were Ridker and Henning (1967). Ridker and Henning (1967) in their study highlighted the significant effect of air pollution ion the preference of household for housing. Using cross-sectional data, they estimated the linear price function through OLS method.

Kain and Quigley (1970) in their study were in the pursuit of explaining the dependent variables house sale price and house rent price through the independent variables the quality of the building, construction quality, features of the house, the location, the success rate of the public school in the location, the age of the house, bathroom number, type of the house, inclusion of warm water and furniture in the rent.

Straszheim (1973), using the linear hedonic price function patter, tried to explain the house sale price with such independent variables as the number of the room, the age of the house, the size of the house. Besides, in the study, ıt was concluded that there was differentiation among the regions in house prices. Namely, he found out that the location is a significant factor in house pricing.

Goodman (1978) in his study divided cities into strata being downtown and suburb. For each stratum, he made an attempt to explain the house sale price through such independent variables as the type of the building, age and the number of black people in the location of the house and the number of rooms. The results of his study revealed that for each stratum, the hedonic price function estimate results differed from each other.

Palmquist (1984), based on the 7 standard metropolitan statistical locations, tried to explain the house sale price with such independent variables as the quality of the house, whether the house has a parking lot, air conditioner, etc…

Kim (1992) tried to explain the monthly average rental price with such independent variables as the number of bathrooms, bedrooms, income level of the household, etc.

Aoki, Proudman and Vlieghe (2004) stressed the importance of house prices due to the use of houses as assurance in order to decrease the cost of borrowing in loan markets.

Aizcorbe and Pho (2005) compared weighted and unweighted price indices through matching model in order to put the difference between the hedonic price index values.

Vor and Groot (2009) studied the effect of such unfavorable factors as traffic in industrial zones, noise, etc. on house sale prices.

Widlak and Tomczyk (2010), using time dummy variable, price index and hedonic estimate methods for the same data set, performed results comparisons.

3. METHODOLOGY AND DATA

3.1. Hedonic Pricing Model and Function

By the method of hedonic pricing model, houses are decomposed into their characteristics and then it is assessed whether each feature has a real effect on the price of the house. This method is based on Lancaster's consumer preferences theory (1966). According to this theory, consumers' benefit from the consumption levels of goods is determined by the properties of the goods. Furthermore, "quality changes" over time can be detected by this method. For these advantages, in literature, hedonic pricing model is preferred if data set is sufficient.

According to hedonic pricing model based on consumer preferences theory, structural features of the houses, number of the components of these features, the location of the house and the specifications of the location should be included as variables in the model.

First of all, construction of the hedonic pricing function is required before calculation of the index by using hedonic pricing model. In the hedonic function, dependent variable is the price of the house; independent variables are structural features of the houses, number of the components of these features, the location of the house and the specifications of the location. If some variables have significant impact on the price of a house, it means that, the price of that house is determined by those significant variables.

The functional form of the hedonic function and the variables included in the function need to be determined accurately (Vries et al, 2009). Functional form is basically determined according to the structure of the relation between the dependent variable and the independent variables; i.e. whether it is linear or nonlinear.

Hence, there are four functional forms. These are the linear model, the logarithmic model, linear logarithmic model and the logarithmic linear model. In the hedonic function the coefficients of characteristics are called hedonic price (Rosen, 1974).

3.2. Hedonic Price Indexes &The Time Dummy Variable Method

The index calculated by using the hedonic pricing function is called hedonic price index. There are four hedonic price index methods. These are the characteristics price index method, the hedonic price imputation method, the hedonic quality adjustment method and the time dummy variable method.

In the time dummy variable method and the characteristics price index method, data sets needed to estimate the hedonic function and to calculate the hedonic price index are the same. Therefore, these methods are called as “direct” methods, whereas the others are called as "indirect" methods (Triplett, 2006).

