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INSTITUTE OF SOCIAL SCIENCES
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A VECM ANALYSIS FOR STOCK AND ESTATE MARKET INDEXES IN TURKEY: GLOBAL CRISIS CHANGED IT?

ÖYKÜ BAYRAKTAR
114622006

ASSOC. PROF. SERDA SELİN ÖZTÜRK

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TÜRKİYE'DE STOK VE GAYRİMENKUL PİYASASI ENDEKSLERİ İÇİN BİR VECM ANALİZİ: KÜRESEL KRİZ NASIL ETKİLEDİ?

ÖYKÜ BAYRAKTAR
114622006

Tez Danışmanı: Doç. Dr. Serda Selin Öztürk
İstanbul Bilgi Üniversitesi

Jüri Üyesi: Dr. Öğr. Üyesi Fatma Didin Sönmez
İstanbul Bilgi Üniversitesi

Jüri Üyesi: Doç. Dr. Prof. Ender Demir
İstanbul Medeniyet Üniversitesi

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Anahtar Kelimeler (Türkçe)
1) VECM
2) BIST100
3) GYO
4) Global Finansal Kriz
5) Döviz Kurları

Anahtar Kelimeler (İngilizce)
1) VECM
2) BIST100
3) REIT
4) Global Financial Crisis
5) Exchange Rates

ABSTRACT

A VECM ANALYSIS FOR STOCK AND ESTATE MARKET INDEXES IN TURKEY: GLOBAL CRISIS CHANGED IT?

Using the global financial crisis in 2007 as a natural experiment, the paper aims to examine the relationship between real estate prices and stock prices, by using data from the Turkish market covering years from 2002 to 2017. The impact of the crisis has been examined in 3 different time periods; pre-crisis, crisis and post-crisis. The study measures the dynamic adjustments between the first differences of the variables by using vector error correction model (VECM). The main findings of this paper are: (1) a long term relation among stock market index and REIT index. (2) In crisis period, the error correction coefficient is statistically insignificant, implying that the process is not converging in the long run, causing instabilities. (3) Speed of adjustment in the pre-crisis period, has the fastest short run dynamic in a long term equilibrium.

KEYWORDS: VECM, BIST 100, REIT, Global Financial Crisis, Exchange Rates, 1-Month Deposit Rate

ÖZET

TÜRKİYE'DE STOK VE GAYRİMENKUL PİYASASI ENDEKSLERİ İÇİN BİR VECM ANALİZİ: KÜRESEL KRİZ NASIL ETKİLEDİ?

Çalışma, 2007 yılı küresel finansal krizin doğal bir deney olarak kullanılmış olup, 2002 yılından 2017 yılına kadar Türkiye pazarından elde edilen veriler kullanılarak emlak fiyatları ile hisse senedi fiyatları arasındaki ilişkiyi incelemeyi amaçlamaktadır. Krizin etkisi 3 farklı zaman dilimi; kriz öncesi, kriz ve kriz sonrası ele alınarak incelenmiştir. Çalışma, vektör hata düzeltme modeli (VECM) kullanarak değişkenlerin ilk farklılıkları arasındaki dinamik ayarlamaları ölçmektedir. Bu yazının ana bulguları (1) borsa endeksi ile GYO endeksi arasındaki uzun vadeli dinamik bir ilişki mevcuttur. (2) Kriz döneminde, hata düzeltme katsayısı istatistiksel olarak anlamsızdır, bu da sürecin uzun vadede yakınsama olmadığını ve kararsızlığa neden olduğunu ima eder. (3) Kriz öncesi dönemde, uzun vadeye en kısa sürede yakınsandığı tespit edilmiştir.

ANAHTAR KELİMELER: VECM, BIST 100, GYO, Global Finansal Kriz, Döviz Kurları, Aylık Faiz Oranı.

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Finally, I want to convey my utmost gratitude to my family. My parents, Hülya and Cemal Bayraktar who always heartened me and kept reminding me that every success is achievable as long as the desire and hard work remains.

ABBREVIATIONS

ADF	**:**	Augmented Dickey Fuller
AIC	**:**	Akaike's Information Criteria
CBRT	**:**	Central Bank of the Republic of Turkey
CRSP	**:**	Center for Research on Security Prices
GDP	**:**	Gross Domestic Product
GYODER	**:**	Association of Real Estate and Real Estate Investment Co.
HQ	**:**	Hannan-Quinn Criterion
REIC	**:**	Real Estate Investment Company
REIDIN	**:**	Real Estate Information and Analytics
REIT	**:**	Real Estate Investment Trust
NCREIF	**:**	National Council of Real Estate Investment Fiduciaries
VAR	**:**	Vector Autoregressive
VECM	**:**	Vector Error Correction Model
TurkStat	**:**	Turkish Statistical Institute
TOKI	**:**	Housing Authority
SBIC	**:**	Schwarz's Bayesian Information Criteria

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To my father Cemal, who resides at the depths of my heart…

To my mother Hülya, with love and eternal appreciation…

INTRODUCTION

In every economy in the world, the stock market and housing market are two very different markets. The stock market is generally more liquid, more variable in price and can be described as similar. On the other hand, the housing market holds; different real estates such as residential, hotel and commercial buildings causing portfolio diversity. For this reason, it is difficult to find two identical objects in the market and it takes time to bring together buyers and sellers, and to ensure the continuity and growth of the market. Although there are differences in both markets, it attracts the attention of investors and affects the development and magnitude of the medium-long-term economy. However, one of the common points is that stock and housing markets are both affected by the changes in the economy, as many other macroeconomic variables.

The most supportive example is that the global crisis, which started in the United States and spread to all countries, had an adverse effects on both stock and property prices. There are many articles on the global crisis, and the first time that global crisis has spoken out is 9 August 2007, with BNP Paribas ending the cancellation of three hedge funds on the grounds of an complete destruction of the liquidity (Naifar, 2011). However, the start date of the crisis varies depending on the economic strength, stability and policies of the countries. One of the most devastating consequences of the crisis is that the housing market in most of the affected countries has been demolished in terms of price and supply. While the Global Crisis continued to affect all countries, the Case-Shiller Index lost value by 25% in the last two years from 2007 to 2008 (Barker, 2009). According to the International Building Association, the average housing price in the UK declined by 14.7% throughout 2008 and coincided with prices in the spring of 2005 (Adair et al., 2009). In Northern Ireland there was a higher decline and housing prices lost 28.2%. In the same study, Adair et al. (2009), it is argued that the debt of $ 7 trillion worldwide has been deleted from the stock exchange during 2008. The New York Stock Exchange S&P 500 has experienced a 38.5% drop in the 12-month period, while the Japan Stock Exchange Nikkei 225 has lost 42%.

The global crisis in the financial system gradually affected both the developed country economies and emerging market economies. Turkey is one of the emerging market economies, that has affected by the global crises drastically. Turkey is included in

the Standard and Poor's and Citigroup BMI Global Index, in the first quarter of 2008, Turkish stock market performance had been showed the strongest reaction by dropping 36.62% (Standard and Poor's, 2008). Another factor affected by all these negativities was the real estate market and as a result of housing prices. REIDIN studies Turkish Residential Property Price Indices, in the period from March 2008 to March 2009 shows that there is a continuous ongoing decline in housing prices (Reidin Turkey, 2010). In addition to the not so-desired performance of house prices, the economy has not been satisfactory in the two-year period in terms of GDP Growth. GDP growth rates was down to 0,7% in 2008 and 4,7% in 2009 (TurkStat Statistical Yearbook, 2009). In addition to the sudden spikes that has affected Turkish Economy, showed improvement at the end of 2010. Coşkun (2011) argues that Turkey has faced less adverse effects from the global financial crisis compared to other countries that has affected terribly. Securitization, derivatives markets and the absence of housing loan market during the financial crisis are some of the reasons that has protected and detached Turkish economy.

Using the global financial crisis in 2007 as a natural experiment, the paper aims to examine the relationship between real estate prices and stock prices, by using data from the Turkish market covering years from 2002 to 2017. The impact of the crisis has been examined in 3 different time periods; pre-crisis, crisis and post-crisis.

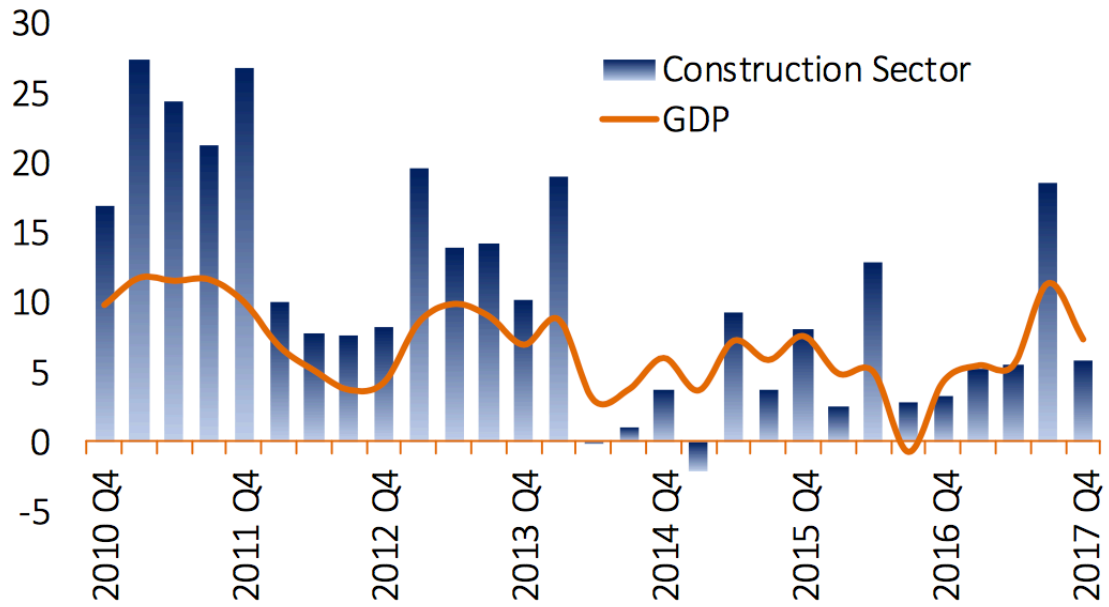
A number of the above-mentioned relationship intensively investigated in the international market, however Turkish market has been less effort to assessed. By using the vector error correction model (VECM), we will examine the relationship of Real Estate Investment Trust (REIT) index, stock index, USD / TRY exchange rate and interest rate data. In addition, as far as is known, it has not been studied in Turkey or other developing countries, by a VECM model covering years from 2002 to 2017, in the present context previously.

The remaining paper is divided into sections 2–7. The organization of the article is detailed below. Section 2 covers the construction and real estate market in Turkey while referring the impact and importance. Section 3 reviews the literature that relates to the study. Section 4 describes the data set and examines first set of results, and Section 5 illustrates the statistical methodology which covered in the analysis. The empirical results are detailed in Section 6 according to different crisis periods. Finally, section 7 transmits the results of the article as a whole.

2. CONSTRUCTION INDUSTRY AND REAL ESTATE MARKET IN TURKEY

The Turkish construction sector grew by 8.9% yoy in 2017 in real terms with its strong growth performance in recent years. The highest growth rate was experienced in the 3rd quarter of 2017 and reached to 18.6% in the last 3.5 years. This development was the result of measures and policies taken by the government to support the economy. In addition, sales campaigns and low base effects, which have been carried out by some construction companies throughout the year, have also contributed to this strong growth. Although some government incentives have slowed down after the end of September 2017, the investment and consumption appetite has decreased gradually, as shown in Figure 1, construction sector grew faster than GDP in 2017, despite the slowdown in the sector.

Figure 1: GDP and Construction Sector Real Growth Rates (%)

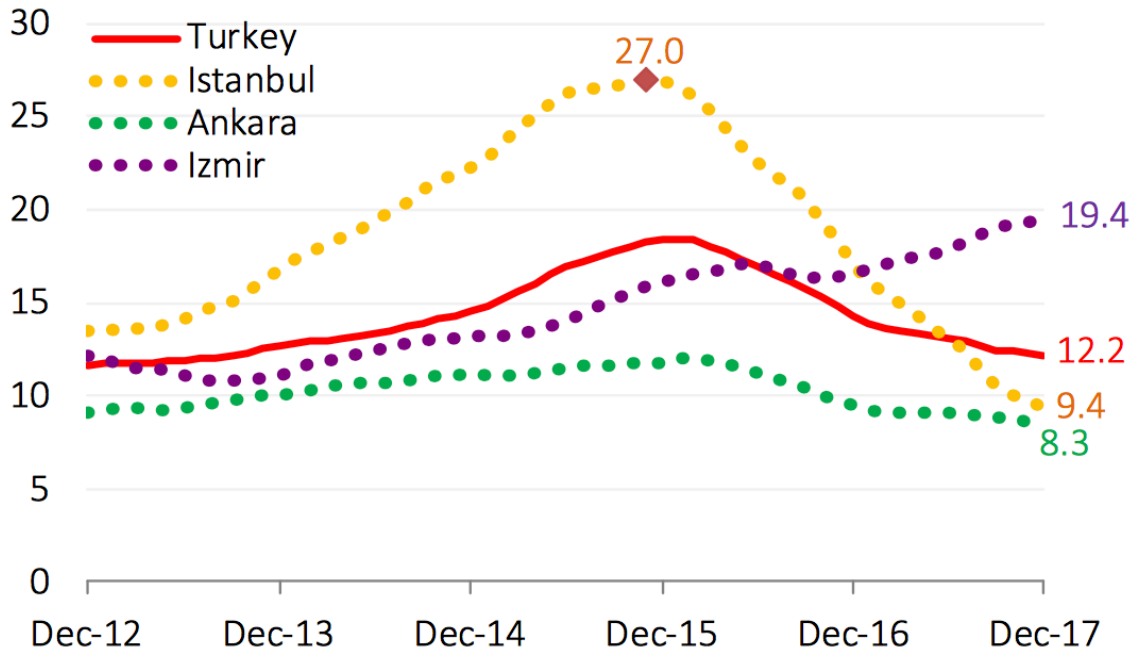


Source: TÜİK, Datastream

However, in recent years, the gap between the rising pace of supply and demand has led to a surplus of supply in the housing market. This situation can be explained by the supply and demand imbalance of building and occupancy permits. According to the data, the average annual increase in the number of building permits was 12% between 2013-2017, while the number of occupation permits increased by only 3.1%. Therefore,

since the end of 2015, there has been a downward pressure on house prices, which got even stronger in 2017. As of December 2017, consumer inflation was realized 11,9%, while house prices across the Turkey was realized as 12.2% higher. However, cities such as Yalova, Bursa, Trabzon and Antalya have rising house prices trend thanks to the foreign investors. (Figure 2)

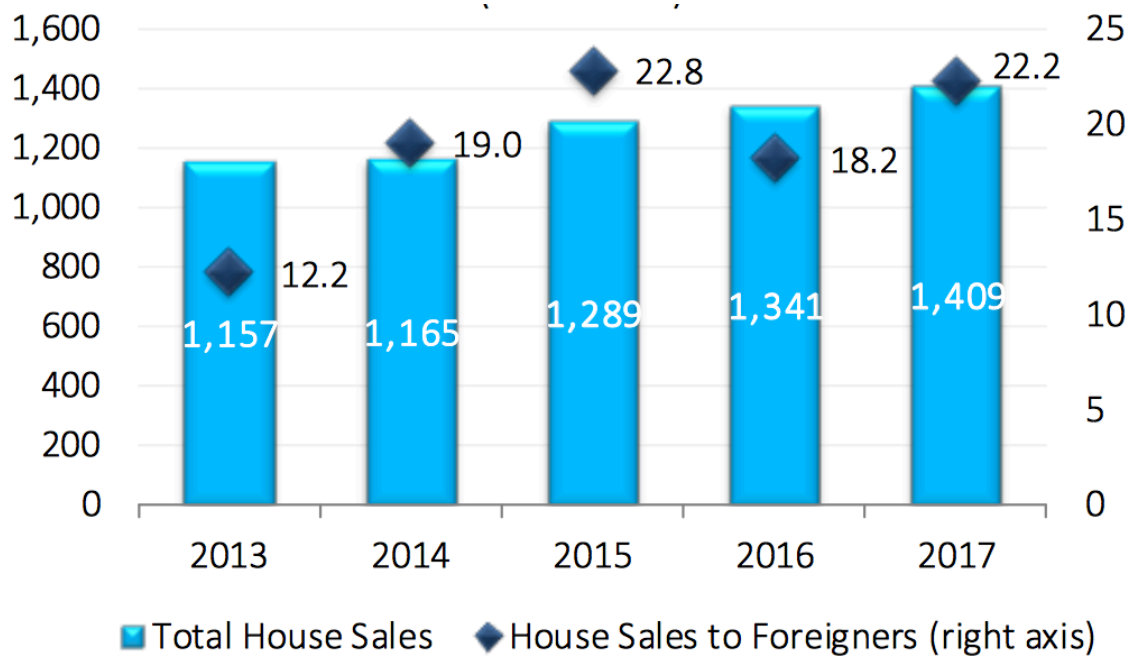
Figure 2: House Price Index (yoy % change)



Source: CBRT, Turkstat

The housing market has a share of approximately 60% in total construction activity. The noticeable rise in the housing market sector will become the largest business area we can observe the expansion easily. The demand for housing in recent years has been caused by many different factors, such as the increasing population and urbanization rate, the need for modern and earthquake-resistant buildings, urban transformation projects, favourable financing opportunities, strong investor preference due to relatively high returns, and increasing foreign investors' appetite. As shown in the Figure 3, house sales throughout Turkey in 2017 increased by 5.1% yoy and was realized 1.4 million items compared to the same period in the previous year, while housing sales to foreigners constituting 1.6% of total sales, increased by 22.2% is noteworthy to mention.

