THE DEMAND FOR NEW HOUSING IN TURKEY: AN APPLICATION OF ARDL MODEL

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ABSTRACT

This study provides empirical estimates for new residential homes demand function in Turkey using the time series data for the period 1964-2004.
An aggregate demand function for new private dwellings in Turkey is formed and is estimated using bounds testing cointegration procedure proposed by Pesaran *et al.* (2001) to compute the short and long-run elasticities of income and price variables. This study also implements CUSUM and CUSUMSQ stability tests on the estimated new housing demand function.
The empirical results indicate that income is the most significant variable in explaining the demand for new housing in Turkey and there exists a relatively stable new housing demand function.

I. INTRODUCTION

The aim of this study is to perform a recent single cointegration technique on the demand for new housing in Turkey and to explore the major determinants and to reveal the importance of a stable housing demand equation for economic policy evaluations.

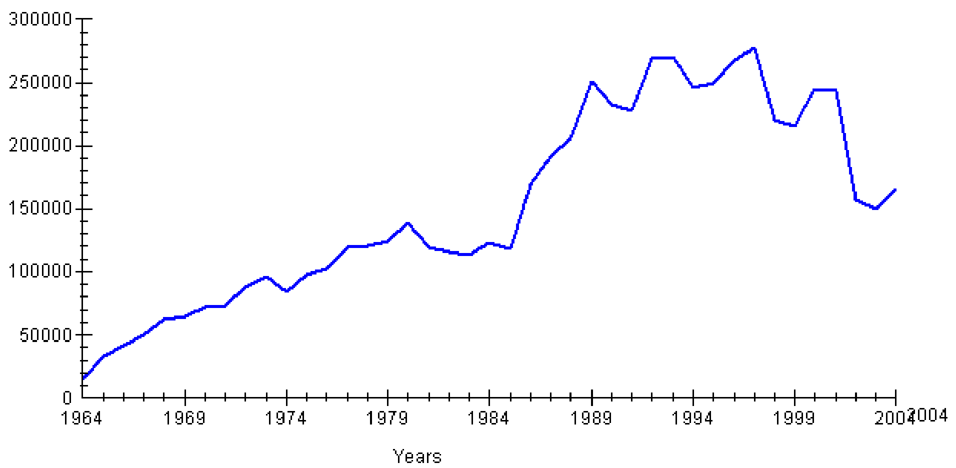
Housing markets presents an interesting field for economic research and it has been the subject of a significant number of studies since Muth's pioneering work in 1960. Housing demand is determined by a number of economic and demographic factors. According to Hillebrandt (2000) irrespective of whether the housing stock or newly constructed the demand for new housing will depend on the demand for all housing, the stock of housing and the amount of replacement; while the amount actually built will depend on this demand and the building industry's supply curve. The measurement of housing in terms of notional units of housing is a conceptual tool since housing is not homogeneous. Housing expenditures usually comprises 20% or more of the household budget, making it the largest single budget item as discussed in Borsch-Supan *et al*. (2001). The price of housing units depends on the internal characteristics of the house itself and external factors such as neighborhood amenities, open spaces, level of industrial use and so on.

In the literature there is considerable empirical evidence both at the micro and aggregate level on housing demand. Despite of a large increase in the literature on the demand for housing in the developing countries over the last two decades, there has not yet been a single empirical study concerning the housing demand in Turkey, as far as this paper is concerned. As a result, very little is known about the working of Turkish housing markets. This situation could be largely attributed to the apparent belief that data limitations combined with the weak socio-cultural and political institutions would hamper specifically the applicability of microeconomic models in the case of developing countries. For Turkey, it is true that microdata is limited. In regards to the macro modelling, however, aggregated time-series Turkish housing data is more readily available and reliable. Therefore, it is possible to conduct an aggregate analysis of the demand for housing in Turkey.

