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Empirical Analysis of Weak Form Efficiency Evidence from The Housing Market in Turkey: Macroeconomic Glance



Türkiye Konut Piyasasında Zayıf Formda Etkinlik Analizi: Makroekonomik Bakış

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Abstract

The aim of this study is to look for an answer to the question of “Is it possible to discuss the existence of an efficient market for the housing market in Turkey?”. It was observed that relatively low housing (mortgage) interest rates were accompanied by price rigidity. Accordingly, in the formation of the housing market definition from the Central Bank (CBRT) database; an empirical analysis was made using the Residential Property Price Index for New Dwellings (NRPPI), the Residential Property Price Index for Existing Dwellings (ERPPI), the Residential Property Price Index (RPPI) and the Hedonic House Price Index (HHPI). The data range for the first three indices is between 1/2010 and 1/2020. Hedonic housing price index data range is between 1/2011 and 1/2020. Unit root tests were used to test the Random Walk Theory, which shows the characteristic condition of the housing market. The results from the study show that above average sustainable returns cannot be obtained from the housing market, as a result the market is poorly efficient. At the same time the housing market in Turkey, the rigidity of prices found along with excess supply situation is worrisome. Therefore, it is necessary to prevent all kinds of manipulative news that may occur in the housing market by the regulatory and supervisory institutions.

Keywords: Efficient market hypothesis, housing markets, efficiency in weak form, macroeconomics, investment.

Öz

Bu çalışmanın amacı Türkiye’de Konut piyasasında etkin bir piyasanın varlığından söz edilebilir mi?” sorusuna cevap aramaktır. Türkiye ekonomisinin son 5 yılında gayrimenkul sektörü önemli bir yatırım aracı olarak değerlendirilmiş, Nispeten düşük konut (mortgage) faiz oranlarının beraberinde fiyat katılığını da yaşandığı görülmüştür. Amacın, farkında olmadan konut sektörünü verimli bir pazara dönüştürmek olduğu bilinse de etkin piyasanın durumu cevaplanmalıdır. Bu doğrultuda Merkez Bankası veri tabanından konut piyasası kavramının oluşumunda arz-talep pazarını temsil eden yeni konut fiyat endeksi (YKF), yeni olmayan konut fiyat endeksi (YOKF), konut fiyat endeksi (KFE) ve hedonik konut fiyat endeksi (HKFE) kullanılarak ampirik bir analiz yapılmıştır. İlk üç endeks için veri aralığı 1/2010 ile 1/2020 arasındadır. Hedonik konut fiyat endeksi veri aralığı ise 1/2011 ile 1/2020 arasındadır. Konut piyasasının özel durumunu gösteren Rastlantısal Yürüyüş Kuramını test etmek için birim kök testleri kullanılmıştır. Çalışmadan elde edilen sonuçlar, konut piyasasından ortalamanın üzerinde sürdürülebilir getiri elde edilemeyeceğini, yani piyasanın zayıf bir şekilde verimli olduğunu göstermektedir. Aynı zamanda Türkiye konut piyasasında, arz fazlası ile birlikte bulunan fiyat katılığı, düşündürücü bir durumdur. Bu sebeple, konut piyasasında oluşabilecek her türlü manipülatif haberin düzenleyici ve denetleyici kurumlar tarafından engellenmesi gerekmektedir.

Anahtar Kelimeler: Etkin piyasa hipotezi, konut piyasaları, zayıf formda verimlilik, makroekonomi, yatırım.

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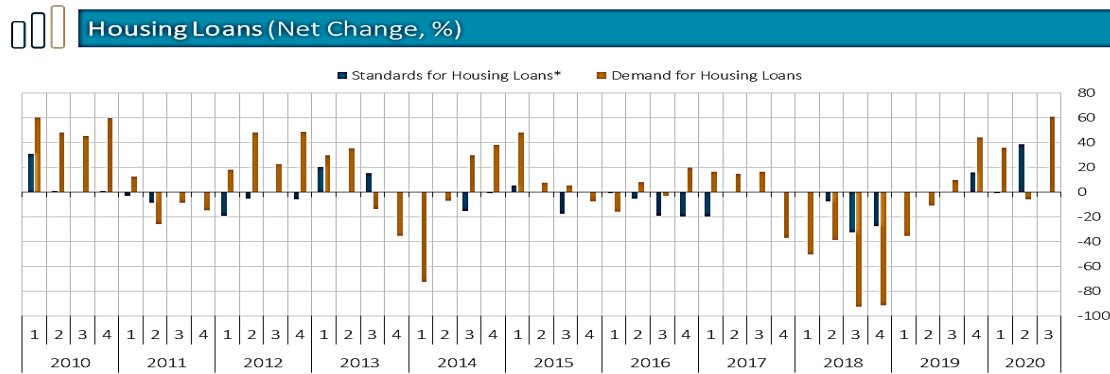
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1. INTRODUCTION

