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Housing market activity and macroeconomic variables: an analysis of Turkish dwelling market under new mortgage system

Ali Hepşen[1] **Nazlı Kalfa**[2]
Finance Department
Faculty of Business Administration
Istanbul University, Istanbul, Turkey

Abstract

The primary purpose of this paper is to examine dynamic causal relationships between housing market activity (construction permits for private use) and six determinants, including consumer price index (CPI), monetary aggregate (M2), interest rate (IR), industrial production index (IPI), real estate investment trusts' indices (REITIX) and volume of mortgage loans (ML), in Turkish dwelling market under new mortgage system. Granger causality tests, impulse response functions and variance decomposition models are utilized for the period 2002 to 2007.

Keywords: *Housing Investment; Granger Causality Tests, Variance Decomposition Models*

Konut piyasası hareketleri ve makroekonomik değişkenler: Türkiye Konut Piyasasının yeni mortgage sistemi altında analizi.

Özet

Bu çalışmanın temel amacı ülkemizdeki konut piyasası hareketleri ile dinamik nedensellik ilişkisine sahip olan değişkenleri belirlemektir. Çalışma kapsamında tüketici fiyat endeksi (CPI), para arzı (M2), faiz oranı(IR), sanayi üretim endeksi (IPI), gayrimenkul yatırım ortaklıkları endeksi (REITIX) ve ipotek kredilerinin hacmi (ML) olmak üzere altı değişken yer almaktadır. Granger nedensellik testi, etki-tepki fonksiyonları ve varyans ayrışım modellerinin kullanıldığı çalışma 2002 – 2007 dönemini kapsamaktadır.

Anahtar Sözcükler: *Konut Yatırımları; Granger Nedensellik Testi; Varyans Ayrışım Modelleri.*

1. Introduction

Policy makers and academicians have long been interested in understanding in fluctuation evident in investment activity in the real estate market. There are several reasons for this interest. First, the perceived value of residential fixed investment as an important leading indicator (Wheeler and Chowdhurry [1], Smith and Tesarek [2]). Second, the performance of the housing market has a major impact on the overall performance of the macro economy (Baffoe-Bonnie [3]).

The fluctuations in housing market variables have stimulated a great deal of academic research. These research concentrated attention on modeling and explaining of housing market variables in the context of a partial macroeconomic framework. Typical researches are those of Mankiw and Weil [4], Case and Shiller [5], Poterba [6], Potepan [7], and Quigley [8]. Key economic variables, such as interest rates, consumer price index (CPI), employment, income, population, and money supply, are usually considered

[1] *alihepsen@yahoo.com (A. Hepşen)*

[2] *nazlikalfa@yahoo.com (N. Kalfa)*

in separate demand and supply equations to investigate whether the general economic conditions can explain housing market activities.

The paper is structured as follows. The next section begins by reviewing some of the existing studies on housing market activities. In section III describes the methodologies employed in this paper. Section IV reviews the data and their time series properties. Section V presents empirical results. Finally section VI provides some concluding remarks.

2. Literature Review

There are several studies on the relationship between interest rates and macroeconomic variables. Bernanke and Blinder [9] noted that the interest rate on U.S. Federal funds was very sensitive to the moving of macroeconomic variables, and the interest rate was an important explanatory variable in monetary policy actions. Stone and Ziemba [10] argued that the fluctuation of interest rate in Japan was the primary cause of the change in property values, including land values between 1985 and 1989, and the notable decrease between 1990 and 1992. On the other hand, Quan and Titman [11] identified that the housing values were closely related to stock values in the long-term, and they were also influenced by the growth rate of the gross domestic product (GDP). Wheaton [12] confirmed a long-term cycle in the growth of office building values and he also noted [13] that the cycle of housing value fluctuations was very different according to housing type. Anari and Kolari [14] note the long term impact of inflation on the homeowner equity by investigating housing price and non-housing goods and services. There are a few studies on the dynamic relationship between housing values and interest rates in the emerging markets. The findings of these researches suggest that the interest rate adjustment policy in developing countries can work very effectively and will contribute to forecasting the growth rate of future housing values (Ji [15], Yun [16], Ma [17], and Cho and Ma [18]).