Figure 3: House Sales (thousands)



Source: CBRT, Turkstat

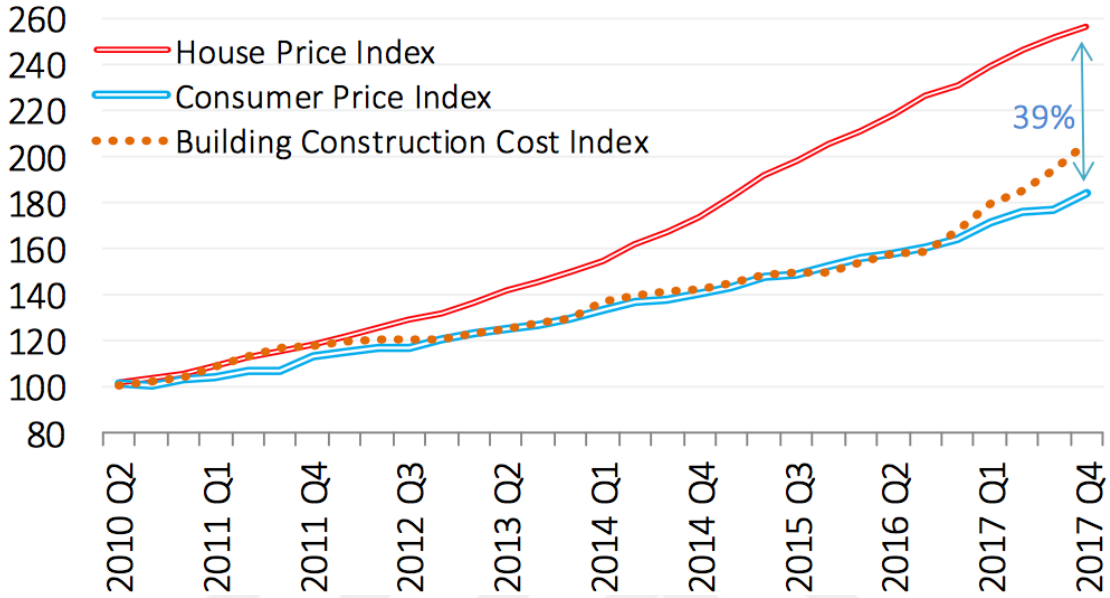
Although the annual increase in house prices has slowed down for the last 2 years, prices have been increasing rapidly for a while. Price increases raised the question of whether there is a bubble in the housing market. That has brought the following question to mind: If it really is a bubble in the housing market, is it possible to explode?

Studies on the issue suggest that the definition of housing bubble cannot be explained by basic factors such as household demand (usually fed by demographic structure) and increasing costs, but it requires observation of housing price increases. In Turkey, as a result of the strong domestic demand and rising production costs of housing, the recent upward trend in housing prices can be explained. The reasons for contributing to the increase in housing prices can be listed as follows: increasing land prices that account for almost half of the production costs, an unexpected increase in construction iron prices and an increase in financing costs.

In Q1 - 2017 Q4, consumer prices increased by 84%, while the increase in construction costs was realized as 106%. When the cost effect and inflation is adjusted, Figure 4 shows that the real price increase in the housing market in this period is 39%. In fact, house prices in the US reached its peak in 2006, and the real price increase - just before the bubble explosion - rose by 73%. Therefore, there is not enough evidence to

prove the existence of a housing bubble in Turkey. Thus, it is possible to mention the existence of a price correction rather than the bursting balloon, as the surplus housing starts to reduce the market prices.

Figure 4: Price and Cost Developments in the Turkish Housing Market

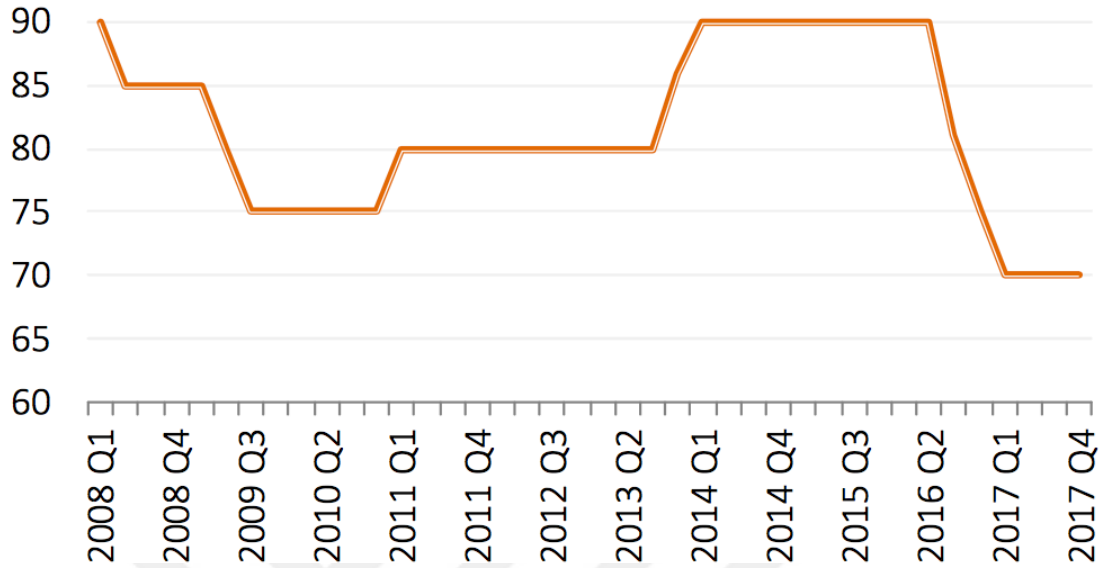


Source: CBRT, Turkstat

In addition to the surplus in the housing market, the commercial real estate market has experienced the same problems in the same way. Factors behind supply and demand imbalance can be listed: strong growth in production and rapid increase in foreign exchange based commercial rents. In 2017, the depreciation of TL at high speed led to a significant increase in the rental costs of the retail sector and consequently the closure of the store locations.

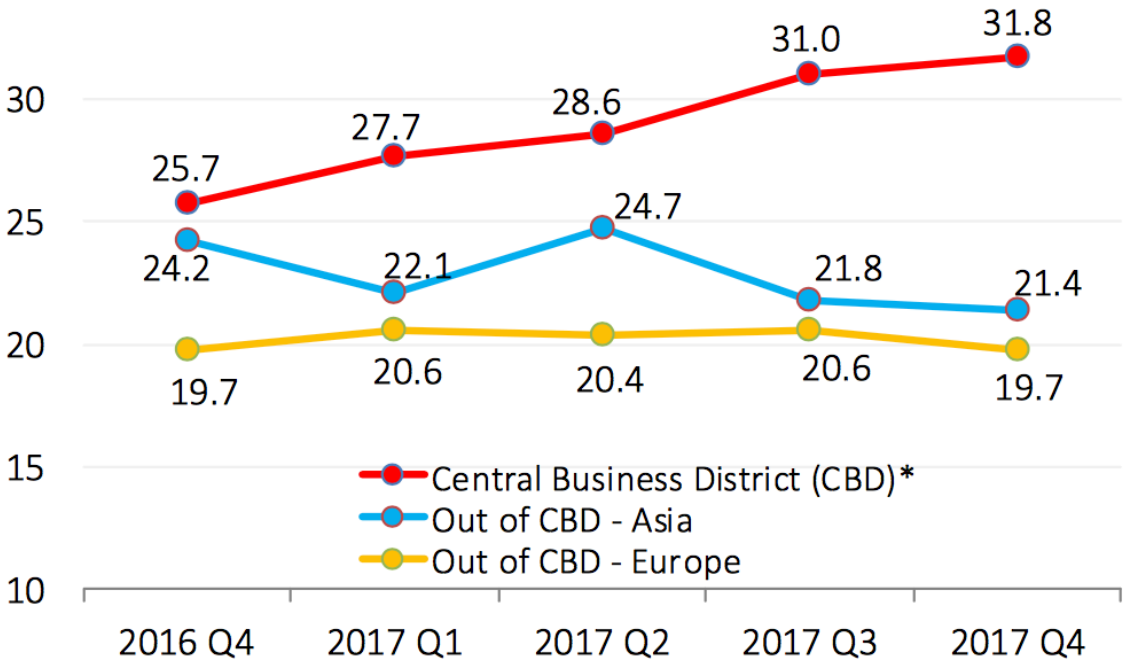
Although the recent increase in the number of foreign visitors has been positive, the ongoing geopolitical risks and a significant change in the spending behaviour related to the change in the visitor profile have caused the trade volume to stagnate for the shops in the tourist regions. The mentioned risks also limit the investment appetite to build new shopping malls. Some of the projects planned to be started and / or planned as of 2018 were either postponed or cancelled. As a result, in the Figure 5 & 6 is shown that the increase in stocks in the office market and the increase in vacancy rates also led to a reduction in rental prices in 2017.

Figure 5: Primary Rent in the Retail Property Market (EUR/m²)



Source: CBRT, Turkstat

Figure 6: Vacancy Rate in Class A Buildings in the Office Property Market (%)



Source: CBRT, Turkstat

The growth and development of the construction sector in recent years is expected to continue in 2018 with the positive impact of ongoing infrastructure projects and urban transformation housing projects. However, expectation is that the growth rate in the sector will remain below the performance of the previous year. It is thought that housing production will be reduced and stocks will be melted by thanks to the improved price cuts and payments conditions supported by the state.

In the years of 2016-2017, since the terrorist attacks, a coup attempt and the state of emergency for almost 3 years have parallelized Turkish Economy, uncertainties have risen and led public and private investors to fled away. As a result, all the struggle has had negative effects on the Turkish economy. State has organized many measures to increase purchasing power, stimulate economic activities and provide investor confidence on these developments.

- ✓ As of 2017, the Regulation on the Implementation of Turkish Citizenship Law, which granted Turkish Citizenship to foreigners acquiring immovable property worth USD 1 million, was amended. As a result, this change in regulation gets the attention of foreign investors from Russia, Middle East and Asia and aims to increase their real estate purchases in Turkey.
- ✓ In March 2017, the construction contracts for land or revenue sharing models, as well as the stamp duty for construction tax contracts between construction contractors and subcontractors, and consultancy service contracts and construction supervision contracts for the works were removed.
- ✓ With the decree dated 31.01.2017, stamp sales tax and real estate sales contracts in pre-paid housing sales contracts were realized as 0%.
- ✓ At the end of 2016, the definition of risky areas was changed positively. In case the public security and order is broken, infrastructure services are insufficient and at least 65% of the total number of buildings is contrary to public housing law, infrastructure and superstructure, the area will be monitored as 'risky'.

In addition, at the beginning of 2018, ‘the savings account for housing’ system was redesigned. Planned measures such as;

- ✓ increased public contribution to savings,
- ✓ lower housing interest rates,

- ✓ reduced legal fees in housing purchases, and
- ✓ recent changes to the Building Law[1] may alleviate pressure on domestic demand.

With the state contribution to be made, urban transformation projects will continue to be less problematic, and thus may stimulate domestic consumption activities in 2018.

2.1.CONTRIBUTION OF REAL ESTATE IN TURKISH ECONOMY

Considering the medium and long-term view of the sector, the construction sector continues to be optimistic that the increasing incomes as a result of increased population and rapid urban development continue to support the development of the economy in the coming period. The government has taken new actions to make housing investments more attractive. Some of these are detailed below.

In the first instance, actions were taken on the use of real estate certificates in order to facilitate access of the construction sector to finance. New arrangements have been made for the use of real estate certificates and development of interest-free financial instruments in urban renewal projects. In this way, the issuer of real estate certificates provides repurchase guarantees to investors in certain predetermined periods. In order to increase housing demand in the sector and to increase the growth of the sector, institutions such as GYODER, EMLAK REIT and TOKI organized new campaigns to reduce the housing loan costs as much as possible. For example; In GYODER's campaign, it provided financing with a monthly interest rate of 0.7% and a maturity of 10 years with 86 projects. As a result, increased housing sales can stimulate the growth of the construction material sector and other sub-sectors by creating a multiplier effect in the economy. As of the first quarter of 2017, the value-added loans, which add value to mortgage loans, have been increased from 75% to 80% and the value added tax (VAT), which was applied as 18% for the sales of houses above 150 square meters, was reduced to 8%. On the other hand, the newly announced package for Eastern and South Eastern

[1] The 'New Turkish Building Earthquake Regulation', which was published in the Official Gazette on March 18, 2018 and put into effect on 1 January 2019, is a more comprehensive revision. The revision includes a total of 17 chapters. Under the new regulation; development of revision works of high-rise, seismic-insulated, cold-formed steel and wooden buildings has been provided. (CBRT, 2018) (Economy, 2018) (Development, 2018) (OECD, 2018)

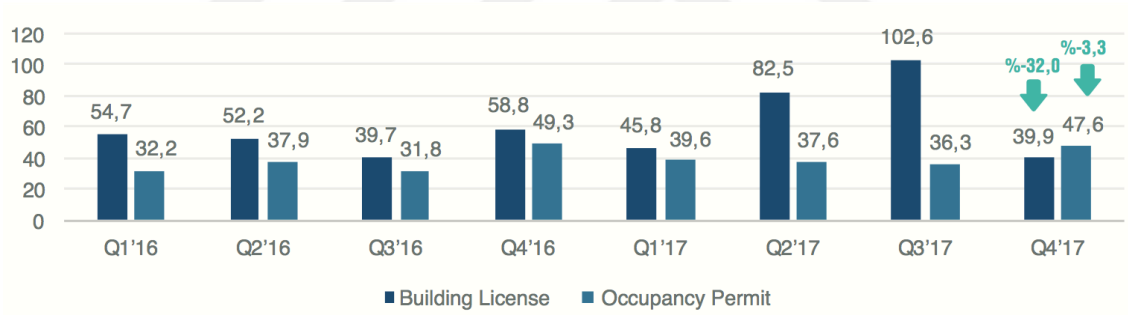
Anatolia includes additional investments for the housing sector and plans to build 66,789 new houses in these regions.

Turkey's demographic and economic characteristics, helps to maintain the vitality of the household sector. In recent years, with the view that the construction sector is the most contributing value to the growth of the economy, it has gained importance in parallel with the housing market. In this part of the study, Turkey's real estate sector and the housing sector is examined, statistical data describing the course of the housing market are presented.

2.1.1. Building Permits Statistics and Percentage Changes

Based on the surface area in the 4th quarter of 2017; the number of building licenses decreased by 32,0% compared to the 4th quarter of 2016 and the number of occupancy permits[2] decreased by 3,3%. (Figure 7)

Figure 7: Surface Area (million m2)



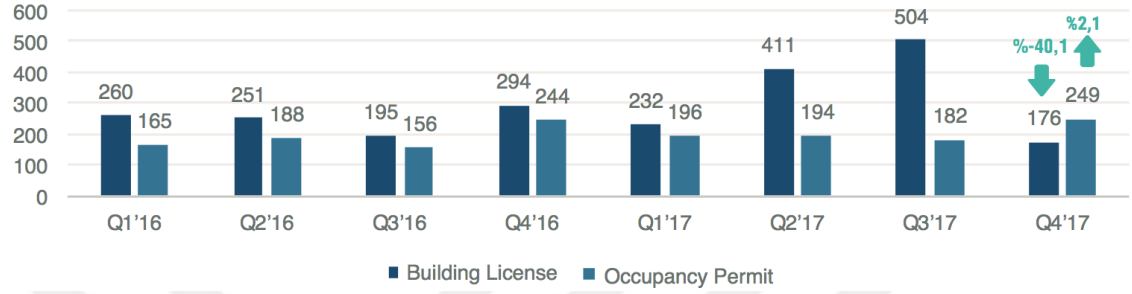
Source: Turkish Statistical Institute

Note: Rates of change are given according to the same period of the previous year.

[2] The Land Development Law No. 3194 details the need for a residence permit in all new buildings. For this purpose, the authorized municipality supervises the building and verifies that it is suitable for the project. These authorities then grant the occupancy permit. The law establishes a 30-day legal period for the municipality to grant a residence permit. Process takes up an average of 2 months. (The Real Estate Sector in Turkey, JLL, 2017)

According to the number of flats, the amount of building license decreased by 40.1% in 4th quarter of 2017 compared to the 4th quarter of 2016 while the amount of occupancy permit increased by 2.1%. The new housing production and supply of completed housing continue. (Figure 8)

Figure 8: Number of flats (thousands)

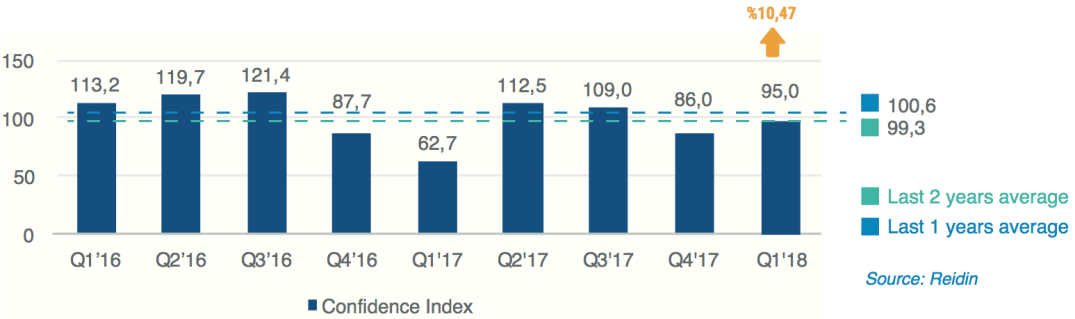


Source: Turkish Statistical Institute

Note: Rates of change are given according to the same period of the previous year.

