ÇANKAYA UNIVERSITY
GRADUATE SCHOOL OF SOCIAL SCIENCES
FINANCIAL ECONOMICS

MASTER THESIS

THE EFFICIENCY OF HOUSING MARKET IN TURKEY

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SEPTEMBER, 2015

Title of the Thesis: **The Efficiency of Housing Market in Turkey**

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ABSTRACT

An Application to Turkey House- Price Indices

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2015, 69 pages

This study investigates the efficiency of housing market and the validity of the ripple effect in Turkey. In order to do this, we examined the housing price dynamics of Turkey with various unit root tests in all 81 cities of Turkey by dividing them into geographical groups apart from İstanbul, Ankara, and İzmir according to the original grouping of Central Bank of Turkey where we acquired our data from. Along with a conventional unit root test which assumes structural stability and linear adjustment, a nonlinear unit root test and also a nonlinear unit root test with structural breaks were applied. Our tests proved evidently that the majority of housing markets in Turkey is inefficient even though the test results were mixed, and also the ripple effect does exists indeed. In the light of this information, the housing market in Turkey calls for urgent investigation towards the inefficient markets and ripple effect originating points.

Keywords: Housing market efficiency, Ripple effect, Linear unit root test, Nonlinear unit root tests, Nonlinear unit root test with structural breaks.

ÖZ

Türkiye'de Konut Piyasasının Etkinliği

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2015, 69 sayfa

Bu çalışmada literatürde bir ilk olarak Türkiye'de konut piyasasının etkinliği ve konut piyasasında dalga etkisinin varlığı incelenmiştir. Bu amaçla, Türkiye'nin 81 ilinin tamamına Türkiye Cumhuriyet Merkez Bankası'nın verilerini değerlendirdiği coğrafi gruplandırmanın aslına bağlı kalınarak çeşitli birim kök testleri uygulanmıştır. Yapısal durağanlık ve doğrusal ayarlamayı benimseyen klasik birim kök testinin yanısıra doğrusal olmayan ve yapısal kırılmaları dikkate alan doğrusal olmayan testler uygulanmıştır. Yapılan testler çelişen sonuçlar ortaya koymasına rağmen Türkiye'deki konut piyasalarının ağırlıklı olarak etkin olmadığını kanıtlarla ispatlamıştır. Ayrıca yine kanıtlara dayanarak Türk konut piyasasında dalga etkisi olduğu ispatlanmıştır. Bu bilgiler ışığında Türk konut piyasası etkin olmayan marketlerin ve dalga etkisi kaynağı olan bölgelerin acilen incelenmesine ihtiyaç duymaktadır.

Anahtar Kelimeler: Konut piyasasının etkinliği, Dalga etkisi, Doğrusal birim kök testi, Doğrusal olmayan birim kök testi, Yapısal kırılmalı doğrusal olmayan birim kök testi.

To My Family,

ACKNOWLEDGEMENTS

I would like to express my first and foremost appreciation for my supervisor Assist. Prof. Dr. Ayşegül Eruygur, who has encouraged and guided me through this research process, with her broad academic knowledge and unique insight. This thesis would be impossible without her patience and valuable support. I really appreciate her for spending her precious time for working on each detail of my thesis.

I would also like to show my sincere gratitude to Assoc. Prof. Dr. Dilek Temiz Dinç and Assoc. Prof. Dr. Seyit Mümin Cilasun who contributed much to this study through sharing their valuable academic contributions and comments. I am also grateful to Prof. Dr. Tolga Omay for his valuable contributions to this thesis.

I would also like to send my gratitude to my beloved fiancée and my future wife, Melis Tartıcı, who has helped me with every step of my work with her great extent of professional knowledge in Economics. I would like to thank for her patience and support during this whole stressful process. She is love, joy and fun of my life.

Finally, I would like to express my greatest and deepest gratitude for my dear father Salahettin Yavuz, my dear mother Emine Yavuz and my dear sister Şefika Yavuz for their support, endurance and belief in me.

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ABBREVIATIONS

ADF : Augmented Dickey Fuller

AR : Auto- Regressive

DF : Dickey Fuller

ESTAR: Exponential Smooth Transition Autoregressive

GDP : Gross Domestic Product

GNP : Gross National Product

GYO : Gayrimenkul Yatırım Ortaklığı

KSS : Kapetanios-Snell-Shin

LNV : Leybourne, Newbold, Vougas

STR : Smooth Transaction Regression

SWOT: Strengths- Weaknesses- Opportunities- Threats

THPI : Turkey’s House-Price Index

UO : Uçar - Omay

CHAPTER 1

1. INTRODUCTION

The efficiency of a market has always been a controversial issue that is considered to be worthy of investigation over and over again in the empirical literature. The efficiency of a market is highly related with its forecastability and since forecasting any market brings the ability of taking advantage of the knowledge which the other actors in the market may not possess, it holds a great importance. In reality, no such thing as a perfectly efficient or absolutely inefficient market exists. However, in theory a market is, in its simplest form, considered efficient when it provides any information fully to all actors. The efficiency of stock markets is often ensured by various regulatory authorities (i.e Capital Markets Board of Turkey) to a certain degree, while it is claimed otherwise for the housing markets. Housing economists claim that housing markets may not be essentially efficient since it easier to track the infrequent trading compared to the trading that occurs in the stock markets, hence to have a better understanding and knowledge of the market. This idea is still both supported and challenged by researchers. Therefore, we decided that further investigation of this debate was necessary. In addition to this, the empirical literature did not contain any researches on this subject focusing the housing market in Turkey. Thus, the investigation of this subject for the housing market in Turkey was a must to have.

In the second part of our study, we examined the house price index of Turkey for the ripple effect presence as well. The ripple effect is the concept of the spreading of a shock that happened in one region to another region. When we have look back to 2008 global recession in order to see the effects of a spreading crisis, we can understand the importance of the ability to prevent a shock from rippling out. Moreover, the ripple effect gives the investors a chance to predict the house prices in the regions which are adjacent to the originating area of the ripple effect. Therefore, this effect indirectly disturbs the efficiency of housing market. In order to give the opportunity to prevent this to the governments and the international economic institutions, we need to prove whether the ripple effect exists or not and this study aims to fulfill this necessity as well.

There are limited studies in the empirical literature on both the efficiency of housing market issue and the ripple effect theory. The majority of the studies in the empirical literature proved the housing economists right about housing markets being inefficient. For instance, Xu et. al. (2007), and Hooi & Russell (2012) both used unit root tests in order to examine the efficiency of Hong Kong and Malaysia markets respectively and they both found enough evidence to prove that these housing markets were inefficient. Rosenthal (2006), on the other hand, was able to prove that the housing market in UK is efficient by applying Autoregressive test. The empirical literature survey on ripple effect showed us almost the entirety of the studies confirmed that the ripple effect exists. To illustrate, Meen (1999), Canarella et al. (2010), and Lean and Symth (2013) found that the ripple effect was present in their sample regions.

To analyze both the efficiency of the housing market in Turkey and the ripple effect presence in the housing market in Turkey we examined the monthly data of Turkish house-price index for the period 2010:1 and 2014:12. The data is acquired from the database of Central Bank of Turkey. 81 cities of Turkey are divided into groups geographically apart from İstanbul, Ankara, and İzmir according to the original grouping of Central Bank of Turkey. The Turkish house-price index (THPI) is also included in the data as a whole. Both linear and nonlinear unit root tests were utilized in this paper. Moreover, to allow for the possibility of structural breaks in the housing price data we also applied a unit root test that accounts for structural breaks. The unit root tests applied in this study are Augmented Dickey Fuller (ADF) test, Kapetanios-Snell-Shin (KSS) test, and the Leybourne, Newbold, Vougas (LNV) test.

Augmented Dickey Fuller (ADF) test, just like the other conventional unit root tests, assumes structural stability and linear adjustment. It interprets deviations from linearity and structural instabilities as permanent stochastic disturbances (Canarella et al, 2010). The nonlinear unit root tests, however, take the existence of the nonlinearities into consideration differently. A nonlinearity can occur in a series at some threshold, while it is stationary outside of that threshold (Teräsvirta, 1994). It can also exist when a structural change affects the economic series. Kapetanios et al. (2003) came up with a nonlinear unit root test (Kapetanios-Snell-Shin (KSS) test) which permits a stable dynamic process with an inherently nonlinear adjustment caused by market frictions and transaction costs, and demonstrated that the nonlinear test proves more powerful than the standard unit-root tests (Canarella et al, 2010). To test the second type of nonlinearities, which happens when a structural change occurs, we applied Leybourne, Newbold, Vougas (LNV) test. The LNV test employs a smooth transition autoregressive (STR) model to allow for smooth structural breaks.

The rest of this paper is organized as follows: Chapter 2 firstly gives general information about the housing industry in general and the housing industry in Turkey, then it clarifies what market efficiency and ripple effect are. In Chapter 3, the results of empirical literature survey on efficiency of housing market and ripple effect are demonstrated and each study is explained briefly. Chapter 4 gives information about the methodology and explains each test that was conducted in this research in detail. Chapter 5 reports the empirical results, which are divided into two groups as the market efficiency results and ripple effect results, of our study. Lastly, Chapter 6 is reserved for the conclusion.

CHAPTER 2

2. HOUSING INDUSTRY, MARKET EFFICIENCY, AND RIPPLE EFFECT

The goal of this chapter is to give general information about the housing industry, housing industry in Turkey, and market efficiency. Firstly, we will introduce the housing industry, then we will give specific information about the housing industry in Turkey, and lastly we will explain what market efficiency is.

2.1 Housing Industry

Housing industry is the construction and sales of houses. It fulfills one of the basic needs of society, sheltering. This sector has an important part in the economy and social life of any country. The construction industry is one of the few industries shaping the economy of a country. Since the housing industry consists more than 80% of the construction industry for most of the countries, the main impact on the economy is actually the housing industry itself. Therefore, these two sectors can be considered as a whole.

The reason housing industry has such a great impact on the economy is it has direct interaction with over 250 subsectors, and keeps them alive (Ertem & Yılmaz, 2014). Some of these sectors are cement, concrete, brick, iron and steel, wood, plastics, ceramics, insulation, kitchen and bath, and furniture. Aside from the sectors that housing industry is directly related, it also has some indirect impacts on some sectors. Such sectors are affected by the spending on housing industry as it leads to the need and therefore more spending of goods like white goods (refrigerators, air conditioners, stoves etc.), brown goods (televisions, computers, digital media players etc.), and home textiles. This impact that housing industry has over other sectors is known as the multiplier effect in economics and the multiplier effect of housing industry is extremely high.

The multiplier effect of housing industry leads to great numbers of job creation from different sectors. Accordingly, it has a highly positive impact on the unemployment issue of a country. Moreover, one of the most important characteristics of this industry about employment is that it provides job opportunities for every person from every education level. Although, it is noteworthy that some of the jobs in the industry are seasonal.

Employment is not the only contribution that the housing industry makes to the economy of a country. It can also increase the economic growth vastly. The industry not only affects the growth rate directly, but also it has an indirect effect. Considering the multiplier effect, even the smallest investment to the housing industry causes countless sectors to grow. Since, as mentioned before, the construction industry and the housing industry is quite parallel, comparing the growth rate of the GDP of a country with the growth rate of its construction industry can give us a good demonstration of the effect of the housing industry on the economic growth. The Turkish construction industry is an excellent example to this, as shown in the following figure;

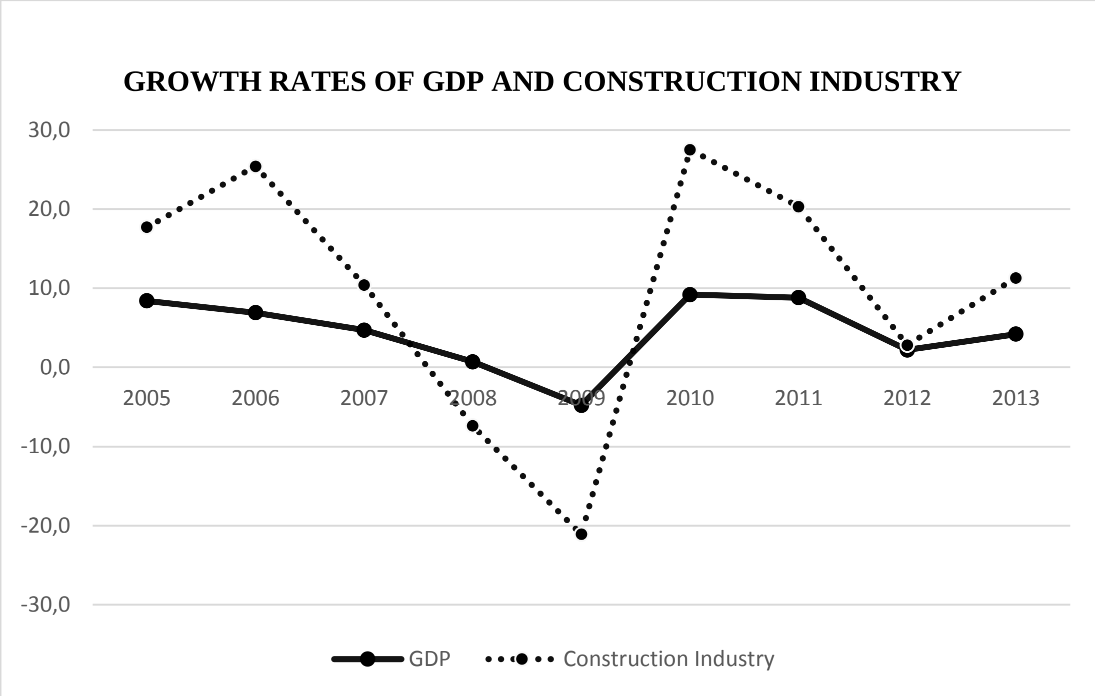


Figure 1. Growth Rates and Construction Industry (*Source: www.tuik.gov.tr)*

Another figure below shows the huge rising trend in the house prices globally. Even though the global house prices were hit hard by the global recession in 2008, which ironically were caused by the house mortgages according to most of the authorities, the importance of the housing industry is undeniable.

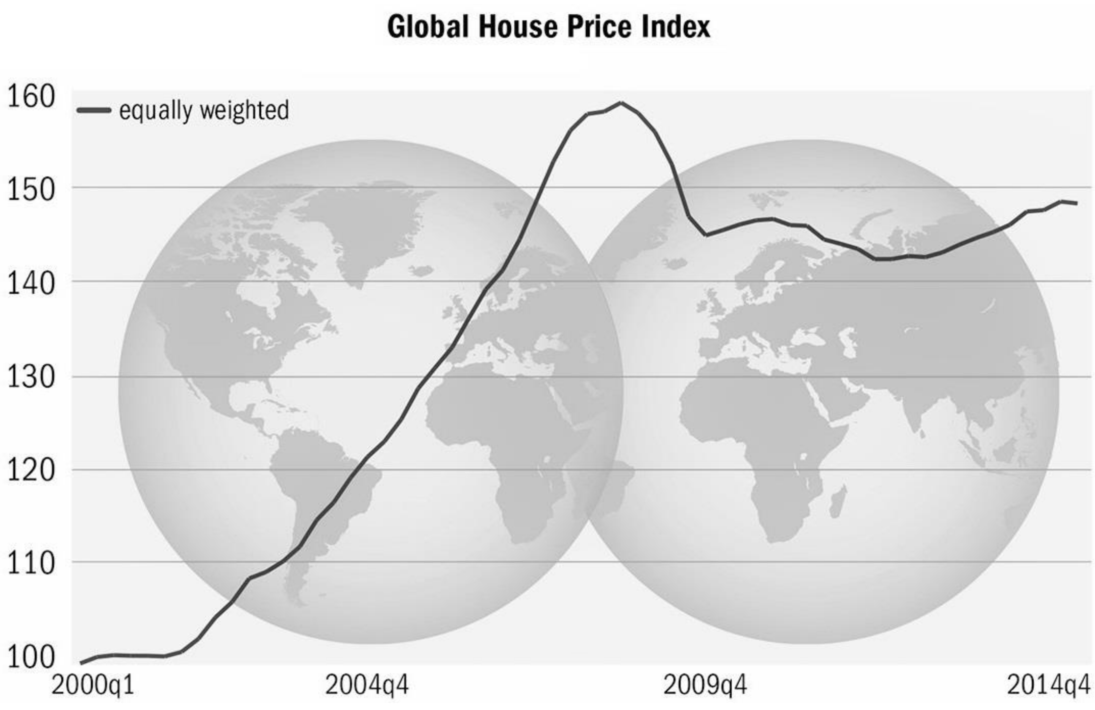


Figure 2. Global House Price Index *(Source: www.imf.org)*

The importance of both construction and housing industries are quite clear even for both economic and social aspects of today’s world. Considering the effects on other sectors, employment, and the growth rate we can definitely say that they have a great influence in the global economy. The global GNP in 2008 was US$3.5 trillion, and the share of the global construction industry in it was 8% (Kılıç, 2008). This rate is not so different in Turkish economy as well, as it is stated by the Turkish Statistics Institute, the share of the construction industry in the GNP of Turkey was always between 5-6% for the last decade. According to the recently published report of the market research company Research and Market (2015) on global construction industry, the global industry is forecast to grow from US$7.4 trillion in 2010 to US$8.5 trillion in 2015 and to US$10.3 trillion in 2020, when measured at constant 2010 prices and exchange rates. Taking all these information into consideration, construction and housing industries are both worth to investigate for sure. Especially for emerging countries like Turkey, these industries provide huge opportunities in order to grow economically if the right policies are carried out.

2.2 The Housing Industry in Turkey

The housing industry is of a great value for the Turkish economy. As mentioned before the share of the construction industry in the Turkish GNP is very remarkable. According to the Turkish Statistics Institute data, the share of construction industry in the GNP of Turkey was 5.7% in 2010, 5.8% in 2011, 5.7% in 2012, 5.9% in 2013, and 6% in 2014. When the sectors affected by the construction industry are taken into consideration as well, the total effect of the industry on the GNP is estimated to be around 30%. The employment provided by the industry was 7.2% in 2013, and it was 7.1% in 2014. Rıfat Hisarcıklıoğlu, the president of the Union of Chambers and Commodity Exchanges of Turkey (TOBB) stated in his speech in February 2015 that the Turkish construction industry is the leading and the most strategic industry in Turkey. In light of all the data we have given and the promises that this industry has, we can say that this statement is quite accurate.

