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What Determines REIT Returns in Turkey? An Application of Time-Varying Arbitrage Pricing Model in an Emerging REIT Market*

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Abstract
This paper investigates the macroeconomic sources of time-varying risk premia in Turkish REIT industry within the arbitrage pricing theory framework. Turkish REIT industry differs substantially from the global REIT market as Turkish REITs do not have to pay out dividends, yet enjoy the exemption from paying corporate taxes, and have highly concentrated ownership structure. These fundamental differences have significant impacts on the performance of REITs compared to other stocks listed on Borsa Istanbul (BIST), especially in terms of the inflation-hedging characteristics and time-varying systematic risk behaviour. This article evaluates the Turkish REIT industry by using a time-varying multifactor model, which compares the REIT industry excess returns with various macroeconomic factors, including GDP growth, industrial production growth, inflation risk premium, and stock market risk premium. Our results provide the evidence of time-varying linkages among macroeconomic risks and the conditional first and second moments of excess returns on REITs. We find that among the macroeconomic factors, inflation risk appears to be the major concern in REIT investment. Additionally, Turkish REITs behave more like stocks than real estate. The documented perverse inflation hedges of REITs, the positive correlation between REIT returns and volatility of real economic activity, and the significant influence of ISE equity risk premium on REIT returns can be quoted as the indications of deviation of REITs' performance from real estate performance. If REITs behave more like stocks than real estate, the diversification benefits of having REITs in a multi-asset portfolio is seriously reduced.
Keywords: *Arbitrage Pricing Theory, Time-Varying Risk Premium, Generalized Method of Moments (GMM) Estimation, REITs, Turkish Real Estate Market.*
JEL Classification: *G, G3, G12, C32.*

Özet. Türkiye'de GYO Getirilerini Belirleyen Makroekonomik Faktörler Nelerdir? Dinamik Arbitraj Fiyatlama Modeli Uygulaması
Bu makale, Arbitraj Fiyatlama Teorisi çerçevesinde ülkemiz GYO sektöründe zamanla değişen risk primlerinin makro ekonomik belirleyicilerini incelemektedir. Türkiye GYO piyasası uluslararası GYO piyasasından farklılaşmaktadır. Ülkemiz GYO sektöründe GYO'lar temettü dağıtmak zorunda olmadıkları gibi her türlü kurumsal vergiden de muaftırlar ve oldukça yoğun bir sahiplik yapısı sergilemektedirler. Bu yapısal farklılıklar nedeniyle GYO hisseleri, IMKB'de işlem gören diğer şirket hisselerinden farklı performans göstermektedirler. Çalışma sonuçlarına göre, GYO sektörü getirileri için en büyük endişe yaratan makro ekonomik faktör enflasyon riskidir. GYO şirketleri portföylerinde ağırlıklı olarak bulundurdukları gayrimenkulden çok hisse senedi gibi davranmaktadır. Enflasyona karşı negatif koruma sağlama, reel sektördeki oynaklıkla pozitif korelasyon sergileme ve IMKB risk priminden ağırlıklı olarak etkilenme özellikleriyle GYO'ların performansı gayrimenkul yatırımları performansından farklılaşmaktadır. GYO'ların gayrimenkulden çok hisse senedi davranışı sergilemesi, portföy çeşitliliği sağlama özelliklerini azaltmaktadır.
Anahtar Kelimeler: *Arbitraj Fiyatlama Teorisi, Zamanla Değişen Risk Primi, GMM Tahminlemesi, GYO'lar, Türkiye Gayrimenkul Piyasası.*
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1. Introduction

The role of real estate in mixed asset portfolios depends on the return generating process when compared to other asset classes. A considerable amount of studies has used Arbitrage Pricing Theory (APT) to investigate the influence of macroeconomic factors on the real estate sector returns and revealed that certain factors such as inflation and interest rates are significant in predicting real estate returns (e.g., Hartzell *et al.*, 1987; Fama and Schwert, 1977; Rubens *et al.,* 1989; Brueggeman *et al.*, 1984; Ibbotson and Siegel, 1984; Miles and Mahoney, 1997). Analysis in private real estate markets is badly hampered by data inadequacies, but the existence of traded real estate securities enables factor models to be tested in real estate markets (Lizieri *et al.*, 2006:1). Recently, researchers have used *asset pricing models* or *multifactor models* to examine macroeconomic influences on the performance of publicly-traded real estate companies; namely the Real Estate Investment Trusts (REIT) industry. Empirical work on the relationship between macroeconomy and REIT returns has been mainly carried out using US data. Although a number of studies have examined REIT industry in UK and Singapore, relationship between the macroeconomic risks and REIT industry returns has attracted less research interest in the developing economies.

This paper investigates the macroeconomic sources of time-varying risk premia in Turkish REIT industry within the APT framework. In 2000, there were only 6 REITs in Turkey. Today, there are 24 REITs with a portfolio value of $10 billion. A sustainable economic expansion combined with strong fundamentals such as population and demographics as well as the high ratio of unlicensed and old housing stock have made Turkey one of the region's fastest growing real estate markets. In May 2012, the law of reciprocity, which eases foreign investment restrictions in Turkey, introduced into the market. Accordingly, European and especially Gulf-based property investors have turned their attention to Turkish real estate markets.[1] The legal framework for the Turkish REITs was introduced in 1995 by the Capital Market Board. This date is much earlier than those for France, UK, Japan, and several other developed countries. Turkish REIT industry differs substantially from the global REIT market as Turkish REITs do not have to pay out dividends on a regular basis, yet enjoy the exemption from paying corporate taxes.[2] This