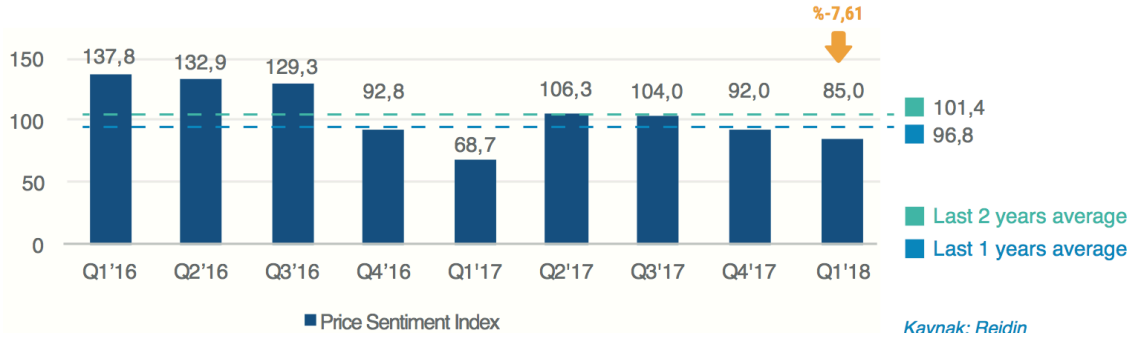
Sectoral confidence measurements are an important factor for the investor's future investment decisions. CBRT policies, recent economic developments, credit market conditions and geopolitical and global conditions directly affect sector confidence. The terrorist attacks on Turkey's agenda, which adversely affects domestic security risks and uncertain environment confidence index. For all these reasons, the construction sector is often fluctuating for the confidence index. As shown in Figure 9 and 10 respectively, the Real Estate Confidence Index, which was measured as 95 in the first quarter of 2018, remained below 100,6, average of the last year, while the Price Expectation Index, measured as 85, remained below last year's average of 96,8. The indices fell from the level of "Partially Optimist" to the "Partially Pessimist".

Figure 9: Real Estate Confidence Index



Source: REIDIN

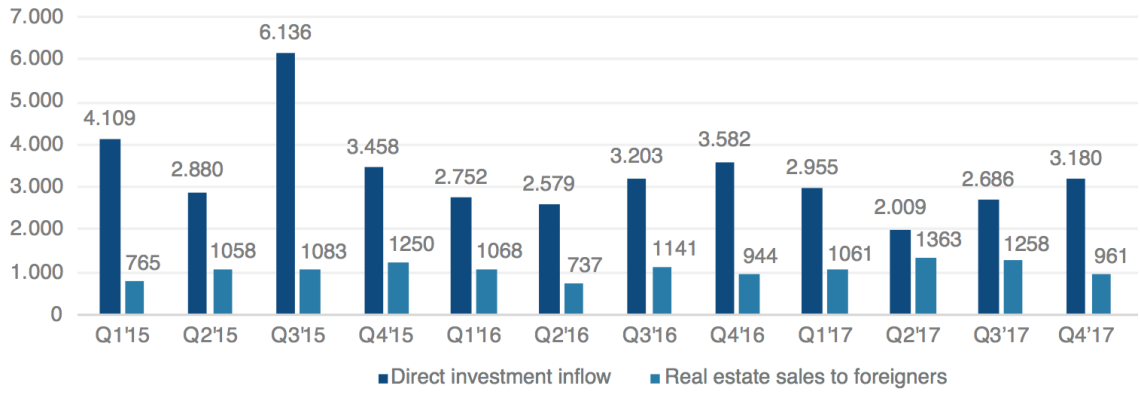
Figure 10: Price Sentiment Index



Source: REIDIN

Since Turkish real estate market, has won the attention of international investors after the global crisis and showed a stable and sustainable growth in the new era. As a result of the enactment of the law of reciprocity Turkey, real estate exceeded the 4.1 Mio USD by 1st quarter of 2015. Looking at the investment side by the end of 2017, FDI inflows rose to US $ 3.180 million, while total FDI inflows to real estate sales to foreigners amounted to US $ 960 million. The real estate market is estimated to have 22% share in FDI. As shown ın Figure 11, the decline in direct investment inflows and foreign real estate sales figures continued throughout the year.

Figure 11: Foreign Direct Investment (million USD)



Source: Ministry of Economy

2.1.2. Turnover and Production

Another important indicator of the construction sector is the turnover and production indices that underline its place in the economy. The indicators provide the follow-up of cash inflows from housing sales and also provide the analysis of seasonal effects and seasonally adjusted data.

According to TurkStat data, the calendar adjusted construction income index increased by 12.7% in the 4th quarter of 2017 compared to the 4th quarter of 2016. Similarly, at the end of 2017, the annual decrease has decreased by 14.2%. On the other hand, the seasonally and calendar adjusted construction income index decreased by 0.4% in the 4th quarter of 2017 compared to the 4th quarter of 2016.

Also, seasonally and calendar adjusted construction production index followed an upward trend as of the third quarter of 2014. It is only affected by the seasonality and has shown a positive performance for the last 3 years. According to TurkStat data, the index displayed a strong course throughout 2016 except for the third quarter. Despite the slight decline in the last quarter of 2017 compared to the 4th quarter of 2016, the upward trend continued throughout the year.

Another indicator that is questioned when examining the construction sector is the tendency of the turnover index to building and outside the building.

In the first quarter of 2017, the total turnover of the construction sector increased by 13.7% compared to the previous year. The said positive growth continued in the 2nd quarter and the index increased by 28% due to the revival and encouragement in the first half of the year. Although the revival of the Russian market supported domestic construction projects, turnover in infrastructure and mega projects followed a fluctuating course.

2.2. STRUCTURE OF REITS IN TURKEY

Measurement of house price changes brings along some difficulties in terms of methodology. Difficulties usually arise from the fact that demand does not occur at a certain frequency or trend, the quality of non-fixed household and neighbourhood, and the heterogeneity of houses. These factors prevent 'accurate' estimation of home price movements. To meet these challenges, several institutions have developed several home price indexes with different methodologies. In many studies such as; Okunev, Wilson, & Zurbruegg (2000), Gyourko and Keim (1992), real estate investment trust (REIT) index was used to estimate the change in real estate prices. The index, as mentioned above, can respond to many challenges and most importantly is comparable to the indices of different countries. Also, REITs are listed on the stock exchange and highly liquidity compared to other stocks. As explained by Eichholtz and Hartzell (1996), this could be an explanation of why the REIT is closer to the movements on the stock exchange than other estimators of property prices.

Turkey's real estate sector by providing employment to the various sub-sectors and creating business volume, has become the biggest supporter and the locomotive of the national economy, also created a continuous and regular jobs and reduces both general and seasonal unemployment. The implementation of REIT regimes supported the expansion of real estate markets worldwide. Currently, there are REIT regimes in 13 EU countries and represent 84% of EU GDP. In addition to forming the basis of the global economy, REITs continue to be extremely attractive to pension funds, insurance companies and other long-term investors (EPRA Global REIT Survey, 2018).

In Turkey the result of the absence of concepts and functions of a 'trust', REITs, are configured as Real Estate Investment Companies (REIC). REIX can invest in real estate, real estate market, real estate projects and real estate rights; is a capital market organization that allows the diversification of the portfolio (Chiang, Y.H., et. al., 2008). In 1995, the Capital Markets Board of Turkey (CMB) after the first legislation made by REITs started to work.

Turkish REICs are companies that are listed in the stock exchange in Istanbul and are exempt from corporate tax. REICs bring together resources from many different investors; realizes various, valuable and high amounts of real estate investments. Thus, while individual investors cannot make large real estate investments with their own

savings, they are given the chance to get indirect shares with REIC investment. In this way, REICs have the opportunity to invest in real estate projects and create a real market through the sale of shares in the stock exchange for illiquid real estate. However, it can be claimed that the REICs, listed on the stock exchange, are traded with a significant discount in trade, contrary to the importance. (Titman & Warga, 1986). Table 1 is a proven example for the Titman & Warga (1986) study. Although the number of REICs are increased only by 34%, the total assets are increased by 3 times and the value of total assets 2.5 times larger than total market value.

There were 23 REICs in 2011 in Turkey as shown in the Table 1 below and this number has reached to 31 in the last period of 2017, expanded by 34%. Market value of 23 REICs was 11.7 Mio TL and this was costed at 6.224 Mio USD in 2011. This market value has reached to 7.125 Mio USD in 2017. The year of 2014 has the biggest market value which is 9.462 Mio USD. The REICs in Turkey have not a regular increase in market value thanks to the USD/TRY appreciation[3]. Thus, after 2014 market value of REICs has decreased till 2017, although the number of companies has increased regularly.

Table 1: Net Asset Value Of Real Estate Investment Trusts Net Asset Value Of Real Estate Investment Trusts

Year	Number of REICs	Total Market Value		Total Assets	
		Thousand TRY	Million $	Thousand TRY	Million $
2011/12	23	11.708	6.224	20.770	11.041
2012/12	25	15.782	8.857	24.087	13.518
2013/12	30	18.632	8.730	37.573	17.605
2014/12	31	21.981	9.462	42.059	18.105
2015/12	31	21.280	7.279	52.530	17.969
2016/12	31	24.962	7.080	60.602	17.189
2017/12	31	26.924	7.125	67.162	17.774

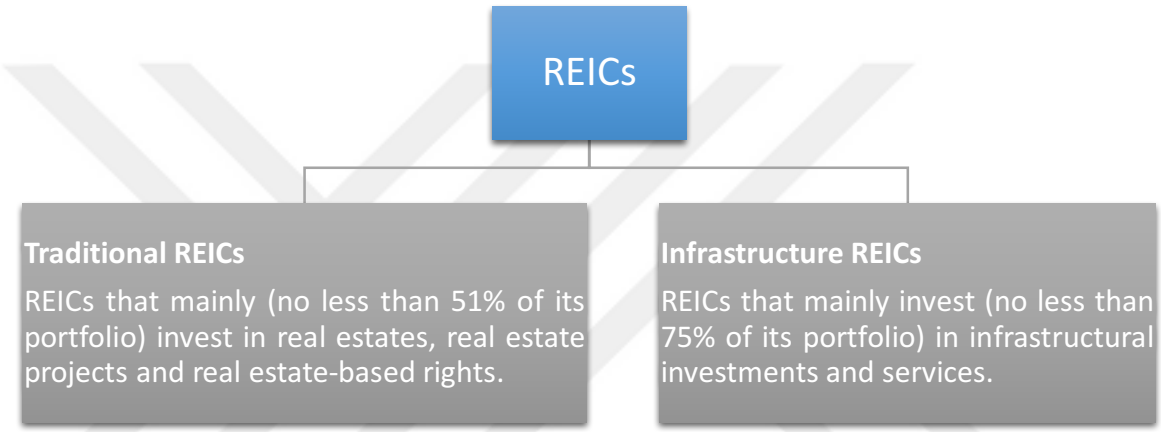
Source: CMB Monthly Statistical Bulletin, December 2018

As of the end of 2017, there are 31 REICs traded on the Istanbul Stock Exchange (BIST) with index name of BIST Real Estate Investment Trusts Index (XGMYO). The real estate in their portfolio includes various assets such as housing, office, shopping

[3] USD/TRY appreciated 9% by 2014. 26%, 21%, and 7% respectively from the yerars between 2015 to 2017 year-end.

centres and hotels. First legislation was passed in 1995 by CMB of Turkey. In 2003, some changes have made on the management structure, incorporation, legal form, capital and some other requirements. Since the beginning of 2009, the Capital Markets Board (CMB) constituted different type of real estate trust – a regulated company: the Infrastructure Real Estate Investment Company (IREIC[4]). Table 2 summarises the two types of REICs Turkey, at present all REICs except one are traditional REICs. The latest major amendment about Turkish REICs was published in January 2017, covering how to practice initial capital, profit distributions, assets or other minor amendments.

Table 2: Two Types of REICs in Turkey



Source: Capital Markets Board of Turkey

Furthermore, a new amendment to extend the period of the temporary clause was published on May 10, 2018. Table 3 gives an overview of the year in which the amendments are published. As of 2018 Turkey REIT continues to grow. The following 3 developments are examples of this growth.

- ✓ One infrastructure REIT is established.
- ✓ Three traditional REITs are in the pipeline.
- ✓ Four electricity distribution companies' applications are under way to become REIT with infrastructure concentration.

Table 3: Amendments through 1995 - 2018

[4] IREICs are investment companies that manage the portfolios of infrastructure investments and services, exempt from corporate tax.

	Enacted year	Citation
REIC	1995	- Capital Markets Law no. 6362 ('CML') - Communiqué on Principles Regarding Real Estate Investment Companies, Serial III No. 48.1 ('Communique')
	2014	- The Communiqué Revising the Communiqué on Principles of Real Estate Investment Companies, Serial III number 48.1.a ('Communique number 48.1.a')
	2017	- The Communiqué Revising the Communiqué on Principles of Real Estate Investment Companies Serial III number 48.1.b ('Communique number 48.1.b')
	2018	- The Communiqué Revising the Communiqué on Principles of Real Estate Investment Companies Serial III number 48.1.c ('Communique number 48.1.c')

Source: Global REIT Survey 2018, ERPA

Turkish REITs, in order to create profits through the various real estate portfolio in the real estate market, also providing easy access, has entered as an advantageous investment. Thus, REITs attract the attention of both domestic and foreign investors. Portfolios are enormous and the total asset value of the listed REICs reached TL 67 million as of December 31, 2017. All of REITs in Turkey is being listed in Table 4 is a summary of financial information.

Table 4 provides general information about Turkish REICs market values of the 4th quarter of 2017. According the Table 4, the largest company is Emlak Konut Gayrimenkul Yatırım Ortaklığı with its market value of 10.678.000.000 TRY, total assets of 20.527.994.000 TRY and number of outstanding shares of 3.800.000.000, besides this its Q4 of 2017 stock price is 2,81 TRY.

Emlak Konut REIT was established in 1953. Principal activity is the production of housing. Emlak Konut REIT, is one of Turkey's most established companies. REIT buys land, develops real estate for middle and upper middle income groups, executes marketing and sales activities. In 2002, the Company became a Real Estate Investment Trust. TOKI owned REIT portfolio in terms of real estate and land taken into account, the stock is the largest, in terms of market value, real estate investment trusts operate in Turkey. First public offering was in 2002 and the secondary offering were realized in 2013, becoming the 5th largest public offering in the history of the Turkey.

Table 4: General Information Of Real Estate Investment Trusts

#	Name of Company	Registered Capital	Paid in Capital	Number Of Outstanding Shares	Asset Allocation %				Total Assets	Stock Price	Market Value
					Real Estate Investments	Affiliates	Money and Capital Market Instruments	Other			
		(TRY)	(TRY)						(TRY)	(TRY)	(TRY)
1	AKFEN GAYRİMENKUL Y.O.	1.000.000.000	184.000.000	184.000.000	59,39	34,15	0,09	6,37	1.217.053.500	2,41	443.440.000
2	AKİŞ GAYRIMENKUL Y.O.	500.000.000	430.091.850	430.091.850	91,22	2,25	2,00	4,52	4.264.607.448	3,13	1.346.187.491
3	AKMERKEZ GAYRİMENKUL Y.O.	75.000.000	37.264.000	37.264.000	82,00	0,00	8,65	9,35	240.541.899	20,46	762.421.440
4	ALARKO GAYRİMENKUL Y.O.	20.000.000	10.650.794	10.650.794	56,14	0,00	41,41	2,45	926.964.533	50,85	541.592.875
5	ATA GAYRİMENKUL Y.O.	135.000.000	23.750.000	23.750.000	68,55	0,00	29,39	2,06	96.717.405	4,79	113.762.500
6	ATAKULE GAYRİMENKUL Y.O.	200.000.000	154.000.000	154.000.000	86,17	0,00	6,57	7,26	388.587.305	2,05	315.700.000
7	AVRASYA GAYRİMENKUL Y.O.	360.000.000	72.000.000	72.000.000	72,75	0,00	21,67	5,58	175.460.856	1,58	113.760.000
8	DENİZ GAYRİMENKUL Y.O.	95.000.000	50.000.000	50.000.000	70,39	11,78	6,55	11,28	249.932.600	2,70	135.000.000
9	DOĞUŞ GAYRİMENKUL Y.O.	500.000.000	332.007.786	332.007.786	98,36	0,00	0,77	0,87	1.165.054.708	3,24	1.075.705.227
10	EMLAK KONUT GAYRİMENKUL Y.O.	4.000.000.000	3.800.000.000	3.800.000.000	67,24	0,00	2,88	29,88	20.527.994.000	2,81	10.678.000.000
11	HALK GAYRİMENKUL Y.O.	1.500.000.000	820.000.000	820.000.000	87,52	0,00	5,18	7,30	2.376.933.740	0,96	787.200.000
12	İDEALİST GAYRİMENKUL Y.O.	50.000.000	10.000.000	10.000.000	84,32	0,00	0,45	15,23	8.153.067	2,04	20.400.000
13	İŞ GAYRİMENKUL Y.O.	2.000.000.000	913.750.000	913.750.000	92,93	0,04	1,57	5,46	5.311.947.256	1,36	1.242.700.000
14	KİLER GAYRİMENKUL Y.O.	1.400.000.000	124.000.000	124.000.000	71,96	8,37	0,94	18,73	1.941.060.448	3,66	453.840.000
15	KÖRFEZ GAYRİMENKUL Y.O.	330.000.000	66.000.000	66.000.000	70,94	0,00	13,55	15,51	107.458.478	1,66	109.560.000
16	MARTI GAYRİMENKUL Y.O.	200.000.000	110.000.000	110.000.000	78,54	16,81	0,01	4,63	533.327.575	2,12	233.200.000
17	MİSTRAL GAYRİMENKUL Y.O.	100.000.000	39.000.000	39.000.000	75,04	0,04	1,34	23,57	287.433.543	7,39	288.210.000
18	NUROL GAYRİMENKUL Y.O.	200.000.000	80.000.000	80.000.000	84,61	0,00	0,68	14,71	1.841.010.507	4,75	380.000.000
19	ÖZAK GAYRİMENKUL Y.O.	300.000.000	250.000.000	250.000.000	82,05	6,05	6,37	5,53	2.525.074.338	2,34	585.000.000
20	ÖZDERİCİ GAYRİMENKUL Y.O	250.000.000	100.000.000	100.000.000	92,19	0,00	0,14	7,67	540.540.365	1,56	156.000.000
21	PANORA GAYRİMENKUL Y.O	90.000.000	87.000.000	87.000.000	94,97	0,01	2,31	2,71	926.112.775	4,89	425.430.000
22	PERA GAYRİMENKUL Y.O.	250.000.000	89.100.000	89.100.000	91,08	3,73	0,75	4,44	166.088.353	0,88	78.408.000
23	REYSAŞ GAYRİMENKUL Y.O.	500.000.000	246.000.001	246.000.001	83,73	2,07	7,26	6,94	1.895.927.195	1,27	312.420.001
24	SERVET GAYRİMENKUL Y.O.	1.000.000.000	52.000.000	52.000.000	76,79	8,05	1,90	13,26	423.584.991	3,04	158.080.000
25	SİNPAŞ GAYRİMENKUL Y.O.	1.000.000.000	600.000.000	600.000.000	61,77	3,64	1,35	33,24	1.992.895.169	0,77	462.000.000
26	TORUNLAR GAYRİMENKUL Y.O.	1.000.000.000	1.000.000.000	1.000.000.000	87,40	2,78	5,31	4,50	11.335.817.000	3,33	3.330.000.000
27	TSKB GAYRİMENKUL Y.O.	200.000.000	150.000.000	150.000.000	95,38	0,00	2,61	2,00	466.563.935	0,73	109.500.000
28	VAKIF GAYRİMENKUL Y.O.	500.000.000	217.500.000	217.500.000	84,11	0,00	2,56	13,33	1.152.183.130	2,60	565.500.000
29	YAPI KREDİ KORAY GAYRİMENKUL Y.O.	100.000.000	40.000.000	40.000.000	80,75	0,25	13,52	5,48	82.634.767	2,32	92.800.000
30	YENİ GİMAT GAYRİMENKUL Y.O	250.000.000	107.520.000	107.520.000	88,72	0,00	10,77	0,51	1.954.234.951	13,58	1.460.121.600
31	YEŞİL GAYRİMENKUL Y.O.	1.000.000.000	235.115.706	235.115.706	59,31	21,67	0,00	19,02	2.039.708.960	0,63	148.122.895