Most housing in Turkey is produced by private developers, public, quasi-public (cooperatives) or private organizations. There are also substantial amount of shanty houses or units of housing settlements around the city centers or provinces that are built by private persons but they are deemed to be illegal one way to another and are without occupancy or construction permits. However they usually benefit from the limited public utilities provided by the local councils. Spontaneous settlements in Turkey are a result of the socio-economic and demographic pressures, which accelerated in the last three decades. Baharoglu and Leitmann (1998) argued that these spontaneous settlements known *gecekondu* hold more than half of the urban populations in major Turkish cities. To this end, Beler and Turksoy (1989) analyses housing policy issues in Turkey in relation to different income groups and suggests the need for the social housing developments for lower income groups. Similarly, Pamuk (1996) assesses the policy tools between the formal and informal housing in Turkey. Housing finance in Turkey is very limited. The main state housing policy tools include subsidies in the form of preferential use of treasury lands and tax relief for the social housing developments that are constructed by the public and quasi-public organizations. As a consequence, Public authorities and cooperatives normally construct dwellings at a price lower than the market price. For the private housing finance, almost the entire system has been self-financing due to spiraling inflation rates in the last three decades borrowing for housing are deemed to be not financially sound instrument. Long running Turkish inflation rate has been recently brought down to single digits along with other economic indicators being more sustainable which lead to discussions of introducing mortgage policy to the Turkish housing market with a view to give a real push to the sluggish construction industry.

During the period, 1964-1984 private housing building activity expanded steadily and it experienced impressive high rates of investment in the period of 1985-1995 but as a result of high interest rates and dollarization of the 1990s which are compounded by the further two severe economic crises in 1999 and 2001 the private housing market declined sharply contributing to an excess demand of houses in the cities, see Figure 1 for a brief account of the new private housing units completions.

Figure 1: Total Units of Private Dwelling Completions by Occupancy Permits, 1964-2004 (in 000s).
Source: own evaluations from Turkish State Institute of Statistics.



This study differs from the previous empirical housing demand studies in a way that it employs a very recent single cointegration technique, Auto Regressive Distributed Lag (ARDL) approach as proposed by Pesaran *et al.* (2001) in addition to performing the stability tests on the selected regression equation. Moreover, there exists no previous other empirical work on the Turkish housing markets as far as this study is concerned.

The organization of the rest of this paper is as follows: section II is allocated to a brief literature review on housing demand. Section III outlines the econometric methodology that is employed in this research. Section IV deals with the econometric results and the concluding remarks are given in Section V.

II. A BRIEF LITERATURE REVIEW ON HOUSING DEMAND

The literature on housing demand is massive and it has been expanding rapidly. This section provides only a fraction of it. Initial literature on housing demand survey in de Leeuw (1971) which only aimed at the cross-section data studies in the 1960s whereas Mayo (1981) and Fulpen (1988) cover extensively theoretical and empirical studies on housing demand in the 1960s and 1970s and in the 1980s, respectively. Donatos (1995) and Ge and Lam (2002) contain a significant number of housing studies in the last two decades. As far as specifically the housing demand in the developing countries are concerned, Malpezzi and Mayo (1987) is only and the most extensive literature survey. The international literature basically provides empirical evidences on housing market in two categories; the first group of studies treats housing demand as a composite commodity (i.e., macro functions based on time series) the second groups analyze it in terms of individual attributes of housing demand (i.e., hedonic functions related to cross-sectional data).

Total housing demand is determined by economic and demographic factors. A number of different variables, such as the housing stock, total number of households and total expenditure on housing market can be used as variables in the model which lead to numerous studies especially related to the developed countries' housing markets.

As Malpezzi and Mayo (1987) argued there are three main reasons for the growth of this literature, firstly many practical issues in the specification of econometric housing models (such as the correct measurement of prices, quantities, incomes, and the choice of functional form) have led to a number of alternative approaches. Thus no generally accepted model exists. Secondly housing markets are not homogenous and show a great deal of diversity from one country to another or city. Therefore consensus amongst researchers on the income and prices of housing demand has been slow. Finally governments actively intervene in housing markets that requires detailed knowledge of housing demand factors.