The relationship between employment and housing market activities is well documented in the literature. Housing market activity is stimulated by higher employment growth, while a decline in real estate activity is associated with lower employment growth (Smith and Tesarek [19], Sternlieb and Hughes [20]).

In addition to interest rate and employment, money supply is an important factor that known to impact many macroeconomic variables (Lastrapes [21]). For example, money supply affects housing investment through its effect on interest rates. The academic researchers studied in developed countries indicate that money supply shocks significantly affect real housing investment (Baffoe-Bonnie [22], Lastrapes [23]).

There are a few studies on the dynamic relationship between housing market activities and macroeconomic variables in the Turkish housing market. The leading article written by Sarı, Ewing and Aydın [24] investigated the relationship between housing starts and macroeconomic variables in Turkey for the period of 1961 to 2000. The article identified that the monetary aggregate has a relatively more important and substantial impact on housing investment than does employment.

3. Methodologies Applied

3.1. Granger Causality Test

Granger causality is a technique for determining whether one time series is useful in forecasting another. A time series *X* is said to Granger-cause *Y* if it can be shown, usually through a series of F-tests on lagged values of *X* (and with lagged values of *Y* also known), that those *X* values provide statistically significant information about future values of *Y*.

The test works by first doing a regression of ΔY on lagged values of ΔY. Once the appropriate lag interval for Y is proved significant (t-stat or p-value), subsequent regressions for lagged levels of ΔX are performed and added to the regression provided that they 1) are significant in and of themselves and 2) add explanatory power to the model. This can be repeated for multiple ΔX's (with each ΔX being tested independently of other ΔX's, but in conjunction with the proven lag level of ΔY). More than 1 lag level of a variable can be included in the final regression model, provided it is statistically significant and provides explanatory power.

3.2. Test of Volatility

İşyerlerinde gerçekleştirilen bu tür zorbaca ve yıldırma amaçlı eylemlere ilişkin materyalin

There are two approaches, impulse response function and variance decomposition, for characterizing the dynamic behavior of the VAR model. The response function and variance decomposition technique suggested by Sims [25] are useful devices in the VAR analysis for testing the sources of variability.

The impulse response functions can be used to produce the time path of the dependent variables in the VAR, to shocks from all the explanatory variables. If the system of equations is stable any shock should decline to zero, an unstable system would produce an explosive time path.

The variance decomposition is an alternative method to the impulse response functions for examining the effects of shocks to the dependent variables. This technique determines how much of the forecast error variance for any variable in a system, is explained by innovations to each explanatory variable, over a series of time horizons. Usually own series shocks explain most of the error variance, although the shock will also affect other variables in the system. It is also important to consider the ordering of the variables when conducting these tests, as in practice the error terms of the equations in the VAR will be correlated, so the result will be dependent on the order in which the equations are estimated in the model.

4. The Data

Monthly time series data are used for analyses for the period of 2002-2007. The sample period is dependent on monthly data availability. Following Sarı, Ewing and Aydın [26], Ewing and Wang [27], Kenny [28], Baffoe-Bonnie [29], and Wheeler and Chowdhury [30], the variables include the natural logarithm of construction permits for private use (CP), consumer price index (CPI), monetary aggregate (M2), interest rate (IR), industrial production index (IPI), real estate investment trusts' indices (REITIX) and volume of mortgage loans (ML). These series are seasonally adjusted. On the other hand the data was gathered from the State Institution of Statistics (SIS), the Central Bank of Turkey, the Bank Association of Turkey and the Istanbul Stock Exchange.

In the paper, the construction permits for two and more dwelling residential buildings are used to measure the housing market activity instead of housing prices. Because there were no official aggregate housing price indices or series in Turkey. Construction covers construction on land and in water, permanent and temporary, public and private, above ground and underground, including additions, alterations and repairs as well as immovable and movable establishment. Construction permit is a certificate which must be given by municipalities to be constructed in the boundaries of municipalities and it must be given by governorships (Turkish Statistical Indicators, 1923-2006 [31]). As Sarı, Ewing and Aydın [32] implied, whether or not a house is actually constructed, the housing permit data signifies plans or intentions to start construction.