The time dummy variable method is based on the method of estimation of the coefficient of the time (Triplett, 2006). This method has two alternative approaches; the adjacent-period time dummy variable and the multi-period time dummy variable. In the multi-period time dummy variable approach, the hedonic function is constructed with the combined data observed in all periods. In the adjacent-period time dummy variable approach the hedonic function is constructed with the combined data observed in only two adjacent periods. This means that, the coefficients of the features (hedonic prices) are kept constant for only two periods.

$$lnP_i^t = \beta_0 + \sum_{k=1}^{k} \beta_k X_{i,k} + \gamma D_i + \varepsilon_i^t \qquad (1)$$

The coefficients of the features (β), in the model, refer to the changes in quality. Gamma (γ) refers to percentage time-based change in price, i.e. price change independent of quality change. Therefore, gamma is interpreted as “pure price change” occurred in the period of analysis.

Since houses have a low rate of technological development, in literature, the time dummy variable method is suggested. In application the adjacent-period time dummy variable approach is adopted for few reasons. First, there is no prior knowledge about the current structure of the Turkish housing market and its characteristics. Second, valuation reports are obtained from banks monthly. Finally, the data set length is relatively short for other approaches and methods.

The constructed hedonic functions have 69 dummy variables[2] representing the structural features of the houses, provincial dummy variables representing location and district dummy variables belonging to each province. The hedonic functional form is determined as log-linear form since all the independent variables used are qualitative. Significant variables have been identified in two stages. In the first stage, each of significant variables was required to be significant at least in 13 periods of 18 periods. In the second stage, regression analysis was repeated with the variables identified in the first stage until only the variables that are significant in all periods remain. Thereby, only the significant variables were identified for each location during the period of December 2010 and June 2012.

In practice, from general to specific approach is adopted. First of all, hedonic house price index for Turkey (THHPI) has been calculated, and then hedonic price index values for the provinces significant in Turkey have been calculated. Finally, for the three big cities, district level hedonic price index values have been calculated.

3.3. Data

Hedonic pricing model is applied on the data obtained via the house price index study performed at the Central Bank of Turkey. At the beginning of the study, the initial intention was to conduct the application with the 756.082 data covering the period from January 2010 to June 2012. However, expected level of relationship between the features of the houses and the house prices could not be detected in the evaluation of the results of analysis of the periods before December 2010. As a possible reason, the effect of the notification issued by the BRSA (Banking Regulation and Supervision Agency) on 12/16/2010 has been examined. The notification ensures that valuation reports are prepared solely by certified real estate appraisal companies. In order to determine the effect, first of all, for every period bank branch (D_PARTY_1), expertise (D_PARTY_2) and valuation firms (D_PARTY_3) have been defined as dummy variables and then estimated in the hedonic functions. According to the estimation results (Table 1.), in the periods before December 2010 there is a significant relationship between the house price and the party preparing the valuation report.

[2] See full version of the thesis for all the dummy variables.

Table 1.Effect of the Notification Issued by the BRSA

Periods		Unstandardized Coefficients		Periods		Unstandardized Coefficients	
		β	Standard Error			β	Standard Error
0110	(Constant)	5.014	0.002	1210	(Constant)	5.017	0.001
	D_PARTY_1	-0.052	0.004	0111	(Constant)	5.025	0.001
0210	(Constant)	5.000	0.007	0211	(Constant)	5.026	0.001
	D_PARTY_1	-0.037	0.008	0311	(Constant)	5.027	0.001
	D_PARTY_3	0.023	0.007	0411	(Constant)	5.027	0.001
0310	(Constant)	4.973	0.002	0511	(Constant)	5.035	0.001
	D_PARTY_3	0.051	0.003	0611	(Constant)	5.041	0.001
0410	(Constant)	4.974	0.009	0711	(Constant)	5.032	0.001
	D_PARTY_1	-0.034	0.010	0811	(Constant)	5.041	0.002
	D_PARTY_3	0.054	0.009	0911	(Constant)	5.032	0.001
0510	(Constant)	5.023	0.003	1011	(Constant)	5.050	0.001
	D_PARTY_1	-0.147	0.006	1111	(Constant)	5.052	0.002
	D_PARTY_2	-0.037	0.013	1211	(Constant)	5.040	0.002
0610	(Constant)	5.016	0.003	0112	(Constant)	5.052	0.002
	D_PARTY_1	-0.152	0.006	0212	(Constant)	5.061	0.002
0710	(Constant)	5.017	0.003	0312	(Constant)	5.066	0.002
	D_PARTY_1	-0.150	0.006	0412	(Constant)	5.066	0.001
0810	(Constant)	5.020	0.004	0512	(Constant)	5.072	0.001
	D_PARTY_1	-0.216	0.008	0612	(Constant)	5.075	0.001
0910	(Constant)	5.021	0.002				
	D_PARTY_1	-0.080	0.005				
	D_PARTY_2	-0.023	0.010				
1010	(Constant)	5.000	0.006				
	D_PARTY_1	-0.027	0.007				
	D_PARTY_3	0.031	0.006				
1110	(Constant)	4.976	0.003				
	D_PARTY_3	0.061	0.003				