Developing countries are more in need of modelling housing than the developed countries since the urbanization growth rate in developing countries are significantly higher than that of the developed countries. As indicated in Malpezzi and Mayo (1987), the housing market research in developing countries tend to be confined into a small number of countries but even this modest amount of research suggest that there are similarities in patterns of housing demand between the developed and developing countries. Accurate estimates of housing demand elasticities are useful not only for housing forecasts and policies, but also for analyzing such diverse issues as the burden of property taxes and suburbanization of metropolitan areas. Despite of significant empirical studies, estimates vary widely on the responsiveness of the demand for housing with respect to changes in permanent (or long-run expected) income and housing price. These differences have arisen largely from the use grouped (aggregated) rather than micro household observations in the cross-section analyses of housing demand. The main reason for employing grouped data is mean of income provides a better proxy for permanent income than does the measured income of an individual household, however as Polinsky (1977) has pointed out that effect of using group data is to impart various aggregation biases in estimating the elasticities of housing demand. The use of micro observations avoids these aggregation biases, but observations from single-year survey data make it difficult to derive the concept of permanent income, see Lee and Kong (1977). Malpezzi and Mayo (1987) reports that most income elasticities range between 0.5 and 1, and the median price elasticity is around -0.2 for the developing countries.

Donatos (1995) pointed out that many practical problems are related to the appropriate definition of income, housing and socio-demographic variables. The debate over income and housing consumption, particularly important in the 1960s and 1970s is characterized by a great heterogeneity of theoretical approaches and statistical procedures. Income maybe measured net or gross of taxation, current or permanent-permanent income, which is not directly measurable, can be approximated with a series of techniques. Housing consumption is even harder to define and quantify: mortgage repayments, market values, rates, rents and imputed rents have variously been used to measure housing expenditure. Also, there seems to be no consensus about the types of socio-demographic variables to be included in housing demand equations and the particular way they should enter these equations.

In brief, arguments in the literature are linked to situations in order to explain the differences in income and price elasticities of housing demand which are clearly dependent on type of data, econometric procedure, and the level of economic development in regards to the country specific studies.

III. METHODOLOGY

Ge and Lam (2002) summarizes a general function of the quantity demand for houses (Q_d) as follows:

$$Q_d = f(G, H_t, D, t) \qquad (t=1, 2, 3, \ldots n) \qquad (1)$$

where G stands for macroeconomic variables such as GDP, interest rates, stock exchange index, etc; H represents housing related variables such as house prices, income, unemployment rate, etc; and D is related to demographic variables such as population, number of marriages, birth rates, etc. Following Reichert (1990), Eq. (1) can be expressed in natural logarithmic multiple regression form as follows:

$$\ln Q_{d_t} = a_0 + a_1 \ln G_t + a_2 \ln H_t + a_3 \ln D_t + \varepsilon_t \qquad (2)$$

Selections of the appropriate economic and demographic variables for Eq. (1) are limited with the country specific cases and available data set to researchers. To this end, Mayo (1981), Fulpen (1988), and Ge and Lam (2002) provide extensive surveys on model specifications and empirical evidences in housing demand studies. In the light of those surveys, this study modifies Eq. (2) for Turkey as follows:

$$\ln HD_t = a_0 + a_1 \ln Y_t + a_2 \ln HC_t + a_3 \ln UR_t + \varepsilon_t \qquad (3)$$

Here, HD is the total units of private houses completed, Y is the real household disposable income, HC is the real average unit cost of dwellings. UR is the urbanization rate index. The expected signs for parameters are as follows: $a_1 > 0$, $a_2 < 0$, and $a_3 > 0$.

For investigating the long-run equilibrium (cointegration) among time-series variables, several econometric methods are proposed in the last two decades. Univariate cointegration examples include Engle and Granger (1987) and the fully modified OLS procedures of Phillips and Hansen's (1990). With regards to multivariate cointegration, Johansen (1988) and Johansen and Juselius (1990) procedures and Johansen's (1996) full information maximum likelihood procedures are widely used in empirical research.