Source: CMB Monthly Statistical Bulletin, December 2018

All the terms and conditions required for Turkish REICs to be traded on the BIST and continue to be traded are summarized in Table 5 below and explained in the following subsections:

Table 5: Requirements of Turkish REICs

1. Legal & Organizational Requirements	
Legal Form	**Minimum Share Capital**
Joint stock company	*TRY 30 million (for T-REITs and TRY 100 million (for Infrastructure T-REITs)*
Organization	**Restriction**
Real estate investment company (REIC)	*-stockholders must have a certain income and satisfy asset ownership requirements* *-stockholders must not be involved in business, industry and agriculture outside of legally allowed* *-stockholders must not be involved in capital market activities other than for managing its own portfolio* *-stockholders must not be involved in construction*
2. Shareholder Requirements	
Shareholder requirements	**Listing mandatory**
Only for company founders	*Yes*
3. Asset Requirements	
Restrictions on assets	
- Only transactions permitted by the Communiqué are allowed. *- Must primarily deal with portfolio management.* *- The portfolio of a general purpose T-REITs is required to be diversified.* *- If a T-REITsis established to display activity in a specific area or invest in a specific project, 75% of its portfolio must consist of assets mentioned in its title and/or articles of association. - Cannot be involved in the construction of real estate.* *- Cannot commercially operate any hotel, hospital, shopping center, etc.* *-Cannot provide services by its personnel to individuals or institutions in project development, project control, financial feasibility and follow-up of legal permission except for the projects related or to be related with the portfolio.* *- Cannot make any expense or commission payment which is not documented or which materially differs from the market value.* *- Cannot sell or purchase real estate for short-term consistently.*	
4. Distribution Requirements	
Operative income	**Capital gains**
T-REITs determine their own profit distribution politics **Timing** *Annually or quarterly.*	*Will be regarded within the*
5. Tax Treatment	
Current income and Capital gains	**Witholding tax**
Tax-exempt.	Credit/refund may be possible.

Source: Global REIT Survey 2018, ERPA

Despite being one of the first countries REIT system that has been applied for the first time in Turkey in 1995, many changes have been made in various arrangements until recently. Therefore, with the system to be modified periodically in Turkey, and due to the global REIT systems it remains the same, significant differences were formed as a result. These differences are particularly important for corporate governance practices at the firm level.

3. LITERATURE REVIEW

The relationship between macroeconomic variables and stocks has been the subject of many researches to date. Nowadays, increasing empirical analyses are taken attention on the correlation between the stock market and REITs. In this section, the studies that investigates the relationship between real estate and stock prices will be reviewed. Although this relationship has been studied intensively in many international markets, Turkey has made in less interference to evaluate.

One of the early researches, Liu and Mei (1992), concluded that the real estate market is correlated with the broad asset which are stocks, bonds, etc. The study used quarterly data from from January 1971 to December 1989, by constructing equally weighted real estate investment trust return series using a portfolio of 50 equity REITS on the CRSP. Dynamic Conditional Correlation GARCH model and panel regression method used in the study. As a result of panel regressions; It has been suggested that the relationship between national inflation rates and high global capital market uncertainty and its interaction with one of them leads to an increase in REIT correlations. In addition, it has been determined that the REIT correlations decrease with the default risk premium in the USA and the increases in global stock market volume. As a result, the finding of the study is that equity REITs behave more like small stocks and have minimal relationships with bonds. Ambrose et al. (1992), evaluated the relationship between the stock market and real estate prices, concluded that both variables exhibits co-integration in the long-run, by working data from US markets. Similar studies, Ling & Naranjo (1999), Peng & Schulz (2013) and Quan & Titman (1999) also found that the stock and real estate markets have a mutual relationship in which one variable affects or depends on the other. Quan and Titman (1999) included 17 countries[5] and studied from 1984 to 1996 in the paper. As a result of a time series work; in 16 of 17 countries, the relationship was insignificant. In the model, stock prices, real estate prices have been investigated and in addition Gross Domestic Product (GDP), inflation and interest rates were included as

[5] Germany, The Netherlands, Belgium, Spain, Australia, France, the U.K, Italy, Japan, New Zeeland, Singapore, Malaysia, Taiwan, Hong Kong, Thailand, Indonesia, and the U.S.

control variables. To further investigate the problem, the yearly data was extended. In this way, the prevalence study exhibited a notable positive correlation.

Eichholtz & Hartzell (1996) conducted a similar study from 1978 to 1993. For the real estate prices, a valuation-based index, NCREIF Property Index and the S&P500 index were used. The ordinary least squares regression model was used in the study in order to talk about correlation. It was concluded that significant and a negative correlation coefficient was occurred between S&P500 and NCREIF Property Index. In addition to the US market, the survey also examined the correlation between Canada and U.K. Both markets exhibited a desired conclusion, in which a significant and negative correlation coefficient was found. In addition, the interaction between real estate market and stock market in the USA has been investigated and the results have shown a strong positive relationship.

The vast majority of the studies have focused on developed countries, specially the US and UK, and less studies have focused on Pasific-Asia Countries. Sim and Chang (2006) analyzed the interaction between stock and real estate prices by conducting vector autoregression (VAR), employing the GDP growth rate and 3-year bond yield as control variables. It has been a study providing detailed and supportive evidence on the 'credit price effect' and 'wealth effect'. In the paper, quarterly data ranging from 1986 through 2005 was used for house prices and for the stock prices Korea Stock Exchange (KSE)'s index is employed. House price data was categorized both regional (Nation, metropolitan areas, mid - size cities, and rural areas) and type-wise (residential, commercial, and industrial land.). The study pointed out three conclusions. Firstly, in many regional real estate markets including house and land, real estate prices concluded to be Granger-cause stock prices. Thus, it is not expected to stock market to Granger-cause real estate market, an opposite causation. Secondly, supported by the VAR analysis, both commercial and industrial land markets were affected from the differentiation in stock prices in a more powerful way, rather than in residential land. Finally, based on the generalized impulse response function, study defended the hypothesis of credit-price affect industrial land prices.

Numerous papers have studied correlation between real estate and stock prices which vary from country to country and over time. Hoesli & Oikarinen (2012) presents

data from US, UK and Australia. The study concluded that REIT's performance is directly affected by real estate performance, less affected by stock returns.

Liow & Schindler (2014) concludes that the European, US and Asia-Pacific REIT markets are more integrated with global stock exchanges (including regional exchanges). However, mentioned regions are less integrated into their own local stock exchanges. In the study, Europe represents Germany, France, Denmark, and the United Kingdom; and Asia-Pacific represents Japan, Australia, Singapore and Hong Kong. These mentioned 9 real estate market represents 85% of the global market, all converted to US Dollars. Weekly data used in the study range from 1990 through 2011. The study intends to analyse not only the return and prices but also examines time framework in order to understand the interaction between stock and real estate market. Four different approaches: 'dynamic conditional correlation (DCC)', 'causality in mean (CIM)', 'causality in variance (CIV)', 'time varying integration scores', 'principal component analysis (PCA)', and finally 'the return convergence approach', are used examine the relationship between real estate and stock markets. Their findings suggest that, even though real estate and stock exchanges are also interrelated in terms of returns and volatilities, causality is less effective than others. It is observed that real estate markets moderately integrate with global stock markets in the long term. However, it can be said that these markets are becoming less integrated with regional exchanges.

Correlation analysis is not sufficient to describe the exact connection between stock market and real estate market. Information about causality lacks. If an event originates any other event, it can be said that there is a causality situation. In these cases, it is necessary to note that 'time frame' is involved, as well. If B is occurring after the occurrence of A, event B cannot cause 'Granger' to the event A. However, the opposite can be said about the event A. In this sense, causality among the stock and real estate market has attracted many studies before.

Su (2001) examined if long term equilibrium correlation exists between the stock and real estate markets in West of Europe, by applying threshold auto-regressive model through a causality test. The study used data from eight Western European countries from 2000 to 2007, and employed non-parametric 'rank test' to describe a long term equilibrium among the mentioned countries. Every country has given a different Granger-

casualty results from one to another. A credit-price effect (unidirectional causality[6]) was observed in 3 countries such as Germany, the Netherlands and the UK. Unidirectional causality was occurred from the real estate market to the stock exchange. A wealth effect was occurred vice a versa. Unidirectional causality for this example happened to be from the stock exchange to the real estate market, in Belgium and Italy. Moreover, both causalities – a bilateral causality[7] - were occurred in Spain, France and Switzerland. McMillan (2012) also discovered a bilateral causality occurring from the real estate trough stock market. McMillan (2012) used the causality model among the variables, gathering data from the US and U.K. using the ESTR model[8]. Data on property prices in the USA were calculated by the Census Bureau raging from 1974 to 2009.

Another identical paper, Kakes & Van Den End (2004), undertook analysis to distinguish causality in the Netherlands from 1985 to 2002. Besides real estate prices and Australia stock exchange index, the paper used 'real disposable income', 'interest rate' and 'the 10-year government bond yield' as control variables by utilizing vector autoregressive modelling. While estimating a VAR model, generalized impulse response function and the variance decomposition methodologies was used. The study concluded that when stock market is altered it affects the real estate market as well, by altering it. The empirical findings showed that stock indexes and interest rate explains the changes in real estate prices in the long term. Further analysis in the study showed that real estate owners' trading in the stock market increases the sensitivity of the housing prices to the stock market and increases both variables at the same rate.

Kallberg, Liu and Pasquariello (2005) examined how the existing relation among real estate and stock markets are affected by the Asian financial crises in 07-1997 with the reduction of the THB. The study focused on Asia Region that soma countries taken in to account which were; Malaysia, Indonesia, South Korea, the Philippines, Thailand, and Taiwan. Monthly time series of local equity returns gathered from 1990 through 1999. Using Granger Causality test and method of Bai, Lumsdaine, and Stock (1998), study identified that the monthly securitized returns and equity indices experienced in eight

[6] Unidirectional causality occurs when event M changes event N, but N do not influence M.

[7] Bilateral causality occurs when the events causes one another at the same time.

[8] Exponential smooth transition model.

Asian countries are changing in the time series of returns and volatility. It was concluded that, as the regime breaks in eight Asian countries, domestic equity markets became more responsive to the volatility in currency markets.

In addition, Kapopoulos and Siokis (2005) examines a relationship among the real estate and stock market, as well. Paper utilizes a Granger causality test covering years from 1993 trough 2003, the study concluded that the wealth effect hypothesis accepted for Athens but not for the cities in Greece (urban areas, not rural). Wealth effect, that has been covered in the paper, explained 'households that has unpredicted share in prices, increases the amount of houses built'.

The first of two articles using the co-integration approach, İbrahim (2010), investigated the relationship among stock market prices and real estate prices in Thailand, from 1995 to 2006. In order to investigate the effect of wealth, the analysis was made by including the actual output and consumer price data and a significant effect was found. In addition, it has been concluded that real activities have an important effect on both housing and equity prices.

Another study, Lean & Smyth (2012), studies Malaysia, using interest rates in the model as control variable. Instead of expressing data as an index rate, every REIT in Malaysia included in the data. While a wealth effect can be mentioned for some REITs, it has been concluded that there is evidence of feedback effects between real estate and stock markets for most of the others.

While the correlation among the variables such as; real estate market, stock market prices has been a wide-spread of interest in both developed and emerging market countries, no attempt has been made to asses Turkey until Yüksel (2016). The paper used global financial crises that happened in 2007 as a control conditions and examined if the relation among the variables; real estate and stock prices has evolved following the global crisis. A threshold co-integration framework employed for the research. Daily closing values were taken into consideration in the data used in the study. Data includes; real estate investment trust index, stock exchange index and the monthly interest rate; covering 2005 through 2009. When the results were taken into consideration, it was observed that the price effects of wealth and credit were different in the pre-crisis and

crisis periods. In the pre-crisis period in Turkey, wealth and credit price effects were observed. In the crisis period, only the effect of credit price has emerged.

4. DATA

The hypothesis of this thesis is to discover the relation among the real estate and stock market in Turkey, Using the global financial crisis occurred in 2007 as a control condition, by modelling the data using the VECM. The paper covers years between 2002 to 2017. Also, the impact of the crisis has been examined in 3 different time periods; pre-crisis, crisis and post-crisis. Four variables studied in the model were carefully selected by searching the relevant literature. BIST100 represents Stock Market, House Price Index is represented by BIST XGMYO. Finally, USD/TRY and one-month deposit rate relation to stock market investigated as well. This section contains information about the variables used in the study.

4.1.CHOICE OF VARIABLES

All data used in this study were taken from REUTERS DataStream on daily-basis. The data includes the stock market values of the real estate investment trust index quoted in BIST, the stock exchange index of BIST 100, the buying rates of the USD / TRY exchange rate and the monthly deposit rate.

The sample period covers 4,176 working days during the period when the global financial crisis of 2007 is continuing worldwide. The time period from January 01, 2002 to May 5, 2006 is categorized as the pre-crisis period, period from June 01, 2006 to January 30, 2009 is categorized as the crisis period whereas from February 02, 2009 to December 31, 2017 time period is categorized as the post-crisis period. Table 6 summarizes the crisis period, which will be referred to through the paper and will be explained how the time periods are decided in this section.

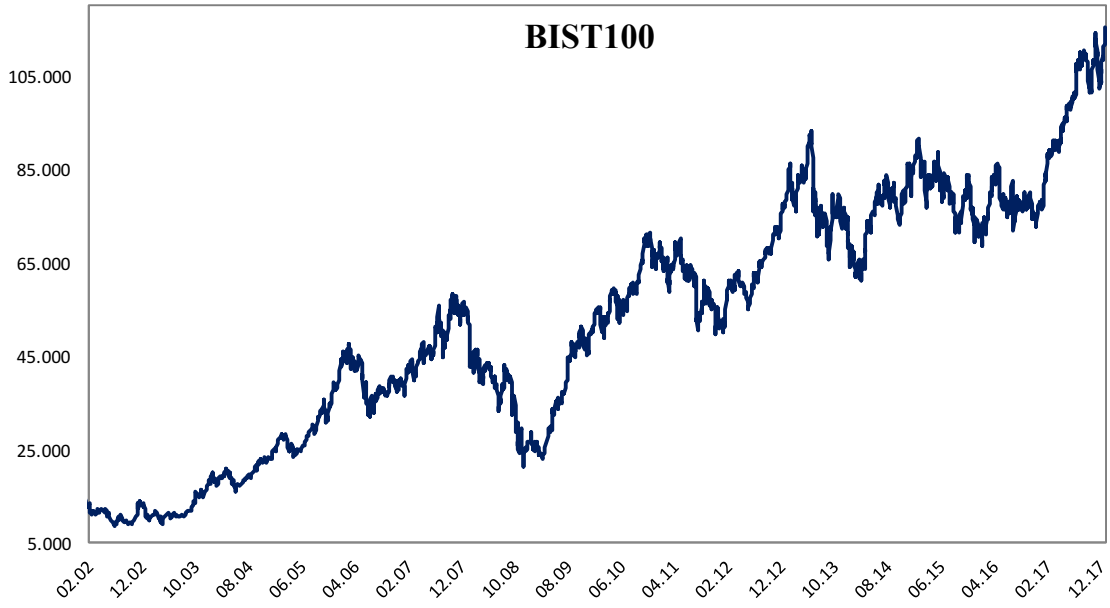
Table 6: Crisis Periods

START DATE	END DATE	PERIOD
1/1/2002	5/31/2006	*pre-crisis*
6/1/2006	1/30/2009	*crisis*
2/2/2009	12/31/2017	*post-crisis*

Borsa İstanbul was established in December 1985 with the short name of BIST. The effects of the global financial crisis, in the period until emerging in Turkey, stock index showed a high and remarkable growth.

In 2002, total market value of 300 listed stocks's market capitalization in BIST increased from 98 billion USD to 236 billion USD, and by the end of 2018, since USD/TRY depreciated market value was calculated 132 billion USD[9]. Figure 12 shows the levels of BIST 100 index covering from 2002 to 2007. As it is seen on the graph, from June 01, 2006 to January 30, 2009 BIST 100 experienced a remarkable decline.

Figure 12: BIST 100 index from 2002 to 2017



Source: DataStream

Employing real estate investment trust data is a common option to examine linkages among stock and real estate investments (Subrahmanyam, 2007) and also check for other studies of Gyourko & Keim (1992) and Okunev et al. (2000) for a similar approach. In order to monitor price movements of the real estates, a Housing Price Index, covering all of Turkey, was created by the Central Bank. The mentioned index started in January 2010 and takes place 8 years after the data we employ for this paper. The

[9] Real Estate Investment Trust Index and Stock Exchange figures in this paragraph are obtained from BIST http://www.borsaistanbul.com/

comparison of the price index and real estate investment trust index (not shown) between the years 2010 and the end of the year 2017 was sketched and showed that the REIT index since the portfolio is more various, is seemed to be volatile than the Index created by Central Bank. As noted previously in Turkey REITs had began to be recognized as of 1995, but since 1997 has been listed on the stock exchange. Turkish REITs do not have to pay both corporate and income tax, in the same way of other countries exempted. However, while other countries have to pay dividends yearly, this is invalid for Turkish REITs.