M2 money reflects the impact of the government's monetary policy on the housing market. The indicative 12-month interest rate of Treasury bill is used. In the paper, prices are measured by the consumer price index (CPI). On the other hand, the real estate investment trusts' indices (REITIX) and volume of mortgage loans (ML) were obtained from the Istanbul Stock Exchange and the Bank Association of Turkey, respectively. Finally, the industrial production index (IPI) is used to determine the national income of Turkey.

5. Empirical Results

The equation for the reduced form of the housing market model to assess the interaction of housing construction permits and macro economic variables.

CP = f(CPI, M2, IPI, IR, REITIX, ML)

We employ Granger causality test, impulse response analyses and variance decompositions generated from VAR. The variables were firstly tested for unit root non stationary by using unit root tests proposed by Dickey and Fuller [33]. The results related to unit root tests are reported in Table 1. The hypothesis that the variables CP, CPI, M2, IPI, IR and REITIX contain a unit root could not be rejected at the 5% significance level. In addition, mortgage loan is stationary at the 10% significance level.

Table 1: Unit Root Tests Results

Variables	Without trend	With trend
CP	-9,18739 (1)*	-9,43607 (1)*
CPI	-3,83214 (0)*	-4,57316 (0)*
M2	-6,34092 (0)*	-6,39344 (0)*
IPI	-12,1658 (1)*	-12,1367 (1)*
IR	-7,06242 (0)*	-7,29481 (0)*
REITIX	-9,11347 (0)*	-9,04702 (0)*
ML	-2,64333 (0)**	-2,37526 (1)

Notes: * denotes significant at 5% level; and ** denotes significant 10% level.

Figures in brackets denote the number of lags in the augmented term.

The order of VAR, that is, the optimal number of lags used on each of the endogenous variables in the system was determined by the likelihood ratio (LR) method and final prediction error (FPE). Up to twelve lags are tested. The smallest valued occur in sixth period lags for both LR and FPE.

5.1. Granger Causality Test

This section concerned with tests of Granger causality between construction permits and macroeconomic variables. The estimated F-statistics of the causality test are reported in Table 2.

Table 2: Granger Causality Test

Variables	Granger Causality	F-statistics	Probabilities
ln(CP) - ln(CPI)	ln(CP) → ln(CPI)	3.233	0.046
ln(CP) - ln(M2)	ln(CP) → ln(M2)	12.852	2.00E-05
ln(CP) - ln(IPI)	ln(CP) ← ln(IPI)	6.190	0.003
ln(CP) - ln(IR)	ln(CP) ↔ ln(IR)	4.696/ 4.373	0.013/ 0.017
ln(CP) - ln(REITIX)	ln(CP) → ln(REITIX)	3.468	0.037
ln(CP) - ln(ML)	ln(CP) ↔ ln(ML)	3.274/ 4.076	0.044/ 0.022

The results indicate that construction permits Granger-cause CPI, M2 and REITIX. The industrial production index (IPI) (national income) is a Granger cause of construction permits without the feedback. Increases in the number of construction permits influenced by the changes in industrial production in Turkey.

Construction permits Granger-cause interest rate (IR) changes and there is a feedback from the interest rate to the construction permits.

Construction permits Granger-cause volume of mortgage loans (ML) changes and there is a feedback from the mortgage loans to the construction permits.

5.2. Variance Decomposition

It is possible to decompose the total variance of housing prices in each of the future periods and determine how much of this variance each macroeconomic variable explains. The estimates of variance decomposition are shown in Table 3 for 10 periods.

Table 3: Variance Decomposition of Construction Permits

Period	lnΔCP	lnΔIPI	lnΔIR	lnΔML
1	100%	0%	0%	0%
2	74,41%	17,67%	3,35%	4,58%
3	57,86%	28,22%	2,89%	11,02%
4	58,48%	27,64%	2,89%	10,99%
5	56,41%	29,50%	2,87%	11,22%
6	55,75%	28,87%	3,39%	11,99%
7	53,60%	27,77%	3,40%	15,24%
8	53,28%	27,68%	3,57%	15,46%
9	54,30%	27,01%	3,49%	15,20%
10	53,18%	25,94%	3,33%	17,55%
Average	**62%**	**24%**	**3%**	**11%**

The results indicate that disturbance originating from construction permits itself inflicted the greatest variability to future permits. The average of 62 percent variability contributed by construction permits changes, there remains 38 percent of variability which is explained by three other factors. The largest source of construction permits variance appears to be from industrial production index (IPI), which accounts for approximately 63 percent of the total variance contributed by the three determinants (that is 24 percent of the total construction permits variance). The second largest proportion of construction permits variance appears to be volume of mortgage loans, which accounts for approximately 29 percent of the total variance contributed by the three determinants (that is 11 percent of the total construction permits variance). The final variable in the model, interest rate, contributes 8 percent to construction permits variance (that is 3 percent of the total construction permits variance).