Unlike other properties, housing has unique features in terms of heterogeneity, durability, spatial stability, and high purchase price for income. These characteristics show that traditional economic concepts should be re-evaluated in order to analyze the micro and macroeconomic issues of housing. In addition, a significant number of households acquire houses by borrowing money. Since a significant fluctuation (increase/decrease) in housing prices changes the wealth of individuals, consumption will affect their economic decisions such as investment.

Therefore, the macroeconomic impact of the subject market dynamics cannot be ignored. The crisis originating from the housing market in the USA in the second half of 2007 shows that a severe contraction in the housing market may cause a negative spread in the whole economy. Considering the reflections of monetary policy channels on the housing sector in recent years, and when bubble formations in housing investments and housing markets are observed, it is known that this sector has reshaped the analysis of housing demand and supply, housing market models, the reasons, and effects of the government's housing policies. Especially in the case of an expansionary monetary policy, the downward movement of interest rates causes the declining interest rates to decrease housing acquisition costs. As a result of this situation, the downward pressure of costs increases the demand for housing. This situation causes the housing prices to rise again with the increase in demand for houses and the housing price index becomes upward. The positive opening of the margin between the housing prices and the cost may also increase the desire to make a profit or to invest in this sector. In such a conjuncture, the increase in housing supply ultimately affects the total output level.¹



Source: CBRT, last observation 2020 Q3.

Figure 1: Housing Loans (Net Change, %)

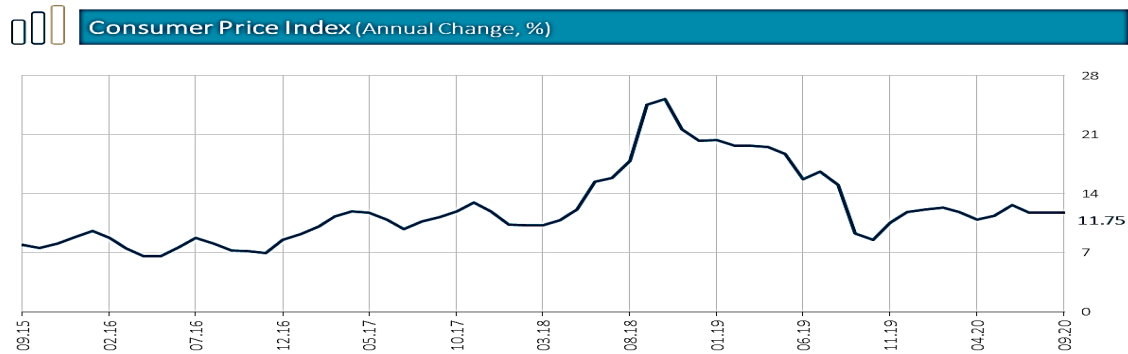
The impact of the developments in the housing market on the world economy started with the mortgage crisis in the USA in 2007, which started with problems in the repayment of risky housing loans. Subsequently, the global economic crisis that emerged in 2009 and the deterioration of the financial markets prevented the healthy resource transfer to the real sector and caused the crisis to reflect on the real sector. The housing sector, which often acts as a lever for the country's economies with the added value and employment opportunities it creates, is not only perceived as the production of a concrete structure, but also means a transparent and sustainable production that directly affects the social structure of the social life that carries environmentally friendly social responsibility.² So after this crisis, housing markets have become one of the focus of policy makers and savers.

While a possible shock in interest rates and growth affects housing prices negatively, a shock in credit volume may affect house prices positively. Housing prices can positively affect growth and

¹ Central Bank of Turkey is a graph made to the information received from the Electronic Data Monitoring system (Figure 1-2-3).