It means that, as of December 2010 the valuations began to be done independently of the subjective judgments and also the composition of the data was eliminated from the effect of individual decisions of banking sector. With regard to results of this analysis, the scope of the application was restricted from December 2010 to June 2012.

4. RESULTS AND DISCUSSIONS

The primary purpose is to analyze the marginal effects of various features of the houses on the prices to observe the price changes in the Turkish housing market and also its submarkets which affect the market itself and to calculate the pure price changes of the houses having constant features.

Results of the analysis for Turkey revealed that 31 structural and 26 locational (provinces) variables are the determining factors in housing prices. The coefficients of the structural variables mean that, for the last comparison period for instance, an elevator increases the hedonic house price of the house 3.5 percent or a stove heating system decreases the hedonic house price of the house 6.8 percent (Table 2.).

Table 2. Coefficients of the Structural Variables

Model	Unstandardized Coefficients		Model	Unstandardized Coefficients	
	β	Standard Error		β	Standard Error
(Constant)	5.172	0.006	D_KALT_1 (Luxury house)	0.111	0.004
D_ALAN_1 (Gross Area: 35-100 m²)	-0.270	0.005	D_KALT_2 (Good quality house)	0.045	0.001
D_ALAN_2 (Gross Area: 101-150 m²)	-0.170	0.005	D_ODA_1 (Have 1 room)	-0.137	0.004
D_ALAN_3 (Gross Area: 151-200 m²)	-0.065	0.005	D_ODA_2 (Have 2 rooms)	-0.100	0.003
D_ALAN_5 (Gross Area: 251-300 m²)	0.109	0.009	D_ODA_3 (Have 3 rooms)	-0.057	0.003
D_ALAN_6 (Gross Area: 301 m² or more)	0.174	0.009	D_OTOP (Have a parking lot)	0.016	0.001
D_ASANS (Have an elevator)	0.035	0.002	D_TKATN_2 (2-storey building)	0.049	0.004
D_BALK_1 (Have a balcony)	0.048	0.002	D_TKATN_4 (4-storey building)	-0.029	0.002
D_BALK_1_1 (Have only 1 balcony)	-0.007	0.002	D_TKATN_5 (5-storey building)	-0.031	0.002
D_BAN_1 (Have only 1 bathroom)	-0.047	0.002	D_TKATN_6 (6-storey building)	-0.038	0.002
D_BAN_3 (Have 3 or more bathrooms)	0.068	0.006	D_TKATN_7 (7-storey building)	-0.020	0.002
D_GUVN (Have security)	0.057	0.003	D_TKATN_12 (12-storey building)	0.017	0.005
D_HAV (Have a pool)	0.066	0.003	D_TKATN_14 (14-storey building)	0.033	0.006
D_IS_1 (Construction level: %100)	0.026	0.002	D_TKATN_15 (15-storey building)	0.055	0.004
D_ISIT_1 (Have a central heating system)	0.025	0.002	D_YYIL_8 (built btw 1993-1997)	-0.013	0.002
D_ISIT_3 (Have a stove heating system)	-0.068	0.002	D_YYIL_10 (built in 1987 or before)	0.052	0.002

Locations of the 26 provinces, which are determinants of house prices in Turkey, are shown on the map. It is interesting to note that these significant provinces border each other.