5.3. Impulse Response Functions

Although variance decomposition by the estimate of the proportion of construction permits variance accounted its determinants, it cannot indicate whether the impact is positive or negative, or whether it is a temporary jump or long run persistence. Thus, the impulse response functions show that the dynamic behavior of a variable can be attributed to random shock in other variables. An impulse response function shows how a variable in the VECM system responds to a single 1 percent exogenous change in another variable of interest.

Figure 1 to 4 illustrates the estimated impulse response functions for 10 periods. In response to a one standard deviation disturbance in current construction permits itself (Figure 1), future construction permits increase by 16,1 percent in the first period. In Figure 2, a shock to the industrial production index initially produces a negative impact on housing demand in first two periods and has a large positive impact in third period. It seems to approach their steady-state level after about six periods. A one standard deviation disturbance originating from interest rate (Figure 3) indicates that there is a fluctuation in first seven period and reaches its steady level. Finally Figure 4 indicates that a shock in volume of mortgage loans increases and decreases construction permits, which reaches its maximum level at third period (0,08) and reaches its minimum level at seventh period (-0,06).

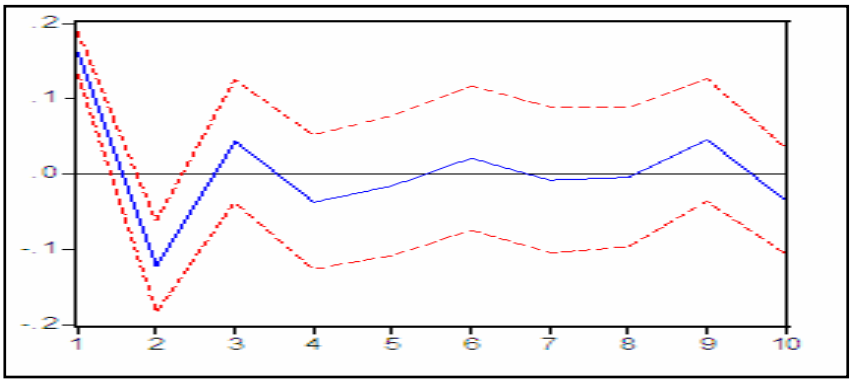

Figure 1: Response of Construction Permits to Construction Permits

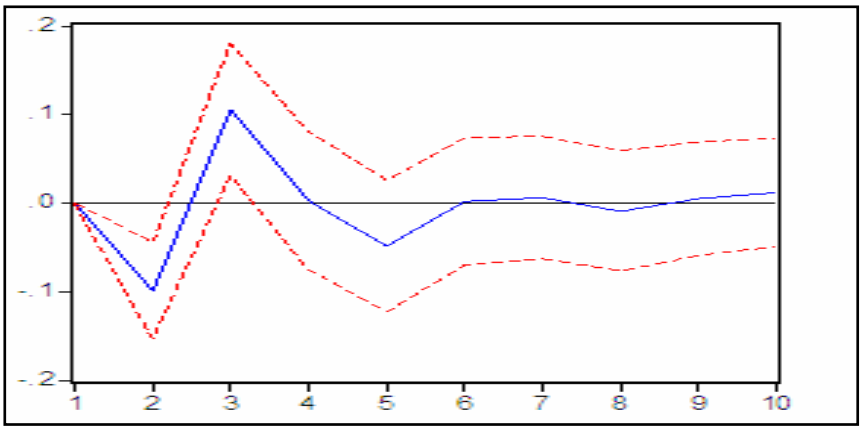

Figure 2: Response of Construction Permits to Industrial Production Index

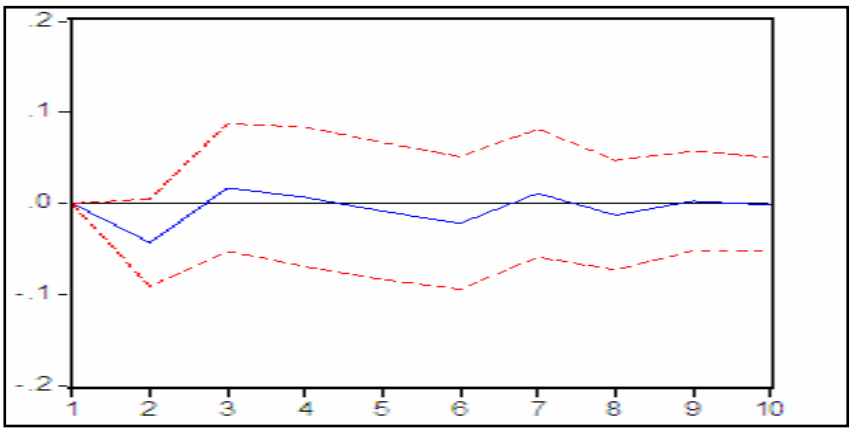

Figure 3: Response of Construction Permits to Interest Rate

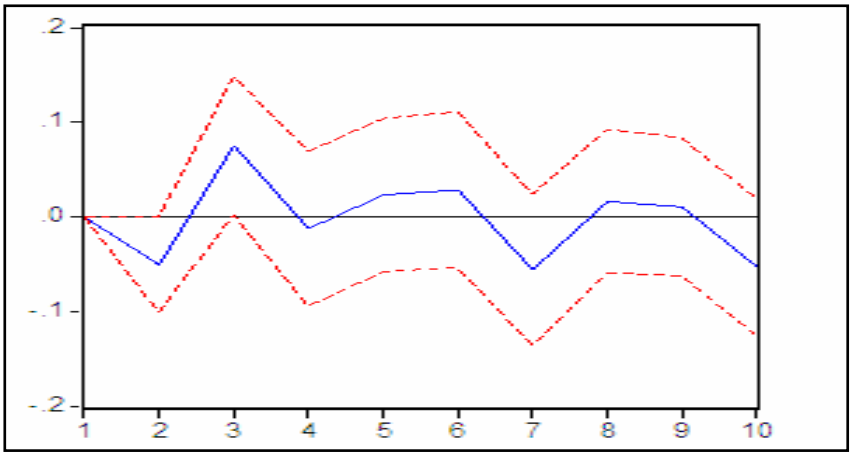

Figure 4: Response of Construction Permits to Volume of Mortgage Loans

6. Conclusion