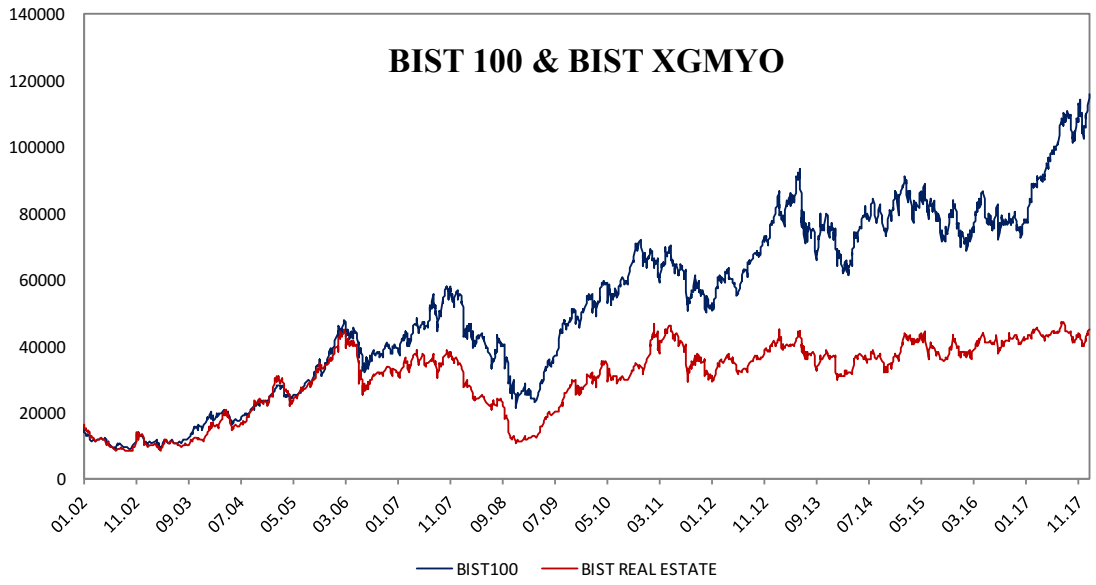
From the beginning of the study period, they accounted for approximately 1.21% of the Turkish Stock Exchange's total capital with 10 REICs traded on the BIST. In 2009, REITs were totals up to 14 and accounted for 2.08% of total market capitalization. As of the end of 2018, 31 REITs are listed in BIST. Figure 13 shows the levels of REIT shares between 2002 and 2017. As shown in the Figure 13, the most significant decline was realized between 2005 and 2006 and the index reached a maximum of 44.990 on 03/01/2006 and closed the day 06/13/2006 at 25.322. There has been a rapid decline of 43.7% between the relevant dates. REIDIN studies Turkish Residential Property Price Indices, in the period from March 2008 to March 2009 shows that there is a continuous ongoing decline in housing prices, as well (Reidin Turkey, 2010).

Figure 13: BIST XGMYO index from 2002 to 2017

Source: DataStream

Figure 14 shows the levels of BIST 100 and BIST XGMYO that moves together through the sample period. It is important that REIT and stock indices react together to certain time intervals. In the Figure 12, REIT and stock market indices graphed together, aiming to show the significant decrease from 2006 to 2008. As a matter of fact, the starting date of the crisis in June 2007 is based on this observation. Likewise, the global financial crisis has affected many countries at different times. For this reason, the analyses were repeated by selecting the start date of the crisis on May 1, 2006 and June 1, 2006, and June, 2006 was selected as the start date of the crisis.

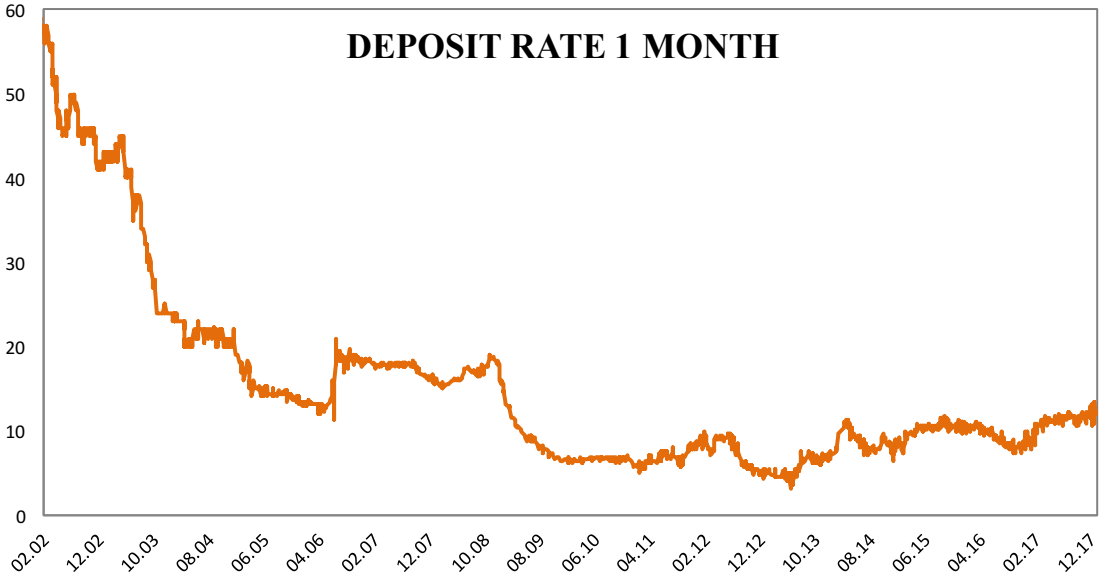
Figure 14: BIST 100 & BIST XGMYO index from 2002 - 2017



Source: DataStream

The other variables used in the study are one-month deposit rate and USD/TRY exchange rate, also covering period from 2009 to 2017. Figure 15 shows the levels of One-Month Deposit Rate from 2002-2017. When the changes in interest rates are examined during the sample period, two striking trends are observed. The first is the upward trend that started in June 2006 and the second decline in the last quarter of 2008. 1-month deposit rate, which was 13% in May 2006, increased by 15% on June 8, 2006 and was realized as 15%. At the end of June 2006, it was increased by 53% compared to May 2006 and realized as 20.25%. After the said increases, the interest rate dropped to 15.50% at the end of 2018. Both of this period, can be explained by the capital outflows from emerging market countries, which is true to Turkey, as well (Yüksel, 2016).

Figure 15: One-Month Deposit Rate from 2002-2017



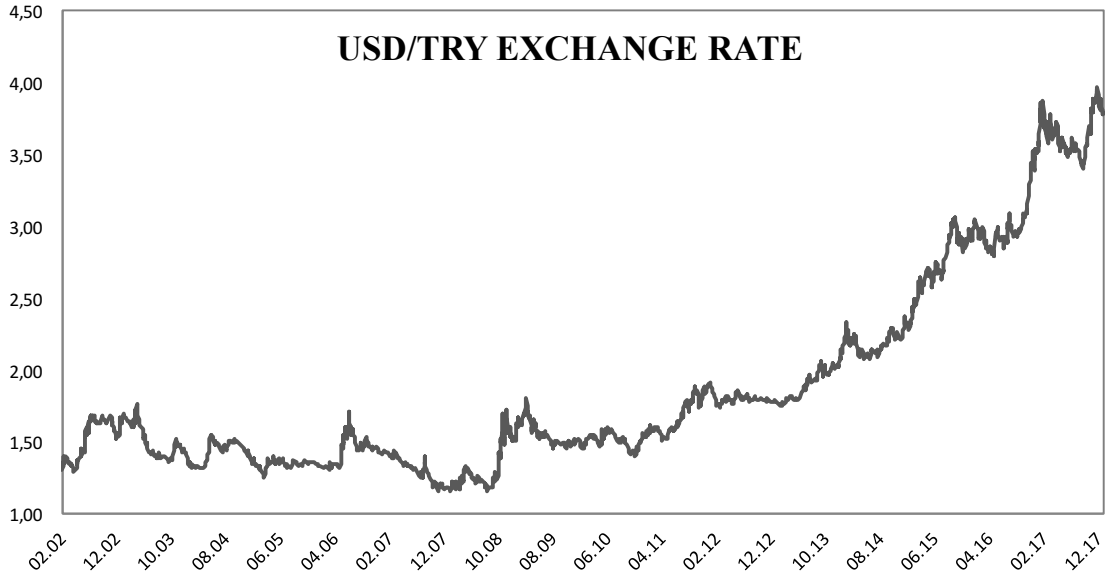
Source: DataStream

In the said periods when interest 1-month deposit rate was affected, the Turkish Lira had depreciated significantly against the USD. Figure 16 represents the levels of USD/TRY exchange rate for the sample period. The exchange rate of USD/TRY, which was realized as 1.30 in May 2006, decreased by 20% against TRY, due to an increase of the exchange rate to 1.71 in June 2006. In addition, faster depreciation occurred in 2008. The exchange rate, which was 1.15 in January 2008, decreased by 33% in the last quarter of 2008 to 1.71. In both cases, the CBRT monetary policy resolutions are the opposite of each other. In the May-June period of 2006, despite an unforeseen and powerful monetary policy to tighten the economy, against capital outflows, an expansionary monetary policy executed in the last quarter of 2008 (Yüksel, 2016).

Yılmaz (2008) describes the statements which are opposed to each other, taking into consideration two different reactions, mostly due to economic dissimilarities and shock sources between the two periods. 2006 was a kind of predictor and precursor for the 2008 financial crisis. The reason for this is that the global crisis that triggered the whole world in 2008 was triggered by the start of the US mortgage crisis in 2006. Demand was strong in 2016, both locally and globally. Therefore, capital outflows triggered exchange rate movements and resulted in an appreciation in estimated inflation. However, the main reasons for the pressure on inflation are the global crisis and the decreasing domestic demand. The 2008 financial crisis, which is considered to be most shocking

crisis in the world since the 1929 crisis, caused remarkable changes in monetary policy. The Central Bank has taken measures in monetary policy and reduced the short term interest rates for balancing the monetary policies. The responses of macroeconomic variables in response to all these policies indicate and prove that the economic conditions are quite unlike in the crises period covering individually; pre-crisis, crisis and post-crisis periods.

Figure 16: USD/TRY Exchange Rate from 2002-2017



Source: DataStream

4.2.DESCRIPTIVE STATISTICS

To understand the distribution of variables, descriptive statistics will be useful. The mean, median, max., min., standard deviation, skewness, kurtosis and Jarque-Bera for BIST100, BIST XGMYO, 1-month deposit rate and USD/TRY exchange rate are shown. Descriptive statistics covering the whole sample period, including 4,176 observations, can be seen in Table 7 below. Descriptive statistics were analyzed separately in each of the 3 periods: pre-crisis, crisis and post-crisis.

Table 7: Descriptive Statistics

Descriptive Statistics	PRE - CRISIS			
	BIST 100	BIST XGMYO	1 Month Deposit Rate	USD/TRY
Mean	20.507	19.468	28,39	1,44
Median	18.234	15.990	22,63	1,39
Max.	47.729	44.990	59,00	1,76
Min.	8.627	7.981	12,00	1,26
Std. Dev.	10.491	10.182	13,89	0,12
Skewness	0,93	0,80	0,56	0,84
Kurtosis	2,87	2,46	1,88	2,45
Jarque-Bera	167,18[a]	136,94[a]	120,24[a]	148,58[a]
Descriptive Statistics	**CRISIS**			
	BIST 100	**BIST XGMYO**	**1 Month Deposit Rate**	**USD/TRY**
Mean	41.171	28.249	17,21	1,35
Median	40.720	31.059	17,60	1,33
Max.	58.232	38.876	20,80	1,73
Min.	21.228	10.269	11,25	1,15
Std. Dev.	8.241	7.882	1,24	0,14
Skewness	-0,12	-0,89	-0,98	0,44
Kurtosis	2,75	2,75	4,44	2,13
Jarque-Bera	3,60	93,45[a]	171,70[a]	43,93[a]
Descriptive Statistics	**POST - CRISIS**			
	BIST 100	**BIST XGMYO**	**1 Month Deposit Rate**	**USD/TRY**
Mean	70.638	36.047	8,31	2,23
Median	72.832	36.944	8,10	1,93
Max.	115.333	47.205	13,40	3,96
Min.	23.036	11.797	3,10	1,39
Std. Dev.	17.216	6.813	2,08	0,72
Skewness	-0,19	-1,31	0,15	0,82
Kurtosis	3,49	5,01	2,07	2,40
Jarque-Bera	36,60[a]	1054,03[a]	92,07[a]	296,49[a]

Notes: For Jarque-Bera test ‘a’ indicates significance at 1% level.

The performance of BIST100 and BIST XGMYO indices were analyzed during crisis periods. Although BIST100 outperforms BIST XGMYO all through the sampling period, during crisis and post-crisis BIST XGMYO have elevated volatilities compared to BIST 100 index. In the pre-crisis period, mean of the BIST 100 index is 20.507 and BIST XGMYO index is 19.460, concludes a lower volatility.

The mean value of all variables are greater than the median value which specifies that 4 variables are positively skewed. The adverse is valid for the 'post crisis and crisis' period for variables; BIST XGMYO and BIST100 index. Also, kurtosis value which diverges from 0, stipulates that the given data aren't normally distributed. Thus, seemingly whole sample data is not normally distributed. Distribution of the variables are not normal in the given time intervals. The skewness values show that BIST 100 and BIST XGMYO, both variables are long right tails, and in contrary interest rate has a long left tail in all time intervals.

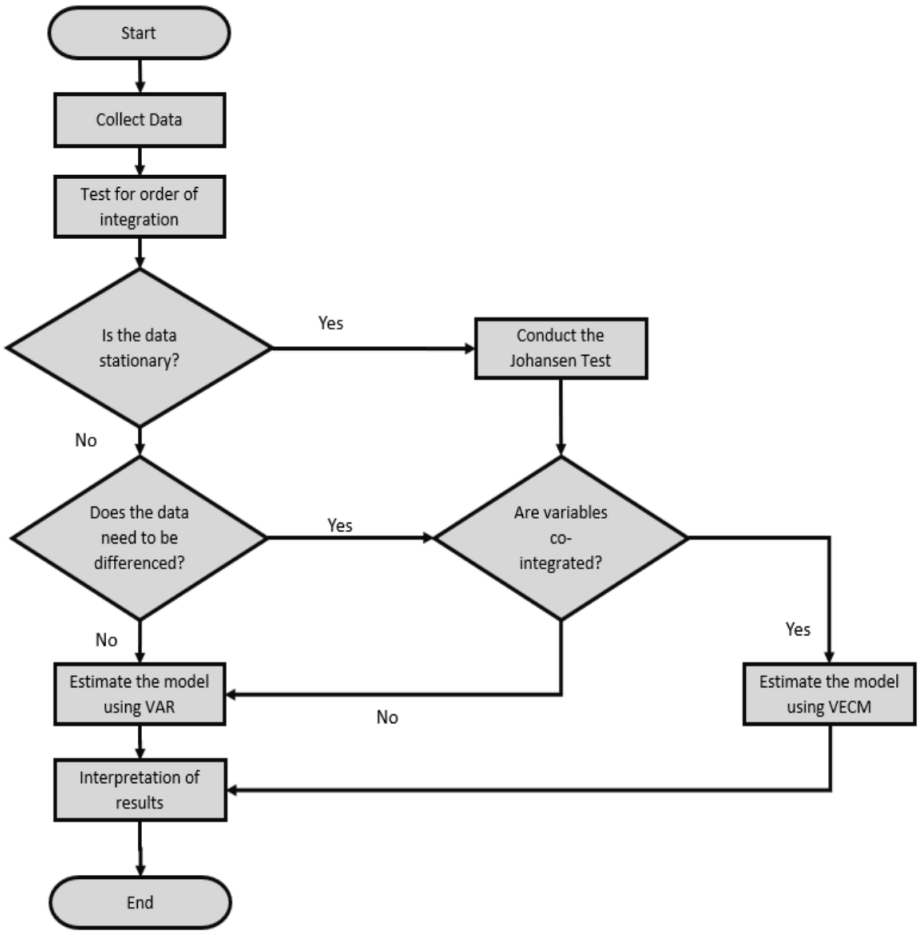
As it is shown in Table 7, the standard deviation of the BIST XGMYO index and 1-month deposit rate depreciates significantly[10] throughout the crisis period from 10 to 7.8 while other variables show minor decreases.

[10] In the periods used in the study, interest rates are very different from each other. Significantly low and high values are observed. After the banking crisis in 2001, an economic program was designed to combat inflation. With respect to all these, the monthly deposit rate of 65% in 2001 was reduced to 19% at the end of 2005.

5. METHODOLOGY

In this section, the methodology to be used for the analysis of the study is detailed. At the beginning, an overview of VAR methodology is presented and the following Figure 17 shows the course of the methodology. Then there are the test series on unmodified data to determine if the VAR model is the most effectual and appropriate econometric model to be used for the study. These tests used to establish the model listed as follows: Augmented Dickey Fuller (ADF) test to decide on stationarity, and Johansen's integration test to determine the integration among the variables. At the same time, it is necessary to determine the lag length criteria to establish the econometric model to test integration. The reason for this is that Johansen test results are very responsive according to the lag length. Johansen test gives the results on how many integration among the variables exists. If at least one or more of the variables have integration, in contrast to the VAR model, the VECM model is used. Afterwards; by taking into account the integrated variables, short and long term relationship is analyzed for the sample data.

Figure 17: Econometric Methodology



5.1.THE VAR METHODOLOGY

In his study, Brooks (2014) described the VAR model being a system regression, which is a compound of a time series and simultaneous equation with a one variable. VAR model is established by the endogenous variables, also every variable is represented by the lagged values of the remaining variables, and an error term; in order to determine the VAR model, the hypothesis that the variables are related and affect one another is studied.