The so-called autoregressive distributed lag (ARDL) also deals with single cointegration and is introduced originally by Pesaran and Shin (1999) and further extended by Pesaran *et al.* (2001). This method has certain econometric advantages in comparison to other single cointegration procedures. Firstly, endogeneity problems and inability to test hypotheses on the estimated coefficients in the long-run associated with the Engle-Granger method are avoided. Secondly, the long and short-run parameters of the model are estimated simultaneously. Thirdly, all variables are assumed to be endogenous. Fourthly, the econometric methodology is relieved of the burden of establishing the order of integration amongst the variables and of pre-testing for unit roots. In fact, whereas all other methods require that the variables in a time-series regression equation are integrated of order one, i.e., the variables are I(1), only that of Pesaran *et al*. could be implemented regardless of whether the underlying variables are I(0), I(1), or fractionally integrated.

An ARDL representation of Eq. (3) is formulated as follows:

$$\begin{aligned}\Delta \ln HD_t &= a_0 + \sum_{i=1}^{m} a_{1i}\Delta \ln HD_{t-i} + \sum_{i=0}^{m} a_{2i}\Delta \ln Y_{t-i} + \sum_{i=0}^{m} a_{3i}\Delta \ln HC_{t-i} + \sum_{i=0}^{m} a_{4i}\Delta \ln UR_{t-i} + a_5 \ln HD_{t-1} \\ &+ a_6 \ln Y_{t-1} + a_7 \ln HC_{t-1} + a_8 \ln UR_{t-1} + \varepsilon_t\end{aligned} \tag{4}$$

Investigation of the presence of a long-run relationship amongst the variables of Eq. (3) is tested by means of bounds testing procedure of Pesaran *et al.* The bounds testing procedure is based on the F or Wald-statistics and is the first stage of the ARDL cointegration method. Accordingly, a joint significance test that implies no cointegration, (H_0: $a_5 = a_6 = a_7 = a_8 = 0$), should be performed for Eq. (4). The F test used for this procedure has a non-standard distribution. Thus, Pesaran *et al*. compute two sets of critical values for a given significance level. One set assumes that all variables are I(0) and the other set assumes they are all I(1). If the computed F-statistic exceeds the upper critical bounds value, then the H_0 is rejected. If the F-statistic falls into the bounds then the test becomes inconclusive. Lastly, if the F-statistic is below the lower critical bounds value, it implies no cointegration. This new approach is similar to the Johansen and Juselius multivariate cointegration procedure, which has five alternative cases for long-run testing too.

Once a long-run relationship is established, then the long-run and error correction estimates of the ARDL model can be obtained from Eq. (4). At the second stage of the ARDL cointegration method, it is also possible to perform a parameter stability test for the appropriately selected ARDL representation of the error correction model.

The stability of coefficients of regression equations are, by and large, tested by means of Chow (1960), Brown *et al*. (1975), Hansen (1992), and Hansen and Johansen (1993). The Chow stability test requires *a priori* knowledge of structural breaks in the estimation period and its shortcomings are well documented (see for example Gujarati, 2003). In Hansen (1992) and Hansen and Johansen (1993) procedures, stability tests require I(1) variables and they check the long-run parameter constancy without incorporating the short-run dynamics of a model into the testing - as discussed in Bahmani-Oskooee and Chomsisengphet (2002). However, it is possible to overcome these shortcomings by employing the Brown *et al*. procedure if we follow Pesaran and Pesaran (1997). The Brown *et al*. stability testing technique, also known as cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests, is based on the recursive regression residuals. The CUSUM and CUSUMSQ statistics are updated recursively and plotted against the break points of the model. Providing that the plot of these statistics fall inside the critical bounds of 5% significance then we assume that the coefficients of a given regression are stable. These tests are usually implemented by means of graphical representation.