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1 Retail development in Turkey is seen as a priority market for Gulf investors. Turkey saw 13 new shopping centers open in the first half of 2012. Commercial office market demand also remains strong as multinationals accept Istanbul as a regional business hub. Approximately 42,000sqm of office space entered the Istanbul office market alone in the first half of 2012, with 3.7 million square meters expected to be completed by the end 2013 (Fast-Growing Turkish Real Estate Market Lures Major Gulf Investors, August 2012) http://capitalbusiness.me/2012/08/05/fast-growing-turkish-real-estate-market-lures-major-gulf-investors/

2 To qualify as a REIT, a company must have the bulk of its assets and income connected to real estate investment and must distribute at least 90 percent of its taxable income to shareholders annually in the form of dividends. US Securities and Exchange Commission, http://www.sec.gov/answers/reits.htm

unique difference makes Turkish REITs' dividend withholding tax rate zero per cent. Moreover, unlike the international REIT market Turkish REITs have highly concentrated ownership structure.[3] Earlier studies reveal that these notable structural differences have considerable impacts on the performance of REIT industry in Turkey (see Erol and Tirtiroglu, 2008 and 2011 for a detailed discussion).

Provided that the performance of Turkish REITs, in terms of inflation-hedging characteristics and systematic risk behaviour, has been significantly different from other stocks listed on Borsa Istanbul (BIST), the present paper aims to analyse the REIT industry in an asset pricing framework. Accordingly, we attempt to answer the two following questions. First, is there any evidence of time-varying macroeconomic risks in Turkey over the past decade? Second, which fundamental macroeconomic factors/risks have systematically affected REIT excess returns over the specified time period? To the best of our knowledge, this article is the first to provide evidence on the evaluation of Turkish REIT industry by estimating arbitrage pricing model, which compares the REIT performance or industry excess returns with various macroeconomic factors, including GDP growth, industrial production growth, inflation risk premium, and stock market risk premium. Recognizing that certain risk factors might change over time, we employ GARCH(1,1) and GMM methods to investigate time-varying risk premiums and the ensuing influence on the behaviour of REIT returns.[4]

Our results provide the evidence of time-varying linkages among macroeconomic risks and the conditional first and second moments of excess returns on REITs. We find that among the macroeconomic factors inflation risk appears to be the major concern in REIT investment, as the REIT excess returns cannot provide hedge against expected and unexpected inflation rate. Overall, our results suggest that Turkish REITs behave more like stocks than real estate. The documented perverse inflation hedges of REITs, the positive correlation between REIT returns and volatility of real economic activity, and the significant influence of Borsa Istanbul (BIST) equity risk premium on REIT returns can be cited as the evidences of deviation of REITs' performance from real estate performance. The remainder of this article is organized as follows. Section 2 reviews the existing empirical studies on the influence of macroeconomic factors on REIT excess returns. Section 3 describes the characteristics and development of Turkish REIT industry. Section 4 explains the data. Section 5 presents methodology and reports empirical results, and finally Section 6 concludes the paper.

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3 The legal requirement that a leader entrepreneur be present with a minimum equity position of 20% introduces the agency problem between the majority and minority owners (Erol and Tirtiroglu, 2011).
4 Vuran and Akkum (2005) also used Arbitrage Pricing Theory (APT) in an attempt to investigate the effect of macroeconomic factors on ordinary stock returns in the Turkish capital markets.

2. Review of the Literature

The influence of macroeconomic factors on REIT returns has been studied since the mid-1980s.[5] The existing studies have mostly focused on the US REIT market (e.g., Brueggeman *et al.*, 1984; Karolyi and Sanders, 1998; Liu and Mei, 1992; Mei and Lee, 1994; Ling and Naranjo, 1997; Chan *et al.*, 1990; Chen *et al.*, 1997; Chen *et al.,* 1998; McCue and Kling, 1994). Additionally, Brooks and Tsolacos (1999) examined the impact of macroeconomic risk premiums on the UK property returns, and a recent study by Liow (2004) investigated this relationship for Singapore. While the US studies have mainly used equity REIT data in an attempt to analyse the variation in securitised real estate returns, Brooks and Tsolacos (1999) used FTSE Property Total Return Index for the UK properties, and Liow (2004) used office and retail property price indices in Singapore.

Empirical findings showed that macroeconomy explained almost 60 per cent of the variation in REIT returns. Of the macroeconomic variables, nominal interest rates explain the greatest percentage of variation in REIT returns, while the output and investment variables explain very little of the variation (McCue and Kling, 1994). Brooks and Tsolacos (1999) claimed that shocks to the term structure spread and unexpected inflation together account for over 50 per cent of the variation in the real estate return series. Moreover, short-term interest rate and dividend yield shocks account for 10-15 per cent of the variance of the FTSE Property Total Return Index.

In general, REIT excess returns are negatively affected by *unexpected changes in inflation* (Brooks and Tsolacos, 1999; Chan *et al.*, 1990; Ling and Naranjo, 1997; Chen, *et al.*, 1997) and *shocks to nominal interest rates* (McCue and Kling, 1994; Ling and Naranjo, 1997). Arbitrage pricing models concluded that major pricing factors in REIT industry are inflation and/ or interest rate-related; however, the impacts of these factors vary widely depending on the sample REITs chosen and the time period examined. More specifically, term structure of interest rates (liquidity premium) and term structure risk premium explain a significant proportion of REIT excess returns.[6] While Brooks and Tsolacos (1999) found the negative impact of liquidity premium on REIT returns, Chan *et al.* (1990) argued that liquidity premium positively affect REIT returns. Term structure risk premium has both positive impacts (Chan *et al.*, 1990) and negative impacts (Chen *et al.*,

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5 One of the initial studies on this body of literature has been carried out for the US equity REITs by Titman and Warga (1986). Since the returns for the chosen REITs over the period examined were extremely volatile, neither CAPM nor arbitrage pricing model produces reliable estimations.