An unrestricted VAR(m) is represented below;

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \cdots + \beta_k y_{t-m} + u_t \qquad \textit{(Equation 1)}$$

where,

- *m* refers to the # of lags, as a result a VAR(*m*) is called to be a VAR model of order *m*.
- y_t denotes the stock market index, vector of each endogenous variable at time t. In the study, y_t has 4 variables which represents the the stock market (BIST100), REIT index (BISTXGMYO), 1-Month Deposit Rate (OMDP) and USD/TRY exchange rate (USDTRY).
- α is an *nx1* vector of constants,
- β_i is the *nxn* coefficient matrix for each of the *m* lags,
- u_t represent white noise error term and is assumed to be independent and identically distributed random variable ~ (0,σ2).

VAR model can be used without having to mention that the variables are endogenous or exogenous and it is stated that it is more flexible and easier to use to analyse multiple time series. However, it is difficult to see the variables have a significant effect on the dependent variable when using VAR model, which concludes that may lead to some weaknesses in the analysis. As the second issue, financial series have a non-stationarity feature; VAR models stand in need of that every variable in the model to be stationarity. Therefore, the VECM model should be run instead of the VAR model. For this, the VECM should meet the stationary requirement, if there is a first difference terms

and the co-integration relationships. Things to do in order to establish a VECM model will be discussed in the following headings, respectively.

5.2.TESTS OF NON-STATIONARITY

Non-stationary data usually produces counterfeit regressions[11], so the stationarity test is vital to continue the analysis. In other words, variables should be integrated to order 0, if not log returns or differencing methods are used. The Augmented Dickey Fuller test is employed to decide if the data is non-stationarity; the null hypothesis accepts that the data has a unit root (non-stationary process), so it is concluded that the data is non-stationary. However, alterative hypothesis is the opposite. If the data doesn't have a unit root, it is concluded that the data is stationary (Brooks, 2014). According to this; if the test statistic of the Augmented Dickey Fuller test is greater than the critical value, the null hypothesis is not accepted but rejected rejected then it is concluded that the data is stationary. Otherwise, if it is smaller than critical value, the null hypothesis is not accepted but rejected, which results that the data is non-stationary.

The equation of ADF test with drift and trend is represented:

$$\Delta y_t = \beta_0 + \varphi^* y_{t-1} + \sum_{i=1}^{p-1} \varphi_1 \Delta y_{t-i} + \beta_1 t + u_t \qquad \textit{(Equation 2)}$$

where,

- y_t is the dependent variable, refers to reit index,
- t is a time index,
- u_t represent white noise error term, residual,
- p is the number of lags.

Augmented Dickey-Fuller test hypothesis is;

$H_0: \varphi \; equls \; to \; 0$ against alternative hypothesis $H_1: \varphi \; less \; than \; 0$

[11] So-called `spurious correlation`.

If H_0 is rejected data, then data has no unit root and it is called to be stationary. The null hypothesis is rejected if the critical values are larger than test statistic under selected significance level (Patel, 2012). First of all, all data transformed to natural logarithms, and ADF test was performed. Results indicate that 4 variables: stock market index (BIST 100), REIT index (BIST XGMYO), 1-month deposit rate, and USD/TRY exchange rate are still non-stationary.

The results presented in Table 8 indicate that ADF tests cannot reject the H_0 of a unit root for the data in natural logarithms. Although, results affirm stationarity when all the data are in their first difference. To sum up, it is concluded that all data are all I(1), which lead to a presumption of co-integration.

Table 8: Unit Root Test, Augmented Dickey-Fuller Test

	t-Statisctics	p-values
BIST 100	-1,102889	0,7169
ΔBIST 100	-64,09674 [a]	0,0001
BIST XGMYO	-1,418149	0,5759
ΔBIST XGMYO	-61,85614 [a]	0,0001
Deposit Rate	-2,756275	0,0648
ΔDeposit Rate	-34,98775 [a]	0,0000
USD/TRY	0,712628	0,9925
ΔUSD/TRY	-67,57052 [a]	0,0001

Notes: Δ indicates first order difference. a, b, and c indicate significance at 1%, 5% and 10% level, respectively.

Figure 18 represents the levels of the variables; stock market and reit indices, 1-month deposit rate and exchange rate, while the first differences of the logs) are presented in Figure 19.

Figure 18: All Variables in Log-Levels

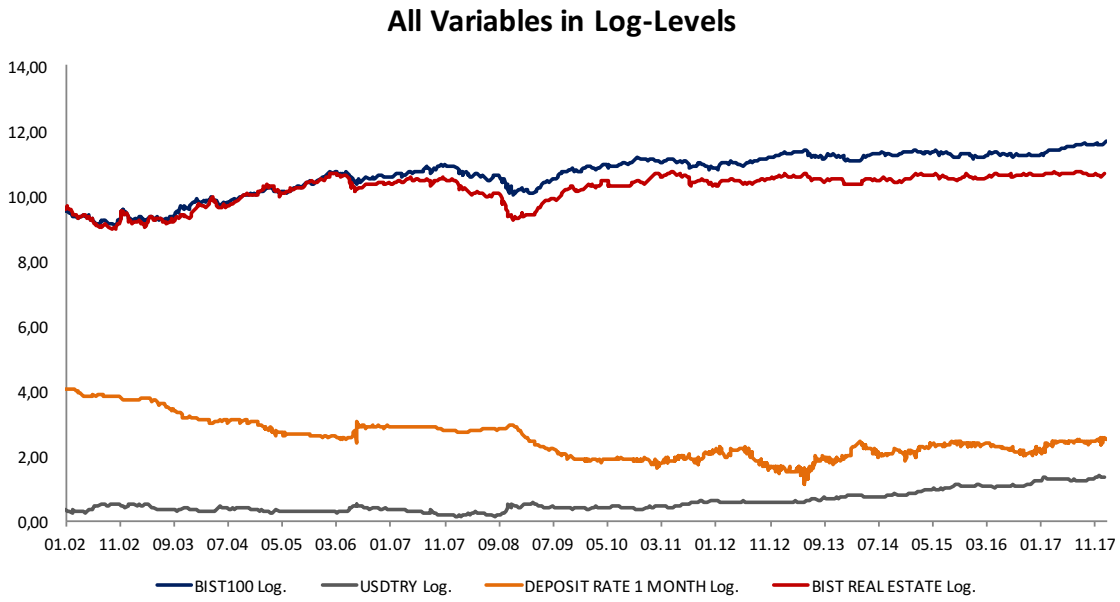
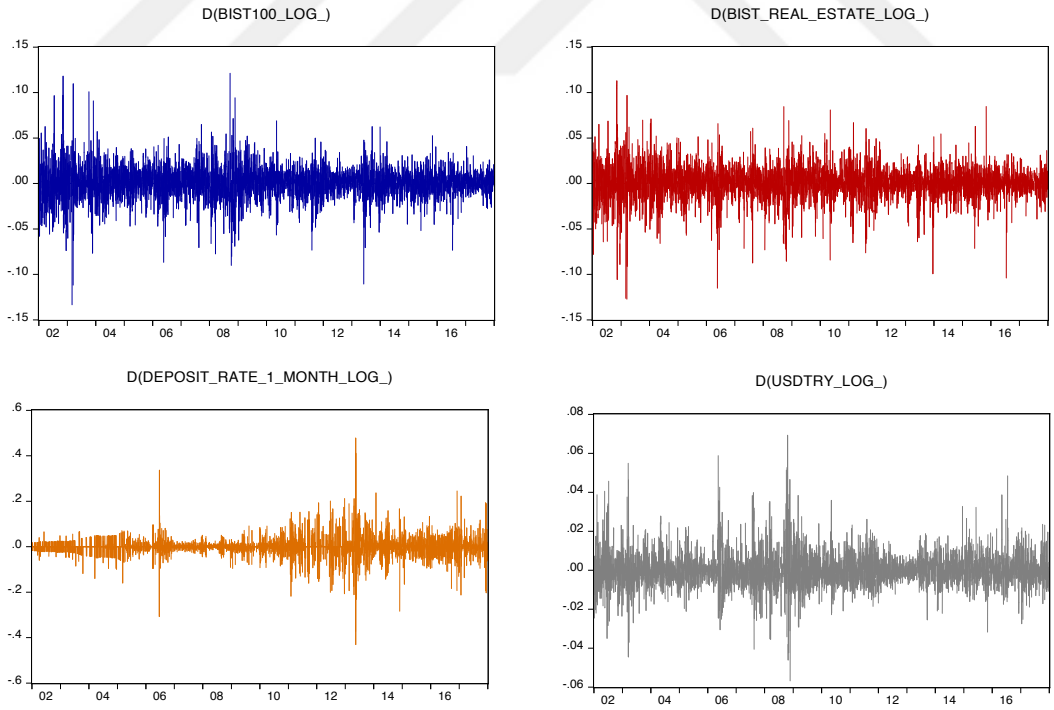


Figure 19: All Variables in First-Differences



The stationarity test, which is required to perform the co-integration test, has been completed so that all variables will be integrated of the same order (Dritsaki, 2005).

5.3.DETERMINING LAG LENGTH

As detailed in Brooks (2014), the co-integration test is performed when the variables are not stationary, but the lag length must be determined for each model before. Although there are more than one approach to determine the delay length, the more common information criteria will be discussed in this study. Information criteria take into account two results; firstly the remaining total squares and the penalty for losing degrees of freedom (Brooks, 2004). To decrease the of the information criteria, to eliminate heteroscedasticity and residual autocorrelation in the model, the number of lags are chosen so that it will reduce the Residual Sum of Squared yet enlarge the error term (Brooks, 2014).

3 different kind of information criteria are used in the literature: Akaike's information criterion (AIC), Schwarz's Bayesian information criterion (SBIC), and Hannan–Quinn criterion (HQ). This paper employs the Akaike information criterion.

A simplified multivariate form of Akaike's Information Criteria can be represented as follows;

$$AIC = T * \ln(residual\ sum\ of\ squares) + 2n\ , \qquad \textit{(Equation 3)}$$

where T equals sample size and n is the number of parameters included.

As show in Table 9, the lag order that is chosen for Akaike Information Criterion to be reduced. Number of lags are decided for the intervals. Pre-crisis period selected as 4, crisis period selected as 2 and finally post-crisis selected as 1.

Table 9: Lag Length, Akaike Information Criterion (AIC)

	LAG	PRE-CRISES	LAG	CRISES	LAG	PRE-CRISES
AIC	3	-10,92541 *	1	-11,31879 *	0	-12,25050 *

Notes: * indicates lag order selected by criterion.

5.4.TESTING FOR CO-INTEGRATION

In the study, methodology employs the vector autoregression model approach firstly, to test integration and relation in timely manner, between the variables (Johansen (1988) and Johansen and Juselius (1990)). The concept of co-integration is defined by Engle and Granger, first. When two or more data is not stationary, and the linear combination of the data is stationary, then it indicates that the series is co-integrated (Azhagaiah and Banumathy, 2015).

Different models are used depending on whether there is a co-integration between the variables, or not. When there is evidence that there is co-integration between variables, the VAR model is not used and is instead estimated using VECM.

The Johansen's test is designated via the cointegration vector (Π), to determine the long term linkage between the variables. The cointegration vector, Π, is an *n by n* matrix. The matrix is established by considering the rank, *r*, of the matrix while examining its eigenvalues (Brooks, 2004). When several kind of different variables are included in to the model, the results of the Johansen test could be explained by various co-integration relationships. Thus, it may indicate more than single integration vector measuring the long-term relationship among the variables.

Differently, to examine the rank of Π matrix, Johansen's test enables to check two different test statistics. The *trace statistic,* is one for them, represented by λ_{trace} . The other statistics is *maximal eigenvalue statistic*, represented by λ_{max}.

$$\lambda_{trace}(r) = -T \sum_{i=r+t}^{g} \ln(1-\lambda_i) \qquad \textit{(Equation 4)}$$

where r is the # of co-integrating vectors to test the null hypothesis H_0. T is the # of observations taking in to account the # lags and λ_i is the estimated eigen values from the Π matrix (Brooks, 2004). The null hypothesis of the λ_{trace} is to compute if the number of co-integrating vectors is equal to or less than r; alternatively, H_1 hypothesis measures if the # of co-integrating vectors is greater than r (Brooks, 2014).

The H_0 hypothesis of the Johansen Co-integration is;

$$H_0 = no\ cointegrating\ equations:\ r = 0$$

Vs. the alternative hypothesis; $H_1 = H_0\ is\ not\ true$: r < 0

In this study, data are integrated and order of integration is 1 and data transformed to stationary after first difference. After deciding on the integration of each variable, testing should continue for co-integration. By Johansen test, trace and maximum eigenvalue statistics are examined for each stock market index, REIT index, 1-month deposit rate and USD/TRY exchange rate data during the pre-crisis, crisis and post-crisis periods. While testing for the Johansen co-integration log transformed data is used.

Results are given below in Table 10, valid for the pre-crisis and crisis periods, the trace and maximum eigenvalue statistics show the lack of co-integration. However, post-crisis period presents of not less than one cointegration relation among the variables, implying that the model should be estimated using the VECM.

As shown below on Table 7, 56,00463 is greater than 47,85613, the 95 percent critical value of the $\lambda_{trace}(0)$ statistic. Therefore, the H_0 of no co-integrating equation is rejected, instead the H_1 that at least one co-integrating equation is accepted. While $\lambda_{max}(0)$ is accepted, $\lambda_{max}(1)$ has a max-eigen statistics value of 23,73124 which is greater than 21,13162. As a result, the H_0 of no co-integrating equations is rejected, instead the H_1 that there are at least one co-integrating equation is accepted.

Table 10: Johansen Cointegration Test

	TRACE				**MAXIMUM EIGENVALUE**			
	r = 0	**r ≤ 1**	**r ≤ 2**	**r ≤ 3**	**r = 0**	**r ≤ 1**	**r ≤ 2**	**r ≤ 3**
PRE-CRISIS	45,313315	19,62715	7,270045	0,813649	25,686	12,3571	6,456396	0,813649
	47,85613	*29,79707*	*15,49471*	*3,841466*	*27,58434*	*21,13162*	*14,2646*	*3,841466*
	(0,0850)	(0,4485)	(0,5465)	(0,3670)	(0,0858)	(0,5128)	(0,5554)	(0,3670)
CRISIS	37,4133	16,31548	6,310123	0,845441	21,09782	10,00536	5,464683	0,845441
	47,85613	*29,79707*	*15,49471*	*3,841466*	*27,58434*	*21,13162*	*14,2646*	*3,841466*
	(0,3283)	(0,6899)	(0,6589)	(0,3578)	(0,2703)	(0,7442)	(0,6824)	(0,3578)
POST-CRISIS	56,00463	28,92141	5,130169	0,252913	27,08322	23,79124	4,877255	0,252913
	47,85613	*29,79707*	*15,49471*	*3,841466*	*27,58434*	*21,13162*	*14,2646*	*3,841466*
	(0,0071) *	(0,0628)	(0,7948)	(0,6150)	(0,0579)	(0,0206) *	(0,7573)	(0,6150)

Notes: p-values are provided in parentheses, 0.05 critical value is represented in italic. Lag order is chosen such that the error terms are serially uncorrelated and the Akaike Information Criterion (AIC) is minimized.

5.5.THE VECTOR ERROR CORRECTION MODEL (VECM)

As mentioned in previous chapters, the Vector Error Correction is an extension of a Vector Auto Regression model, it is restricted VAR model. The model is preferred when two or more variables are found to be non-stationary and co-integrated, by applying some of the methodologies explained in previous chapters. A Vector Error Correction model exhibits the short and long term relation among the variables by taking into account the lagged levels of co-integrated variables and differenced equations (Brooks, 2014). To define a long term correlation through dependent variable to the remaining of the variables; the VECM must be in equilibrium which is acquired by the co-integration vector 'Π' (Brooks, 2014). The short run relationship from each individual variable on the right hand side to the dependent variable is also investigated by capturing the first differenced term. To estimate VECM model, several resulting system equations must be interpreted. Each equation has one dependent variable and the remaining variables are independent. Considering the purpose of the thesis, this study investigates one system equation where the REIT index (BIST XGMYO) is the dependent variable.

Brooks (2014) illustrates the VECM as follows:

$$\Delta Y_t = \omega_1 + \varphi_1 ECT_{t-1} + \sum_{i=1}^{m} \delta_i \Delta Y_{t-1} + \sum_{i=1}^{m} \gamma_i \Delta X_{t-1} + u_t \qquad \textit{(Equation 5)}$$

$$ECT_{t-1} = Y_{t-1} - \alpha - \beta X_{t-1} \qquad \textit{(Equation 6)}$$

ΔY_t denotes REIT index, ECT is error correction term, X_t is macroeconomic factors, in this study; stock market index, exchange rate and 1-month deposit rate, u_t represents the white noise, t is a time index and m is a number of lags (Brooks, 2014).

Additionally, to analyse the long run relation between variables, VECM also estimates error correction. When the error term is significant, and expected to be between -1 and 0, it is concluded that past macroeconomic factors have a long-run impact on the dependent variable (Kwon & Shin, 1999). If the error correction term is positive, suggests that the variables are diverging from the equilibrium instead of moving towards it. It is expected to be closer to -1 so that the errors correct themselves faster and the variables converges to the mean quicker (Bekhet, 2009). As a result, by VECM approach, values and sign of coefficients will be determined between REIT index and other variables in this study.

6. EMPRICAL RESULTS

The analysis will be conducted over 3 different periods taking into account the crisis and the VECM was made separately for each; pre-crisis, crisis and post-crisis. The study conducts VECM in order to verify if long and short run relation exists among the REIT index and variables such as; stock market index, 1-month deposit rate and USD/TRY exchange rate.

REIT index, stock market index are selected as endogenous variables, while 1-month deposit rate and USD/TRY exchange rate are selected as exogenous variables. Even though the variables are non-stationary, a discovery of the integration among the variables, indicates a long-run equilibrium, which will be analysed for the mentioned 3 periods. Results of VECM for the pre-crisis, crisis, and post-crisis are evaluated in the following headings.