A general error correction representation of Eq. (4) is formulated as follows:

$$\Delta \ln HD_t = a_0 + \sum_{i=1}^{m} a_{1i}\Delta \ln HD_{t-i} + \sum_{i=0}^{m} a_{2i}\Delta \ln Y_{t-i} + \sum_{i=0}^{m} a_{3i}\Delta \ln HC_{t-i} + \sum_{i=0}^{m} a_{4i}\Delta \ln UR_{t-i} + \lambda EC_{t-1} + u_t \tag{5}$$

where λ is the speed of adjustment parameter and EC is the residuals that are obtained from the estimated cointegration model of Eq. (4).

IV. ESTIMATION

In analyzing the time series data properties, the Augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979 and 1981) unit root test is most commonly applied. The ADF unit root tests for the variables are implemented and Table 1.1 of appendix displays results. All the series in Eq. (3) appear to contain a unit root in their levels, indicating that they are integrated at order one and thus they are difference stationary.

A two-step ARDL cointegration procedure is implemented in estimating Eq. (4) for Turkey using annual data over the 1964-2004 periods. In the first stage, to ascertain the existence of a long-run relationship among the variables in Eq. (4), the bounds testing approach was employed. In the second stage, Eq. (4) was estimated by the ARDL cointegration method.

In the first stage of the ARDL procedure, the order of lags on the first –differenced variables for Eq. (4) is usually obtained from unrestricted vector autoregression (VAR) by means of Akaike Information Criterion (AIC) and Schwarz Bayesian Criterion (SBC), which indicated the optimal lag level as one for this study, see Table 1.2 of appendix. Then an F deletion test was applied to Eq.(4) in order to test the existence of a long-run housing demand equation which warrants proceeding to the second stage of estimation, see Table 1.3 of appendix.

In a search to find the optimal length of the level variables of the long-run coefficients of Eq. (4), lag selection criteria of AIC, and SBC were utilized. The long-run results of Eq. (4) based on several lag criteria are reported in Panel A of Table 2 along with their appropriate ARDL models. The diagnostic test results of Eq. (4) for short-run estimations are also displayed in the respective columns of each selection criterion in Panel B of Table 2. As can be seen from Table 2, the long-run results are very similar with regard to coefficient magnitudes and statistical significance. All the estimated models display the expected signs for the regressors and they are statistically significant.

Table 2. ARDL Estimations

Panel A: the long-run results		
Dependent variable $\ln HD$		
	Model Selection Criterion	
Regressors	AIC	SBC
	ARDL (1,0,1,1)	ARDL (1,0,1,1)
$\ln Y$	1.151	0.996
	(2.532)	(2.625)
$\ln HC$	-0.201	-0.227
	(3.129)	(2.849)
$\ln UR$	0.019	0.034
	(2.216)	(2.416)
Constant	1.913	2.398
	(3.952)	(3.872)
Panel B: the short-run diagnostic test statistics		
	$\chi^2_{SC}(1)=0.484$	$\chi^2_{SC}(1)=0.085$
	$\chi^2_{FC}(1)=3.460$	$\chi^2_{FC}(1)=2.870$
	$\chi^2_{N}(2)=0.385$	$\chi^2_{N}(2)=1.873$
	$\chi^2_{H}(1)=0.213$	$\chi^2_{H}(1)=0.047$

Notes: The absolute value of t-ratios is in parentheses. χ^2_{SC}, χ^2_{FC}, χ^2_{N}, and χ^2_{H} are Lagrange multiplier statistics for tests of residual correlation, functional form mis-specification, non-normal errors and heteroskedasticity, respectively. These statistics are distributed as Chi-squared variates with degrees of freedom in parentheses.

In order to implement the stability test on the preferred error correction representation of the ARDL method, the ARDL error correction representation of Eq. (5) were estimated as auxiliary models. The estimation results and the respective appropriate optimal lag length selection criteria are displayed in Table 3.