6 Term structure of interest rates or the yield-curve shows yields or interest rates for different maturities. Yields on long-term bonds are greater than the expected return from short-term bonds in order to compensate investors in long-term bonds for bearing interest rate risk. This is called liquidity premium in the bond markets. Corporate bonds have default risk, thus corporate bonds earn an expected excess return over default-free government bonds. This is called term structure risk premium.

1998) on REIT sector excess returns.

As a main macroeconomic factor in asset pricing models, *stock market risk premium* explains small portion of REIT industry excess returns (Liow, 2004; Karolyi and Sanders, 1998). According to McCue and Kling (1994), *industrial output* also explained very little of the REIT return structure. On the contrary, Liow (2004) concluded that conditional variances *of industrial output* and *growth in GDP* have statistically significant and negative impact on REIT industry excess returns in Singapore.

3. Turkish REIT Industry

Turkey established her legal structure that allows the foundation of a REIT in 1995.[7] This date is much earlier than those for France, UK, Japan, and several other developed countries. Communiqué on the principles regarding REITs is based on Articles 32, 35, and 36 of the Capital Market Law[8] and defines officially REITs as "capital market institutions which can invest in real property, capital market instruments backed by real estate, real estate projects, rights backed by real estate and capital markets instruments, which can found ordinary partnerships and engage in other activities allowed by this Communiqué"[9]

According to the 1998 Communiqué, REITs may be founded (i) for a specific period to realise a certain project, (ii) for a specific or unlimited period to invest in specific areas, (iii) for a specific or unlimited period without any limitation of objectives.[10] All currently operating Turkish REITs are of the third type; so, they are not limited by a certain product type or geographic location, but are bound by the general principles as set forth by the Capital Markets Board (CMB).

REITs are joint stock corporations whose shares can be and are traded on the Borsa Istanbul (BIST). However, REITs' operations are governed by the Communiqué on the Real Estate Investment Trusts, issued by the CMB. At least one of the initiator shareholders (founders) should be 'leader entrepreneur,' who holds at least 20% of that REIT's capital individually or in total. The majority of REITs are set up by large, established financial groups that retain a controlling interest. The REIT structure has given these financial groups the option to transfer their real estate assets from their balance sheets to the newly-formed REITs' balance sheets. Thus, these groups do not have to finance their real estate assets anymore; the public at large does that for them.

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7 The Turkish acronym for the REIT is GYO (Gayrimenkul Yatırım Ortaklılğı).

8   Article 32: Capital Market Institutions, Article 35: Scope of Activities of Invetsment Companies, Article 36: Establishment and Operation of Invetsment Companies.

9 1998 Communiqué, Article 4.

10 1998 Communiqué, Article 5.

A key difference between the Turkish REITs and the REITs in developed economies is that Turkish REITs are not obliged to pay out dividends to the shareholders on an annual basis while their counterparts in the US, UK, Canada, Germany, France, Japan, Hong-Kong, Singapore, and other countries face legally a minimum payout ratio of anywhere from 90% to 100%. Turkish REITs do not have to pay out dividends, yet enjoy the exemption from paying corporate taxes. This unique difference makes Turkish REITs' dividend withholding tax rate zero per cent. The lack of pay-out requirement creates the free cash-flow problem (Jensen, 1986) and increases the agency costs (Erol and Tirtiroglu, 2008 and 2011).

Currently, REITs must invest a minimum 50% of their portfolios in real estate and real estate-backed securities, which has been decreased from 75%.[11] This change has enabled REITs to invest 50% of their portfolios in money and capital markets instruments and engage in direct equity participations. Table 1 presents the portfolio allocation and business focus of individual REITs as of June 2011. Obviously, a small number of REITs largely invest in money and capital markets instruments in their asset portfolios. For example, Alarko GYO invested 41% of its assets in money and capital market instruments. Similarly, Atakule GYO invested 39%, Sağlam GYO invested 28%, Torunlar GYO invested 19%, and Özderici GYO invested 18% of its assets in money and capital markets instruments. Conversely, the majority of REITs largely - 88% to 100% - invest in real estate. AkMerkez GYO, Marti GYO, Yeşil GYO, and EGS GYO invest 100% of their assets in real estate. Business focus for REITs in terms of sector is also provided in Table 1. While Emlak Konut GYO, Sinpaş GYO and Idealist GYO have only residential investments, Vakıf GYO and Avrasya GYO focus on office properties. Akfen GYO is the only Hotel-REIT in the industry. Other REITs have mixed-sector portfolios including retail, office, residential, hotel, and warehouse properties.

As of the end of 2010, there are 23 REITs listed in Borsa Istanbul (BIST) with a total portfolio of US$ 11.2 billion (see Figure 1). In September 2011 portfolio value of REIT industry considerably declined to US$ 6.8 billion. Figure 2 displays the portfolio value and net asset value of individual REIT companies as of June 2011. Emlak Konut GYO stands out as the industry leader both in portfolio value and net asset value (NAV) terms. Emlak Konut GYO is an affiliate of Turkish Mass Housing Authority (TOKİ) and has the portfolio value of 6.8 billion TRY (or USD 4.2 billion)[12]. Emlak Konut GYO is followed by Torunlar GYO (with USD 2.1 billion portfolio value), Sinpaş GYO (with USD 1.6 billion portfolio value), İş GYO (with USD 0.9 billion

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11 Article 27 of the Communiqué sets strict limitations regarding portfolio diversification of Turkish REITs; however, the limits were discontinued with the 2004 Communiqué.
12 As of 30 June 2011, USD/TRY exchange rate on banknotes was 1.6259.

portfolio value), and Kiler GYO (with USD 0.7 billion portfolio value), respectively. Note that except for İş GYO, all other REITs with comparatively higher portfolio values became publicly traded companies very recently. Specifically, Emlak Konut GYO and Torunlar GYO initial public offerings were approved in 2010. Sinpaş GYO and Kiler GYO became publicly traded companies in 2011. Indeed, a single company's; namely, Emlak GYO's portfolio value makes up about 36% of the overall industry portfolio value. As the Mass Housing Authority (TOKİ) owns 39% of Emlak Konut GYO and is strategic partner in its investment decisions[13], the government has a sizeable influence in REIT industry.