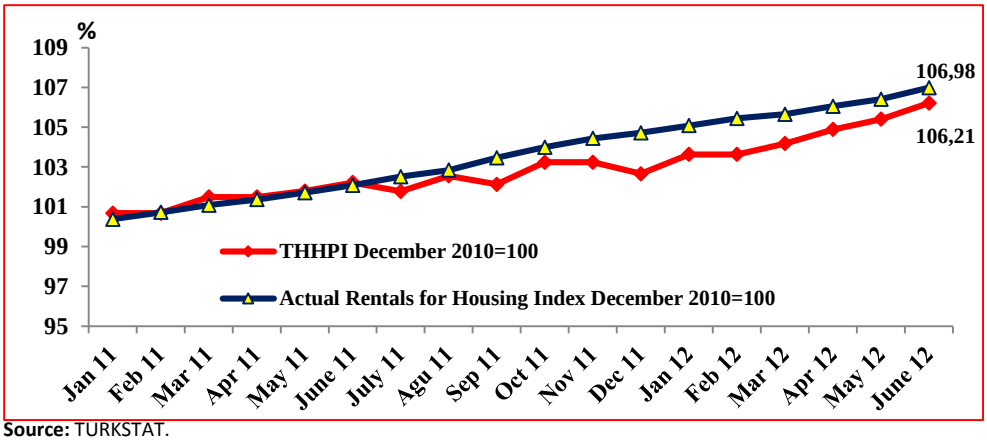
Figure 1: Locations of the 26 Provinces, Which are Determinants of House Prices in Turkey

Province of Aydın is excluded from the hedonic function for failing to protect the significance in all periods. Provinces of Gaziantep and Şanlıurfa have been identified as provinces that must be followed in the long term since they began to be significant during the last six periods. The coefficients of the locational variables mean that, for the last comparison period for instance, being in Istanbul increases the hedonic house price of the house 22.1 percent or being in Kahramanmaraş decreases the hedonic house price of the house 12.5 percent (Table 3.).

Table 3. Coefficients of the Locational Variables

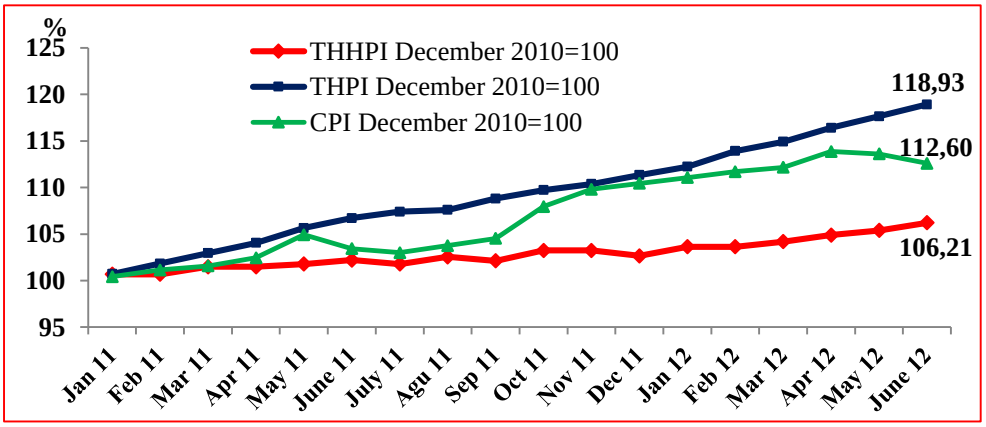
Model	Unstandardized Coefficients		Model	Unstandardized Coefficients	
	β	Standard Error		β	Standard Error
D_IL_01 (Adana)	0.041	0.005	D_IL_34 (İstanbul)	0.221	0.002
D_IL_02 (Adıyaman)	-0.086	0.012	D_IL_35 (İzmir)	0.153	0.003
D_IL_06 (Ankara)	0.062	0.002	D_IL_38 (Kayseri)	-0.044	0.005
D_IL_07 (Antalya)	0.070	0.003	D_IL_41 (Kocaeli)	0.045	0.004
D_IL_10 (Balıkesir)	0.066	0.005	D_IL_42 (Konya)	-0.031	0.005
D_IL_11 (Bilecik)	-0.057	0.010	D_IL_44 (Malatya)	-0.055	0.008
D_IL_16 (Bursa)	0.047	0.004	D_IL_45 (Manisa)	0.044	0.005
D_IL_17 (Çanakkale)	0.024	0.007	D_IL_46 (Kahramanmaraş)	-0.125	0.008
D_IL_19 (Çorum)	-0.069	0.008	D_IL_48 (Muğla)	0.158	0.006
D_IL_21 (Diyarbakır)	-0.061	0.006	D_IL_51 (Niğde)	-0.083	0.012
D_IL_26 (Eskişehir)	0.028	0.005	D_IL_72 (Batman)	-0.095	0.015
D_IL_31 (Hatay)	0.046	0.006	D_IL_77 (Yalova)	0.061	0.010
D_IL_33 (Mersin)	-0.05	0.004	D_IL_80 (Osmaniye)	-0.075	0.010