² http://www.emlakkonut.com.tr/_Assets/Upload/Images/file/Yatirimci/seykorRaporu/EKGYO-Sektor-Raporu-aralik-2018.pdf

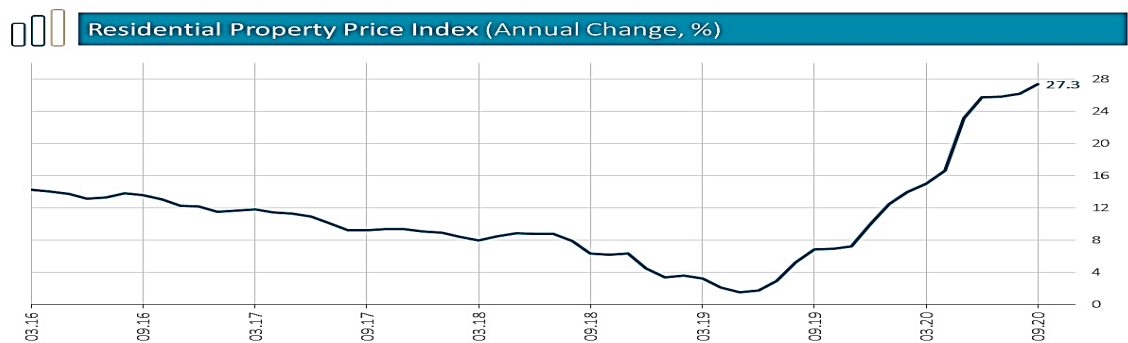
credit volume and create negative pressure on high-interest rates and CPI in the developing process. Therefore, for housing prices to have an impact on growth, the functioning of financial markets should be improved, that is, market economy rules should be followed.



Source: CBRT, last observation 2020 Q3.

Figure 2: Consumer Price Index (Annual Change, %)

In economies where macroeconomic instabilities are experienced, negative effects can occur very quickly on the housing markets. For example, the tendency of households to spend in January 2018 may not be the demand to purchase housing, but rather to meet a demand for the consumption of similar goods and services, especially non-residential needs, or there may be an inflation high caused by the price rigidity on the supply side due to cost.



Source: CBRT, last observation 2020 Q3.

Figure 3: Residential Property Price Index (Annual Change, %)

Therefore, the decrease in the housing price index is a possible result as the demand for housing is not at a sufficient level in the relevant month. A possible sharp decline in housing prices rising rapidly in the last 15 years in many countries, including Turkey, as seen during the 2008 global financial crisis, macroeconomic performance and adversely affect the financial stability makes it inevitable. In such a situation, it enables the estimation of the downside risks to the growth of the Gross Domestic Product (GDP) and triggers it to be considered as a direct target in the formulation of monetary and macro-prudential policies.

This paper is important to investigate whether there is an active market in terms of investing in the housing market in Turkey. Therefore, Turkey has carried out research on the different housing market. However, this study is one of the rare studies investigating the efficacy of EFHs Turkey in the framework of a holistic housing market.

In the other parts of this study, the existence of an effective market in the Housing Market will be tested and an attempt will be made to answer the research question. Especially fluctuated in

monitoring macroeconomic indicators of Turkey's economy and the increasingly competitive market structure to increase the real story of transformation into a market bubble may occur.

2. LITERATURE REVIEW

There are some academic studies on efficiency analysis in the housing market. There are various disputed, especially in testing the existence hypothesis in the housing market. In this section, some of the analyzed time series of academic studies in the literature or panel using the unit root test for testing whether the existence of an active housing market as a rational investor makes the investment in housing in Turkey.

In the research of Fama (1965a), which is theoretically one of the first studies in the literature; which is theoretically one of the first studies in the literature; as effective (at least semi-performing) and defined as a random walk, the market theory notes that successive price changes in individual stocks are independent and there is no memory for a sequence of stock price changes; thus, the previous history of the series cannot be used to forecast the future history. Empirical evidence suggests that, while price fluctuations might not be completely independent, reliance is so limited that any strategy based on mechanical trading rules is defeated by a simple buy-and-hold strategy.

In their study, Alp and Seven (2019a) carried out an analysis of effectiveness in the housing markets with both rooted and nonrooted unit root tests. They used two of structural rooted tests as Lee-Strazicich (LS) and Clemente, Montañés and Reyes (CMR) unit root tests. After their analysis, they decided that the housing market was effective in a weak form. The period they approached is the date range of 01.2010-07.2018.

Atan and Ozdemir (2009) analyzed the efficiency of the ISE market for the period of January 3, 2003- December 30, 2005 with 15-minute and session frequency data and concluded that the ISE is an active market in a weak form.