The NAV for a REIT is equal to the sum of its total portfolio value and its non-portfolio liquid assets less its total debt. As noted above, Emlak Konut GYO is the industry leader and its share of the REIT industry is 36% in NAV. Torunlar GYO, İş GYO, and Sinpaş GYO have NAV shares of 16%, 8.9%, and 8.6% of the industry, respectively.

4. Data

We analyse monthly excess returns of both individual REITs and the BIST REIT Index over the period between April 2002 and September 2011. The websited of Borsa Istanbul (http://borsaistanbul.com) and the Central Bank of Turkey (http://www.tcmb.gov.tr) are the sources of data on monthly REIT returns and 3-month Treasury bill rates, respectively. REIT Index is a value-weighted index of that includes 24 equity REITs, which are traded on Borsa Istanbul (BIST). The website of Borsa Istanbul (BIST) provides data on stock market prices for the Borsa Istanbul (BIST) All-share Index, the related sectoral indices (BIST-100, BIST-30, BIST-Industrial, BIST Financial), BIST REIT Index and all sample individual REITs. The holding period return on the Treasury bills is our measure of short-term interest rates.

The set of macroeconomic factors that may affect the performance of REIT industry are; GDP growth, industrial production growth, expected and unexpected inflation rate, stock market return, and short-term interest rates (Table 2). Note that macroeconomic variables are chosen based on prior economic grounds, extant literature and generated by availability of data. Table 2 provides the sources of data. All data are transformed to their natural logarithms, and their frequency is monthly. The sample period is dictated by the availability of risk-free interest rate (T-Bill rate) data, and runs from April 2002 until September 2011, a total of 126 observations.[14]

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13 http://www.toki.gov.tr/english/partnerships.asp
14 The first REIT was listed on ISE in 1997 and the REIT Index was created in 2000. Since the data on risk-free interest rate (T-Bill interest rates) is available from April 2002, our sample period starts in April 2002.

Figure 3 provides the time-series behavior of REIT Index returns between February 2000 and September 2011. Obviously, time-varying effects are visible in the fluctuations of the REIT return series in Turkey.

5. Methodology and Empirical Results

APT affirms that expected returns of securities are related not only to the risk premiums associated with the macroeconomic factors but also to their sensitivities to those macroeconomic factors that can also vary over time (Karolyi and Sanders, 1998). Earlier studies in the real estate literature have pointed out that CAPM-related single index models are not satisfactory to analyse the risk-return relationship of real estate returns.[15] Titman and Warga (1986) highlighted the fact that multi-index asset pricing models may be more proper for real estate portfolios than single-index models as the portfolio returns are particularly sensitive to unexpected changes in inflation and interest rates. Hence, the APT proposed by Ross (1976) has been widely used as the theoretical framework for studying real estate portfolio returns, if more than one factor does play a significant role in real estate returns (Chen *et al.,* 1997).

This paper employs *macroeconomic variable model* to implement APT empirically and uses pre-specified macroeconomic factors since the underlying factors are observable economic phenomena and the associated factor sensitivities and risk premiums can be directly interpreted.[16] We evaluate the Turkish REIT industry under two different models. First, we employed the classical multifactor model. Second, following Liow (2004), a time-varying multifactor regression analysis, in which macroeconomic risk premiums vary over time, has been carried out.

Classical Multifactor Model

The correlation matrix for the explanatory or macroeconomic variables is presented in Table 3. Correlations between explanatory variables are considerably low, indicating that there is not a multicollinearity problem. Our unit root tests show that all the variables are stationary. There is no autocorrelation in the data and the problem of heteroscedasticity does not arise; therefore, the basic assumptions of linear regression model are all satisfied. The following multifactor model is estimated in order to link excess return on REITs and the macroeconomic risks.

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15 See Brueggeman *et al.* (1984, 1992) and Chen and Tzang (1988) among others.

16 Because of the unspecified nature and number of priced factors, two approaches have been used to empirically implement the APT. These are namely; factor loading model and macroeconomic variable model. Factor loading model is proposed by Gehr (1978) and extended by Roll and Ross (1980). Chen *et al.* (1986) proposed macroeconomic variable model and used macroeconomic variables to explain asset returns in the APT framework. Chan *et al.* (1990) applied macroeconomic variable model (see Chen *et al.*, 1997 for the detailed discussion).

$$ER(REIT)_{jt} = \alpha_{jt-1} + \sum_{k=1}^{N} \beta_{jk} F_{kt} + \varepsilon_{jt} \tag{1}$$

where

ER(REIT) = REIT excess return

α = Expected excess return

F = Macroeconomic factors

ε = component of excess return not captured by economic indicators

The linear factor model for excess return implies that the conditional variance of the excess return can be formulated as the following equation:

$$Var_{t-1}\left(R_{jt}\right) = \sum_{k=1}^{N} \sum_{m=1}^{N} b_{jk} b_{jm} F_{kt} F_{mt} \tag{2}$$

Table 4 displays the classical multifactor model regression results for the REIT index. Evidently, economic activities, including ***growth in industrial production*** and ***GDP growth*** have statistically significant and positive effects on REIT sector excess returns.[17] Stronger economic growth normally leads to rising real estate prices in the economy. ***Stock market (BIST) risk premium*** is one of the main drivers of excess returns in REIT industry, too. The estimated market beta, which measures the expected response of REIT portfolio to movements in an overall stock market index, is 1.035. Estimated coeficients associated with the ***expected and unexpected inflation*** variables are negative at 1% significance level. Hence, when the market is in equilibrium securitised real estate cannot provide positive hedge against inflation. In contrast, REIT returns demonstrate perverse-hedging characteristics, especially under unexpected inflation.