Figure 2: Hedonic house price index for Turkey (THHPI)



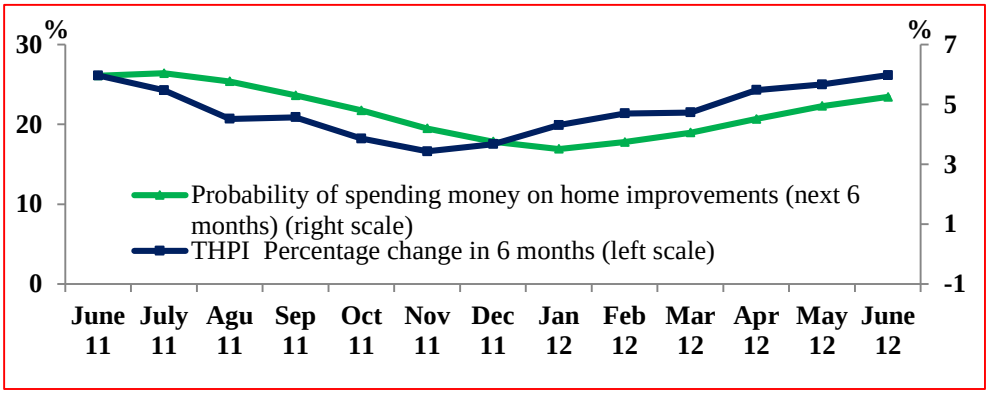
Source: TURKSTAT.

Figure 3: Comparison of Hedonic House Price Index for Turkey (THHPI) with Central Bank of Turkey Publishes House Price Index for Turkey (THPI) is made with the Consumer Price Index (CPI)



Source: TURKSTAT, CBRT

Figure 4: Probability of Spending Money on Home Improvements (Next 6 Months) and Central Bank of Turkey Publishes House Price Index for Turkey (THPI)



Source: TURKSTAT, CBRT

Comparing the Hedonic house price index for Turkey (THHPI) with the actual rentals for housing index, one of the sub-items of consumer price index (CPI), it is seen that (Figure 2.) THHPI is realized in the same direction but at a lower level.

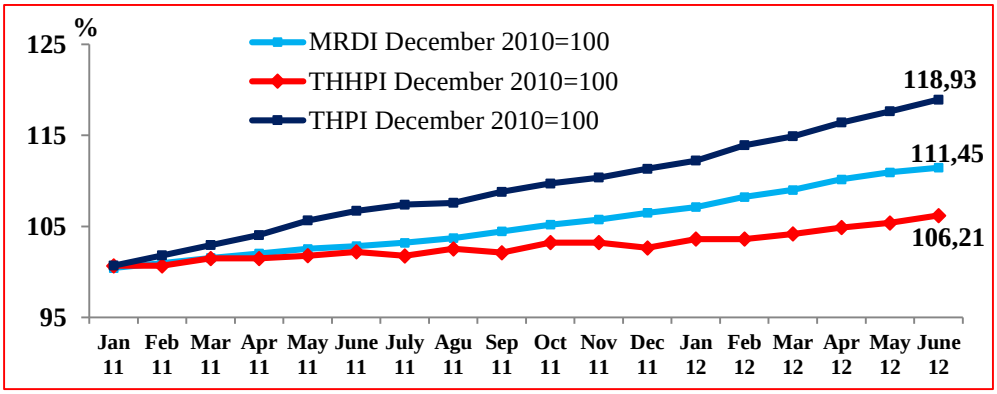
Comparison of THHPI with THPI is made with the CPI, because of the lack of relationship with all of the sub-items of CPI and housing, the desired level of explanatory power is not available (Figure 3.) On the other hand, it is observed that the percentage change in 6 months of the THPI has almost same direction with probability of spending money on home improvements (next 6 months), one of the sub-items of real sector confidence index (Figure 4.).