Berke, Ozcan and Dizdarlar (2014) analyzed the monthly spot and forward exchange rates of TL against Euro and US dollars for the period 2006:04-2013:12, for the analysis of the efficiency of foreign exchange markets. According to the unit root test results, the Turkish foreign exchange market displays a weak, efficient, and random walk. According to the results of the cointegration analysis, these markets have included the findings that they are not efficient in semi-strong form.

According to Coskun and Seven (2016), BIST market efficiency analysis, month-end second session closing data of the BIST100 Index for the period 1993-2015 were used and it was observed that BIST100 was not effective in weak form.

Telatar, Turkmen and Teoman (2002) analyzed the efficiency of prices formed in cotton exchanges using Standard 1 (STD1), Liverpool A (LIVA) and Memphis (MEM) with cotton price indices daily for the period 06/01/2000 and 26/04/2001. With cotton prices in Turkey were found to be in a relationship between the prices in international stock markets occurred. In terms of agricultural policy in comparison with the determination of prices through the stock market in Turkey intrusive methods would be more appropriate method is concluded.

It is examined that macroeconomic variables exhibit various structural breaks in unknown number, duration, and form. However, the majority of these tests can comprise a certain number of breaks. After all, it is quite difficult to know the exact dates, numbers, and forms of these breaks (Prodan, 2008). Therefore, modeling processes of fractures are very risky and there is a specification error in models that deal with fractures inaccurately.

Iskenderoglu and Akdag (2019) worked on whether there is a bubble in housing prices in some cities in Turkey. They conducted unit root tests on monthly real hedonic housing price index data for

the period between January 2010 and December 2018. According to the results, across Turkey, namely Ankara, Istanbul, and Izmir, have reached the findings that there is a balloon effect in prices.

In their research, Zhang, Jong and Haurin (2013) measured the rationality of expectations of house price changes using the Wall Street Journal's economic forecast survey covering the years 2007-2012 and with the "three-dimensional" panel dataset. In the study, it was concluded that the expectations determining the housing prices according to the Efficiency test results significantly affect the actual prices, that is, it supports an effective market hypothesis.

Gumus and Zeren (2014) analyzed the "efficient market" hypothesis with the Fourier ADF and Fourier CSR unit root test for G20 countries. While proving that the effective market hypothesis is valid for 9 of 17 countries, they have reached the findings that it is invalid for 8 countries.

Contrary to studies such as Gau (1984, 1985), Linneman (1986), Alp and Seven (2019b) which concluded that housing markets are efficient, Case and Shiller (1989, 1990) obtained test results rejecting poor efficiency in the housing market and emphasized that there is no conclusive evidence that housing markets are efficient. Although Kuo (1996) reached the findings that house prices do not show a random walk, Case and Shiller (1989, 1990) criticized the random selection of the data used by Case and Shiller (1989, 1990), the inconsistency of their estimators, and the results of the Bayesian approach, and therefore the estimates were too sensitive to the techniques used.³

3. METHODOLOGY AND DATA

3.1. Modeling Approach

The effective market hypothesis indicates that the prices valid in the markets cover all kinds of information and therefore it is impossible to obtain an over-normal return using this information (Celik, 2007). Different levels of effectiveness appear depending on the density of financial information. The aim of this study is to test the Random Walk Hypothesis, which shows a special situation of active markets in weak form (Koyuncu and Aslan, 2019). Unit root tests are mostly used to test the random walk hypothesis.

The founder of the Efficient Market Hypothesis is known as Eugene Fama. Fama (1965b) concluded that; The main conclusion will be that the data appears to support the random-walk model consistently and strongly. This means that chart reading, while maybe an amusing pastime, is of little real benefit to investors in the housing market. The Random Walk Hypothesis (RWH) is a paradigm validating Effective Market Hypothesis concepts (EMH). Technically, the Random Walk Hypothesis (RWH) states that a random walk matches asset prices. In other words, a predictable trend does not define asset prices. In addition, in the conceptualization of effective business hypotheses, knowledge efficiency plays an important role (EMH) (Loredana, 2019).

The case of weak form of activity, making studies on the estimation of the future price of any financial asset by using the past price information allows to obtain a higher return than the return that can be reached by choosing the technical analysis method of the financial asset in question (Altunoz, 2016).

Unit root tests are classified according to whether the series discussed is linear or not. There are many different tests in each class. Therefore, it is necessary to decide which model to use linear or nonlinear for the related series before applying the unit root test.