Additionally, we carry out the same regression analysis both for the individual REITs[18] and other Borsa Istanbul (BIST) sectoral indices (industrial, financial and service sector indices) and determine which macroeconomic factors commonly explain the stock market excess returns. Table 5 summarizes the statistically significant factors that affect excess returns on Borsa Istanbul (BIST) sectoral indices and individual REIT companies. All Borsa Istanbul (BIST) sectoral indices behave like Borsa Istanbul (BIST) REIT index. That is to say, excess returns on Borsa Istanbul (BIST) Industrial, Borsa Istanbul (BIST) Financial and Borsa Istanbul (BIST) Services indices are i) positively affected by economic activities (GDP growth and industrial production growth) and stock market risk premium; ii) negatively affected by the inflation risk premium. Examining REIT companies separately does not lead us to a clear conclusion on the fundamental macroeconomic factors

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17 It is the GDP growth that explains a significant proportion of the REIT excess returns in a positive way.

18 Regression analysis was carried out for only 13 REITs out of 24 existing companies. This is because other REITs were very recently listed and we could not collect sufficient data for them.

that systematically affect excess returns. This implies that REITs as being portfolios of real property and property-based assets, behave differently from the stock market at the company level. Only Yapı Kredi Koray GYO returns behave similar to the ISE REIT and other ISE-sectoral indices. For the remaining companies, stock market risk premium is consistently the main driver of excess returns. Except for AkMerkez GYO and Sağlam GYO, all companies' excess returns are negatively affected by the unexpected changes in inflation rate. Lastly, it is not possible to observe a clear and consistent impact of economic activities on REIT excess returns at the company level.

Time-Varying Multifactor Model

Recognizing that certain risk factors might change over time, we first estimate the conditional variances of macroeconomic factors using GARCH (1,1) model and next we employ Generalized Method of Moments (GMM) estimation in order to investigate time-varying risk premiums and their influence on the behaviour of REIT returns. Note that we basically follow Liow (2004)'s study.

GARCH model allows the conditional variances to change over time and hence the second moments of the distribution may have an autoregressive structure[19]. Each macroeconomic factor defined in Table 1 is modeled as a standard GARCH (1,1) specification:

$$F_t = a * F_{t-1} + \varepsilon_t \tag{3}$$

$$\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \theta \sigma_{t-1}^2 \tag{4}$$

The mean equation given in Equation (3) is expressed as a function of one-month lagged factor values with an error term. The conditional variance, σ_t^2, specified in Equation (4) is a function of the mean (ω), volatility observed in the previous month (the ARCH term ε_{t-1}^2) and the last period's forecasted variance (the GARCH term σ_{t-1}^2). Table 6 displays estimation results of the GARCH (1,1) model specified for each explanatory/macroeconomic variable and the dependent variable. Except for the industrial production growth – IPI_Growth_SA – all macroeconomic variables are independent; namely, the conditional volatilities of GDP growth, stock market risk premium, expected and unexpected inflation are time-varying. Additionally, the conditional volatility of the dependent variable – excess return on REIT index, ER(REIT) – is also statistically significant. Excess returns on REIT index exhibit time-varying conditional volatility at 5% significance level. Figure 4 provides us the graphs for the conditional volatilities of macroeconomic factors in order to observe the time-varying behavior of model variables.

19 As stated by Liow (2004:56), Bollersley (1986) provides a discussion of the GARCH model and its applications in asset pricing and finance.

The residuals obtained from the estimated GARCH models are used as the macroeconomic factors that appear in Equation (1), and the estimated conditional variances are maintained for the GMM estimation (Liow, 2004). The GMM estimated is carried out in order to estimate the two equation system of Equation (1) and (2).[20] It is well-known that, unlike maximum likelihood estimation, GMM model does not require information of the exact distribution of the disturbances. Moreover, GMM is widely used to estimate APT models that are subject to nonlinear restrictions on the parameters (Liow, 2004: 53).

We first derive the conditional variances and the conditional covariances of the macroeconomic factors from the earlier GARCH (1,1) estimations and use these estimates to construct a set of instrumental variables in our GMM estimation. Note that the conditional covariance between any two macroeconomic factors is computed by taking products of square roots of the estimated conditional variances. Thus, our instrument set includes a constant, the conditional variance of GDP growth, the conditional variance of industrial production growth, the conditional variance of expected inflation, the conditional variance of unexpected inflation, the conditional variance of market portfolio and ten conditional covariance terms.

GMM estimates of the factor coefficients are presented in Table 7. Noticeably, economic growth variables – GDP growth and industrial production growth – do not have significant effects on REIT excess returns. Hence, economic growth does not lead to higher prices for securitised real estate. Estimated coefficients associated with expected and unexpected inflation are significantly negative at the 1% level. REITs provide perverse hedge against inflation. In other words, REIT excess returns cannot protect investors against inflation risk. Lastly, market portfolio risk premium – Stock_ MRKT – has significantly positive effect on REIT excess returns. Market beta is estimated to be 1.662. As a consequence, stock market performance is one of the main drivers of REIT excess returns.