The biggest promise of the housing industry of Turkey is the urban transformation project. The project involves demolishment and reconstruction of the risky buildings in terms of being prone to earthquake. Considering most of the regions of Turkey are known to be earthquake areas, we can see that the urban transformation project has a massive potential. Therefore, this potential increases the expectations from the housing industry in Turkey.

When we observe the recent history, the period that is investigated in this study, of the housing industry in Turkey we see a positive trend. The constant increases in the house price index and the house sales numbers are indicators of this trend. The following figures demonstrate it quite clearly.

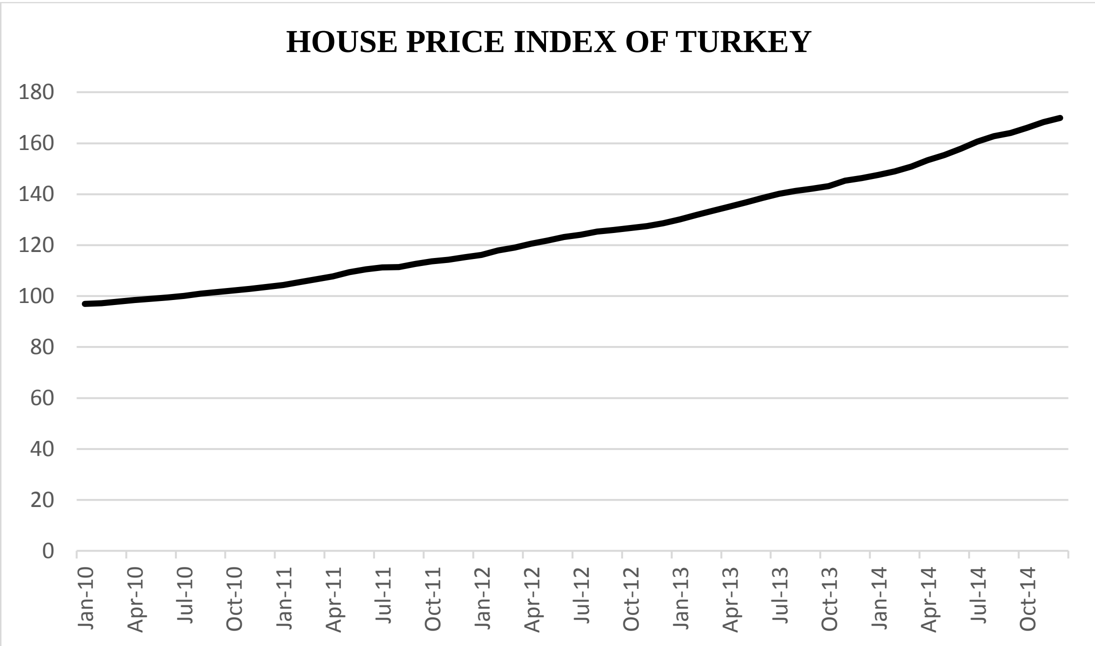


Figure 3. House Price Index of Turkey (*Source: www.tcbm.gov.tr)*

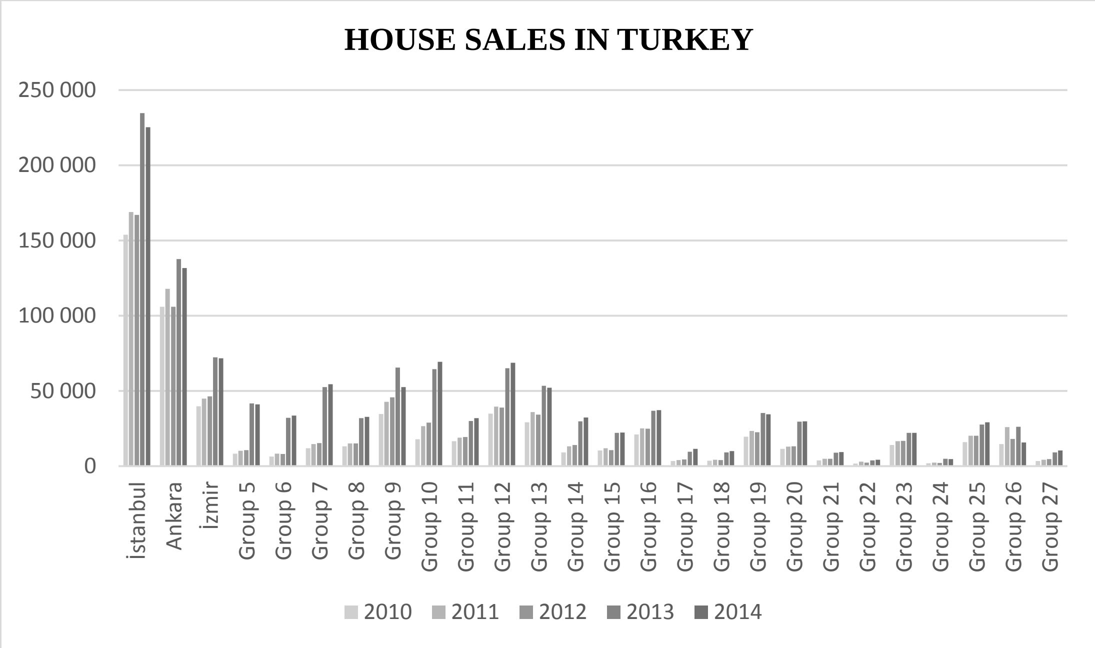


Figure 4. House Sales in Turkey (*Source: www.tuik.gov.tr*)

In Figure 4, cities were grouped according to the original grouping carried out by the Central Bank of Turkish Republic, from where the data was acquired. (The detailed grouping is given in Table 2)

Even though the housing industry in Turkey has a great potential, in order to have a complete understanding of it we need to have a much broader look at the industry. In order to do this, SWOT analysis can be used as the perfect tool. SWOT analysis is a technique that is used in order to identify and understand both the internal and the external factors that may influence an organization or an entire industry. SWOT stands for Strengths, Weakness, Opportunities, and Threats. Strengths and weaknesses are the internal factors, while opportunities and threats are driven by external factors. Therefore, to have a better understanding of the industry, we examined the SWOT analysis of the industry conducted by two different establishments, which are Institute of Strategic Thinking and Emlak Konut GYO. The most noteworthy items are listed below,

Strengths:

- The demand for housing is still higher than the supply
- The experience that the industry has
- The trust in the industry
- High quality production

The strongest side of the housing industry in Turkey, is the unending demand for houses. Moreover, this demand is even higher than the current supply. This means that as long as the demand persists, the suppliers have nothing to fear while investing for more projects in this industry. Another strength that the industry has is the experience over years. Furthermore, the industry is perceived as a quite trustworthy industry and it provides high quality products.

Weaknesses:

- Negative effects of high tax rates on both supply and demand
- High rate of off-the-books housing to avoid taxes
- Institutionalization of the operating companies is not common
- Education level of the mid and low level workers is low

The tax rates, just like any other tax in Turkey, are awfully high for both suppliers and buyers and this affects the industry in a very negative way. Another weakness caused by the first one is the high tax rates drive the actors of this industry to prefer off-the-books housing. Since there is no inspection over the off-the-books housing, the quality significantly drops, and it harms the overall image of the industry. In addition, since the prices of these illegal houses a lot lower compared to the legal ones, it also affects the demand negatively. The next weakness is the low institutionalization rate of the operating companies. Last but not the least weakness of the industry is caused by the low education level in Turkey. Both the mid and low level workers are mostly uneducated. This prevents the industry from having a better overall quality and success.

Opportunities:

- The urban transformation project
- The young population
- Increasing rate of population growth
- Increasing demand in foreign investment
- The growth in the economy

The urban transformation project is by far the biggest opportunity that Turkey's housing industry has. The project sees the demolishing and renewing of millions of buildings which is presumed as unsafe considering Turkey's earthquake-prone provinces. The market value of the project is estimated to be over USD 500 billion within a decade. This attracts the attention of the leaders of global construction industry. One of the other opportunities is the young population Turkey has. Young population can create more work force for the industry, and it also creates more demand in time as the young population come to the age of marriage. Moreover, the overall population of Turkey is also growing which will lead to even more demand for housing over time. As the industry gets bigger, is attracts the foreign investors and this can be considered as another opportunity for the industry. Lastly, the possible economic growth can be an opportunity in the future as well.

Threats:

- Prone to global economic and political crises
- The constant rising of the land prices
- The risk of the house price uptrend to be perceived as a housing bubble

Housing industry in Turkey is highly prone to global economic and political crises, and this threatens the industry the most. Another threat to the industry is the increasing land prices. Since the land price is a direct cost for housing, the price increase trend might hit the industry badly. Lastly, the increased house prices are perceived as a housing bubble by some authorities and this may drive the buyers to wait until the prices drop, leading to a drop in the demand for houses.

2.3 Market Efficiency

The purpose of an investment in any market is always the same, to make a profit out of it. However, there is more to it than that for some people, which is beating the market. This can be achieved in numerous ways like foreseeing future prices based on past prices, or having information that is not available to all the participants in the market. Market efficiency is the key to prevent such events from happening.

The general concept of an efficient market is often defined by the words of Fama (1970): "A market in which prices always 'fully reflect' available information is called 'efficient'". In addition to this, availability and arrival of complete and simultaneous information are required for a market to be efficient. Moreover, information cost should not exist while transaction costs should be substantially low. These requirements are mostly relevant to the markets like stock market. The efficiency of housing market, however, is mostly related to the past prices. In order for a housing market to be efficient the past prices should not give any idea about the future prices. This concept is known as the weak-form efficient market which is one of the three efficient market types suggested by the Efficient Market Hypothesis. According to this theory, if the future prices can be predicted by examining the price history of a market then we can say that the market is inefficient because it would create the opportunity to abuse the market by taking action according to the information that has been forecast. If the historical house prices do not have any patterns which would make the future price movements foreseeable then the market is weak-form efficient. Though it is worth to mention that weak-form efficient markets are, as the name suggests, the weakest type of efficient markets considering it is rather easy to access to the price history of a market.

The numbers of actors in the housing market are gradually increasing and more and more people perceive the housing market as an investment tool over time. Some of these actors are the homeowners, investors, mortgage bankers, and hedge funds (Schindler, 2010). These increase also boosts the volume of transactions in the housing market. Low transaction volume is one of the reasons why it is hard to understand whether housing markets are efficient or not compared to stock markets. Thus, the increasing investment trend in housing market is why the efficiency of housing markets is worthy of investigation. To the best of our knowledge, there has not been any studies inspecting the efficiency of the housing market in Turkey. Therefore, we decided to investigate it for the first time in the literature in our study.

2.4 Ripple Effect

Ripple effect, by definition, is the gradually spreading effect or influence caused by a single action or event. The effect can be imagined as, as the name implies, the ripples caused by an object when it is dropped into the water. In the literature, this term is used to describe the house-price diffusion effect in the housing markets According to the ripple effect theory, house-price shocks in one city or region are likely to have temporary or permanent impacts on the other regions (Pollakowski and Ray, 1997). Considering the generally accepted factors affecting the house prices such as the local demand and supply, the economic theory and intuition rejects the idea of house prices across regions moving together (Canarella et al, 2010). However, as shown in the following chapter containing the empirical literature survey, considerable evidence on the ripple effect exists on numerous studies. If the ripple effect exists, then there is a long-run convergence in housing prices. In the literature, the ripple effect is investigated by analyzing the time series properties of the deviations of the regional house prices from the national prices. If these deviations are found to be stationary, then the ripple effect is verified.

Meen (1999), came up with four theories trying to explain the ripple effect, which were migration, equity transfer, spatial arbitrage, and spatial differences:

- Migration: This requires the movement of the households from one area to another due to the effects of a shock. This causes the shock to spread to the destination regions.
- Equity Transfer: The change in house prices leads to a change in homeowners' equity (Stein, 1995). If the equity increases, the householders gain more mobility making them able to move to another region to buy a similar house for a lower price. The mass movement of home owners to different regions inflates the prices at that new region as well (Gupta & Miller, 2009).

- Spatial Arbitrage: Similar to equity transfer there is a chance to take an advantage of the different house prices between the regions that is affected first by the shock and the regions that is not affected by it yet. However, instead of the households, the financial capital that moves between regions this time (Gupta & Miller, 2009).
- Spatial Differences: Regions react to shocks with varied speeds, consequently, house prices change first in the region that reacts the fastest (Canarella et al, 2010). Then the slower reacting areas get hit by the shock leading to a later change in the house prices.

Regardless of the source of the effect of ripple effect, it is crucial to understand whether such an effect exists in housing markets in the first place. Considering the global financial end economic crisis in 2008, which originated from the collapse of the house prices due to the failure of mortgage system and spread globally, it is absolutely essential to know if a shock in an area spreads over to other areas or not both on country-wide scale and global scale. In other words, it is a must to know if the shocks in a region ripple out or not in order to make governments or international economic organizations able to prevent such local crisis from spreading to wider scales.

CHAPTER 3

3. EMPIRICAL LITERATURE ON HOUSING MARKET EFFICIENCY AND RIPPLE EFFECT

3.1 Empirical Literature on Housing Market Efficiency

In this section, the empirical literature about the housing market efficiency was analyzed. In the history of empirical literature researchers mostly preferred to study the efficiency of the stock markets rather than the housing markets. Therefore, we can say that it is a fairly new study area. Accordingly, there are not many studies that have been done on this subject in the literature. Not to mention this paper is the first one in the literature studying the Turkish housing market efficiency.

Huang et. al. (2006) examined Shanghai housing market and used Rescaled Range Analysis method. They found enough evidence to reject null hypothesis of efficient market as they were not able to find a unit root presence.

Rosenthal (2006) conducted Autoregressive test on the UK housing market for the period between 1991 and 2001. The results have indicated that the UK market contain a unit root, hence it is an efficient market. Therefore, this market does not provide opportunities to make a profit by predicting future prices.

Xu et. al. (2007) analyzed the Hong Kong market for the period 1984 to 2005. They preferred to apply ADF and PP unit root tests. These tests demonstrated that the Hong Kong market is stationary, in other words the market is inefficient.

In another study, Larsen et. al. (2008) utilized Case-Shiller time-structure test on the housing market of Oslo for the years between 1991 and 2002. The findings lead to the acceptance of the alternative hypothesis of inefficient market.

Hooi & Russell (2012) studied 14 states of Malaysia. They applied Univariate and Panel Lagrange Multiplier (LM) unit root tests with one and two structural breaks. They showed that the markets of these 14 states were lacking a unit root. Thus, they rejected the null hypothesis of efficient market, proving the market is stationary.

In the most recent study, Tsangyao et. al. (2014) investigated South Africa for the period quarter 1 of 1978 to quarter 4 of 2012. They exercised Sequential Panel Selection Method (SPSM) in their study. As the results pointed to a stationary market, they accepted the alternative hypothesis of inefficient market.

In Table 1, the survey results are shown in chronological order to make it easier to follow,

Table 1. Literature Survey of Housing Market Efficiency

Researcher	Sample	Period	Method	Result
Huang et. al. (2006)	Shanghai		Rescaled Range Analysis	Inefficient market
Rosenthal (2006)	The UK	1991-2001	Autoregressive test	Efficient market
Xu et. al. (2007)	Hong Kong	1984-2005	ADF and PP unit root tests	Inefficient market
Larsen et. al. (2008)	Oslo	1991-2002	Case-Shiller time-structure test	Inefficient market

Hooi & Russell (2012)	14 states of Malaysia		Univariate and Panel Lagrange Multiplier (LM) unit root tests with one and two structural breaks	Inefficient market
Tsangyao et. al. (2014)	South Africa	1978:Q1-2012.Q4	Sequential Panel Selection Method (SPSM)	Inefficient market

3.2 Empirical Literature on Ripple Effect

The empirical literature on ripple effect is full of studies that confirm the ripple effect. However, there are some studies that only confirm it within regions rather than spreading nationally. The results of our survey on this topic are reported below. To our knowledge, this is the first study that analyzes the ripple effect for the housing market in Turkey.

Meen (1999) examined Great Britain by estimating a new model in which the coefficients exhibit non-random spatial patterns. He suggested in his paper that the structural differences in regional housing markets are significant. He came up with the result that the model can generate a ripple effect irrespective of regional growth patterns.

Cameron et al. (2005) used an annual econometric model of regional house prices in Britain for the period 1972 to 2003. They found enough evidence to prove that the ripple effect exist in Great Britain, originating from London and spreading to other regions, starting with the adjacent regions.

Shi et al. (2009) conducted Granger causality test based on a vector error correction model (VECM) in their study. They did their research on New Zealand between the years 1994 and 2004. They found in the long run that the ripple effect is constrained within regions in all likelihood. In other words, they proved that the ripple effect is not likely to spread nationally between main regional centers.

Canarella et al. (2010) applied Lumdaine-Papell and Lee-Strazicich tests to the US housing market. They examined the stationarity of the metropolitan house-price ratios. Since their test results were contradictory, they found only limited evidence that the US housing market contains some ripple effects.

Balcılar et al. (2013) analyzed five major metropolitan areas of South Africa based on quarterly data of the period of quarter 1 of 1966 to quarter 1 of 2010. These 5 metropolitan areas were Cape Town, Durban Unicity, Greater Johannesburg, Port Elizabeth/Uitenhage and Pretoria. They applied Bayesian and non-linear unit root tests along with the standard linear tests of stationarity with and without structural break. As a result of their tests, they found undeniable proofs supporting the existence of ripple effect in South African metropolitans. This effect starts from Cape Town for the large housing segment and from Durban for the medium and small sized houses and then spreads to other areas.

Lean and Symth (2013) conducted their research on 14 regional locations in Malaysia. They preferred to use univariate and panel Lagrange multiplier (LM) unit root tests with one and two structural breaks. As distinct from the other studies in the literature on this subject, they investigated the ripple effect for five different housing price indices namely, aggregate housing, detached housing, semi-detached housing, terrace housing and high-rise housing. They were able to confirm the ripple effect as well. Moreover, just like the other studies they exhibited that the ripple effect originates from the most developed areas spreading to the less developed ones.

Chiang (2014) investigated six first-tier Chinese cities based on the data covering the period 2003 to 2013. They used a cointegration estimation technique and applied the Toda-Yamamoto causality test in their paper. They accepted the ripple effect hypothesis as well, and found that the originating source of ripple effect in Chinese market is Beijing.