Central Bank of Turkey publishes house price index for Turkey (THPI) monthly by the method of stratified median price. The method of stratified median price cannot decompose the quality changes that occur in housing characteristics over time. Therefore, this method includes both time-based price changes and quality related price changes in the index value.

THHPI calculates the value of the pure price changes (time-based price changes) that occur under fixed housing characteristics. Comparison of THHPI with THPI is made with the value of maintenance and repair of the dwelling index (MRDI), one of the sub-items of CPI, it is seen that the value of THPI is very close to sum of the values of THHPI and MRDI (Figure 5.). MRDI represents the value of quality related price changes in the index value.

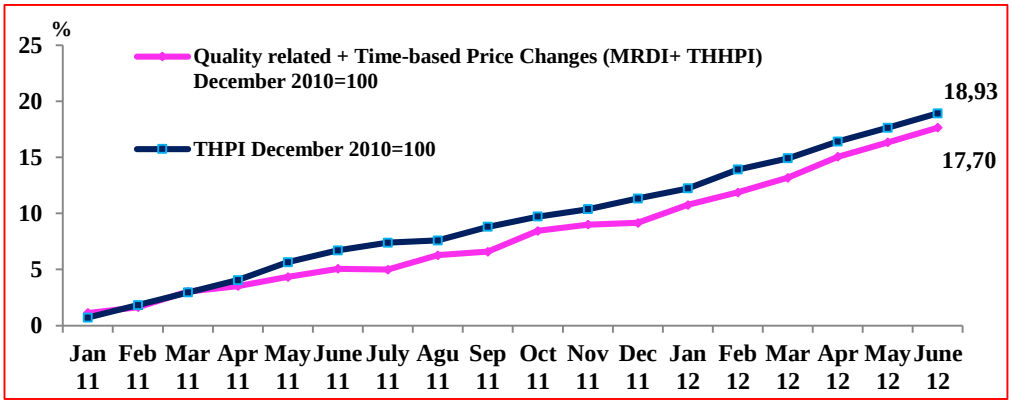
As a result, THPI ≅ THHPI + MRDI (Figure 6.)

Figure 5: Comparison of MRDI, THHPI and THPI



Source: TURKSTAT, CBRT

Figure 6: Comparison of MRDI + THHPI and THPI



Source: TURKSTAT, CBRT

The difference between the sum of THHPI and MRDI and the THPI occurs for two reasons. First, the methods used in THPI, MRDI and THHPI are different. And the second, there are some changes in price due to other unobservable variables.

In application, employing the parameters that are significant in every period ensures that hedonic price determined in one period is comparable with other periods. Thus, hedonic price trends can be followed in all periods. This refers to the fact that trends in consumer preferences can also be followed.

When the hedonic prices of some selected provinces examined during the 18 periods, it is seen that, the biggest increase in the hedonic price is observed in İstanbul. It can be inferred that, in general, consumers are willing to pay more to the houses in Istanbul than to the ones in the other provinces.

For the last period, being in İstanbul, Izmir, Muğla, Ankara and Antalya increases the hedonic house price of the house 22.12 %, 15.34%, 15.84%, 6.99% and 6.22%, respectively (Figure 7.).

It is seen from the area chart that consumers are willing to pay more for the houses which have an area of 251-300 m² (D_ALAN_5) or 301 m² or more (D_ALAN_6). In Turkey, in the cases of the houses which have an area of 35-100 m², 101-150 m² or 151-200 m², hedonic prices fall (Figure 8.).