The estimated coefficients on the conditional variance and covariance terms in Equation (2) are given in Table 8. Conditional first and second moments of excess returns on REITs are time-varying and dynamically related to the macroeconomic risk captured by the five factors. Our results reveal that the expected risk premiums on REITs are positively correlated with the conditional variances of growth in GDP and industrial production output; and negatively correlated with unexpected inflation. Hence, uncertainties in GDP growth and especially industrial production growth results in higher excess

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20 A main requirement of the GMM estimation is to write the moment condition as an orthogonality condition between an expression including the parameters and a set of instrumental variables. The GMM estimator selects parameter estimates so that the sample correlations between the instruments and disturbances are as close to zero as possible. The estimated parameters are consistent and asymptotical normal (see Endnote #4 in Liow(2004): 56-57).

returns on REITs. Evidently, the effects of the conditional variance of the stock market portfolio and conditional variance of expected inflation on the excess returns are minimal. The conditional covariances of the macroeconomic factors have additional effects on the expected returns on REITs. Whilst the covariance between industrial production growth and unexpected inflation has a negative effect on the excess returns, covariance between GDP growth and unexpected inflation has a strong positive effect on excess returns on REITs. Finally, it is the conditional variance of unexpected inflation that has a strong negative effect on the second moment of REIT excess returns. Overall, among the macroeconomic factors inflation risk appears to be the major concern in REIT investment.

6. Concluding Remarks

Turkish REIT industry differs substantially from the global REIT market as Turkish REITs do not have to pay out dividends on a regular basis, yet enjoy the exemption from paying corporate taxes, and have highly concentrated ownership structure. These fundamental differences have significant impacts on the performance of REITs compared to other stocks listed on ISE, especially in terms of the inflation-hedging characteristics and time-varying systematic risk behaviour (Erol and Tirtiroglu, 2008; Altinsoy et al., 2010). This paper is the first attempt to evaluate Turkish REIT industry within the arbitrage pricing theory framework. For this purpose, we attempt to answer the two following questions. First, is there any evidence of time-varying macroeconomic risks in Turkey during the sample period between April 2002 and September 2011? Second, which fundamental macroeconomic factors/risks have systematically affected REIT excess returns over the specified time period?

Empirical results from the classical multifactor model indicate that excess returns on REIT index and other ISE sectoral indices are positively affected by economic growth and stock market risk premium, but negatively affected by the inflation risk. An analysis of individual REIT companies does not lead us to a clear conclusion on the macroeconomic determinants of stock market excess returns. Hence, REITs as being portfolios of real properties and property-based assets behave differently from the stock market at the company level.

Estimation of the multifactor model with time-varying risk premia reveals that all macroeconomic factors, except for the industrial production growth, are independent. Namely, the conditional volatilities of GDP growth, stock market risk premium, expected inflation and unexpected inflation are time-varying throughout the sample period. The most notable findings of the time-varying arbitrage pricing model are the following: First, economic growth does not lead to higher prices for securitised real estate because the GDP growth

and industrial production growth do not have statistically significant effects on REIT industry excess returns. Indeed, it is the uncertainty (the conditional variance) in GDP growth and especially in industrial production growth that results in higher REIT excess returns. Hence, the volatility or higher risk in real sector returns positively affects REIT industry performance in Turkey. Second, REIT excess returns cannot provide a hedge against inflation risk. This result is entirely consistent with the findings of Brooks and Tsolacos (1999), Chan *et al.* (1990), Ling and Naranjo (1997), and Chen *et al.* (1997). Moreover, it is the conditional variance of unexpected inflation that has a strong negative effect on the second moment of REIT excess returns. Hence, among the macroeconomic factors inflation risk appears to be the major concern in REIT investment. Third, unlike the earlier findings of Liow (2004), Karolyi and Sanders (1998), stock market risk premium explains a significant portion of the time-varying risk premium in Turkish REIT industry.

Overall, our results suggest that Turkish stocks of REITs behave more like common stocks than real estate in several aspects. The documented perverse inflation hedges of REITs, the positive correlation between REIT excess returns and volatility of real economic activity, and the significant influence of ISE equity risk premium on REIT returns can be cited as the evidences of deviation of REITs' performance from real estate performance. In line with McMahan's (1994) argument, if REITs behave more like stocks than real estate, the diversification benefits of having REITs in a multi-asset portfolio is seriously reduced.

Further research may include investigating the impact of bond market risk premium on the REIT industry excess returns. Extant literature shows that term structure maturity yield and term structure default risk premium explain a significant proportion of REIT excess returns. Since the corporate bond market in Turkey is still in its initial stage of development, the current data inadequacy problem prevents us to evaluate term structure default risk premium in explaining REIT excess returns.

References

Altinsoy G., I. Erol and S.K. Yildirak. 2010. Time-Varying Beta Risk of Turkish Real Estate Investment Trusts. *METU Studies in Development* **37(2)**: 83-114.

Bollersley T. 1986. Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics* **31**: 307-327. http://dx.doi.org/10.1016/0304-4076(86)90063-1

Brooks C. and S. Tsolacos. 1999. The Impact of Economic and Financial Factors on UK Property Performance. *Journal of Property Research* **16(2)**: 139-152. http://dx.doi.org/10.1080/095999199368193

Brueggeman W., A. Chen and T. Thibodeau. Fall 1984. Real Estate Investment Funds: Performance and Portfolio Considerations. *AREUEA Journal* **12(3)**: 333-354. http://dx.doi.org/10.1111/1540-6229.00326

Brueggeman W., A. Chen and T. Thibodeau. 1992. Some Additional Evidence on the Performance of Commingled Real Estate Investment Funds: 1972-1991. *Journal of Real Estate Research* **7:** 433-448.