Table 2 presents the literature survey results in chronological order,

Table 2. Literature Survey of Ripple Effect

Researcher	Sample	Period	Method	Result
Meen (1999)	Britain			Ripple Effect is confirmed
Cameron et al. (2005)	Britain	1972 – 2003		Ripple Effect is confirmed
Shi et al. (2009)	10 urban areas in New Zealand	1994 – 2004	Granger causality test based on a vector error correction model (VECM)	Ripple Effect is confirmed only within regions
Canarella et al. (2010)	The US		Lumdaine-Papell and Lee-Strazicich tests	Limited evidence to confirm Ripple Effect
Balcılar et al. (2013)	5 regions of South Africa	1996:1 – 2010:1	Bayesian and non-linear unit root tests	Ripple Effect is confirmed
Lean and Symth (2013)	14 regions of Malaysia		Lagrange multiplier (LM) unit root tests	Ripple Effect is confirmed
Chiang (2014)	6 cities of China	2003 – 2013	Toda-Yamamoto causality test	Ripple Effect is confirmed

In addition to these studies, Holmes (2007) reported in his paper that some other studies came up with varied results supporting ripple effect as well. These studies are Holmans (1990), MacDonald and Taylor (1993), Alexander and Barrow (1994), Drake (1995), Ashworth and Parker (1997), Petersen et al. (2002) and Holmes and Grimes (2005), and also Meen (1999) which we mentioned in our study before.

Holmes (2007) also noted that most of these studies applied Engle and Granger (1987) or Johansen (1988) likelihood ratio tests of cointegration.

CHAPTER 4

4. METHODOLOGY

In this thesis, our aim is to analyze the efficiency of the Turkish housing market and to test for the ripple effect (i.e., whether house price shock are transmitted across regions). To this end, a variety of unit root tests are used. Augmented Dickey Fuller (ADF) test was used as the sole linear unit root test. As for the nonlinear unit root test, the Kapetanios-Snell-Shin (KSS) test was conducted. Finally, to allow for structural breaks in the housing price series the Leybourne, Newbold, Vougas (LNV) test were implemented. The null hypothesis for all these tests is accepted when there is a unit root. If the null hypothesis is accepted for the housing price series, in other words if there is a unit root present we can say that the housing market of Turkey is efficient. Moreover, if the ratio of a region's house price index to the national house price index is stationary, then the ripple effect will be verified.

4.1 The Augmented- Dickey Fuller (ADF) Test

The Dickey Fuller test is modeled as follows;

$$Y_t = Y_{t-1} + u_t \qquad (4.1)$$

This equation causes a random walk without drift. The alternative hypothesis is stationary in AR (1) process and u_t is the error term,

$$Y_t = \rho Y_{t-1} + u_t \qquad 1 - \leq \rho \leq 1 \qquad (4.2)$$

In equation (4.2) if $\rho = 1$, in other words if there is a unit root present, we get a non-stationary stochastic process and a random walk model without drift (Gujarati, 2004). In the equation (4.2) Y_{t-1} was subtracted from both sides. When they are added back we get the equation,

$$Y_{t-1} - Y_t = \rho Y_{t-1} - Y_{t-1} + u_t \qquad \Longrightarrow (\rho - 1) Y_{t-1} \tag{4.3}$$

And 4.3 can be written as,

$$\Delta Y_t = \delta Y_{t-1} + u_t \tag{4.4}$$

$$\delta = (\rho - 1)$$

$H_0: \delta \geq 0$ (A unit root is present / Non-stationary)
$H_1: \delta < 0$ (No unit root presence / Stationary)

The various possibilities of DF test can be estimated in three different forms:

$\Delta Y_t = \delta Y_{t-1} + u_t$ (Pure random walk)

$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t$ (Y_t has a random walk with drift)

$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + u_t$ (Y_t has a random walk with drift around a stochastic trend)

The critical values of the tau test to test the $\delta = 0$ hypothesis are different for these three determinations. This difference is highly noteworthy (Gujarati 2004). These critical values are, 1%, 5% and 10%. DF or MacKinnon (1991) critical tau value was used in Dickey Fuller test instead of the standard t distribution and t statistic.

$$|\tau| > |McK - DF|$$

When this is the case, H_0 is rejected, which means we have a stationary time series.

Dickey Fuller test was developed further into the Augmented Dickey Fuller (ADF) test using the three different forms of DF test. "This test is conducted by "augmenting" the preceding three equations by adding the lagged values of the dependent variable ΔY_t" (Gujarati 2004). ADF test is estimated as follows,

$$\Delta Y_t = \beta_1 + \beta_{2t} + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \varepsilon_t \quad (4.5)$$

Where ε_t is pure white noise error term,

$$\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$$

And,

$$\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$$

We need to test δ = 0 hypothesis for ADF test as well. Since the ADF test follows the same asymptotic distribution with the DF test, we can use the same critical values (Gujarati 2004).

The null hypothesis $\delta = 0$ can be tested against the alternative hypothesis $\delta < 0$ using the ADF test. If the t value lower than the critical value, null hypothesis is rejected. In this case, we accept the alternative hypothesis. Therefore, we say that series are stationary due to the lack of unit root presence.

4.2 Kapetanios-Snell-Shin (KSS) Test

Kapetanios et al. (2003) suggested a testing procedure against an alternative of globally stationary nonlinear exponential smooth transition autoregressive (ESTAR) process. The model they came up with is given below,

$$y_t = \beta y_{t-1} + \gamma y_{t-1}\Theta(\theta;\ y_{t-d}) + \varepsilon_t \quad t = 1, \dots, T \tag{4.6}$$

With $\Theta(\ \theta; y_{t-d}) = 1 - \exp(-\theta\ y_{t-d}^2\ )$

Where $\theta \geq 0\ and\ d \geq 1$, which gives

$$y_t = \beta y_{t-1} + \gamma y_{t-1}\{1 - \exp(-\theta\ y_{t-d}^2\ )\} + \varepsilon_t \tag{4.7}$$

y_{t-1} can be subtracted from both sides in order to re-parameterize the equation (4.7) to get,

$$\Delta y_t = \ \phi y_{t-1} + \gamma\ y_{t-1}[1 - \exp(-\theta\ y_{t-d}^2\ )] + \ \varepsilon_t \tag{4.8}$$

if $\phi = \beta - 1$. If $\theta > 0$, then it sets the speed of mean reversion and $\varepsilon_t \backsim iid\ (0, \sigma^2\ )$, and $\beta, \phi\ , \theta\ and\ \gamma$ are unknown parameters. In the model, y_t is assumed to be a mean zero stochastic process. Imposing $\phi = 0 \quad d = 1$ gives the specific ESTAR model (4.8) as

$$\Delta y_t = \ \gamma\ y_{t-1}[1 - \exp(-\theta\ y_{t-1}^2\ )] + \ \varepsilon_t \tag{4.9}$$

$H_0: \theta = 0$ Null Hypothesis

$H_1: \theta > 0$ Alternative Hypothesis

4.3 Leybourne, Newbold, Vougas (LNV) Test

Leybourne et al. (1998) and Kapetanios et al. (2003) are both smooth-transition models. The difference between LNV and KSS is the adoption of the logic transition function which is used in the structural change series with the time item (Zeng et al.2011). The developers of LNV test are Leybourne, Newbold, Vougas (1998) (LNV). Leybourne et al. (1998) proposed a stationarity around a smoothly changing trend as the alternative hypothesis of their test. They tested the null hypothesis against three possible alternatives. The derivation of the model is,

Model 1 : $y_t = \alpha + \alpha_2 S_t(\gamma, \tau) + \varepsilon_t$

Model 2 : $y_t = \alpha + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + \varepsilon_t$

Model 3 : $y_t = \alpha + \beta_1 t + \alpha_2 S_t(\gamma, \tau) + \beta_2 t S_t(\gamma, \tau) + \varepsilon_t$

Where y_t be a changing trend function with smooth transition on the time domain $t = 1,2,,\ldots,T$. ε_t is a zero mean I (0) process and $S_t(\gamma.\tau)$ is logistic smooth transition function, based on a sample of size T and N.

$$S_t(\gamma.\tau) = [1 + \exp\{-\gamma(t - \tau T)\}]^{-1} \ , \ \gamma > 0 \qquad (4.10)$$

"In this modeling strategy, the structural change is modeled as smooth transition between different regimes rather than instantaneous structural break as in Leybourne et al (1998). The transition function $S_t(\gamma,\tau)$ is continuous function bounded between 1 and 0. Thus the Smooth Transition Regression (STR) model can be interpreted as regime-switching model that allows for two regimes, associated with the extreme values of the transition function, $S_t(\gamma,\tau)$= 0 and $S_t(\gamma,\tau)$=1 , whereas the transition from one regime to the other is gradual. The parameter γ determines the smoothness of the transition, and thus, the smoothness of transition from one regime to the other. The two regimes are associated with small and large values of the transition variable $S_t = t$ relative to the threshold $c = \tau$.For the large values of γ , $S_t(\gamma,\tau)$ passes through the interval (0,1) very rapidly, and as γ approaches +∞ this function changes value from 0 to 1 instantaneously at time $t = \tau T$. Therefore, if we assume that ε_t is zero mean I (0) process and then model 1 y_t is stationary process around a mean which changes from initial value α_1 to final value $\alpha_1 + \alpha_2$" (Omay et al.2014).

Omay et al. (2014) suggested the following hypotheses, for unit root testing based on the three equations mentioned above:

H_0: Unit Root, (Linear Nonstationary)

H_1: Nonlinear Stationary (Nonlinear and Stationary around smoothly changing trend and intercept)

CHAPTER 5

5. DATA AND EMPIRICAL RESULTS

5.1 Data

The efficiency of the housing market of Turkey is examined using the monthly data of Turkish house-price index over the period 2010:1 and 2014:12. The data is acquired from the database of Central Bank of Turkey. All 81 cities are included in the data, however they are divided into groups geographically apart from İstanbul, Ankara, and İzmir. The Turkish house-price index (THPI) is also examined as a whole. The groups of cities are shown in Table 3,

Table 3. Geographically divided groups according to Central Bank of Turkey

1 : THPI
2 : İstanbul
3 :Ankara
4 : İzmir
5 : Edirne, Kırklareli, Tekirdağ
6 : Balıkesir, Çanakkale
7 : Aydın, Denizli, Muğla
8 : Afyon, Kütahya, Manisa, Uşak
9 : Bursa, Eskişehir, Bilecik
10 : Bolu, Kocaeli, Sakarya, Yalova, Düzce
11 : Konya, Karaman
12 : Antalya, Burdur, Isparta

13 : Adana, Mersin

14 : Hatay, Kahramanmaraş, Osmaniye

15 : Nevşehir, Niğde, Aksaray, Kırıkkale, Kırşehir

16 : Kayseri, Sivas, Yozgat

17 : Zonguldak, Bartın, Karabük

18 : Çankırı, Kastamonu, Sinop

19 : Samsun, Çorum, Amasya, Tokat

20 : Artvin, Giresun, Gümüşhane, Ordu, Rize, Trabzon

21 : Erzurum, Erzincan, Bayburt

22 : Ağrı, Ardahan, Kars, Iğdır

23 : Bingöl, Elazığ, Malatya, Tunceli

24 : Van, Bitlis, Hakkari, Muş

25 : Kilis, Adıyaman, Gaziantep

26 : Diyarbakır, Şanlıurfa

27 : Batman, Mardin, Siirt, Şırnak

In the following tables the summary statistics of the housing price indices and the summary statistics of the capital gains are demonstrated.

Table 4. Summary Statistics of the housing price indices

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
THPI	126.159	123.645	170.01	96.92	21.54315	0.407847	2.019214	4.068246
İstanbul	133.9342	127.05	202.27	96.69	30.03918	0.653904	2.358345	5.305205
Ankara	120.8063	119.43	152.19	96.63	16.5306	0.304979	1.914318	3.876887
İzmir	125.9578	125.685	165.81	97.9	20.4994	0.286413	1.906803	3.808024
Group 5	143.9308	121.63	162	97.28	192.6641	7.552937	58.37914	8374.885
Group 6	113.8393	112.945	140.99	97.22	12.20702	0.608299	2.426116	4.523635
Group 7	121.6288	114.185	160.69	96.01	20.24757	0.60137	2.0208	6.013539
Group 8	129.7765	128.82	169.87	98.06	23.42255	0.136687	1.632182	4.86415
Group 9	116.7913	114.305	144.31	97.72	13.7646	0.388245	1.997004	4.022342
Group 10	115.9385	115.49	142.79	96.98	13.0937	0.448649	2.132172	3.89567
Group 11	127.4892	125.985	169.1	94.65	21.9909	0.225628	1.823	3.972404
Group 12	124.6362	122.025	166.73	97.24	20.82352	0.483358	2.065121	4.521344
Group 13	129.955	130.24	174.89	94.8	22.83653	0.177826	1.920118	3.231582
Group 14	120.7595	120.79	152.17	96.95	16.10235	0.273552	2.096254	2.790195
Group 15	121.6968	120.075	152.07	95.21	17.51287	0.140304	1.702736	4.404087
Group 16	126.4962	128.71	164.82	95.67	20.17151	0.142309	1.826662	3.64432

Group 17	124.0532	128.445	150.29	92.47	16.27885	-0.30871	1.946485	3.727764
Group 18	128.8435	132.39	160.97	97.39	20.94107	-0.09917	1.590885	5.062367
Group 19	115.6797	115.625	136.76	97.44	12.26521	0.146996	1.715649	4.339969
Group 20	116.2363	117.115	137.85	97.1	12.39805	0.149283	1.813224	3.743949
Group 21	137.9762	141.44	179.66	95.44	27.31986	-0.11669	1.615054	4.931361
Group 22	123.1845	122.975	150.83	93.61	17.36526	-0.06598	1.670345	4.463486
Group 23	119.1737	118.27	145.46	95.43	14.96952	0.127583	1.683501	4.495696
Group 24	116.6348	112.235	141.68	95.3	14.21319	0.274717	1.677839	5.124964
Group 25	155.0187	154.335	221.13	95.87	43.1157	0.138399	1.625187	4.91682
Group 26	133.4532	143.14	161.34	96.37	22.97719	-0.39832	1.525975	7.018482
Group 27	122.3513	121.67	160.47	95.37	17.69384	0.40006	2.244821	3.02622

Notes: Sample means, medians, maximums, minimums, and standard deviations in the table belong to the housing price indices. Jarque-Bera (1987) is the test for non-normality based on the skewness and kurtosis of the distribution.

Table 4 shows the summary statistics of the housing price indices of Turkey. Group 25, Group 21, Group 5 have the highest means among all cities and groups, while Group 6, Group 10, Group 19 have the lowest means. The largest maximum value belongs to Group 25 with 221.13, and İstanbul follows this with 202.27. The smallest minimum value is 92.47 which belongs to Group 17. In terms of volatility, Group 5 has a standard deviation level which is way off the charts with 192.6641. This is followed by Group 25 with only 43.1157 and this level is also a lot more volatile than the rest of the groups. Since volatility is extremely high in these groups, they are considered to be the most risky groups. As for the least volatile groups, Group 6 and Group 19 stand out with the lowest standard deviation levels. In contrast with the highly risky groups, these groups exhibit the lowest risk among all groups since they are the least volatile ones. We can see that Group 17, Group 18, Group 21, Group 22, Group 26 exhibit significant negative skewness. Jarque-Bera test is a test that is used to confirm the non-normality of the distributions. According to the results of this test, Group 5 and Group 26 are non-normally distributed, while all the remaining cities and groups are normally distributed.