Studies carried by McLeod and Li (1983), Keenan (1985), Tsay (1986) are developed to test linearity. These tests generally include the null hypothesis linearity assumption and nonlinearity assumption. However, the series must be $I(0)$ or $I(1)$ for the validity of the tests. In the unit root test developed by Harvey and Leybourne (2007), there is no need for preliminary information about the

³ <https://dergipark.org.tr/tr/download/article-file/726463>

integrated level of the process. It uses a regression estimate that includes linear and nonlinear components for both I (0) and I (1). Wald's statistic is calculated by this regression by the limited regression that excludes nonlinear elements. However, the limited distribution of Wald statistics is different for I (0) and I (1). Harvey et.al (2008), on the other hand, developed the weighted Wald statistics to eliminate this issue. This statistic is based on the weighted averages of Harvey and Leybourne (2007) Wald statistics, and has a standard chi-square distribution in both I (0) and I (1) of the null hypothesis. Harvey et.al (2008) found that the finite sampling characteristics of this test they developed were quite good and stronger than Harvey-Leybourne (2007). Therefore, the test in Harvey (2008) is used in this study.

Harvey et al. The test phase they carried out in 2008 consists of three stages. First of all, they tested the linearity hypothesis against the nonlinearity hypothesis based on the assumption that a time series such as Y_t is I(0) and has an AR (1) process.

The test phase Harvey et al. did in 2008 consists of three stages. At first, they tested the linearity hypothesis against the nonlinearity hypothesis, based on the assumption that a time series like Y_t is I (0) and has the AR (1) process.

$$Y_t = \mu + v_t \tag{1}$$

$$v_t = \rho v_{t-1} + \delta f(v_{t-1}, \theta) + \varepsilon_t \tag{2}$$

The terms ρ , δ and $f(., \theta)$ are chosen to ensure the global stability of v_t .

The function $f(., \theta)$ is assumed to have a second order Taylor expansion, based on the assumption $\theta = 0$. Based on this preliminary information about Y_t , they obtained the following unconstrained regression model (Harvey et. al, 2008: 3).

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + \beta_2 Y_{t-1}^2 + \beta_3 Y_{t-1}^3 + \sum_{j=1}^p \beta_{4,j} \Delta Y_{t-j} + \varepsilon_t \tag{3}$$

The last explanatory variable ΔY_{t-j} in this equation is the term added to the model to address the problem of autocorrelation in the error term (ε_t).

The zero and alternative hypothesis is as follows.

$$H_{0,I(0)}: \beta_2 = \beta_3 = 0 \text{ (linearity)}$$

$$H_{1,I(0)}: \beta_2 \neq 0 \text{ ve/veya } \beta_3 \neq 0 \text{ (nonlinearity)}$$

The unconstrained regression model, on the other hand, was created within the framework of the assumptions in the null hypothesis. Wald test statistics developed to test the null hypothesis are as follows.

$$W_0 = T \left(\frac{RSS_0^r}{RSS_0^u} - 1 \right)$$

The number of T-observations specified in the test statistics, $[RSS]_0^r$ and $[RSS]_0^u$ denote the total error squares obtained from the least squares estimation of the restricted and unconstrained model.

In the second stage of this test, they first tested the linearity hypothesis against the nonlinearity hypothesis, based on the assumption that a time series such as Y_t is I (1) and has an AR (1) process.

$$Y_t = \mu + v_t \tag{4}$$

$$\Delta v_t = \phi \Delta v_{t-1} + \lambda f(\Delta v_{t-1}, \theta) \Delta v_{t-1} + \varepsilon_t \tag{5}$$

The terms ϕ , λ and $f(\cdot, \Theta)$ that will ensure the global stability of Δv_t is determined. The function $f(\cdot, \theta)$ is assumed to approach the second order Taylor expansion, based on the assumption $\theta = 0$. The first difference of Y_t is the condition of non-linearity.

They tested the linearity hypothesis against the nonlinearity hypothesis for this second stage of data generation. In the light of the information about equations (4) and (5), the unrestricted regression model is as follows.

$$\Delta Y_t = \lambda_1 \Delta Y_{t-1} + \lambda_2 (\Delta Y_{t-1})^2 + \lambda_3 (\Delta Y_{t-1})^3 + \sum_{j=1}^p \lambda_{4,j} \Delta Y_{t-j} + \varepsilon_t \quad (6)$$

As stated earlier, the last explanatory variable $[\Delta Y]_{t-j}$ in this equation is the term added to the model to eliminate the problem of autocorrelation in the error term (ε_t).