Figure 7: THHPI for İstanbul, Izmir, Muğla, Ankara and Antalya

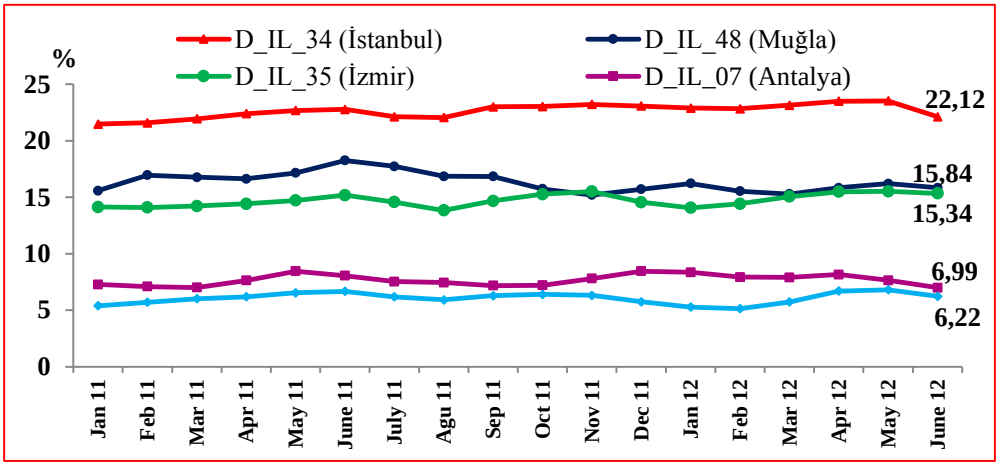


Figure 8: THHPI for Area of Houses

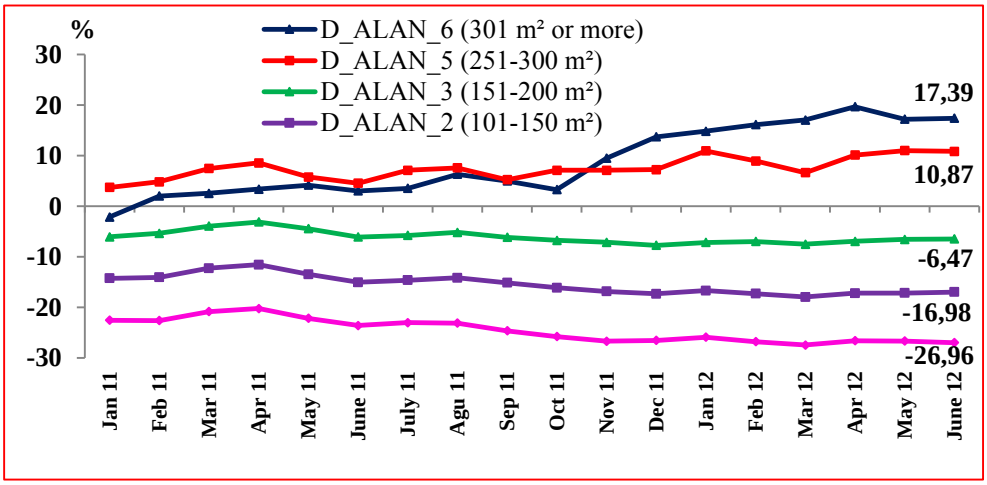
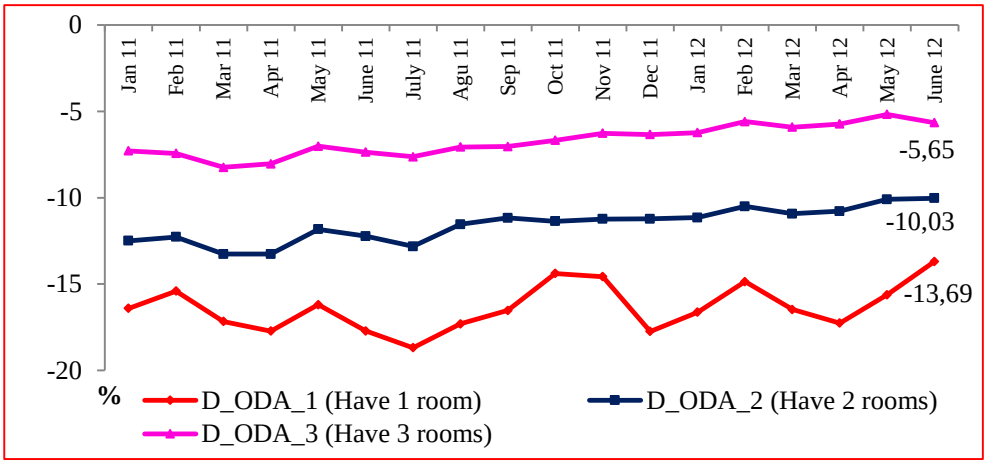


Figure 9: THHPI for Number of Rooms at Houses



In Turkey, consumers are willing to pay less to the houses with 1, 2 or 3 rooms. The hedonic price drops 5.65%, 10.03% and 13.69 % in the cases of 3, 2 or 1 rooms respectively (Figure 9.).