Table 5. Summary Statistics of the Capital Gains

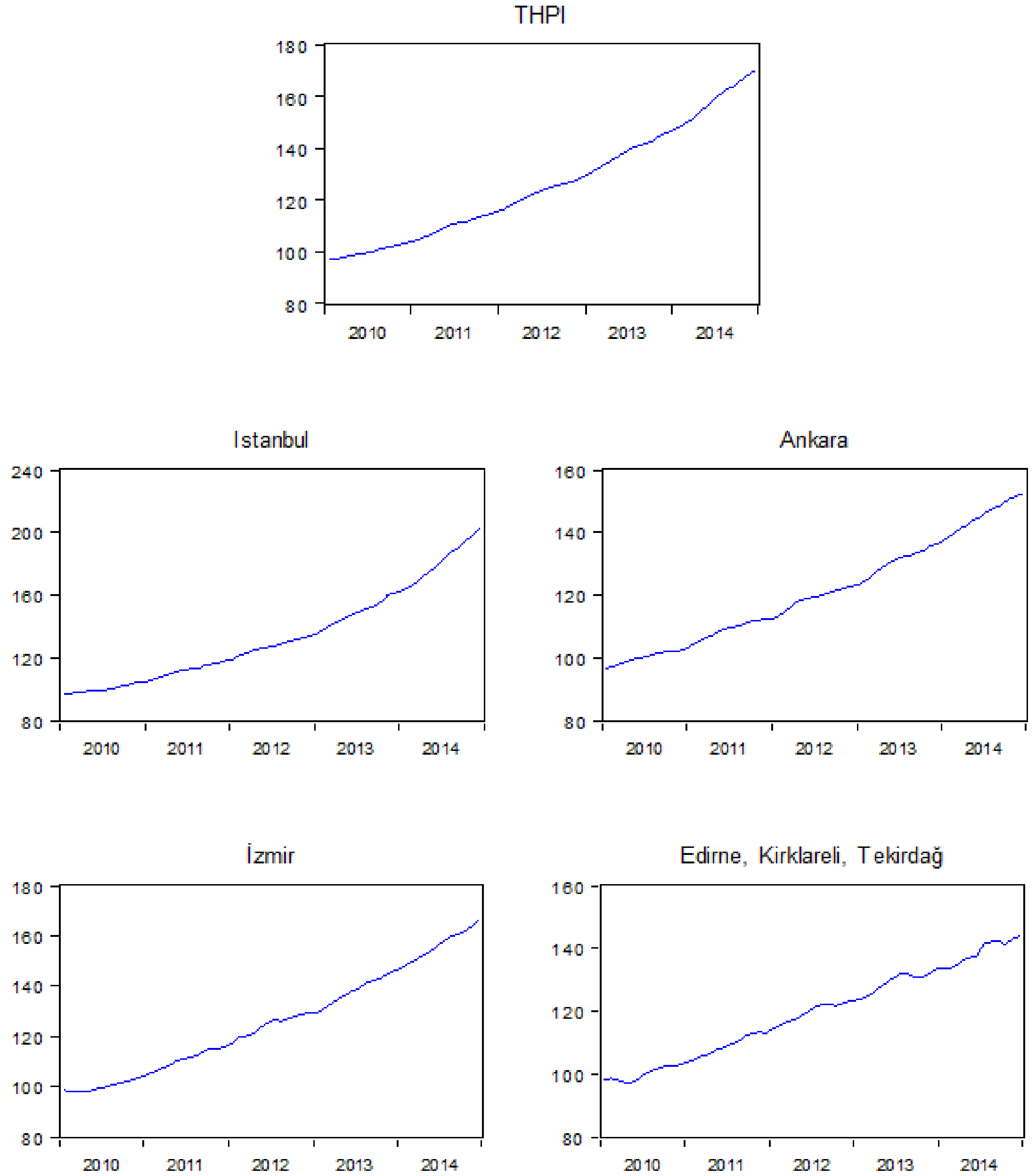
	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis	Jarque-Bera
THPI	0.009525	0.008982	0.017093	0.001797	0.003479	0.231469	2.426272	1.336044
İstanbul	0.01251	0.011845	0.028157	-0.00091	0.006511	0.234501	2.473216	1.222932
Ankara	0.007699	0.007102	0.016857	-8.92E-05	0.003979	0.284868	2.385765	1.725462
İzmir	0.008822	0.009042	0.020885	-0.00642	0.005428	-0.36628	3.235833	1.456002
Group 5	0.006487	0.006107	0.026802	-0.00904	0.006656	0.079355	3.792401	1.605507
Group 6	0.0063	0.005828	0.025301	-0.01383	0.009638	-0.16627	2.538545	0.795312
Group 7	0.008534	0.008897	0.076235	-0.01874	0.014558	1.429792	9.206015	114.7841
Group 8	0.009136	0.008229	0.030404	-0.01035	0.008933	0.277404	2.590684	1.168574
Group 9	0.006608	0.00661	0.022163	-0.00268	0.004576	0.546884	4.231444	6.668923
Group 10	0.00652	0.007098	0.020918	-0.01058	0.007212	-0.05511	2.691015	0.264563
Group 11	0.00965	0.009254	0.026004	-0.01419	0.009466	-0.25247	2.578803	1.062934
Group 12	0.009139	0.009489	0.029424	-0.00733	0.00669	0.278892	4.086517	3.666953
Group 13	0.010379	0.010232	0.020804	-0.00435	0.004835	-0.13141	3.452661	0.673522
Group 14	0.007641	0.007323	0.032071	-0.01062	0.008576	0.289289	3.118273	0.857324
Group 15	0.007772	0.007122	0.060176	-0.0186	0.012949	0.933378	6.398582	36.96138
Group 16	0.009219	0.007625	0.040317	-0.01573	0.009926	0.595377	4.478878	8.862231
Group 17	0.008232	0.006917	0.045718	-0.02752	0.014423	0.319759	3.462661	1.531636
Group 18	0.008183	0.007874	0.045192	-0.02944	0.014913	0.102752	2.944062	0.111513
Group 19	0.005746	0.005586	0.017847	-0.01245	0.005859	-0.24482	3.653604	1.63958
Group 20	0.00568	0.005144	0.02662	-0.02084	0.009418	-0.35579	3.424727	1.688262
Group 21	0.010677	0.005599	0.054055	-0.04718	0.01869	0.184417	3.926193	2.443269
Group 22	0.008029	0.007067	0.035444	-0.02104	0.013874	-0.05542	2.443739	0.79087
Group 23	0.007144	0.006095	0.034219	-0.01996	0.010418	0.022679	3.616687	0.939968
Group 24	0.00666	0.005825	0.076993	-0.05899	0.027356	0.441989	4.057514	4.670224
Group 25	0.014165	0.015042	0.037627	-0.01124	0.010356	-0.08585	2.524343	0.628679
Group 26	0.008436	0.007731	0.03909	-0.01759	0.011487	0.40794	3.522847	2.308445
Group 27	0.008819	0.009615	0.056869	-0.05185	0.018976	-0.38686	4.506294	7.049443

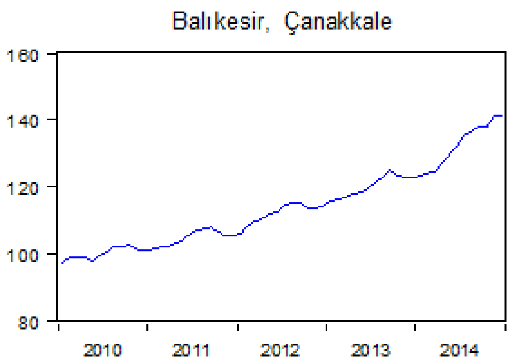
Notes: Sample means, medians, maximums, minimums, and standard deviations in the table belong to the capital gain from the sale of houses series. Jarque-Bera (1987) is the test for non-normality based on the skewness and kurtosis of the distribution.

In Table 5, the summary statistics of the capital gains are demonstrated. The highest means are provided by İstanbul, Group 21, and Group 25, while Group 6, Group 19, and Group 20 provide the lowest ones. Group 24 has the largest maximum value with 0.076993. Ankara has a minimum value that is off the charts with -8.92E-05. Group 24 records the highest standard deviation level which is 0.027356. Ankara has the minimum standard deviation value as well with 0.003979. Although, it needs to be mentioned that the capital gain level of THPI is lower than Ankara. These results point Group 24 as the highest risky group and Ankara as the lowest risky city. İzmir, Group 6, Group 10, Group 11, Group 13, Group 19, Group 20, Group 25, and Group 27 have significant negative skewness. According to the Jarque-Bera test results, Group 7, Group 15, Group 16, and Group 27 are non-normally distributed. The rest of the cities and groups are normally distributed.

Following figures display the time-series plots of housing price indices and time-series plots of capital gains.

Figure 5. Time-Series Plots of Housing Price Indices




Balıkesir, Çanakkale
160
140
120
100
80
2010
2011
2012
2013
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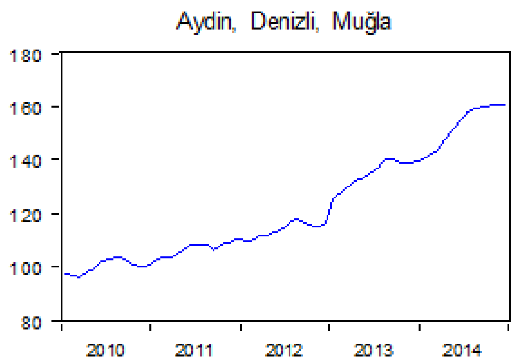
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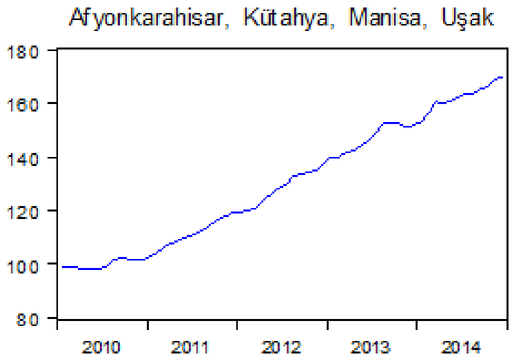
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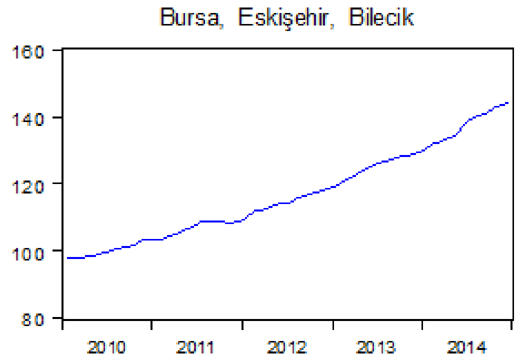
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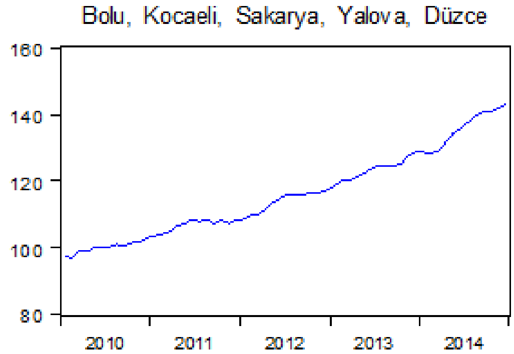
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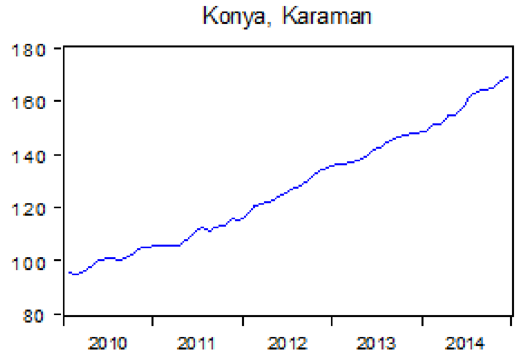
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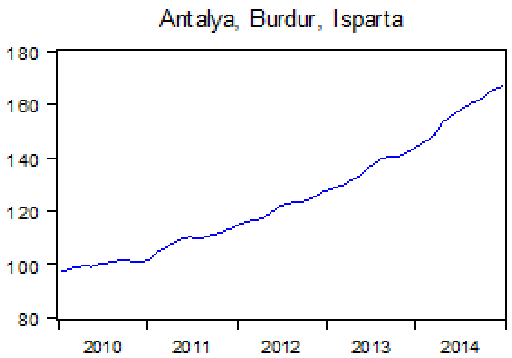
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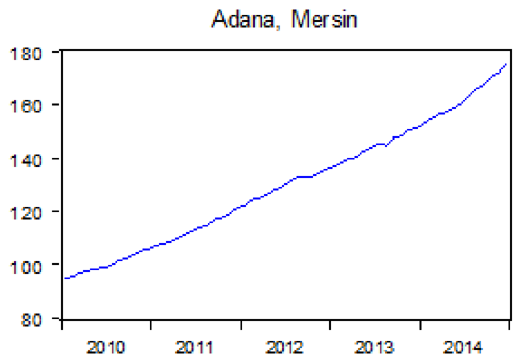
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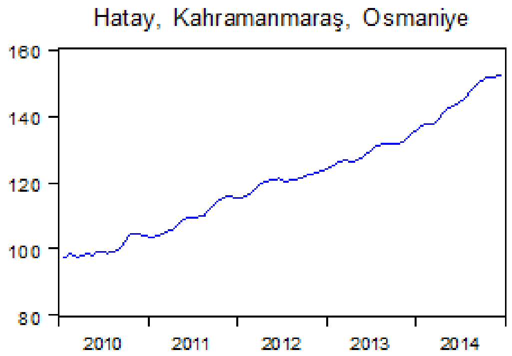
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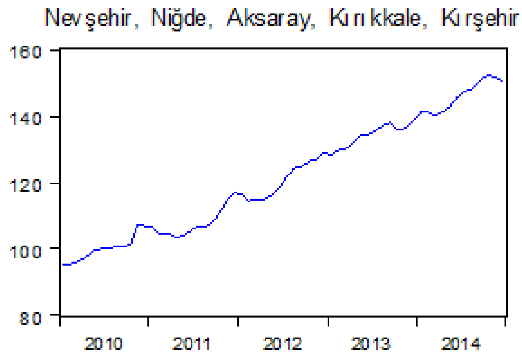
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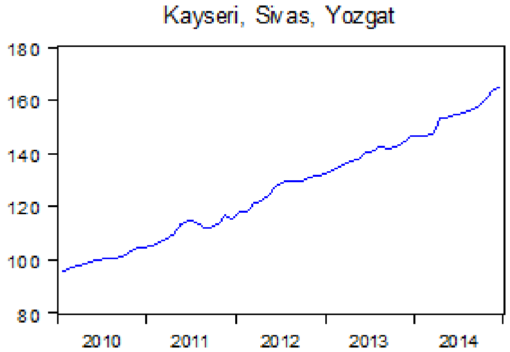
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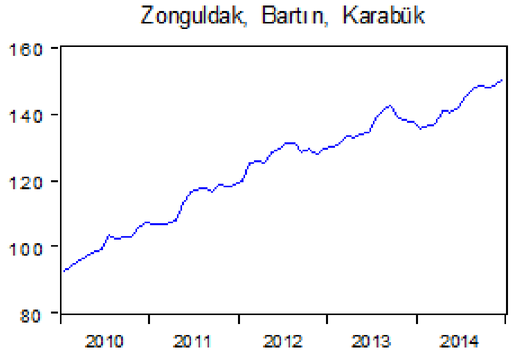
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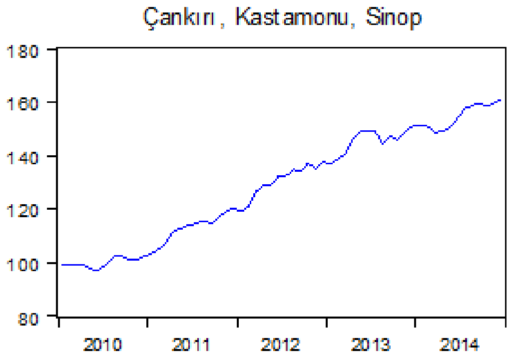
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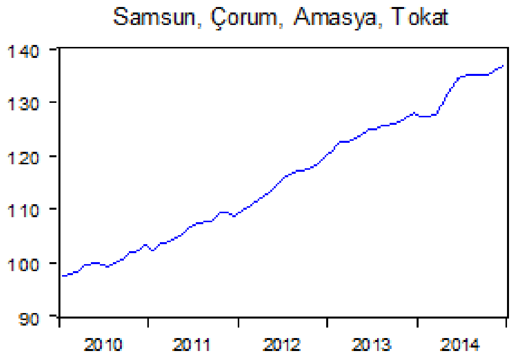
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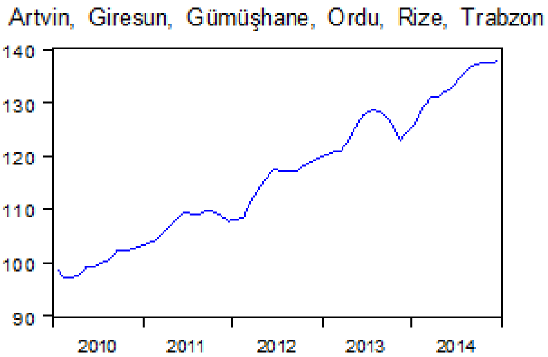
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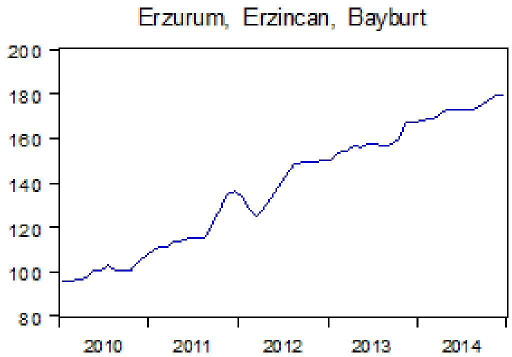
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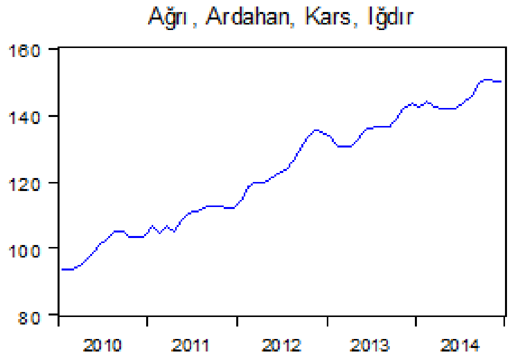
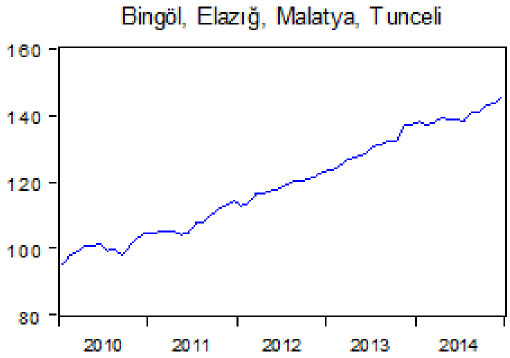
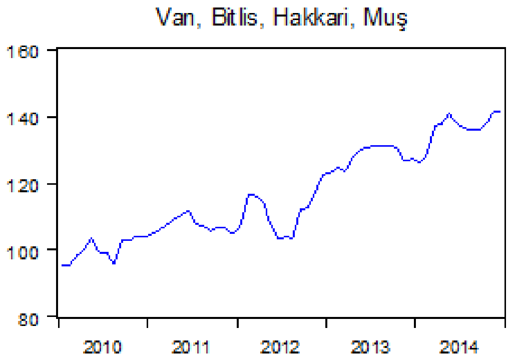
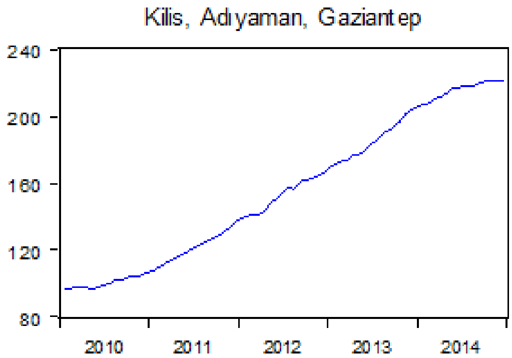
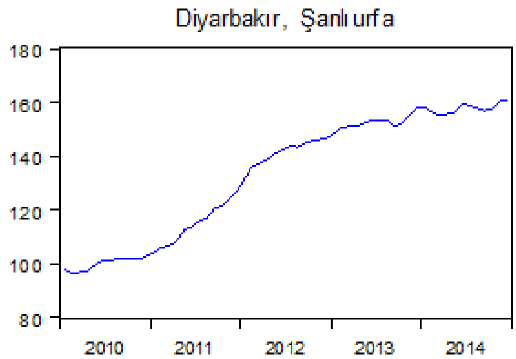
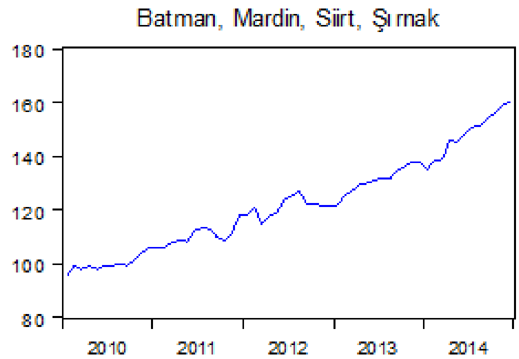