The overall objective of this paper is to examine dynamic causal relationships between housing market activity (construction permits for private use) and six determinants, including consumer price index (CPI), monetary aggregate (M2), interest rate (IR), industrial production index (IPI), real estate investment trusts' indices (REITIX) and volume of mortgage loans (ML). In particular, we focus on housing investment activities in Turkish dwelling market for the period 2002 to 2007. The methodologies employed include unit root tests, Granger causality tests, impulse response functions and variance decomposition models.

The results of causality tests indicate that the industrial production index is a Granger cause of construction permits without the feedback. On the other hand, feedback effects are observed for interest rate and volume of mortgage loans change. We test the source of volatility and identify the responses from housing market activities' determinants. The result indicates that disturbance originating from construction permits itself inflicted the greatest variability to future permits. The average of 62 percent variability contributed by construction permits changes, there remains 38 percent of variability which is explained by three other factors. The largest source of construction permits variance appears to be from industrial production index (IPI), which accounts for approximately 63 percent of the total variance contributed by the three determinants (that is 24 percent of the total construction permits variance). The second largest proportion of construction permits variance appears to be volume of mortgage loans, which accounts for approximately 29

percent of the total variance contributed by the three determinants (that is 11 percent of the total construction permits variance). The final variable in the model, interest rate, contributes 8 percent to construction permits variance (that is 3 percent of the total construction permits variance).

Finally, shocks to macroeconomic variables (i.e., national income, interest rate and volume of mortgage loans) were each found to have noticeable impacts on changes in the housing market activities. In addition to this, the performances of the housing market activities have a major impact on the overall performance of the macro economy. These results offer that housing investment should be taken as an important leading indicator under the new mortgage system for Turkey.

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