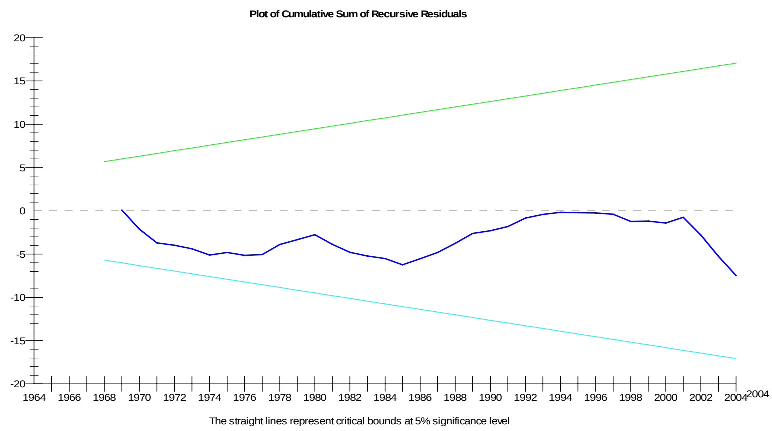
Table 3. Error Correction Representations of ARDL Model
Dependent variable $\ln \Delta HD_t$

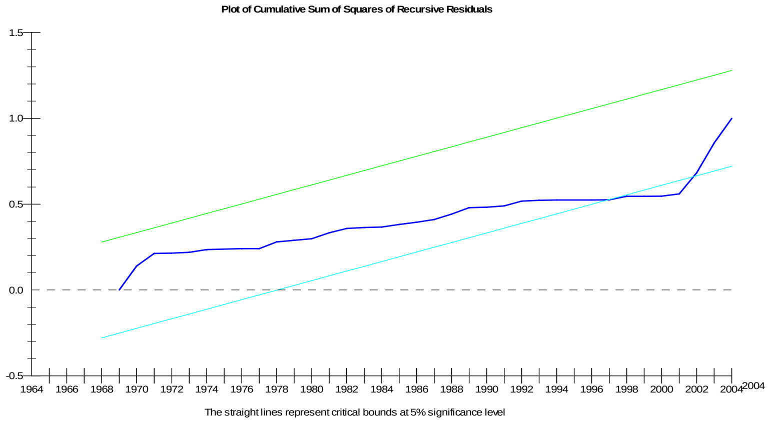
	Model Selection Criterion	
Regressors	AIC ARDL (1,1,1,0)	SBC ARDL (1,1,0,0)
$\ln \Delta HD_{t-1}$	0.708 (5.660)	0.959 (3.545)
$\ln \Delta Y_t$	0.632 (3.112)	0.529 (2.851)
$\ln \Delta Y_{t-1}$	0.186 (1.298)	0.165 (1.109)
$\ln \Delta HC_t$	-0.359 (2.762)	-0.514 (2.621)
$\ln \Delta HC_{t-1}$	0.241 (1.349)	0.120 (1.743)
$\ln \Delta UR_t$	0.035 (2.429)	0.092 (2.356)
Constant	2.145 (3.420)	2.090 (3.390)
EC_{t-1}	-0.295 (3.093)	-0.281 (2.643)
$\overline{R}^2$	0.591	0.583
F-statistics	5.637	5.116
DW-statistics	1.806	1.834
RSS	0.540	0.547

Notes: The absolute values of t-ratios are in parentheses. RSS stands for residual sum of squares.

Table 3 enables us to select the most appropriate model of implementing the stability test for the housing demand equation. According to the reported diagnostic tests results, the AIC-based error correction model of Eq. (4) seems to be relatively better fit than the SBC-based error correction model. Therefore, although we also performed the CUSUM and CUSUMSQ stability tests for the SBC-based error correction model, we present only the graph of the AIC-based error correction model. It can be seen from Figure 2, the plots of CUSUM and CUSUMSQ statistics are within the critical bounds implying that all coefficients in the error correction model are stable.