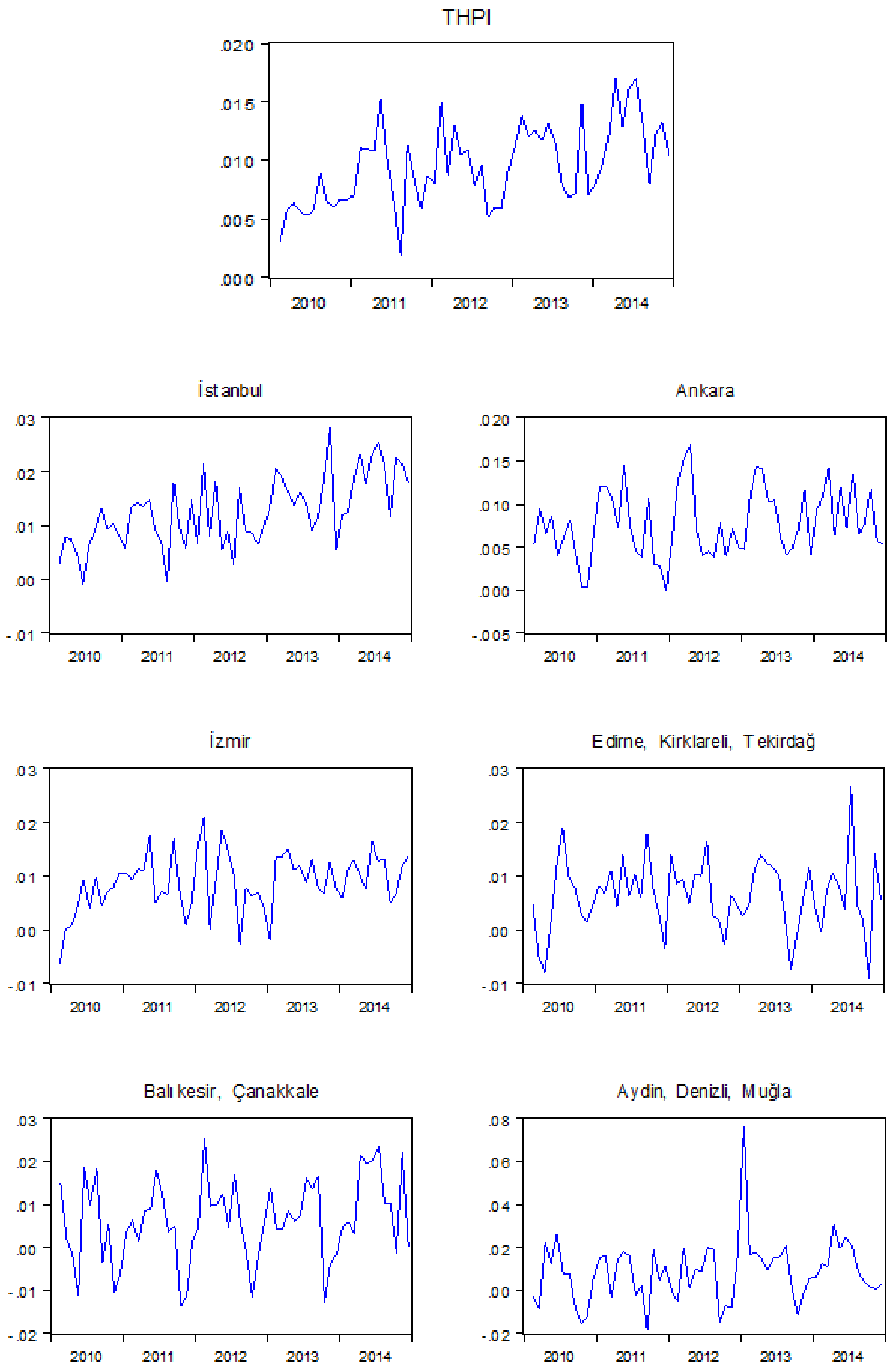


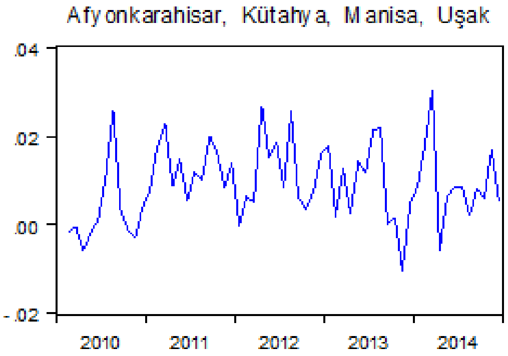




The figures above exhibits the time-series plots of house price indices (P_t) for the 27 groups outlined above, where P_t is taken as the natural logarithm of the house price index of the relevant region at time *t*. As it can be seen from the above graphs housing prices are in general increasing in every geographical region. However, volatility changes to a greater extent across regions with bigger cities experiencing less volatility than smaller regions. Also structural breaks are quite pronounced in smaller regions as compared to the larger ones.

Figure 6. Time-Series Plots of Capital Gains

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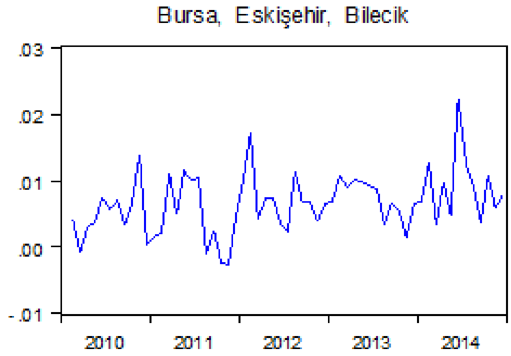
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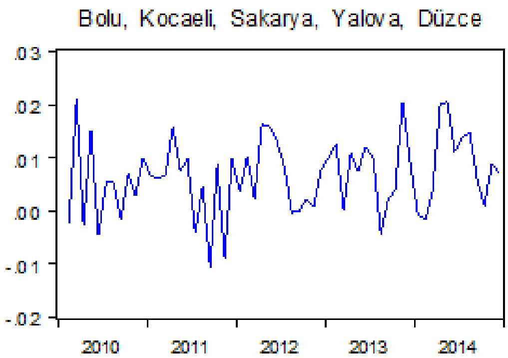
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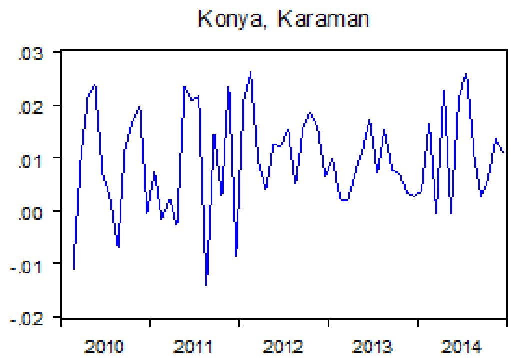
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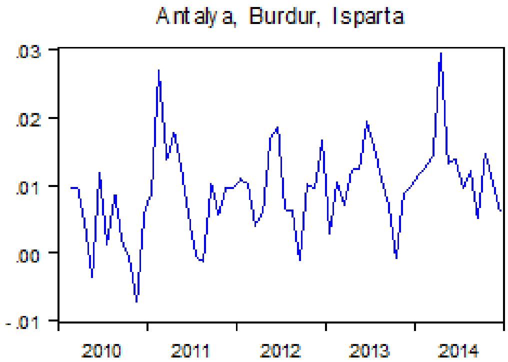
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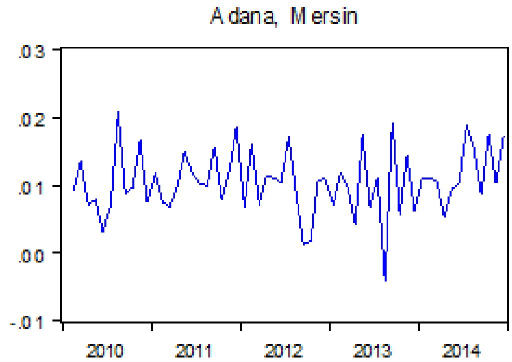
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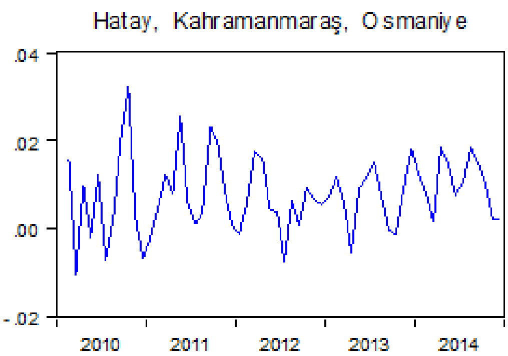
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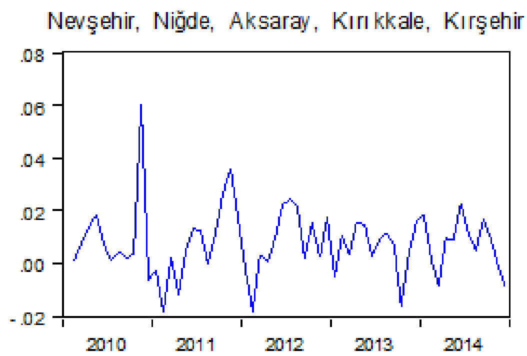
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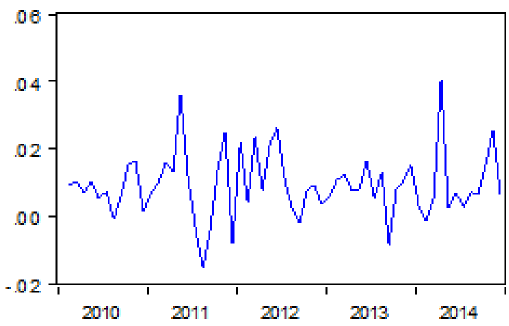

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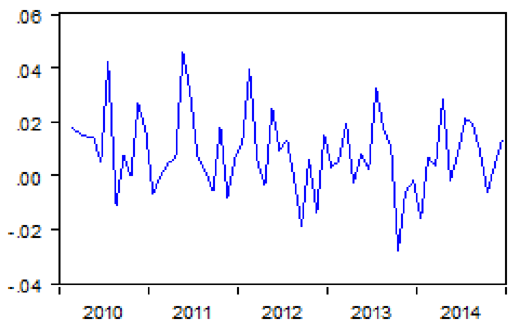
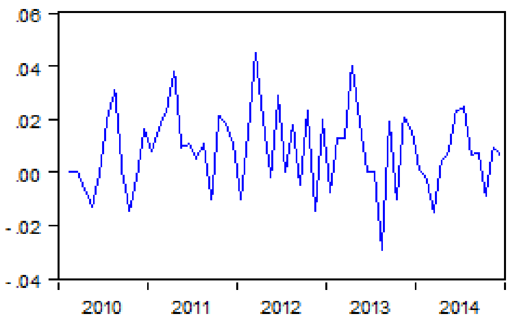


Çankırı, Kastamonu, Sinop



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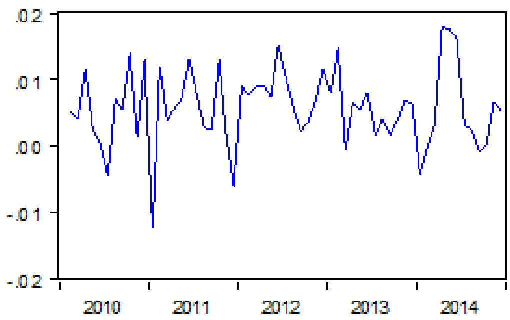

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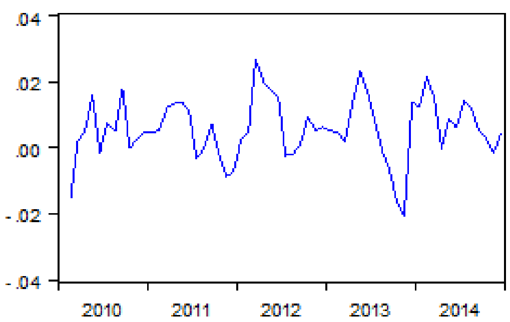

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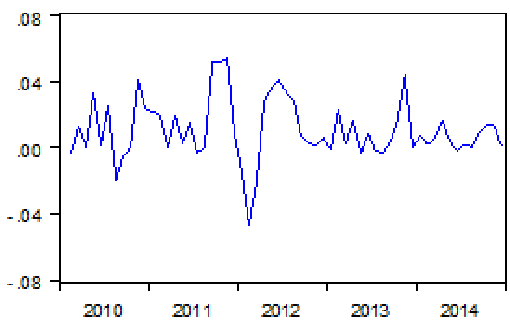

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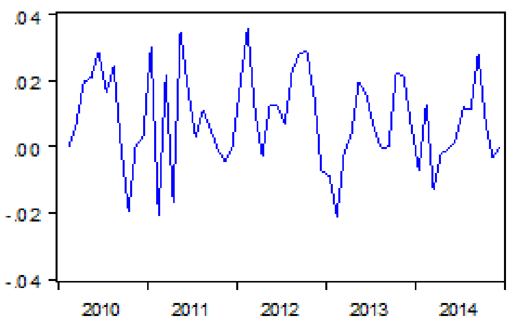

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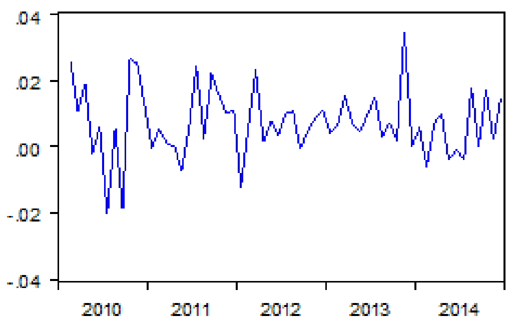

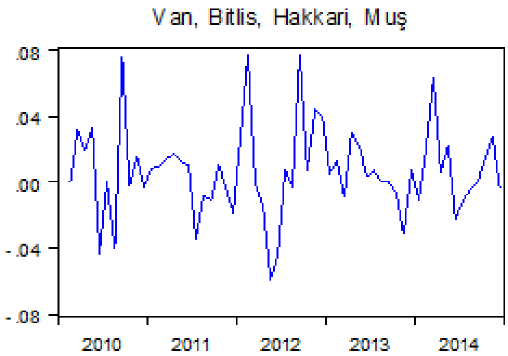

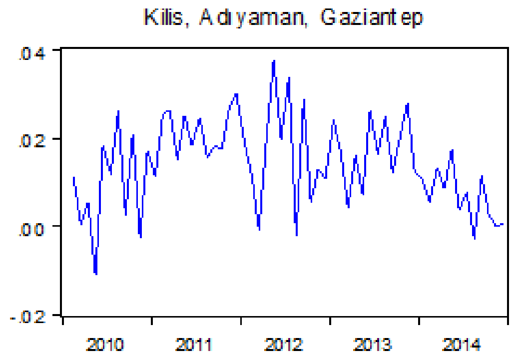

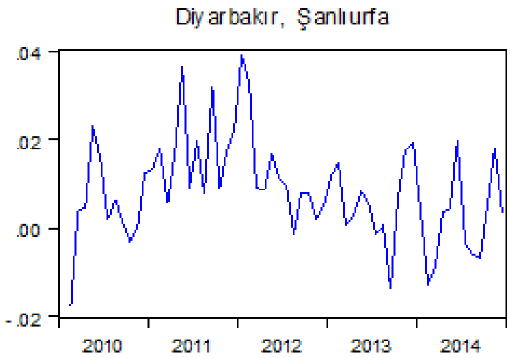

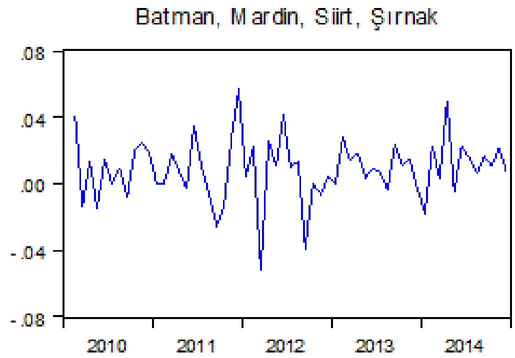

The figures above exhibits the time-series plots of capital gain from the sale of houses indices. In order to remind once again, ΔP is used to denote the capital gain and calculated as shown in the following equation;

$\Delta P_t = P_t - P_{t-1}$,

where P_t refers to the natural logarithm of the house price index at time *t*.

When we examine the time-series plots of capital gain the first thing we notice is the recession period in 2011 in most of the cities and groups and also in Turkey as general. In spite of the fact that the data span is quite limited to have detailed information, we still can observe at least one structural break for each city and group.

Upon visual inspection, the biggest drops that stand out are in Group 24 (Van, Bitlis, Hakkari, Muş) from 0.8 to around -0.6 in 2012, Group 21 (Erzurum, Erzincan, Bayburt) from around 0.5 to lower than -0.4 at the end of 2011 and the beginning of 2012, and lastly Group 15 (Nevşehir, Niğde, Aksaray, Kırıkkale, Kırşehir) from 0.6 to lower than 0.0. The sharpest increase, on the other hand, happened in Group 7 (Aydın, Denizli, Muğla) from around -0.1 to 0.8. The most volatile figures belong to Group 11 (Konya, Karaman), and Group 6 (Balıkesir, Çanakkale). Interestingly enough, in the three metropolitan cities İstanbul, Ankara, İzmir are far from being volatile and no structural breaks can be seen.

5.2 Empirical Results

In this section the results of the tests are reported and discussed. First, the results on market efficiency will be shown and then ripple effect test results will be reported. Since both linear and nonlinear tests are applied, they will be reported in two different sections.

5.2.1 Market Efficiency Results

In this section we are concerned with the time series properties of the house price series of all the 27 geographical regions in Turkey. While examining the results, to find out whether the market is efficient or not we checked for the presence of a unit root in the house price series. If the house price are stationary, then future prices can be foreseen and this creates the opportunity to make a profit out of this. Therefore the market becomes inefficient. On the other hand, if a unit root is present, then one can conclude that the housing market of that region is efficient.