Chan K.C., P.H. Handershott and A.B. Sanders. 1990. Risk and Return on Real Estate: Evidence from Equity REITs. *AREUEA Journal* **18:** 431-452. http://dx.doi.org/10.1111/1540-6229.00531

Chen S., C. Hsieh, T.W. Vines and S. Chiou. 1998. Macroeconomic Variables, Firm-Specific Variables and Returns to REITs. *Journal of Real Estate Research* **16:**269-277.

Chen S., C. Hsieh and B.D. Jordan. 1997. Real Estate and the Arbitrage Pricing Theory: Macrovariables vs. Derived Factors. *Real Estate Economics* **25(3):** 505-523. http://dx.doi.org/10.1111/1540-6229.00725

Chen K.C. and D.T. Tzang. 1988. Interest Rate Sensitivity of Real Estate Investment Trusts, *Journal of Real Estate Research* **3(3):** 13-22.

Chen N., R. Roll and S.A. Ross. 1986. Economic Forces and the Stock Market. *Journal of Business* **59:** 383-403. http://dx.doi.org/10.1086/296344

Erol I. and D. Tirtiroglu. 2008. The inflation-hedging properties of Turkish REITs. *Applied Economics* **40(20):** 2671-2696. http://dx.doi.org/10.1080/00036840600970237

Erol I. and D. Tirtiroglu. July 2011. Concentrated Ownership, No Dividend Payout Requirement and Capital Structure of REITs: Evidence from Turkey. *Journal of Real Estate Finance and Economics* **43(1-2):** 174-204. http://dx.doi.org/10.1007/s11146-010-9242-7

Fama E.F. and G.W. Schwert. 1977. Asset Returns and Inflation. *Journal of Financial Economics* **5:** 115-146. http://dx.doi.org/10.1016/0304-405X(77)90014-9

Gehr A. 1978. Some Tests of the Arbitrage Pricing Theory. *Journal of the Midwest Finance Association* **7:**91-106.

Hartzell D., J.S. Hekman and M.E. Miles. 1987. Real Estate Returns and Inflation. *AREUEA Journal* **15(1):** 617-637. http://dx.doi.org/10.1111/1540-6229.00407

Ibbotson R. and L. Siegel. Fall 1984. Real Estate Returns: A Comparison with Other Investments. *AREUEA Journal* 219-242. http://dx.doi.org/10.1111/1540-6229.00320

Jensen M. C. 1986. Agency Cost of Free Cash Flow, Corporate finance, and Takeovers. *American Economic Review* **76(2):** 323–329.

Karolyi G.A. and A.B. Sanders. 1998. The Variation of Economic Risk Premiums in Real Estate Returns. *Journal of Real Estate Finance and Economics* **15(3):** 245-262. http://dx.doi.org/10.1023/A:1007776907309

Ling D.C. and A. Naranjo. 1997. Economic Risk Factors and Commercial Real Estate Returns. *Journal of Real Estate Finance and Economics* **14(3):** 283-307. http://dx.doi.org/10.1023/A:1007754312084

Liow K.H. 2004. Time-Varying Macroeconomic Risk and Commercial Real Estate: An Asset Pricing Perspective. *Journal of Real Estate Portfolio Management* **10(1):** 47-57.

Liu C. and J. Mei. 1992. The Predictability of Returns on Equity REITs and their Co-movements with other Assets. *Journal of Real Estate Finance and Economics* **5:** 401-418. http://dx.doi.org/10.1007/BF00174808

Lizieri C., S. Satchell and Q. Zhang. 2006. The Underlying Return Generating Factors for REIT Returns: An Application of Independent Component Analysis. *Real Estate and Planning Working Papers* rep-wp2006-12, Henley Business School, Reading University.

McCue T.E. and J.L. Kling. 1994. Real Estate Returns and the Macroeconomy: Some Empirical Evidence from Real Estate Investment Trust Data: 1972-1991. *Journal of Real Estate Research* **9(3):** 277-287.

McMahan J. August 1994. The Long View: A Perspective on the REIT Market. *Real Estate Issues* 1-4.

Mei J. and A. Lee. 1994. Is There a Real Estate Factor Premium? *Journal of Real Estate Finance and Economics* **9:** 113-126. http://dx.doi.org/10.1007/BF01099970

Miles M. and J. Mahoney. 1997. Is Commercial Real Estate and Inflation Hedge? *Real Estate Finance* **13(4):** 31-45.

Roll R. and S.A. Ross. 1980. An Empirical Investigation of the Arbitrage Pricing Theory. *Journal of Finance* **35:** 1073-1103. http://dx.doi.org/10.1111/j.1540-6261.1980.tb02197.x

Ross S.A. December 1976. The Arbitrage Theory of Capital Asset Pricing. *Journal of Economic Theory* **13:** 341-360. http://dx.doi.org/10.1016/0022-0531(76)90046-6

Rubens J.H., M.T. Bond and J.R. Webb. 1989. The Inflation-hedging Effectiveness of Real Estate. *Journal of Real Estate Research* **4:**45-56.

Titman S. and A. Warga. 1986. Risk and Performance of Real Estate Investment Trusts: A Multiple Index Model. *AREUEA Journal* **14:** 414-431. http://dx.doi.org/10.1111/1540-6229.00395

Vuran, B. and T. Akkum. 2005. The Analysis of Macroeconomic Factors which may Affect Stock Returns in the Turkish Capital Market by Arbitrage Pricing Theory, *İktisat İşletme ve Finans*, **20 (**233): 28-45.