Table 11: Results of VECM for the pre-crisis, crisis, and post-crisis

	BIST REIT INDEX BIST XGMYO	**BIST REIT INDEX BIST XGMYO**	**BIST REIT INDEX BIST XGMYO**
Cointegration Equation			
BIST 100	1,050698 ***	1,931078 ***	0,535085 ***
C	-0,558453	-10,28058	4,51287
Error Correction Term			
Error Correction Term	-0,027895 ***	0,005049 *	-0,011814 ***
BIST REIT (-1)	0,031810	0,106095 *	0,041050
BIST REIT (-2)	0,072328	-0,073253	-
BIST REIT (-3)	-0,137568 ***	-	-
BIST REIT (-4)	-0,069950	-	-
BIST 100 (-1)	0,011500	0,048371	-0,070613 **
BIST 100 (-2)	-0,047269	0,038460	-
BIST 100 (-3)	0,107187 **	-	-
BIST 100 (-4)	0,063398	-	-
DEPOSIT RATE	-0,007639	-0,059251 **	0,001125 *
USDTRY	-1,150929 ***	-0,723332 ***	-0,739646 ***
INTERCEPT	0,000618	-0,001223 *	0,000852 ***

Notes: The values in the table indicate the slope coefficients of the explanatory variables. *, **, *** are the %10, %5, and %1 confidence level.

6.1.VECM RESULTS: PRE-CRISIS

Since only the REIT index is of interest to us, the Vector Error Correction Estimates of REIT index as an endogenous variable. Estimated VECM model for the pre-crisis period contain 4 lags and 1 co-integrating equations, presented below.

Co-integrating equation (Long-Run Model): *(Equation 7)*

$$ect_{t-1} = 1.0000 BIST\_Real\_Estate_{t-1} - 1.050698 BIST100_{t-1} + 0.558453$$

$$BIST\_Real\_Estate_{t-1} = 1.050698 BIST\_100_{t-1} - 0.558453$$

Estimated VECM with BIST_Real_Estate as target variable: *(Equation 8)*

$$\begin{aligned}\Delta BIST\_Real\_Estate_t &= -0.027895 ect_{t-1} + 0.03181 \Delta BIST\_Real\_Estate_{t-1} \\ &+ 0.072328 \Delta BIST\_Real\_Estate_{t-2} \\ &- 0.137568 \Delta BIST\_Real\_Estate_{t-3} - 0.06995 \Delta BIST\_100_{t-4} \\ &+ 0.0115\ \Delta BIST\_100_{t-1} - 0.047269\ \Delta BIST\_100_{t-2} \\ &+ 0.107187 \Delta BIST\_100_{t-4} - 0.007639 \Delta DepositRate_{t-1} \\ &- 1.150929\ \Delta USD\_TRY_{t-1} + 0.000618\end{aligned}$$

Table 12: Results of VECM for the pre-crisis period

	PRE-CRISIS
	BIST REIT INDEX
	BIST XGMYO
Cointegration Equation	
BIST 100	-1,050698 ***
C	0,558453
Error Correction Term	
Error Correction Term	-0,027895 ***
BIST REIT (-1)	0,031810
BIST REIT (-2)	0,072328
BIST REIT (-3)	-0,137568 ***
BIST REIT (-4)	-0,069950
BIST 100 (-1)	0,011500
BIST 100 (-2)	-0,047269
BIST 100 (-3)	0,107187 **
BIST 100 (-4)	0,063398
DEPOSIT RATE	-0,007639
USDTRY	-1,150929 ***
INTERCEPT	0,000618

Notes: The values in the table indicate the slope coefficients of the explanatory variables. *, **, *** are the %10, %5, and %1 confidence level.

Equation 7 represents long-run dynamics, whereas equation 8 represents short-run dynamics among the variables. Co-integration equation coefficient is negative and significant, thus it is concluded that a long term causality relation exists, extending from BIST REIT index toward BIST 100 index, concluding that model comes to equilibrium in the long-run. Co-integration equation implies that; in pre-crisis period, a 1% increase in BIST 100 index leads to a 1,05% increase in BIST REIT index in the long-run.

The error correction coefficient is around -0.027895 and it is statistically significant at 10% significance level. The error correction coefficient shows, how long it converges to the long term, and enables to interpret of "the short run dynamic in a long run equilibrium accounting for the speed of adjustment" (Brooks, 2014). As it is shown above in Table 12, the speed of adjustment is calculated as 2,79% per day and in order to reach a long-run relationship approximately 35,8 days are required. As a result, the long run effect of one variable on the other happens to be in 35.8 days which corresponds to 1.7 months due to the data, taken as working days.

The coefficients of the error correction term of BIST REIT index, BIST 100 and USD/TRY are all significant in 1%, 5% and 1% confidence levels respectively, but the coefficient of 1-Month Deposit rate is insignificant. The changes of the lagged independent variable report the short term causal effect. According to the Table 12, taking only significant variables in to the account;

- BIST REIT index (-3) is statistically significant at 1% confidence level. A 1% increase in the REIT index 3 days ago, the effect on its own will be 13,76%.

- BIST 100 index (-3) is statistically significant at 5% confidence level. A 1% increase in the BIST 100 index 3 days ago, the effect on REIT index will be 10,72%.

- USD/TRY exchange rate (0) is statistically significant at 1% confidence level. A 1% increase in the USD/TRY exchange rate, the effect on REIT index will be 150%.

6.2.VECM RESULTS: CRISIS

Estimated VECM model for the crisis period contain 2 lags and 1 co-integrating equations, presented below.

Co-integrating equation (Long-Run Model): *(Equation 9)*

$$ect_{t-1} = 1.0000BIST\_Real\_Estate_{t-1} - 1.931078BIST100_{t-1} + 10.28058$$

$$BIST\_Real\_Estate_{t-1} = 1.931078BIST\_100_{t-1} - 10.28058$$

Estimated VECM with BIST_Real_Estate as target variable: *(Equation10)*

$$\begin{aligned}\Delta BIST\_Real\_Estate_t &= +0.005049ect_{t-1} + 0.106095\Delta BIST\_Real\_Estate_{t-1} \\ &- 0.073253\Delta BIST\_Real\_Estate_{t-2} + 0.048371\ \Delta BIST\_100_{t-1} \\ &+ 0.03846\ \Delta BIST\_100_{t-2} - 0.059251\Delta DepositRate_{t-1} \\ &- 0.723332\ \Delta USDTRY_{t-1} - 0{,}001223\end{aligned}$$

Table 13: Results of VECM for the crisis period

	CRISIS
	BIST REIT INDEX
	BIST XGMYO
Cointegration Equation	
BIST 100	-1,931078 ***
C	10,28058
Error Correction Term	
Error Correction Term	0,005049 *
BIST REIT (-1)	0,106095 *
BIST REIT (-2)	-0,073253
BIST 100 (-1)	0,048371
BIST 100 (-2)	0,038460
DEPOSIT RATE	-0,059251 **
USDTRY	-0,723332 ***
INTERCEPT	-0,001223 *

Notes: The values in the table indicate the slope coefficients of the explanatory variables. *, **, *** are the %10, %5, and %1 confidence level.

Equation 9 represents long-run dynamics, whereas equation 10 represents short-run dynamics among the variables. Co-integration equation coefficient is negative and significant thus it is concluded that a long term causality relation exists, extending from BIST REIT index toward BIST 100 index, concluding that model comes to equilibrium in the long-run. Co-integration equation implies that; in crisis period, a 1% increase in BIST 100 index leads to a 1,93% increase in BIST REIT index in the long-run.

The error correction coefficient is around 0,005049 and it is statistically insignificant and has positive sign, which implies that the process is not converging in the long run, causing instabilities. The error correction coefficient shows, how long it converges to the long term, and enables to interpret of "the short run dynamic in a long run equilibrium accounting for the speed of adjustment" (Brooks, 2014). As it is shown above in Table 13, the speed of adjustment is calculated as -0,5% per day, so rather than converging it is concluded to be diverging.

The coefficients of the error correction term of BIST REIT index, 1-Month Deposit Rate and USD/TRY are all significant in 10%, 5% and 1% confidence levels respectively, but the coefficient of BIST 100 index is insignificant. The changes of the lagged independent variable describe the short run causal impact. According to the Table 13, taking only significant variables in to the account;

- BIST REIT index (-1) is statistically significant at 10% confidence level. A 1% increase in the REIT index 1 day ago, the effect on its own will be 10,61%.

- 1-Month Deposit Rate (0) is statistically significant at 5% confidence level. A 1% increase in the 1-Month Deposit Rate, the effect on REIT index will be 5,92%.

- USD/TRY exchange rate (0) is statistically significant at 1% confidence level. A 1% increase in the USD/TRY exchange rate, the effect on REIT index will be 72,33%.

6.3.VECM RESULTS: POST CRISIS

Estimated VECM model for the post-crisis period contain 1 lag and 1 co-integrating equations, presented below.

Co-integrating equation (Long-Run Model): *(Equation11)*

$$ect_{t-1} = 1.0000BIST\_Real\_Estate_{t-1} - 0.5351BIST\_100_{t-1} - 4.5129$$

$$BIST\_Real\_Estate_{t-1} = 0.5351BIST\_100_{t-1} + 4.5129$$

Estimated VECM with BIST_Real_Estate as target variable: *(Equation12)*

$$\begin{aligned}\Delta BIST\_Real\_Estate_t &= -0.011814ect_{t-1} + 0.041050\Delta BIST\_Real\_Estate_{t-1} \\ &- 0.070613\ \Delta BIST\_100_{t-1} + 0.001125\Delta DepositRate_{t-1} \\ &- 0.739646\ \Delta USDTRY_{t-1} + 0.000852\end{aligned}$$

Table 14: Results of VECM for the post-crisis period

	POST-CRISIS
	BIST REIT INDEX BIST XGMYO
Cointegration Equation	
BIST 100	-0,535085 ***
C	-4,51287
Error Correction Term	
Error Correction Term	-0,011814 ***
BIST REIT (-1)	0,041050
BIST 100 (-1)	-0,070613 **
DEPOSIT RATE	0,001125 *
USDTRY	-0,739646 ***
INTERCEPT	0,000852 ***

Notes: The values in the table indicate the slope coefficients of the explanatory variables. *, **, *** are the %10, %5, and %1 confidence level.

Equation 11 represents long-run dynamics, whereas equation 12 represents short-run dynamics among the variables. Co-integration equation coefficient is negative and significant, thus it is concluded a long term causality relation exists, extending from BIST REIT index toward BIST 100 index, concluding that model comes to equilibrium in the long-run. Co-integration equation implies that; in post-crisis period, a 1% increase in BIST 100 index leads to a 0,53% increase in BIST REIT index in the long-run.

The error correction coefficient is around -0,011814 and it is statistically significant at 1% significance level. The error correction coefficient shows, how long it converges to the long term, and enables to interpret of "the short run dynamic in a long run equilibrium accounting for the speed of adjustment" (Brooks, 2014). As it is shown above in Table 14, the speed of adjustment is calculated as 1,18% per day and in order to reach a long-run relationship approximately 84.7 days are required. As a result, the long run impact of one variable on the other happens to be in 84.7 days which corresponds to 4.2 months due to the data, taken as working days.

The coefficients of the error correction term of BIST 100, 1-Month Deposit Rate and USD/TRY are all significant in 5%, 10% and 1% confidence levels respectively. The changes of the lagged independent variable describe the short run causal impact. According to the Table 14, taking only significant variables in to the account;

- BIST 100 index (-1) is statistically significant at 5% confidence level. A 1% increase in the BIST 100 index 1 days ago, the effect on its own will be 7,06%.

- 1-Month Deposit Rate is statistically significant at 10% confidence level. A 1% increase in the 1-Month Deposit Rate, the effect on REIT index will be 0,11%.

- USD/TRY exchange rate is statistically significant at 1% confidence level. A 1% increase in the USD/TRY exchange rate, the effect on REIT index will be 73,96%.

7. CONCLUSION

This thesis explores the relation among real estate prices and stock prices, by employing data from the Turkish economy covering years from 2002 to 2017. In addition, global financial crisis in 2007 is used as a natural experiment and examined the effect on 4 variables, which are real estate investment trust index, stock exchange index, 1-Month Deposit Rate and USD/TRY Exchange Rate. Thus, results have been examined in 3 different periods; pre-crisis, crisis and post-crisis.

1-Month Deposit Rate and USD/TRY exchange rate were added to the model due to the possibility that investors might influence their ability to finance their investments in real estate and equity markets.

A VECM approach has utilized throughout the paper. In order to apply a VECM; Augmented Dickey-Fuller test, Johansen co-integration test are applied. Main finding from Johansen co-integration test is that even though sample period gives a co-integration among the variables for the sample, when the sample period divided in 3-periods, variables found out to be co-integrated in only post-crisis period.

Empirical results show that in the long-run, there is a long-run dynamic relationship between BIST REIT index and BIST 100 stock index and long term causality relation extending from BIST REIT index toward BIST 100 index. Results

- In pre-crisis period (01/20002-05/2006), a 1% increase in BIST 100 index leads to a 1,05% increase in BIST REIT index in the long-run.
- In crisis period (01/2006-01/2009), a 1% increase in BIST 100 index leads to a 1,93% increase in BIST REIT index in the long-run.
- In post-crisis period (02/2009-12/2017), a 1% increase in BIST 100 index leads to a 0,53% increase in BIST REIT index in the long-run.

As a result, the nature of the long term relation among REIT index and Stock Index has evolved after the outbreak of global financial crisis. After the change in economic conditions resulted from the global crisis, long-run dynamics of BIST 100 and BIST REIT index has changed drastically.

In the short-run dynamics; it is examined that, in crisis period, the error correction coefficient is statistically insignificant and has positive sign, which implies that the process is not converging in the long run, causing instabilities. The period of crisis is selected from June 2006 to January 2009, in which the variables used in the study showed high volatility. With the emergence of the crisis, the economic conjuncture has changed and is one possible explanation for error correction coefficient to be positive. In the period examined, two successive major shocks with a deep negative impact on both REIT and stock markets occurred. The first shock was associated with the U.S. subprime crisis, occurring between 2007 and 2010. The second shock was due to the European debt and insolvency problems.

Whereas pre-crisis and post-crisis periods are statistically significant and enables the interpretation of "the short run dynamic in a long run equilibrium accounting for the speed of adjustment" (Brooks, 2014). In addition, in post-crisis period to reach a long-run relationship among BIST stock market index and BIST REIT index approximately 4.2 months and in pre-crisis period approximately 35,8 days are required

The main findings of this paper are: (1) a long term relation among stock market index and REIT index. (2) In crisis period, the error correction coefficient is statistically insignificant, implying that the process is not converging in the long run, causing instabilities. (3) Speed of adjustment in the pre-crisis period, has the fastest short run dynamic in a long term equilibrium.

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9. APPENDIX

Appendix 1: Augmented Dickey-Fuller Tests, E-Views

Augmented Dickey-Fuller Unit Root Test on BIST100_LOG_

Null Hypothesis: BIST100_LOG_ has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.102889	0.7169
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(BIST100_LOG_)
Method: Least Squares
Date: 11/18/18 Time: 20:42
Sample (adjusted): 1/02/2002 12/31/2017
Included observations: 4175 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BIST100_LOG_(-1)	-0.000460	0.000417	-1.102889	0.2701
C	0.005417	0.004458	1.214895	0.2245

R-squared	0.000291	Mean dependent var	0.000509
Adjusted R-squared	0.000052	S.D. dependent var	0.017874
S.E. of regression	0.017874	Akaike info criterion	-5.210457
Sum squared resid	1.333194	Schwarz criterion	-5.207421
Log likelihood	10878.83	Hannan-Quinn criter.	-5.209383
F-statistic	1.216365	Durbin-Watson stat	1.983661
Prob(F-statistic)	0.270139		

Augmented Dickey-Fuller Unit Root Test on D(BIST100_LOG_)

Null Hypothesis: D(BIST100_LOG_) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-64.09674	0.0001
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(BIST100_LOG_,2)
Method: Least Squares
Date: 11/18/18 Time: 20:43
Sample (adjusted): 1/03/2002 12/31/2017
Included observations: 4174 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BIST100_LOG_(-1))	-0.992158	0.015479	-64.09674	0.0000
C	0.000500	0.000277	1.806018	0.0710

R-squared	0.496159	Mean dependent var	-5.08E-06
Adjusted R-squared	0.496038	S.D. dependent var	0.025180
S.E. of regression	0.017875	Akaike info criterion	-5.210308
Sum squared resid	1.333073	Schwarz criterion	-5.207272
Log likelihood	10875.91	Hannan-Quinn criter.	-5.209234
F-statistic	4108.393	Durbin-Watson stat	2.000459
Prob(F-statistic)	0.000000		

Augmented Dickey-Fuller Unit Root Test on BIST_REAL_ESTATE_LOG_

Null Hypothesis: BIST_REAL_ESTATE_LOG_ has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.418149	0.5749
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(BIST_REAL_ESTATE_LOG_)
Method: Least Squares
Date: 11/18/18 Time: 20:44
Sample (adjusted): 1/02/2002 12/31/2017
Included observations: 4175 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BIST_REAL_ESTATE_LOG_(-1)	-0.000868	0.000612	-1.418149	0.1562
C	0.009135	0.006262	1.458835	0.1447

R-squared	0.000482	Mean dependent var	0.000264
Adjusted R-squared	0.000242	S.D. dependent var	0.018516
S.E. of regression	0.018514	Akaike info criterion	-5.140115
Sum squared resid	1.430350	Schwarz criterion	-5.137080
Log likelihood	10731.99	Hannan-Quinn criter.	-5.139041
F-statistic	2.011147	Durbin-Watson stat	1.912638
Prob(F-statistic)	0.156222		

Augmented Dickey-Fuller Unit Root Test on D(BIST_REAL_ESTATE_LOG_)

Null Hypothesis: D(BIST_REAL_ESTATE_LOG_) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-61.85614	0.0001
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(BIST_REAL_ESTATE_LOG_,2)
Method: Least Squares
Date: 11/18/18 Time: 20:45
Sample (adjusted): 1/03/2002 12/31/2017
Included observations: 4174 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(BIST_REAL_ESTATE_LOG_(-1))	-0.956748	0.015467	-61.85614	0.0000
C	0.000250	0.000286	0.873656	0.3824