In other words, we can either have a stationary or nonstationary series. We can test for market efficiency by testing the value of ρ, and checking if the series contain a unit root. Where house price index is denoted by P and capital gain is denoted by ΔP, if P is an I(1) process, then ΔP must be an I(0) process by definition. In this case we can definitely confirm that the housing market is efficient. Conversely, if P is stationary (i.e. I (0)), then the housing market is inefficient. Overall, to conclude that the housing market of any region in Turkey is efficient, we have to find stationary housing price series for that region.

5.2.1.1 Linear Test Results

There is only one linear unit root test applied in this study, and that test is the ADF test. The results of this test are reported in Table 6.

Table 6. ADF Test Results

	P
1	-0.174
2	-0.311
3	-1.534
4	-0.316
5	-2.115
6	-0.164
7	-1.633
8	-2.064
9	-0.523
10	-1.712
11	-2.776
12	-0.909
13	-1.782
14	-2.305
15	**-3.754****
16	-2.747
17	-0.973
18	-2.069
19	-2.689
20	**-3.569****
21	-0.987
22	-1.717
23	**-4.193*****
24	-3.039

25	-1.693
26	**-3.348***
27	-1.182

Notes: The superscripts *, **, *** represent significance at the 10%, 5% and 1% levels respectively using the ADF critical values for T=50 (the sample size is 60). We use Akaike Information Criteria (AIC) with a maximum lag length of 12. The ADF test regression is carried out including both a constant and a trend term. The ADF t-statistic critical values for the intercept and trend case are -3.18, -3,50 and -4.15 at 10%, 5% and 1% significance levels, respectively.

As shown in Table 6 only 4 groups do not have unit root. These groups are, Group 15, Group 20, Group 23, and Group 26. Since these groups are stationary, the housing markets of the cities involved in these groups are inefficient. On the other hand, the remaining groups and the 3 big cities and the Turkish House Price Index (THPI) contain a unit root. Thus, the housing markets of these regions and cities are efficient. The remaining cities and groups do not have a unit root present in the change in price, so these markets are efficient and there is no possible way to foresee the future prices. According to these results, a total of 23 markets are efficient and the remaining 4markets are inefficient. This gives us a rate of 15% of inefficient markets and 85% of efficient markets.

5.2.1.2 Nonlinear Test Results

To allow for nonlinear mean reversion in the housing price series we also applied the KSS nonlinear unit root test. Results of this test will be reported in this section.

Table 7. KSS Test Results

	P
1	-0.923
2	-0.060
3	-0.205

4	-0.873
5	-1.743
6	-2.038
7	**-3.490****
8	-1.982
9	-0.651
10	-1.181
11	-2.060
12	-1.982
13	-2.075
14	-1.591
15	-2.582
16	-1.988
17	-2.198
18	-1.634
19	**-3.463****
20	**-4.509*****
21	-0.918
22	-1.103
23	-1.719
24	-0.891
25	0.216
26	-1.986
27	-1.912

Notes: The superscripts *, ** and *** represent significance at the 10%, 5% and 1% levels respectively using the KSS critical values. We used Akaike Information Criteria (AIC), and a lag selection criterion is 12 lag with an upper bound. The KSS test is carried out using demeaned and detrended data. The KSS critical values for the nonzero mean and trend case are -3.13, -3.40 and -3.93 for 10%, 5% and 1% significance levels, respectively.

Table 7 shows that Group 7, Group 19, and Group 20 do not contain unit root. Thus, the markets of the cities involved in these groups are stationary, in other words inefficient. All the remaining big cities and groups contain a unit root. Thus, accounting for nonlinearity has in fact reduced the number of markets that are inefficient. All the big cities housing markets seem to be efficient according to the KSS unit root test. These results give us a rate of almost 89% of efficient markets in Turkey according to KSS test and this rate is the highest efficient market rate out of all tests.

5.2.1.3 Unit Root Test Results allowing for Structural Breaks

To account for the possible structural breaks in the housing price series and to investigate whether accounting for them affects the market efficiency results we applied the LNV unit root test. As argued before, the LNV test allows for smooth structural breaks which is more realistic when analyzing economic data. Figures 5 and 6 depicted above have also verified the possibility of structural breaks in the housing price series.

Table 8. LNV Test Results

	P
1	**-4.380****
2	-2.390
3	**-4.379****
4	-2.733
5	**-4.497****
6	**-4.765****
7	**-4.108***
8	**-5.414*****
9	**-4.514****
10	-3.374
11	-2.789
12	**-5.299*****
13	-1.413
14	-3.027
15	-3.793

16	-3.911
17	-3.289
18	**-4.854****
19	**-4.470****
20	**-5.060*****
21	**-6.647*****
22	**-4.906****
23	-3.995
24	**-4.698****
25	-3.494
26	-1.962
27	-2.357

Notes: The superscripts *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively using the LNV critical values for T=50 (the sample size is 60) and Model 1. The LNV critical values for T=50 are -4.009, -4.363 and -5.095 for 10%, 5% and 1% significance levels, respectively.

As the Table 8 demonstrates when smooth structural breaks are allowed 12 geographical groups, Ankara, and the index itself are stationary, hence inefficient. These groups are, Group 5, Group 6, Group 7, Group 8, Group 9, Group 12, Group 18, Group 19, Group 20, Group 21, Group 22, and Group 24. The housing markets of the remaining 11 groups, İstanbul and İzmir are non-stationary. In other words, these markets are efficient. The number of inefficient markets has increased considerably when structural breaks in the housing price series are accounted for. According to the LNV test 52% of the housing markets in Turkey are inefficient. LNV test gives the highest inefficiency rate among all the tests considered.

It is highly noteworthy that the housing market of Ankara and Turkey as a whole are inefficient according to the LNV test. In other words Turkey's national housing market and its second biggest market are predictable and available to make a profit out of this.

To provide clearer interpretation of the time path implied by the estimated deterministic component, it is plotted, together with the actual values of the individual House Price Index Series, in Figure 11 at Appendix A. For all cities, the transition between regimes seems to be not rapid in general but rather smooth.

5.2.2 Ripple Effect Results

The results of the tests that were applied in order to investigate the ripple effect will be reported in the following section. We are concerned with the time series properties of the ratios of the geographical house price indices to the national house price index in Turkey. To this end, we define the regional house price ratio d_t as follows:

$$d_t = p_t - n_t$$

where p_t denotes the natural logarithm of the Turkish regional housing prices at time *t* and n_t refers to the natural logarithm of the Turkish housing price index at time *t*. If d_t is found to be stationary, then the ripple effect exists in the sense of Meen (1999).

This section will be divided into two parts as linear test results and nonlinear test results just like the empirical results on market efficiency section.

5.2.2.1 Linear Test Results

Table 9. ADF Test Results

	d_t
2	1.043
3	0.701
4	0.742
5	-1.200
6	-1.794
7	-0.758
8	-1.654
9	-1.234

10	-2.114
11	-1.552
12	-2.018
13	-2.576
14	-1.209
15	-1.028
16	-2.648
17	-2.358
18	-2.087
19	-2.730
20	**-4.918*** **
21	-1.696
22	-0.991
23	-1.845
24	**-3.917** **
25	-1.271
26	0.125
27	-1.419

Notes: The superscripts *, **, *** represent significance at the 10%, 5% and 1% levels respectively using the ADF critical values for T=50 (the sample size is 60). We use Akaike Information Criteria (AIC) with a maximum lag length of 12. The ADF t-statistic critical values for the intercept and trend case are -3.18, -3,50 and -4.15 at 10%, 5% and 1% significance levels, respectively.

According to ADF test results the ripple effect is confirmed for only two groups. For Group 24 namely, Van, Bitlis, Hakkari, Muş, the ADF test rejects the null hypothesis at 5-percent significance level with two lag lengths. In other words, there was no unit root presence and the series was stationary. This means Group 24 is a ripple effect originating point. ADF test also proved the lack of unit root for Group 20 (Artvin, Giresun, Gümüşhane, Ordu, Rize, Trabzon) at 1-percent significance level with one lag length. Thus, the alternative hypothesis was accepted meaning the stationarity was confirmed. With regard to this we can say that a ripple effect originates from Group 20 cities. Thus, according to the ADF unit root test the house price shocks originating from Van, Bitlis, Hakkari, and Muş as a region; and Artvin, Giresun, Gümüşhane, Ordu, Rize, and Trabzon as a region ripple out and affect the house price changes in Turkey significantly. For the remaining cities and groups ADF test provided evidence to prove nonstationarity owing to the unit root presence. Therefore, for these cities and groups the null hypothesis was accepted which means there was no ripple effect detected. In other words, the housing markets of the other 24 geographical regions are highly segmented. Thus, any shock hitting the house prices of these regions seems not to influence the house price changes in Turkey. To sum, according to the ADF test, the percentage of the cities and groups with ripple effects with both 5-percentage significance level and 1-percentage significance level is 3.85%, while the 92.3% percent of the cities and groups has no ripple effect.

The ripple effect originating points according to ADF test are demonstrated in the figure below:

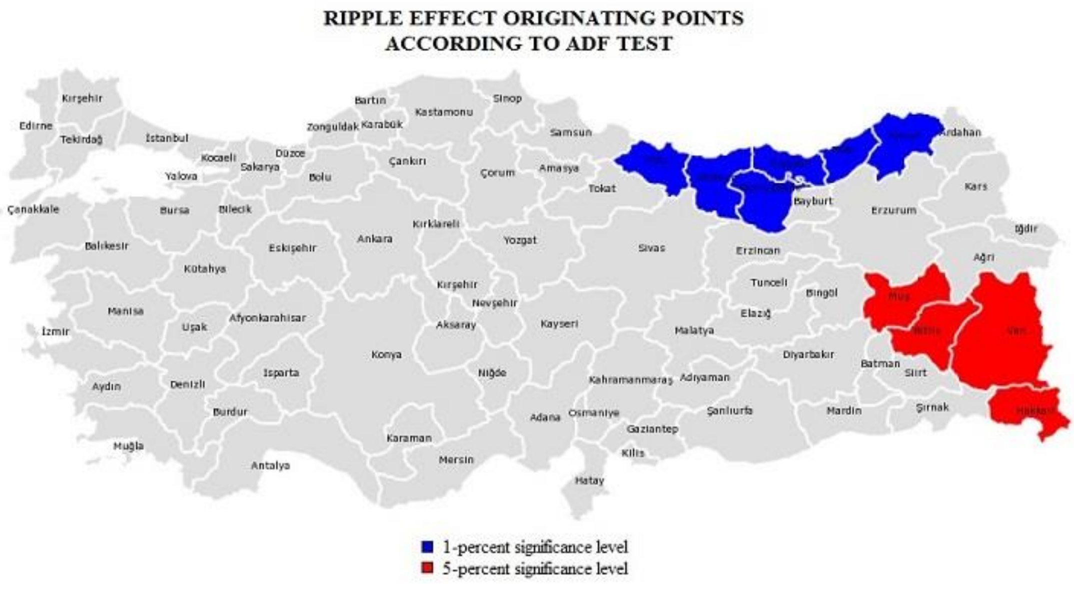

Figure 7. Ripple Effect Originating Points According to ADF Test

5.2.2.2 Nonlinear Test Results

To allow for nonlinearity in the house price ratios we also implemented the KSS nonlinear unit root test. This will allow us to see whether accounting for nonlinearity changes the results obtained from the ADF test.

Table 10. KSS Test Results

	d_t
2	1.454
3	1.159
4	1.038
5	-1.770
6	-1.911
7	-0.876
8	-2.379
9	-1.233
10	-1.977
11	-2.648
12	-1.403
13	-2.293
14	-2.552
15	-1.316
16	**-3.363***
17	-1.967
18	-2.790
19	-2.371
20	**-3.875****
21	-2.376
22	-1.351
23	-2.193
24	-2.038
25	-1.694
26	-0.235
27	-1.527

Notes: The superscripts *, ** and *** represent significance at the 10%, 5% and 1% levels respectively using the KSS critical values. We used Akaike Information Criteria (AIC), and a lag selection criterion is 12 lag with an upper bound. The KSS critical values for the nonzero mean and trend case are -3.13, -3.40 and -3.93 for 10%, 5% and 1% significance levels, respectively.

Similar to the linear test results, the KSS test spotted 2 groups that exhibit ripple effect. First one is Group 16, which consists of Kayseri, Sivas, Yozgat, with 5-percent significance level with one lag length. KSS fails to find a unit root for this group, meaning that the series was stationary. Thus, the null hypothesis was rejected which lead to the approval of the ripple effect that starts from Group 16 and spreads to the adjacent cities. Group 20 (Artvin, Giresun, Gümüşhane, Ordu, Rize, Trabzon) is highly noteworthy since it was proved to be a ripple effect originating point according to both ADF and KSS test results. KSS test was unable to find a unit root for Group 20 at a 5-percent significance level with one lag length as well. In other words, the series of Group 20 was stationary. The remaining cities and groups contained a unit root, so the null hypothesis, which means there was no ripple effect, was accepted for them. So according to the KSS test, the percentage of the cities and groups that have ripple effect is 7.7% (with 5-percent significance level), while the remaining 92.3% has no ripple effect. KSS test failed to find any cities or groups with 1-percent significance level.

Overall, region 16 seems to be nonlinear stationary and thus supporting the ripple effect when nonlinearity in the house price ratios is allowed for.

The ripple effect originating points according to KSS test are demonstrated in the figure below:

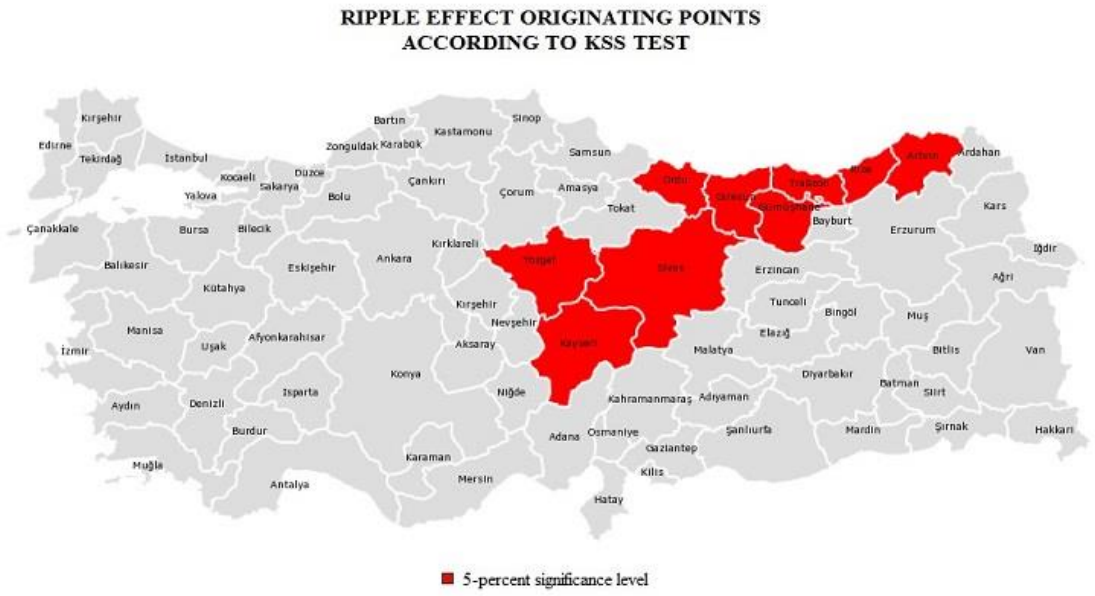

Figure 8. Ripple Effect Originating Points According to KSS Test

5.2.2.3 Unit Root Test Results allowing for Structural Breaks

To account for the possible structural breaks in the house price ratios, we applied the LNV unit root test that allows for smooth structural breaks in the series.

Table 11. LNV Test Results

	d_t
2	-3.340
3	**-4.963****
4	**-4.622****
5	**-5.353*****
6	-2.027
7	-2.902
8	-2.494
9	**-4.362***
10	-2.870
11	**-4.470****
12	-1.869

13	-3.490
14	**-5.925*** **
15	-1.696
16	-3.074
17	-3.047
18	**-6.084*** **
19	-3.145
20	**-4.968** **
21	**-5.692*** **
22	**-7.180*** **
23	**-7.434*** **
24	**-4.554** **
25	**-4.436** **
26	-2.666
27	-3.685

Notes: The superscripts *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively using the LNV critical values for T=50 (the sample size is 60) and Model 2. The LNV critical values for T=50 are -4.009, -4.363 and -5.095 for 10%, 5% and 1% significance levels, respectively.

In contrast to the other tests applied, the LNV test uncovered considerably higher evidence in favor of the ripple effect. Thus, accounting for structural breaks has greatly changed our results. LNV test was unable to find any unit root presence for 2 cities and 11 groups. As expected, the ripple effect was confirmed for 2 of the 3 major cities of Turkey, which are Ankara and İzmir. LNV test provided evidence of stationarity for both cities at a 5-percent significance level. The groups that were proven to have a ripple effect with 5-percent significance level were Group 11, Group 20, Group 24, and Group 25. Group 5, Group 14, Group 18, Group 21, Group 22, and Group 23 were found to be stationary at 1-percent significance level. Group 9 was found to be stationary at the 10 percent significance level. The existence of ripple effect was evidently rejected for İstanbul and the other groups. LNV test was the most similar one with most of the other studies in the literature on ripple effect. It was in line with the other studies in terms of proving that the major cities, or regions in some instances, tend to be the originating point of a ripple effect over smaller cities (or regions) or their adjacent cities (or regions). Interestingly enough, İstanbul, as the leading metropolitan of Turkey in terms of economy and population, was not proved to have a ripple effect on any other cities or regions. The LNV test results gave us the highest rates of ripple effect. The rates of the cities and groups with both 5-percent and 1-percent significance levels are 23% while it is almost 4% for the ones with 10-percent significance level. In other words, the remaining 50% has no ripple effect present.