The basic and alternative hypotheses to be used for the test are as follows.

$$H_{0,I(1)}: \lambda_2 = \lambda_3 = 0 \text{ (linearity)}$$

$$H_{1,I(1)}: \lambda_2 \neq 0 \text{ ve/veya } \lambda_3 \neq 0 \text{ (nonlinearity)}$$

Wald test statistics developed to test the null hypothesis are as follows.

$$W_1 = T \left(\frac{RSS_1^r}{RSS_1^u} - 1 \right)$$

is obtained as above. In this test statistic, $[RSS]_{1 \wedge r}$ and $[RSS]_{1 \wedge u}$ represent the sum of the error squares obtained from the least squares estimates of the restricted and unconstrained model.

Also, Harvey et al. (2008: 5) suggested that W_0 statistics should be used when the series under consideration is stationary and W_1 statistics should be used when the series is unit-rooted. However, both statistics require primarily the use of any unit root test. Instead, they suggested a new test statistic consisting of weighted averages of both test statistics, and this statistic is as follows.

$$W_\lambda = \{1 - \lambda\}W_0 + \lambda W_1$$

The W_λ test statistics match the χ_2^2 distribution. Whether Y_t series is stationary or rooted in the unit, it is a function that λ is likely to converge to zero. With the studies of Monte Carlo, this test revealed that it has finite small sampling features.

In this study, our target is to examine whether the data belong to different periods of activity in the housing market in Turkey. Whether investors continue to make rational choices in weakly influenced markets, it will be tested whether the prices in the housing market are effective for investors and what an analysis of the effective market hypothesis is in actual literature.

The monthly frequency data of the housing price index series obtained from The Central Bank of the Republic of Turkey Electronic Data Dissemination System (EVDS) were used and unit root test tests were carried out together with the Harvey linearity test.

3.2. Unit root test

The unit root test we use in our study is a unit root test with Fourier functions. The advantage of this test is that it uses selected frequency components from the Fourier approach to represent these structural fractures in an unknown form. Becker et al. (2004) have determined that such tests with Fourier functions are stronger, especially when fractures are progressive. They noted that even a small number of low-frequency components of the Fourier functions include the properties of one or more structural break series. This test is meaningful to use as the trigonometric terms used to represent these components in the model are meaningful. For this reason, in this study, progressive fracture is discussed using this test.

Analyzes made with time series are usually performed depending on unit root tests. Depending on the needs many unit root tests have been developed in last forty years. The series related to the social sciences, especially the economic series, since they include potential breaks, unit root tests (Zivot-Andrews, Lampell-Papel, Lee Strazitch etc.) including breaks have been developed. However, the majority of these tests can address a certain number of breaks. However, it is quite difficult to know the dates, numbers and exact of these breaks (Prodan, 2008). Considering this problem, Becker et al. (2006) demonstrated that tests based on the Fourier approach are more appropriate. They assumed that a small number of low-frequency components of the Fourier functions include the properties of one or more structural break series. Becker et.al (2006) developed tests based on this approach in many studies after these studies. Instead of determining the date of the break, the number of breaks and the function of the break, the appropriate frequency component is included in the equation estimated in these tests.

Christopoulos and Leon-Ledesma (2011) brought the following test to the literature based on the research of Becker et al. (2006)

Stochastic for y_t is as follows;

$$y_t = \delta(t) + v_t \tag{7}$$

Here $v_t \sim N(0,1)$ and $\delta(t)$ denote a deterministic mean that changes over time. Becker et al. (2004) and Becker et al. (2006) studied a Fourier series to get closer to the unknown refraction number of $\delta(t)$ in the unknown structure;

$$\delta(t) = \delta_0 + \sum_{k=1}^G \delta_1^k \sin\left(\frac{2\pi kt}{T}\right) + \sum_{k=1}^G \delta_2^k \cos\left(\frac{2\pi kt}{T}\right) \tag{8}$$

Here, the frequency number of the Fourier function k is a trend, T is the sample size and $\pi=3,1416$. When G grows, the unknown functional structure $\delta(t)$ can be predicted fairly well. If H_0 hypothesis $\delta(k)$ is rejected for at least one frequency $k = G_1, G_2, \dots, G_M, G_1 > 0$, then the nonlinear component can adequately explain the deterministic component of y_t and at least one structural It provides changes. Otherwise, the linear model occurs as a special case without any structural change. In this specification, fractures are modeled as soft processes instead of level shifts and are interpreted in the same way from an economic point of view.