The findings with regard to the preferences of the number of rooms and the area of the house support each other.

5. CONCLUSION

In practice, in some locations (particularly in some districts), due to the lack of the composition and the quantity of the data, regional hedonic price index cannot be calculated. Therefore, in the long run, "multi-period time dummy variable method" is recommended for these locations.

Furthermore, some structural changes have been identified especially in some provinces and districts after a certain period. These structural changes emerged due to effects of TOKI (Republic of Turkey, Prime Ministry, Housing Development Administration) and other private housing projects in housing market. In practice, within the data set used in this study, there is no data for TOKI and other private housing projects. It is recommended that in order to conduct further analysis, TOKI and other private housing projects are included.

In addition, it is needed to monitor some of the results achieved in this study in the long-term. Therefore, evaluation of the results by repeating the analysis of each term is required.

REFERENCES

- Aizcorbe, A. and Pho Y., (2005). Differences in Hedonic and Matched-Model Price Indexes: Do the Weights Matter? BEA Working Paper, WP2005-2006, http://www.bea.gov/bea/papers/ hedonicprice.pdf

- Aoki, K., Proudman, J. and Vlieghe, G., (2004), House Prices, Consumption, and Monetary Policy: a Financial Accelerator Approach, Journal of Financial Intermediation, Elsevier, Vol. 13, Issue 4, p. 414 – 435.
- Eurostat (December 2011), Handbook on Residential Property Prices Indices.
- Goodman, A. C. (1978), Hedonic Prices, Price Indices and Housing Markets, Journal of Urban Economics, Vol.5, p.471 - 484.
- Haas, G. C. (1922), Sales Prices as a Basis for Farm Land Appraisal. Technical Bulletin No. 9, St. Paul, The University of Minnesota Agricultural Experiment Station.
- Kain, J. F. and Quigley, J. M., (1970), Measuring the Value of House Quality, Journal of the American Statistic-al Association Vol.65, Issue 330, p.532 - 548.
- Kim, S., (1992), Hedonic Prices and Housing Demand, The Review of Economics and Statistics, Vol. 74, Issue 3, p.503 - 508.
- Lancaster, K. (1966), Consumer Demand: A New Approach, The American Economic Review, Vol.65, p.194 - 199.
- Nair, B. P. (2004), Use of Hedonic Regression Methods for Quality Adjustments in Statistics Nz. Inflation Measures Division, Statistics New Zealand.
- Straszheim, M. R., (1973), Estimation of the Demand for Urban Housing Services from Household Interview Data, Review of Economics and Statistics, Vol.55, p.1 - 8.
- Palmqnist, Raymond, B. (1984), Estimating the Demand for the Characteristics of Housing, Review of Economics and Statistics, Vol. 66, p.394 - 404.
- Ridker, Ronald G. and Henning, John, A. (1967 May), The Determinants of Residential Property Values with Special Reference to Air Pollution, Review of Economics and Statistics, Vol.49, p. 246 - 257.
- Rosen, S. (1974), Hedonic Prices And Implicit Markets: Product Differentiation in Pure Competition, The Journal of Political Economy, Vol. 82, Issue 1, p.34 - 55.
- Triplett, J. E. (2006), Handbook on Hedonic Indexes and Quality Adjustments in Price Indexes: Special Application to Information Technology Products, OECD STI Working Paper.

- Vor, F., Groot, H. L. F., (2009), The Impact of Industrial Sites on Residential Property Values: A Hedonic Pricing Analysis for The Netherlands, Tinbergen Institute Discussion Paper 09-035/3.

- Vries, P., Haan J., Wal, E. V. D. and Mariën, G. (2009), A House Price Index Based on the Spar Method, Journal of Housing Economics, Vol.18, p.214 - 223.

- Widłak, M., Tomczyk, E., (2010), Measuring Price Dynamics: Evidence from the Warsaw Housing Market, Journal of European Real Estate Research, Vol. 3, Issue: 3, p.203 – 227.