The ripple effect originating points according to LNV test are demonstrated in separated figures according to the significance levels below:

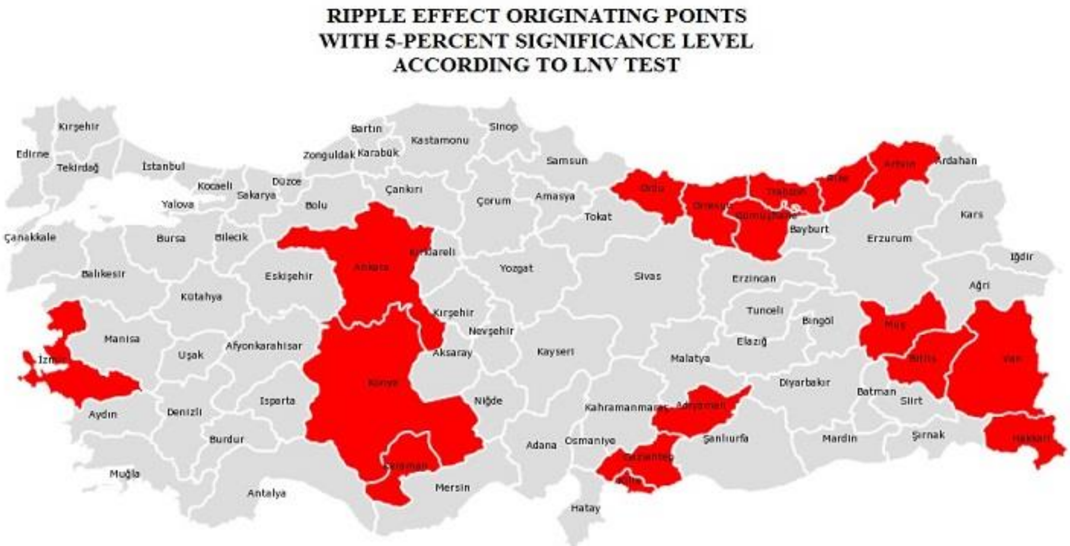

Figure 9. Ripple Effect Originating Points with 5-Percent Significance Level According to LNV Test

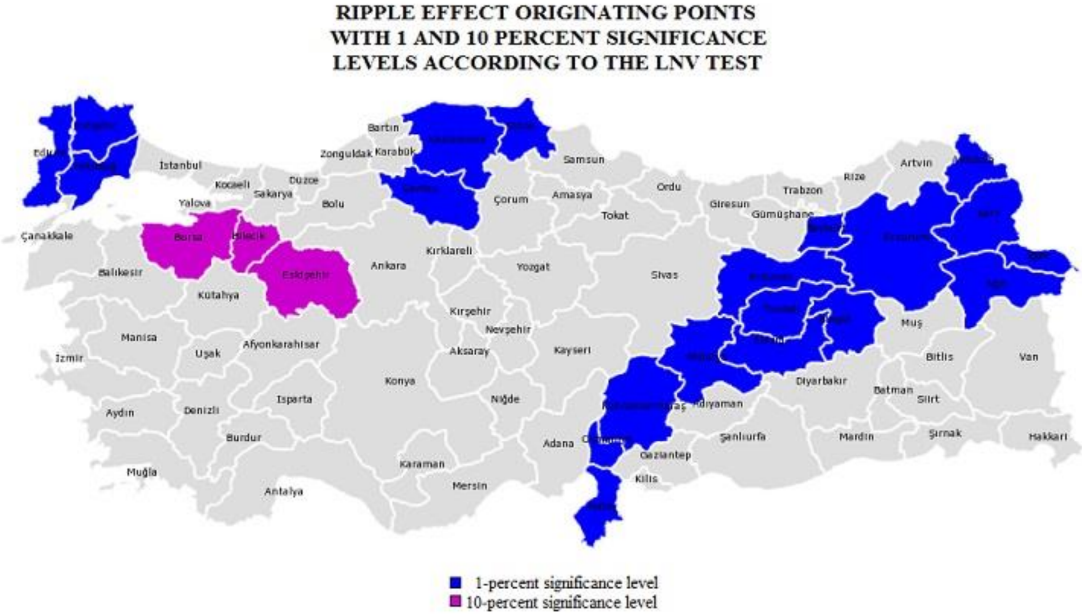

Figure 10. Ripple Effect Originating Points with 1 and 10-Percent Significance Levels According to LNV Test

CHAPTER 6

6. CONCLUSION

The aim of this paper was to analyze the efficiency of the housing market in Turkey and the ripple effect presence in the housing market in Turkey. We chose these topics because there were not any studies that investigated the housing market in Turkey in terms of these subjects. Therefore, we wanted to shed some light on the Turkish market and inform the actors in it. To this end, we conducted our tests on the monthly data of Turkish house-price index for the period 2010:1 and 2014:12. Several unit root tests had been applied in this paper. We preferred to apply linear, nonlinear unit root tests and unit root tests that allow for structural breaks. First of all, the conventional Augmented Dickey Fuller (ADF) test was implemented in this paper. Then, we used the univariate nonlinear Kapetanios, Snell and Shin (KSS) unit root test. In this test, the null hypothesis (unit root) is tested against an alternative hypothesis (no unit root) represented by a STAR model. Finally, we conducted the Leybourne, Newbold, Vougas (LNV) unit root test in order to check for the structural breaks.

When we applied ADF test to test the efficiency of housing markets in Turkey, we failed to find a unit root presence for 4 groups namely, Group 15, Group 20, Group 23, and Group 26. This means, these groups were inefficient according to ADF test. The others cities, groups and the THPI contained unit root which means that these markets were efficient. Therefore, the remaining 23 areas (cities and groups) were proved to be efficient by the ADF test. These areas include the three big cities İstanbul, Ankara and İzmir, as well the Turkish housing price index itself. Thus, the rate of efficient markets according to ADF test was 85%. The application of ADF test to check the ripple effect presence gave us 2 ripple effect originating points, as they contained unit root, in housing market in Turkey. The first group was Group 24 with a 5-percent significance level, while the other originating point was Group 20 with 1-percent significance level. The rate of cities and groups with ripple effect was 7.7%. Thus, according to the conventional ADF unit root test the housing price shocks arising from these two groups ripple out and affect the Turkish housing market significantly.

KSS test for market efficiency was not able to find unit root for Group 7, Group 19, and Group 20, meaning that they were inefficient markets. Thus, when nonlinearity in the housing prices are allowed for 24 geographical regions and cities in Turkey were proved to be efficient. The rate of inefficient markets was only 11% according to the KSS test. KSS test that allows for nonlinearity gives the highest number of regions with efficient housing markets. KSS test for ripple effect found 2 groups had ripple effect presence as well. This means that both groups were proved to be stationary. However, this time both groups had 5-percent significance level. These groups were, Group 16 and Group 20. The rate of cities and groups with ripple effect was 7.7% according to KSS test too. Thus, accounting for nonlinearity has not changed the number of regions with the ripple effect.

When the structural breaks in the housing prices were considered and the LNV test was applied, we obtained the highest number of inefficient markets. The markets of Ankara, 12 groups, and the THPI itself were found stationary, therefore inefficient. These 12 groups were, Group 5, Group 6, Group 7, Group 8, Group 9, Group 12, Group 18, Group 19, Group 20, Group 21, Group 22, and Group 24. The efficient markets included the two big cities of Turkey, namely İstanbul and İzmir. The groups with efficient markets according to LNV test were, Group 10, Group 11, Group 13, Group 14, Group 15, Group 16, Group 17, Group 23 and Group 27. Therefore, the rate of efficient markets according to LNV test was only 48%, with more than 50% of the housing markets in Turkey exhibiting inefficiency. Also the LNV test provided a considerably high number of regions for which the ripple effect holds. The ripple effect was confirmed for 2 metropolitans and 11 groups in Turkey. The metropolitans were Ankara and İzmir and they both had 5-percent significance levels. The groups with 5-percent significance level were Group 11, Group 20, Group 24, and Group 25, while the groups with 1-percent significance level were Group 5, Group 9, Group 14, Group 18, Group 21, Group 22, and Group 23. Thus, allowing for structural breaks and implementing the LNV test provided the highest rate of ripple effect. The rate of the cities and groups with 5-percent significance level was 23%, and the rate of the cities and groups with 1-percent significance level was 27%, while the other 50% had no ripple effect.

To sum up, our work provided mixed results for the housing market efficiency. The rates of efficient markets according to ADF test, KSS test, and LNV test were 85%, 89%, and 48% respectively. This means that the Turkish housing prices do not display nonlinear behaviour but rather are subject to structural breaks. Accounting for these structural breaks, which were also verified from the visual inspection of the housing price data, has led us to conclude that more than 50% of the regions in Turkey have inefficient housing markets. The results for ripple effect, also evidently demonstrated that the ripple effect does exist. There were 2 ripple effect originating points according to both ADF and KSS tests, and 13 points according to LNV test.

As a result of our study, our suggestion to the Turkish Government and to Turkish economic authorities is to realize the importance of the risks that the inefficient markets possess and the potential of a spreading shock due to the ripple effect. The Turkish government and the regulatory authorities should investigate the reason behind the existence of inefficient markets and why some regions act as a ripple effect originating point.

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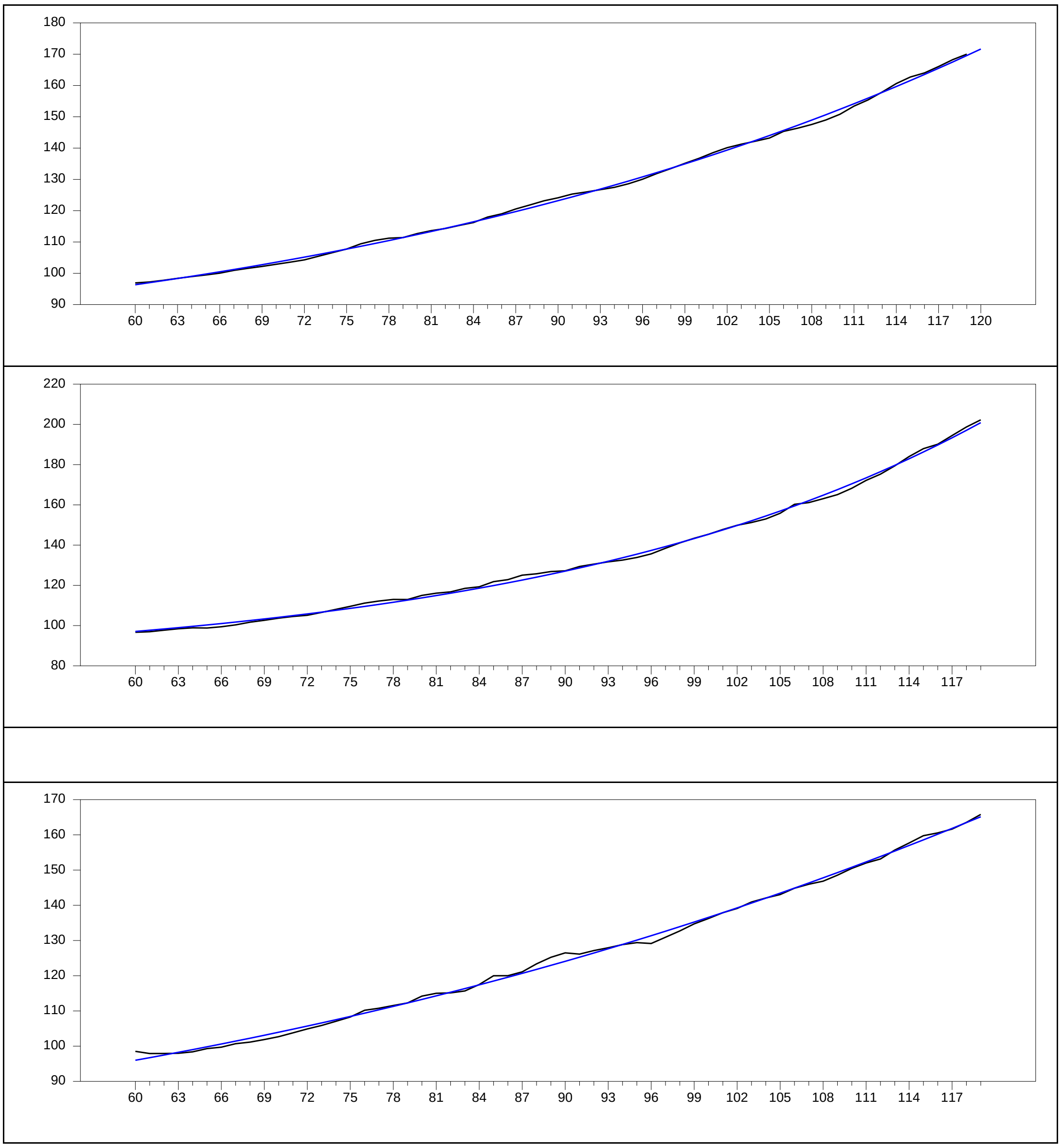
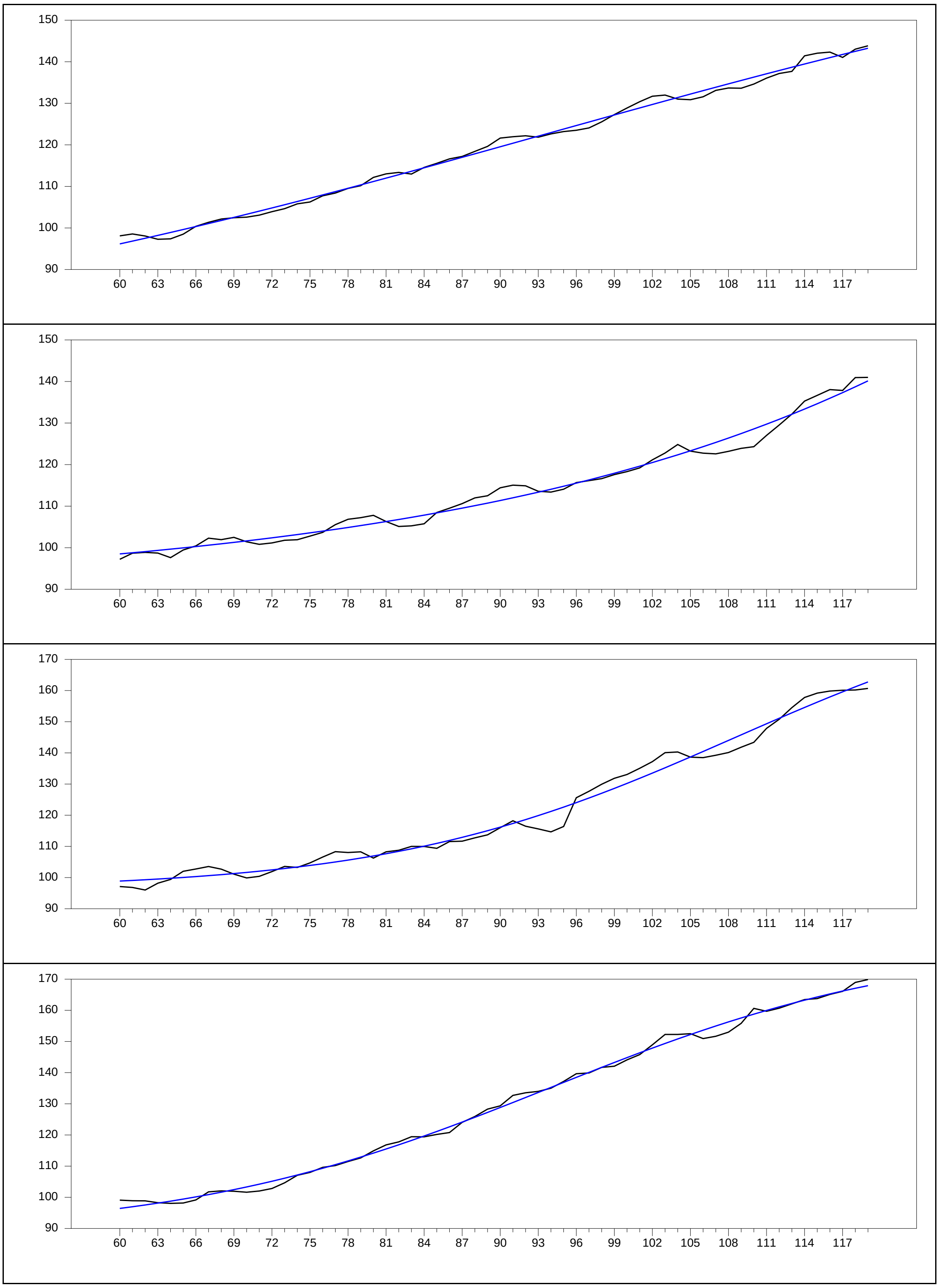
APPENDICES