A specification issue about Equation (8) is to determine the appropriate number of frequencies to add to the appropriate model. Ludlow and Enders (2000) stated about this determination that only one frequency is sufficient to obtain Fourier expansion in experimental studies. Equation (8) is expressed again as follows;

$$\delta(t) = \delta_0 + \delta_1 \sin\left(\frac{2\pi kt}{T}\right) + \delta_2 \cos\left(\frac{2\pi kt}{T}\right) \tag{9}$$

If the appropriate frequency k is known, then it is possible to examine the presence of unknown structural breaks in *basic equation (7)*. However, the true value of k is typically unknown. A classic way to determine the optimal frequency is to obtain *equation (7)* for each value of k in a certain range. Becker et al. (2006) stated that since refractions shift the spectral density function to zero frequency, it is likely that the optimal frequency range for a break is at the lower end of the spectrum. Therefore, low frequencies are best suited for the unit root test against stationarity. Because these indicate structural breaks rather than short-term cyclical behavior. Thus, the value of k is determined by the Bayes Information Criterion (BIC), and Christopoulos and Leon-Ledesma (2011) determined the appropriate frequency in the range of $k = [0.1, 0.2, 0.3, \dots, 4.9, 5]$ and therefore fractional frequency it was named after.

Testing the presence of soft breaks in the data creation process of y_t is done with $H_0: \delta_1 = \delta_2 = 0$ against $H_1: \delta_1 = \delta_2 \neq 0$. Here, the known F statistic is discussed to test the H_0 hypothesis.

To obtain the Fourier ADF (FADF) equation, equation (7) is specified as follows.

$$\delta(t) = \delta_0 + \delta_1 \sin\left(\frac{2\pi kt}{T}\right) + \delta_2 \cos\left(\frac{2\pi kt}{T}\right) + v_t \quad (10)$$

The H_0 hypothesis of the test is expressed as follows;

$$H_0: v_t = \mu_t, \mu_t = \mu_{t-1} + h_t$$

Here, h_t is considered to be a zero mean stationary process. In the test statistics, firstly the correct value of the frequency value k is determined and after the equation (10) is estimated with EKK, EKK residues are obtained as in the following equation;

$$\hat{v}_t = y_t - [\hat{\delta}_0 + \hat{\delta}_1 \sin(2\pi \tilde{k}t/T) + \hat{\delta}_2 \cos(2\pi \tilde{k}t/T)] \quad (11)$$

In the second phase, a unit root test is performed in the least square residuals of the first phase with the following regression.

$$\Delta \hat{v}_t = \alpha_1 v_{t-1} + \sum_{j=1}^p \beta_j \Delta v_{t-j} + u_t \quad (12)$$

Here Z is a white noise process, which allows testing the unit root in the original series after removing the structural break in the deterministic components in the model.

$$H_0: \alpha_1 = 0 \text{ (nonstationary)}$$

$$H_1: \alpha_1 < 0 \text{ (stationary)}$$

As a result of the test statistics compared with the critical values, it is determined whether the series is unit rooted or stationary.

4. EMPIRICAL FINDINGS

In the empiric studies, while analyzes are usually made in the time series, the series in the literature are made considering that they are not linear or linear. In this way, it will be a correct approach to test the linearity of the series in the analysis. In this context, this test will be done based on the study of Harvey et al. (2008).

In this study, the unit root test described in the methodology section was used to test the existence of the activity in the housing market. New housing prices index (YKF), non-new houses price index (YOKF), housing price index (KFE) and hedonic housing price index (HKFE) representing this market were used for empirical analysis. The data range for the first three indexes is the 2010: 01-2020: 01 data range. The data range for the hedonic housing price index is 2011: 1 to 2020: 1. Unit root tests are divided into two according to the linearity and non-linearity of the series. Unit root tests produced for linear series cause power loss in order not to reject the null hypothesis when the series is not linear. For this reason, there are many tests developed for non-linearity of series in the literature. It is necessary to test whether the series are linear before proceeding to the unit root test process. Commonly used tests in the literature Harvey et al. [2008] and Harvey and Leybourne [2007] tests. The results of these tests are given in Table 1.