R-squared	0.478381	Mean dependent var	-5.26E-07
Adjusted R-squared	0.478256	S.D. dependent var	0.025615
S.E. of regression	0.018502	Akaike info criterion	-5.141343
Sum squared resid	1.428252	Schwarz criterion	-5.138307
Log likelihood	10731.98	Hannan-Quinn criter.	-5.140269
F-statistic	3826.181	Durbin-Watson stat	2.002568
Prob(F-statistic)	0.000000		

Augmented Dickey-Fuller Unit Root Test on DEPOSIT_RATE_1_MONTH_LOG_

Null Hypothesis: DEPOSIT_RATE_1_MONTH_LOG_ has a unit root
Exogenous: Constant
Lag Length: 6 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.756275	0.0648
Test critical values:	1% level	-3.431734	
	5% level	-2.862037	
	10% level	-2.567078	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DEPOSIT_RATE_1_MONTH_LOG_)
Method: Least Squares
Date: 11/18/18 Time: 20:46
Sample (adjusted): 1/10/2002 12/31/2017
Included observations: 4169 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DEPOSIT_RATE_1_MONTH_LOG_(-1)	-0.002561	0.000929	-2.756275	0.0059
D(DEPOSIT_RATE_1_MONTH_LOG_(-1))	-0.507075	0.015475	-32.76805	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-2))	-0.258493	0.017302	-14.94018	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-3))	-0.192795	0.017610	-10.94793	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-4))	-0.149531	0.017618	-8.487348	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-5))	-0.090003	0.017314	-5.198374	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-6))	-0.046417	0.015480	-2.998565	0.0027
C	0.005622	0.002410	2.332760	0.0197

R-squared	0.209783	Mean dependent var	-0.000375
Adjusted R-squared	0.208454	S.D. dependent var	0.040592
S.E. of regression	0.036114	Akaike info criterion	-3.802340
Sum squared resid	5.426946	Schwarz criterion	-3.790183
Log likelihood	7933.978	Hannan-Quinn criter.	-3.798040
F-statistic	157.8064	Durbin-Watson stat	2.001447
Prob(F-statistic)	0.000000		

Augmented Dickey-Fuller Unit Root Test on D(DEPOSIT_RATE_1_MONTH_LOG_)

Null Hypothesis: D(DEPOSIT_RATE_1_MONTH_LOG_) has a unit root
Exogenous: Constant
Lag Length: 5 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-34.98775	0.0000
Test critical values:	1% level	-3.431734	
	5% level	-2.862037	
	10% level	-2.567078	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(DEPOSIT_RATE_1_MONTH_LOG_,2)
Method: Least Squares
Date: 11/18/18 Time: 20:47
Sample (adjusted): 1/10/2002 12/31/2017
Included observations: 4169 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(DEPOSIT_RATE_1_MONTH_LOG_(-1))	-2.242423	0.064092	-34.98775	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-1),2)	0.734582	0.057612	12.75043	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-2),2)	0.476197	0.048800	9.758135	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-3),2)	0.283874	0.038906	7.296379	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-4),2)	0.135040	0.027975	4.827246	0.0000
D(DEPOSIT_RATE_1_MONTH_LOG_(-5),2)	0.045821	0.015490	2.957982	0.0031
C	-0.000839	0.000560	-1.497463	0.1343

R-squared	0.717455	Mean dependent var	3.20E-19
Adjusted R-squared	0.717048	S.D. dependent var	0.067946
S.E. of regression	0.036143	Akaike info criterion	-3.800996
Sum squared resid	5.436854	Schwarz criterion	-3.790358
Log likelihood	7930.175	Hannan-Quinn criter.	-3.797233
F-statistic	1761.402	Durbin-Watson stat	2.001367
Prob(F-statistic)	0.000000		

Augmented Dickey-Fuller Unit Root Test on USDTRY_LOG_

Null Hypothesis: USDTRY_LOG_ has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		0.712628	0.9925
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(USDTRY_LOG_)
Method: Least Squares
Date: 11/18/18 Time: 20:50
Sample (adjusted): 1/03/2002 12/31/2017
Included observations: 4174 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
USDTRY_LOG_(-1)	0.000312	0.000438	0.712628	0.4761
D(USDTRY_LOG_(-1))	-0.045464	0.015478	-2.937365	0.0033
C	6.37E-05	0.000284	0.223996	0.8228

R-squared	0.002151	Mean dependent var	0.000231
Adjusted R-squared	0.001673	S.D. dependent var	0.008834
S.E. of regression	0.008827	Akaike info criterion	-6.621359
Sum squared resid	0.324963	Schwarz criterion	-6.616805
Log likelihood	13821.78	Hannan-Quinn criter.	-6.619748
F-statistic	4.495677	Durbin-Watson stat	1.995317
Prob(F-statistic)	0.011211		

Augmented Dickey-Fuller Unit Root Test on D(USDTRY_LOG_)

Null Hypothesis: D(USDTRY_LOG_) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=30)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-67.57052	0.0001
Test critical values:	1% level	-3.431732	
	5% level	-2.862036	
	10% level	-2.567077	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(USDTRY_LOG_,2)
Method: Least Squares
Date: 11/18/18 Time: 20:50
Sample (adjusted): 1/03/2002 12/31/2017
Included observations: 4174 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(USDTRY_LOG_(-1))	-1.045050	0.015466	-67.57052	0.0000
C	0.000241	0.000137	1.766368	0.0774

R-squared	0.522533	Mean dependent var	-8.30E-07
Adjusted R-squared	0.522418	S.D. dependent var	0.012772
S.E. of regression	0.008826	Akaike info criterion	-6.621716
Sum squared resid	0.325003	Schwarz criterion	-6.618680
Log likelihood	13821.52	Hannan-Quinn criter.	-6.620643
F-statistic	4565.775	Durbin-Watson stat	1.995301
Prob(F-statistic)	0.000000		

Appendix 2: Lag Length, Akaike Information Criterion (AIC), E-Views

Pre-Crisis Period

VAR Lag Order Selection Criteria
Endogenous variables: D(BIST100_LOG_) D(BIST_REAL_ESTATE_LOG_)
Exogenous variables: C D(DEPOSIT_RATE_1_MONTH_LOG_) D(USDTRY_LOG_)
Date: 11/18/18 Time: 21:14
Sample: 1/01/2002 5/31/2006
Included observations: 1143

Lag	LogL	LR	FPE	AIC	SC	HQ
0	6248.205	NA	6.19e-08	-10.92249	-10.89603*	-10.91250*
1	6251.922	7.401193	6.19e-08	-10.92200	-10.87789	-10.90534
2	6256.299	8.698897	6.19e-08	-10.92266	-10.86091	-10.89934
3	6261.871	11.05713*	6.17e-08*	-10.92541*	-10.84602	-10.89543
4	6264.681	5.565251	6.18e-08	-10.92333	-10.82629	-10.88669
5	6265.985	2.579354	6.21e-08	-10.91861	-10.80393	-10.87531
6	6268.227	4.424511	6.23e-08	-10.91553	-10.78321	-10.86557
7	6270.819	5.106271	6.25e-08	-10.91307	-10.76311	-10.85644
8	6272.960	4.211071	6.27e-08	-10.90982	-10.74221	-10.84653

* indicates lag order selected by the criterion

Crisis

VAR Lag Order Selection Criteria
Endogenous variables: D(BIST100_LOG_) D(BIST_REAL_ESTATE_LOG_)
Exogenous variables: C D(DEPOSIT_RATE_1_MONTH_LOG_) D(USDTRY_LOG_)
Date: 11/18/18 Time: 21:13
Sample: 6/01/2006 1/30/2009
Included observations: 697

Lag	LogL	LR	FPE	AIC	SC	HQ
0	3943.987	NA	4.24e-08	-11.29982	-11.26068*	-11.28469
1	3954.599	21.07081*	4.16e-08*	-11.31879*	-11.25356	-11.29357*
2	3955.526	1.835820	4.20e-08	-11.30997	-11.21865	-11.27466
3	3957.163	3.231863	4.23e-08	-11.30319	-11.18577	-11.25779
4	3959.297	4.200013	4.25e-08	-11.29784	-11.15432	-11.24235
5	3963.613	8.471658	4.25e-08	-11.29875	-11.12914	-11.23317
6	3965.895	4.465550	4.27e-08	-11.29382	-11.09811	-11.21815
7	3969.991	7.993414	4.27e-08	-11.29409	-11.07230	-11.20834
8	3970.543	1.072948	4.31e-08	-11.28420	-11.03631	-11.18836

* indicates lag order selected by the criterion

Post-Crisis

VAR Lag Order Selection Criteria
Endogenous variables: D(BIST100_LOG_) D(BIST_REAL_ESTATE_LOG_)
Exogenous variables: C D(DEPOSIT_RATE_1_MONTH_LOG_) D(USDTRY_LOG_)
Date: 11/18/18 Time: 21:12
Sample: 2/02/2009 12/31/2017
Included observations: 2327

Lag	LogL	LR	FPE	AIC	SC	HQ
0	14259.46	NA	1.64e-08*	-12.25050*	-12.23567*	-12.24510*
1	14261.55	4.170020	1.64e-08	-12.24886	-12.22414	-12.23985
2	14265.06	7.014799	1.64e-08	-12.24844	-12.21384	-12.23583
3	14270.12	10.07205*	1.64e-08	-12.24935	-12.20485	-12.23314
4	14272.90	5.545041	1.64e-08	-12.24831	-12.19392	-12.22849
5	14275.21	4.577103	1.65e-08	-12.24685	-12.18258	-12.22343
6	14277.49	4.541283	1.65e-08	-12.24537	-12.17121	-12.21835
7	14280.80	6.566245	1.65e-08	-12.24478	-12.16073	-12.21415
8	14281.88	2.137595	1.65e-08	-12.24227	-12.14833	-12.20804

* indicates lag order selected by the criterion

Appendix 3: Johansen Cointegration Test, E-Views

Pre-Crisis

Johansen Cointegration Test

Date: 12/19/18 Time: 16:49
Sample (adjusted): 1/08/2002 5/31/2006
Included observations: 1147 after adjustments
Trend assumption: Linear deterministic trend
Series: BIST100_LOG_ BIST_REAL_ESTATE_LOG_ DEPOSIT_RATE_1_MONT...
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.022145	45.31315	47.85613	0.0850
At most 1	0.010716	19.62715	29.79707	0.4485
At most 2	0.005613	7.270045	15.49471	0.5465
At most 3	0.000709	0.813649	3.841466	0.3670

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.022145	25.68600	27.58434	0.0858
At most 1	0.010716	12.35710	21.13162	0.5128
At most 2	0.005613	6.456396	14.26460	0.5554
At most 3	0.000709	0.813649	3.841466	0.3670

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Crisis

Johansen Cointegration Test

Date: 12/19/18 Time: 16:52
Sample (adjusted): 6/08/2006 1/30/2009
Included observations: 692 after adjustments
Trend assumption: Linear deterministic trend
Series: BIST100_LOG_ BIST_REAL_ESTATE_LOG_ DEPOSIT_RATE_1_MONT...
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.030028	37.41330	47.85613	0.3283
At most 1	0.014355	16.31548	29.79707	0.6899
At most 2	0.007866	6.310123	15.49471	0.6589
At most 3	0.001221	0.845441	3.841466	0.3578

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.030028	21.09782	27.58434	0.2703
At most 1	0.014355	10.00536	21.13162	0.7442
At most 2	0.007866	5.464683	14.26460	0.6824
At most 3	0.001221	0.845441	3.841466	0.3578

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Post-Crisis

Johansen Cointegration Test

Date: 12/19/18 Time: 16:52
Sample (adjusted): 6/08/2006 1/30/2009
Included observations: 692 after adjustments
Trend assumption: Linear deterministic trend
Series: BIST100_LOG_ BIST_REAL_ESTATE_LOG_ DEPOSIT_RATE_1_MONT...
Lags interval (in first differences): 1 to 4

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.030028	37.41330	47.85613	0.3283
At most 1	0.014355	16.31548	29.79707	0.6899
At most 2	0.007866	6.310123	15.49471	0.6589
At most 3	0.001221	0.845441	3.841466	0.3578

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.030028	21.09782	27.58434	0.2703
At most 1	0.014355	10.00536	21.13162	0.7442
At most 2	0.007866	5.464683	14.26460	0.6824
At most 3	0.001221	0.845441	3.841466	0.3578

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Appendix 4: VECM Results, E-Views

Pre-Crisis

Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 11/19/18 Time: 23:07
Sample (adjusted): 1/08/2002 5/31/2006
Included observations: 1147 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
BIST_REAL_ESTATE_L...	1.000000
BIST100_LOG_(-1)	-1.050698 (0.04409) [-23.8293]
C	0.558453

Error Correction:	D(BIST_REA...	D(BIST100_...
CointEq1	-0.027895 (0.00731) [-3.81377]	-0.017641 (0.00670) [-2.63401]
D(BIST_REAL_ESTATE...	0.031810 (0.04534) [0.70153]	0.058230 (0.04152) [1.40248]
D(BIST_REAL_ESTATE...	0.072328 (0.04540) [1.59320]	0.039099 (0.04157) [0.94060]
D(BIST_REAL_ESTATE...	-0.137568 (0.04569) [-3.01119]	-0.099191 (0.04183) [-2.37116]
D(BIST_REAL_ESTATE...	-0.069950 (0.04564) [-1.53250]	-0.044980 (0.04179) [-1.07622]
D(BIST100_LOG_(-1))	0.011500 (0.04853) [0.23696]	-0.052862 (0.04444) [-1.18954]
D(BIST100_LOG_(-2))	-0.047269 (0.04865) [-0.97167]	-0.059966 (0.04454) [-1.34623]
D(BIST100_LOG_(-3))	0.107187 (0.04878) [2.19713]	0.068272 (0.04467) [1.52837]
D(BIST100_LOG_(-4))	0.063398 (0.04871) [1.30160]	0.012192 (0.04460) [0.27336]
C	0.000618 (0.00060) [1.02446]	0.000961 (0.00055) [1.73941]
D(DEPOSIT_RATE_1_M...	-0.007639 (0.02610) [-0.29269]	-0.025173 (0.02390) [-1.05329]
D(USDTRY_LOG_)	-1.150929 (0.06596) [-17.4489]	-1.178605 (0.06040) [-19.5146]

Crisis and Post-Crisis

Vector Error Correcti

Vector Error Correction Estimates
Date: 11/19/18 Time: 23:05
Sample: 6/01/2006 1/30/2009
Included observations: 697
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
BIST_REAL_ESTATE_L...	1.000000
BIST100_LOG_(-1)	-1.931078 (0.53983) [-3.57719]
C	10.28058

Error Correction:	D(BIST_REA...	D(BIST100_...
CointEq1	0.005049 (0.00303) [1.66454]	0.005765 (0.00335) [1.72297]
D(BIST_REAL_ESTATE...	0.106095 (0.05680) [1.86789]	0.127393 (0.06266) [2.03316]
D(BIST_REAL_ESTATE...	-0.073253 (0.05641) [-1.29855]	-0.071150 (0.06223) [-1.14335]
D(BIST100_LOG_(-1))	0.048371 (0.04976) [0.97209]	0.005488 (0.05489) [0.09998]
D(BIST100_LOG_(-2))	0.038460 (0.04967) [0.77432]	0.046152 (0.05479) [0.84231]
C	-0.001223 (0.00063) [-1.93308]	-0.000396 (0.00070) [-0.56723]
D(DEPOSIT_RATE_1_M...	-0.059251 (0.02447) [-2.42111]	-0.061071 (0.02700) [-2.26216]
D(USDTRY_LOG_)	-0.723332 (0.05221) [-13.8535]	-0.922422 (0.05760) [-16.0148]
R-squared	0.245543	0.291166
Adj. R-squared	0.237878	0.283964
Sum sq. resids	0.189084	0.230100
S.E. equation	0.016566	0.018275
F-statistic	32.03426	40.43124
Log likelihood	1873.004	1804.585
Akaike AIC	-5.351518	-5.155192
Schwarz SC	-5.299331	-5.103005
Mean dependent	-0.001355	-0.000553
S.D. dependent	0.018976	0.021596

Determinant resid covariance (dof adj.)	4.11E-08
Determinant resid covariance	4.01E-08
Log likelihood	3957.190
Akaike information criterion	-11.30327
Schwarz criterion	-11.18585
Number of coefficients	18

Vector Error Correc

Vector Error Correction Estimates
Date: 11/19/18 Time: 23:09
Sample: 2/02/2009 12/31/2017
Included observations: 2327
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
BIST_REAL_ESTATE_L...	1.000000
BIST100_LOG_(-1)	-0.535085 (0.09077) [-5.89527]
C	-4.512870

Error Correction:	D(BIST_REA...	D(BIST100_...
CointEq1	-0.011814 (0.00254) [-4.65515]	-0.007057 (0.00226) [-3.11831]
D(BIST_REAL_ESTATE...	0.041050 (0.03053) [1.34443]	0.023638 (0.02723) [0.86810]
D(BIST100_LOG_(-1))	-0.070613 (0.03345) [-2.11128]	-0.049401 (0.02983) [-1.65625]
C	0.000852 (0.00030) [2.82112]	0.000943 (0.00027) [3.50192]
D(DEPOSIT_RATE_1_M...	0.001125 (0.00605) [0.18606]	-0.008980 (0.00539) [-1.66550]
D(USDTRY_LOG_)	-0.739646 (0.04083) [-18.1159]	-0.789194 (0.03641) [-21.6744]
R-squared	0.135144	0.175946
Adj. R-squared	0.133280	0.174171
Sum sq. resids	0.490060	0.389758
S.E. equation	0.014531	0.012959
F-statistic	72.53648	99.11264
Log likelihood	6547.813	6814.255
Akaike AIC	-5.622529	-5.851530
Schwarz SC	-5.607697	-5.836698
Mean dependent	0.000564	0.000641
S.D. dependent	0.015608	0.014260

Determinant resid covariance (dof adj.)	1.62E-08
Determinant resid covariance	1.61E-08
Log likelihood	14272.46
Akaike information criterion	-12.25480
Schwarz criterion	-12.22020
Number of coefficients	14