APPENDIX A: Graphs

Figure 11. House Price Index Series and the Estimated Transitions

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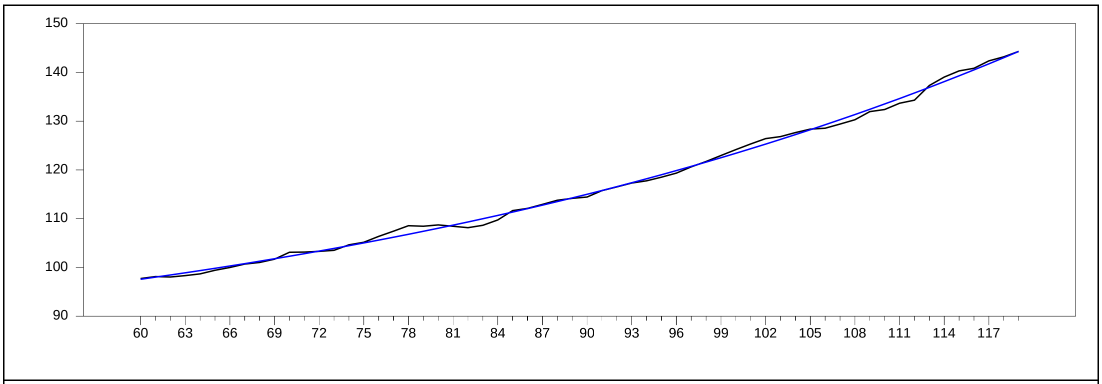
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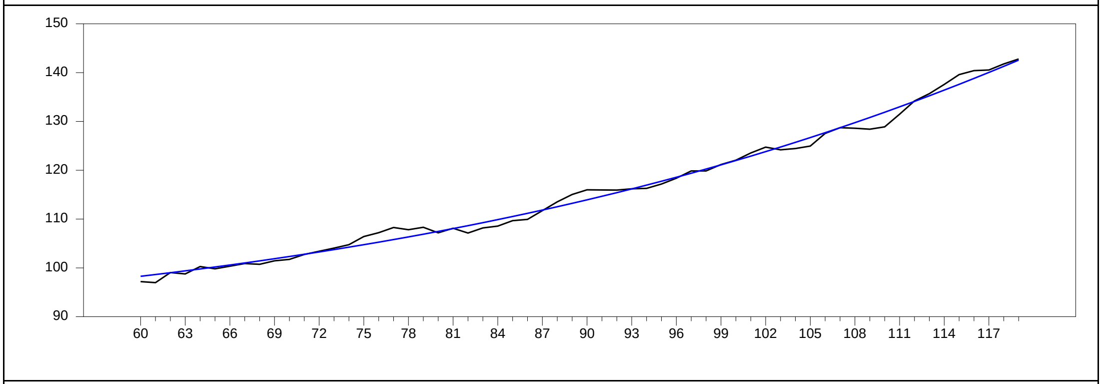
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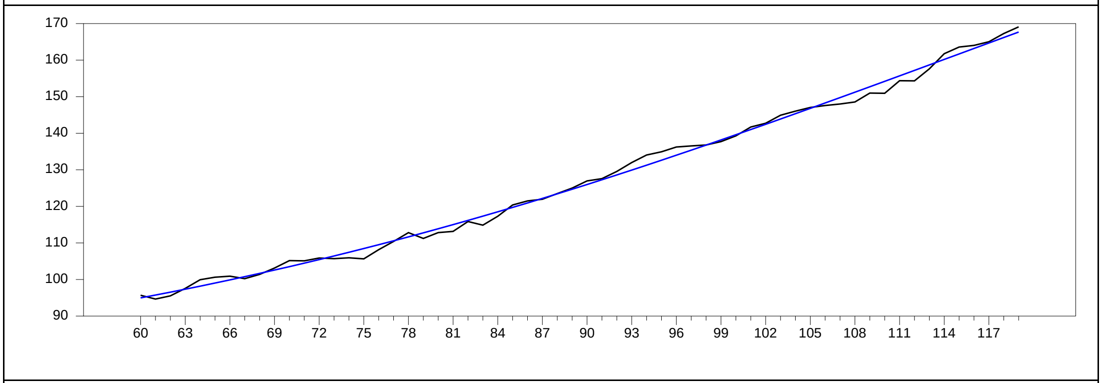
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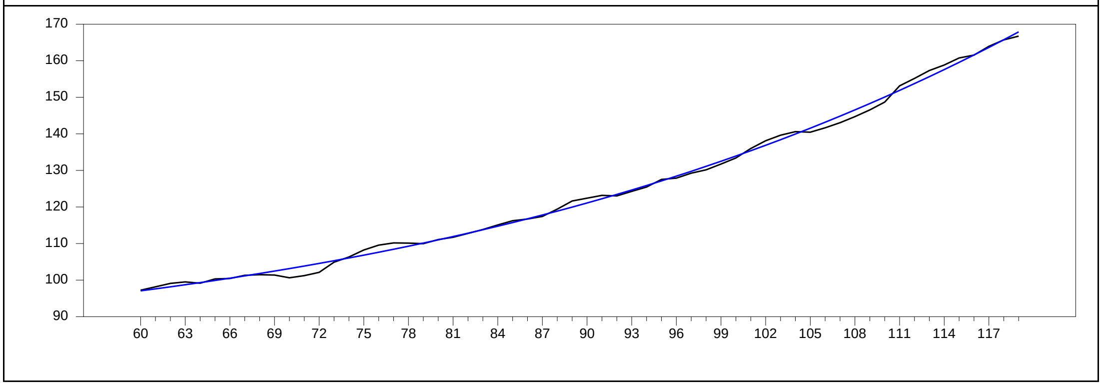
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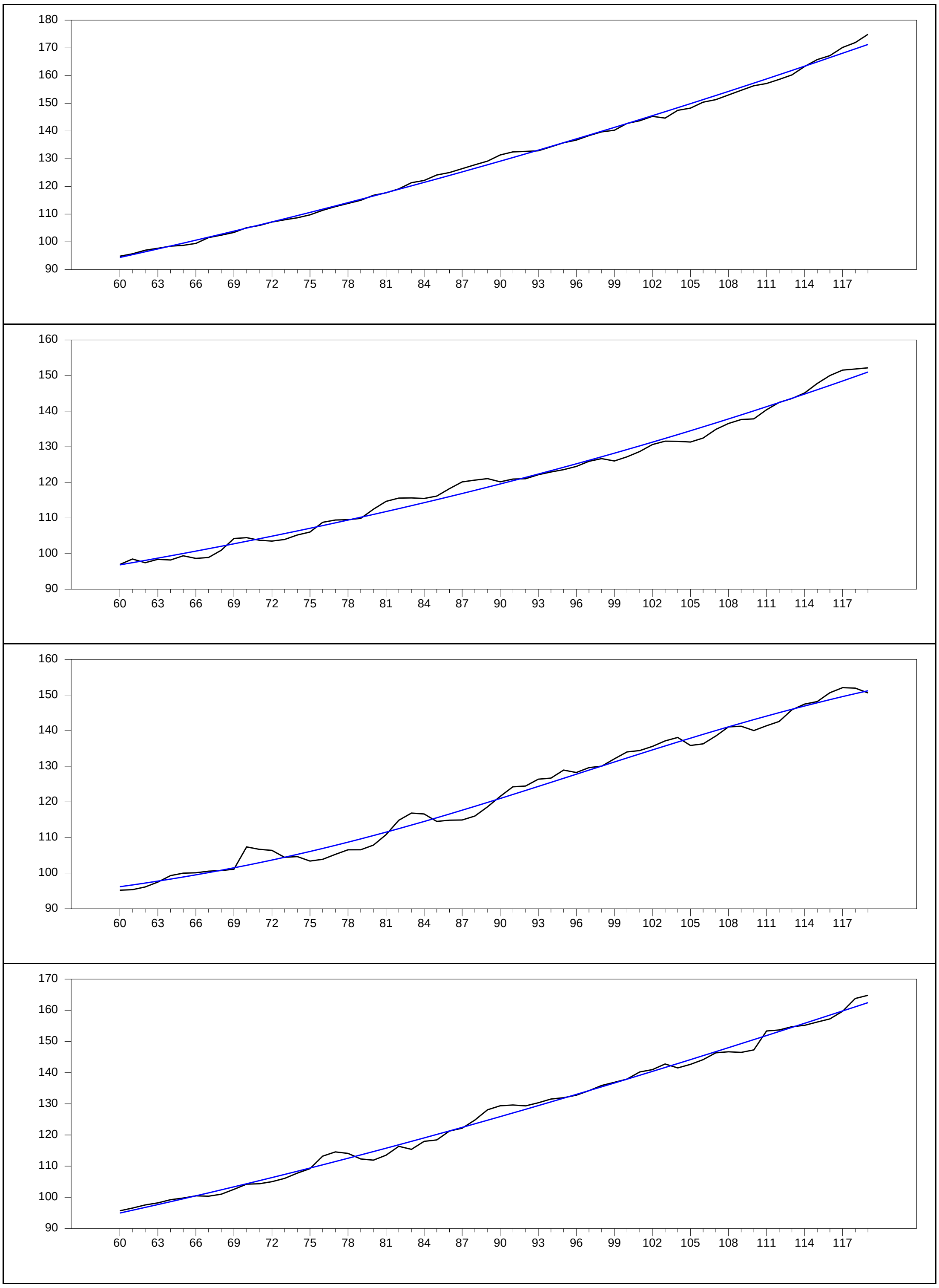
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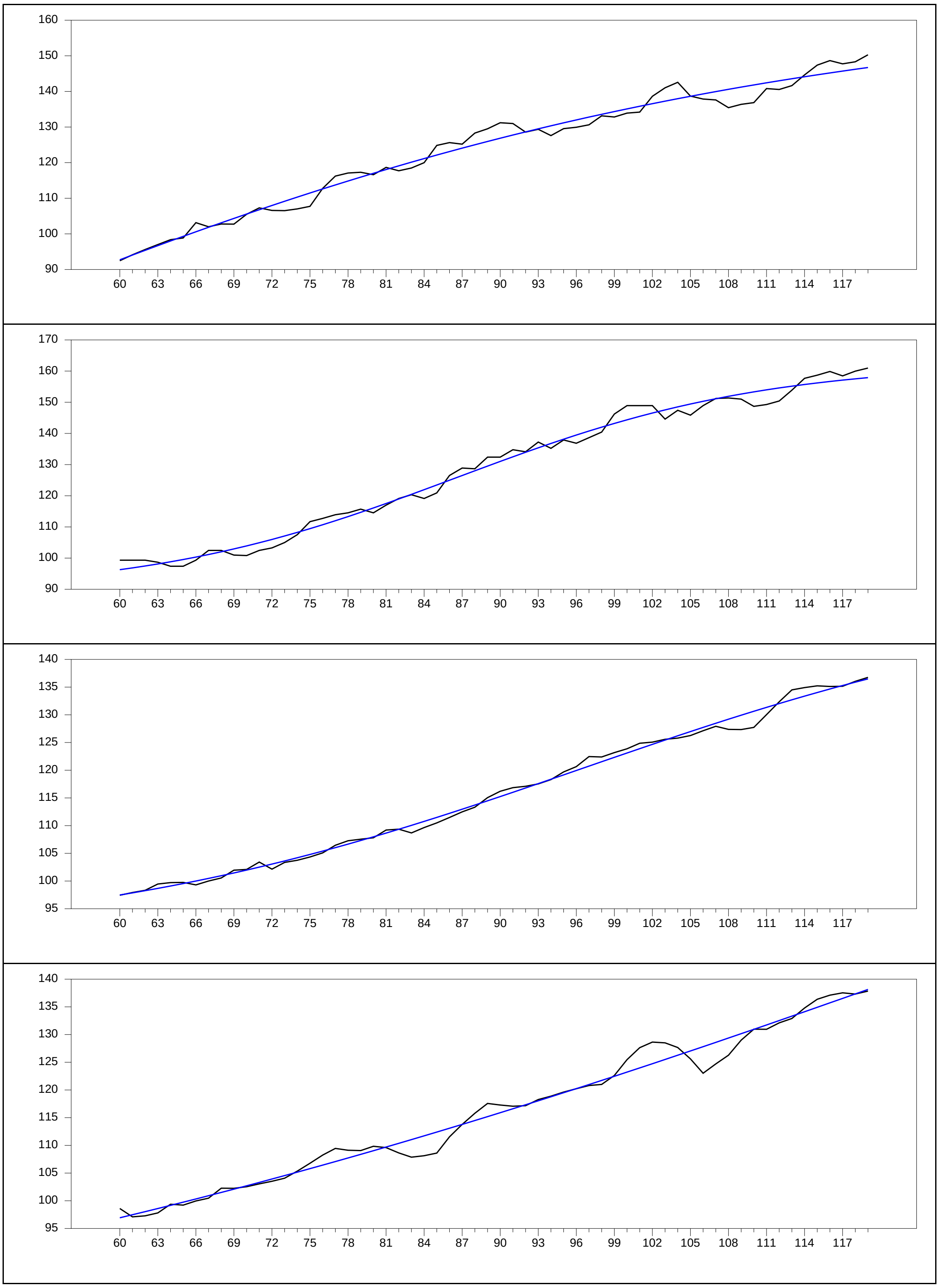
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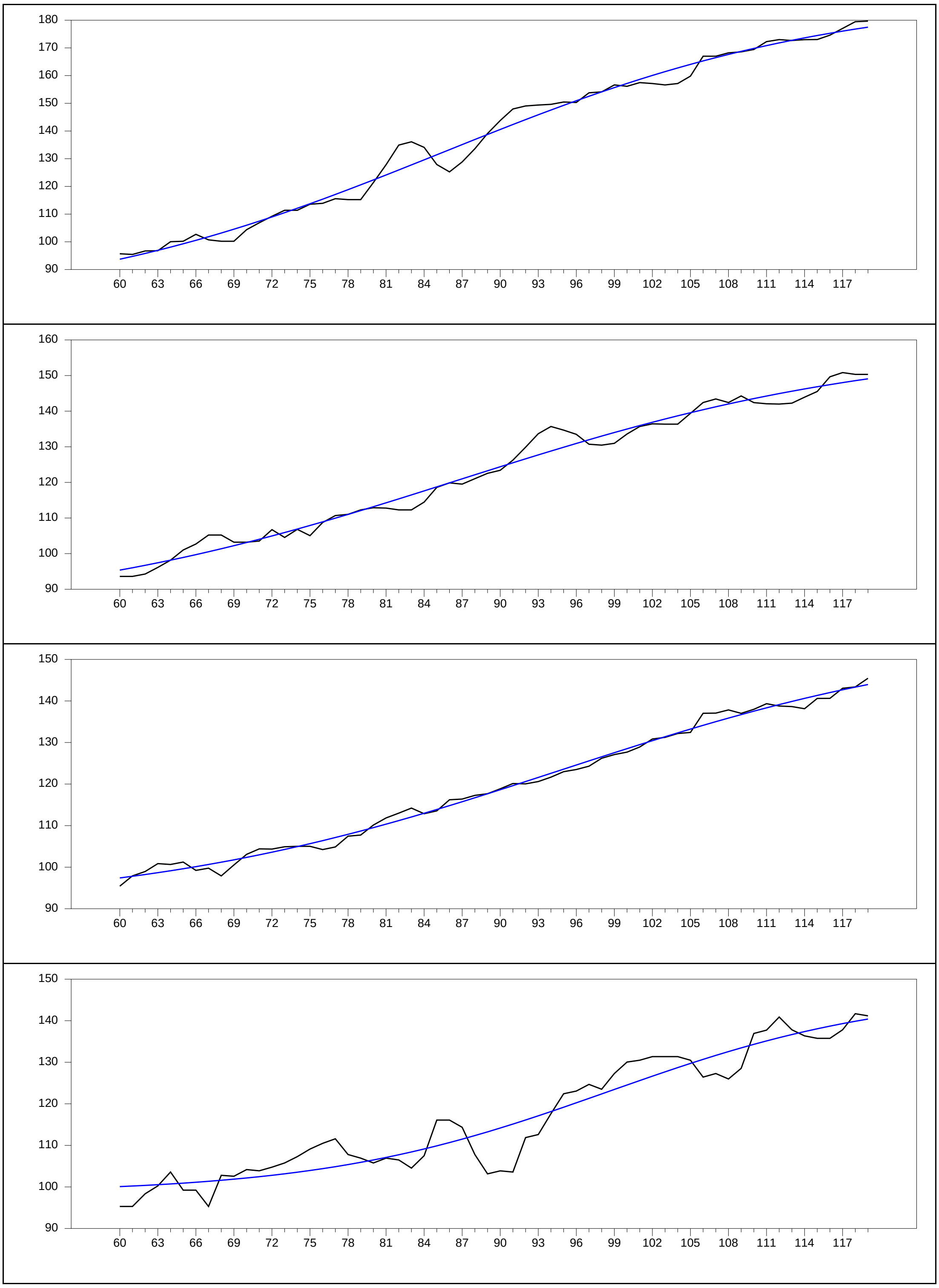
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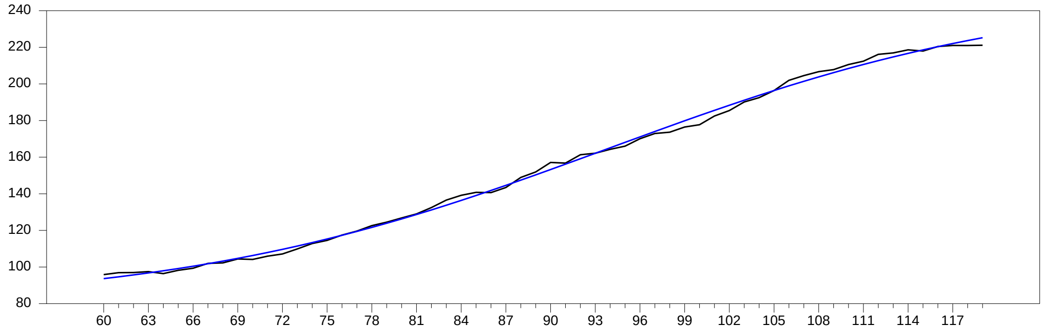
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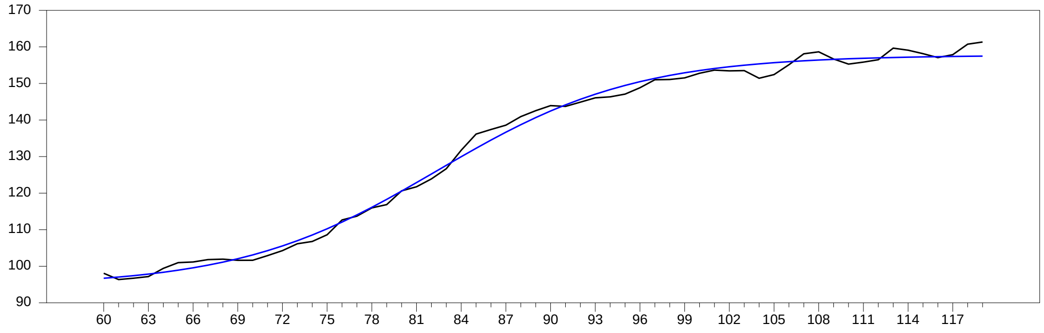
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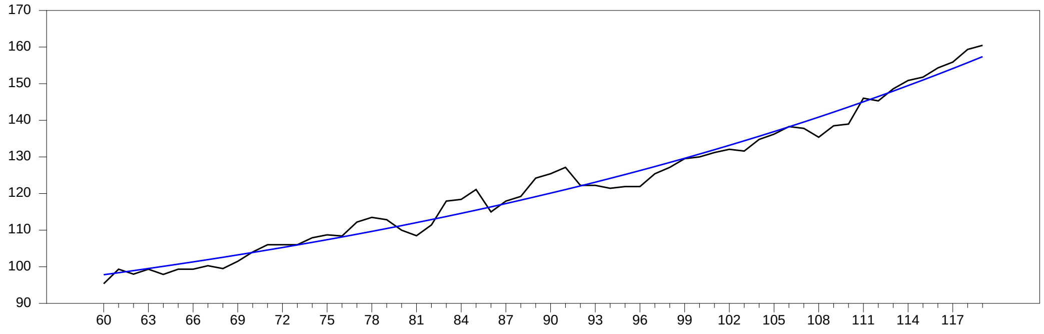
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APPENDIX B: CURRICULUM VITAE

1. **Surname, Name:** YAVUZ, Hüseyin

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2. **Date of Birth:** 04/11/1989

3. **Education:**

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M.S.	Financial Economics	Çankaya University	2013-2015

4. **Thesis Administrated:** 'An Application to Turkey House-Price Indices: New Evidence for Market Efficiency.' **Supervisor:** Assist. Prof. Dr. Ayşegül Eruygur.