Table 1: Harvey et.al (2007-2008) Test Results

Variable	Harvey vd. (2008)	Harvey and Leybourne (2007)	Result		
		%10	%5	%1	
KFE	0.14	1.42	1.44	1.47	Linear
YKF	1.24	1.14	1.15	1.17	Linear
YOKF	0.50	2.28	2.31	2.36	Linear
HKFE	3.32	6.98	7.04	7.14	Linear

Note: Harvey et al. (2008) test critical values are 9.21, 5.99 and 4.60 for 1%, 5% and 10%, respectively. The critical values of Harvey and Leybourne (2007) test are 13.27, 9.48 and 7.77 for 1%, 5% and 10%, respectively. *** For 10%, the linearity indicates that the basic hypothesis has been rejected.

According to the results in Table 1, since all variables belonging to the housing index are linear, a linear test is used as the unit root test. Linear tests are divided into two as refractive and non-breakable tests. For refractive tests, there are tests using the dummy variable approach. In studies conducted in the literature on the housing market, tests based on this approach are generally used. As is known, these tests are developed for sharp fractures. As mentioned earlier, it is quite difficult to accurately determine the number, structure, and break time of structural breaks. Enders and Lee (2012) test, which is a Fourier function unit root test that overcomes these problems and does not use prior knowledge, is used. This test is a test developed briefly by adding Fourier terms to the increased Dickey-Fuller (ADF) regression. The results of this unit root test are as in Table 2.

Table 2: Christopoulos and Leon-Ledesma (2011) Results of Fractional Frequency Fourier ADF Unit Root Test

Variable	Frekans	F test	Test statistics	Result
KFE	K=1	448.3635	-2.761194	Unit rooted
YKF	K=1	467.6463	-3.074564	Unit rooted
YOKF	K=1	413.2799	-2.704085	Unit rooted
HKFE	K=1	297.5621	-1.845870	Unit rooted

Note: Test statistics critical values: 1% -4.4, 5% -3.85, 10% -3.52. Test statistics critical values are taken from Christopoulos and Leon-Ledesma (2011) Table 1. The critical values of F statistic are 6,730, 4,929 and 4,133, respectively, at 1%, 5% and 10% significance level. Critical values of the F statistic are taken from Becker, Enders and Lee (2006) Table 1. Values in square brackets are appropriate lag lengths.

Under the null hypothesis, which assumes that series is a random walk, in other words, it has a unit root which is concluded that all variables have a unit-root as a result of the comparison of the test statistics values with the critical values (found at the bottom of the table). Since, the random walk hypothesis is confirmed for all variables (KFE, YKF, YOKF and HKFE), we can say that housing market is weakly efficient. This conclusion is parallel to the Alp and Seven's (2019a) findings which is procured by sharp breakpoint tests.

In Table 2, the findings are for the fixed model and in Table 3, the findings are for the fixed and trending models. As seen from both tables, the k value (number of frequencies) that minimizes the residual squares was estimated as 1 for all variables. It is seen that all the variables are unit rooted as a result of comparison of the test statistics values with the critical values (located at the bottom of the table) for this test, which is assumed that the series has a random walk under the null hypothesis, it is unit rooted. In other words, for all variables (KFE, YKF, YOKF and HKFE), the random walking hypothesis is confirmed and hence it is said that this is efficient in the weak form for the housing market. This finding is parallel to the findings obtained by Alp and Seven (2019a) with sharp break tests.

5. CONCLUSION

When you put aside the creation of living space, which is the main reason for the demand for housing, we see that savings are largely transformed into speculative transactions in order to obtain return from buying-selling or renting. For this reason, the fact that housing prices are in an upward trend includes various findings that cannot be explained only by supply and demand conditions, suggesting that speculative effects on prices in the housing market may have occurred. It is known that such situations that trigger price increases especially speculatively will not be sustainable.

It should not be forgotten that the formation of volatility due to periodicity in an effectively functioning market mechanism is part of the result. This analysis of the housing market study concluded that Turkey is weakly efficient market. In other words, it shows that housing prices reflect all the information disclosed to the public and that above average returns cannot be obtained in the housing market by using past price movements. Therefore, with the aim of spreading the capital to the base, it is necessary to create educational short advertisements and visual videos and raise the level of awareness to encourage everyone concerned, who are investors in the housing market, to alternative investment tools. In addition, it is necessary to prevent all kinds of manipulative news that may occur in the housing market by the regulatory and supervisory institutions.

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