Figure 2. CUSUM and CUSUMSQ Plots for Stability Tests





V. CONCLUSIONS

This study attempted to estimate an aggregate private housing demand function for Turkey using a recent single cointegration technique, ARDL. The results from this estimation suggest that the most significant factor in determining the level of housing demand is real income, which is followed by the house prices and urbanization level. The estimated income and price elasticities are in line with the previous empirical studies in the housing demand literature. This paper was able to present empirically that the estimated private housing demand function reveals a stable long-run relationship between its dependent and independent variables. To this end, it utilized the CUSUM and CUSUMSQ stability tests and they indicate that there exists a relatively stable housing demand function. Fluctuations in the Turkish private housing demand have seemed to be following the general cyclical pattern of the macroeconomic indicators. The financial liberalisations in the early 1980s gave a big impetus in the number of dwellings built for about a decade. The unfavourable macroeconomic and political situations in the 1990s, which eventually lead to a couple of series economic crises recently, have caused a major decline in the private housing market. Considering inward and backward linkages of the construction industry with the rest of the other industries in an economy, the private housing sector requires special financial incentives. To this end, in the light of the recent improvements in the Turkish macroeconomic indicators, ongoing policy discussions on the private housing financing in the form of mortgage is a rather plausible housing policy option. Moreover providing temporary tax relief and limited usage of the treasury lands at market costs to the private developers may reduce the current excess housing demand to certain extent. In order to alleviate pressure the spontaneous settlements in and around the major cities of Turkey, social housing developments by the public and cooperatives should be encouraged significantly through further subsidies.

These results indicate that it is possible to use the estimated aggregate private housing demand function as a policy tool in implementing housing policy in Turkey. As far as the Turkish housing policy is concerned, it is assumed that stability of a housing demand function will reduce the uncertainty of macro economic environment and will increase the credibility of its commitment to pursue a sustainable housing policy. For a sustainable housing policy and stable housing demand, the Turkish government should continue to provide more business incentives and develop economic policy tools to both to the public and non-public housing organisations so that they would stimulate successive investment in the construction sector.

APPENDIX. VARIABLES, DATA SOURCES AND ADDITIONAL TEST RESULTS

All series are in natural logarithmic form (*ln*). Definitions of variables and data sources are as follows:

DH is the total of housing units constructed by the private sector and granted occupancy permits by the local councils. Source: Economic and Social Indicators 1923-1998 and subsequent annual issues, Turkish State Institute of Statistics, (SIS), Ankara. *Y* is the real disposable income millions of Turkish Liras (TL) at 1990 prices, used as a proxy for permanent income. The nominal household's consumption expenditures are deflated by the Turkish consumer price index (CPI) of 1990=100. Source: SIS. *HC* is the average real cost of a unit dwelling in thousands of Turkish Liras. Since there is no data available on house prices, it represents a proxy for the house prices. The average nominal unit dwelling costs are deflated by the CPI=1990. Source: SIS. UR is the urbanization rate described as the ratio of total cities and town population to the total population. This ratio is converted to 1990=100 base index. The Turkish definition of town refers to the residential area that its population is greater than two thousand people and it has a municipality. Source: SIS

Table 1.1 Order of Integration

Variable	Levels	*k* lag	Difference	*k* lag
*ln*HD	-1.894	1	-4.597*	1
*ln*Y	-1.651	1	-5.325*	1
*ln*HC	-1.032	1	-6.315*	1
*ln*UR	-3.055	3	-3.750*	3

Notes: Sample levels 1964-2004 and differences 1965-2004. Rejection of unit root hypothesis, according to McKinnon's critical value at 5 % is indicated with an asterisk. ADF tests include an intercept and a 1 to 5 lagged difference variable and *k* stands for the lag level that maximizes the AIC (Akaike Information Criteria) and SBC (Schwarz Bayesian Criteria).

Table 1.2 The order of the VAR model

Order	AIC	SBC
4	124.170	89.399
3	124.031	82.152
2	127.946	98.950
1	132.866	116.697
0	9.745	6.523

Table 1.3 F-statistic for testing the existence of a long-run housing demand equation

Order of Lag	F-statistic
1	$F(4, 27)=3.9306^{*}$

Notes: The relevant critical value bounds are obtained from Table C1.iii (with an unrestricted intercept and no trend; with three regressors) in Pesaran *et al.* (2001). They are 2.72-3.77 at 90%, and 3.23- 4.35 at 95%. * denotes that the F-statistic falls above the 90% upper bound.

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