Table 1: Portfolio Allocation and Business Focus of Individual REITs - 30 June 2011

Company Name	Business Focus	Portfolio Allocation		
		Real Estate Investment	Affiliates	Money& Capital Market Instruments
Emlak Konut GYO	Residential	88%	0%	12%
Torunlar GYO	Retail, Residential Office	70%	11%	19%
Iş GYO	Retail, Office, Hotel, Residential	94%	0%	6%
Sinpaş GYO	Residential	91%	7%	2%
Kiler GYO	Retail, Residential, Office	94%	0%	6%
AkMerkez GYO	Retail	100%	0%	0%
Akfen GYO	Hotel	50%	44%	6%
Reysaş GYO	Warehouses	98%	1%	1%
Alarko GYO	Office, Residential, Hotel	59%	0%	41%
Martı GYO	Residential, Hotel	100%	0%	0%
Atakule GYO	Retail, Office, Hotel	61%	0%	39%
TSKB GYO	Office, Residential, Hotel	94%	0%	6%
Yeşil GYO	Retail, Residential	100%	0%	0%
Doğuş GYO	Retail, Residential, Office	89%	0%	11%
Pera GYO	Retail, Hotel, Office	94%	2%	4%
Vakıf GYO	Office	91%	0%	9%
Özderici GYO	Office, Residential	82%	0%	18%
Yapı Kredi Koray GYO	Residential, Office	53%	47%	0%
Avrasya GYO	Office	98%	0%	2%
Sağlam GYO	Office, Residential, Factory	68%	4%	28%
Nurol GYO	Retail, Residential, Office	83%	0%	17%
EGS GYO	Retail	100%	0%	0%
Idealist GYO	Residential	95%	0%	5%

Source: The Association of Real Estate Investment Companies, REIT Sector Information: www.gyoder.org.tr

Table 2: List of Macroeconomic Variables

Macroeconomic Variables	Definition	Denoted	Source of Data
GDP Growth	Seasonally-adjusted growth; Tramo-Seats method is applied)	GDP_Growth_SA	Ministry of Development (www.dpt.gov.tr)
Industrial Production Growth	Seasonally-adjusted growth; Tramo-Seats method is applied	IPI_Growth_SA	Ministry of Development (www.dpt.gov.tr)
Expected Inflation	Obtained by Fama-Gibbons methodology	Exp_INF	Central Bank of Turkey (http://www.tcmb.gov.tr)
Unexpected Inflation	The difference between the realised inflation rate (% change in CPI) and expected inflation	UnExp_INF	Central Bank of Turkey (http://www.tcmb.gov.tr)
Stock Market Return	Residuals obtained from regressing macroeconomic factors on stock market excess returns[**]	Stock_MRKT	Istanbul Stock Exchange (http://www.ise.gov.tr)
Short-term Interest Rate	3-month holding period retun on T-Bills	Int_Rate	Central Bank of Turkey (http://www.tcmb.gov.tr)

* Dependent variables are excess returns on REIT Index, individual REITs and other ISE Indices. Security excess returns are calculated by subtracting T-Bill interest rate (risk-free rate of interest) from the corresponding nominal returns.
** Stock market return is the filtered stock market effect.

Table 3: Correlation Matrix for the Macroeconomic Variables

	Exp_INF	Stock_MRKT	UnExp_INF	Gdp_Growth_SA	IPI_Growth_SA
Exp_INF	1.000000	3.13E-17	-0.173452	-0.059407	0.009599
Stock_MRKT	3.13E-17	1.000000	5.59E-16	1.12E-16	1.05E-16
UnExp_INF	-0.173452	5.59E-16	1.000000	0.149242	0.091791
Gdp_Growth_SA	-0.059407	1.12E-16	0.149242	1.000000	0.007339
IPI_Growth_SA	0.009599	1.05E-16	0.091791	0.007339	1.000000

Table 4: Regression Results for the REIT Index

ISE REIT Index				
Dependent Variable: [REIT Excess Return]				
Sample (Adjusted): 2002/04 – 2011/09				
Included Observation: 114				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Constant	-0.139	0.007	-19.794[***]	0.000
GDP_Growth_SA	1.696	0.394	4.303[***]	0.000
IPI_Growth_SA	0.443	0.163	2.726[***]	0.007
Exp_INF	-0.445	0.194	-2.288[**]	0.024
UnExp_INF	-1.607	0.096	-16.736[***]	0.000
Stock_MRKT	1.035	0.039	26.589[***]	0.000
R-squared	0.902		Mean dependent var	-0.194
Adjusted R-squared	0.898		S.D. dependent var	0.191
S.E. of regression	0.061		Akaike info criterion	-2.695
Sum squared resid	0.4058		Schwarz criterion	-2.551
Log likelihood	159.615		Hannan-Quinn criter.	-2.636
F-statistic	199.127		Durbin-Watson stat	2.025
Prob(F-statistic)	0.000			
[*] stands for 10% significance level [**] stands for 5% significance level, [***] stands for 1% significance level for the two-tailed t-test.				

Table 5: Statistically Significant Macroeconomic Factors in Multifactor APM Regression

Dependent Variable [REITNominal Returns – T-Bill Rate]	GDP_Growth_SA	IPI_Growth_SA	Exp_INF	UnExp_INF	Stock_MRKT
ISE Industrial Index	+	+	-	-	+
ISE Financial Index	+	+	-	-	+
ISE Services Index	+	+	-	-	+
ISE REIT Index	+	+	-	-	+
AkMerkez GYO	+			+	+
Alarko GYO			-	-	+
Atakule GYO				-	+
Avrasya GYO		+	-	-	+
Doğuş GYO		+	-	-	+
İş GYO		+		-	+
Nurol GYO		+		-	+
Özderici GYO		+		-	+
Pera GYO	+	+		-	+
Sağlam GYO	+				+
Vakıf GYO			-	-	+
Yapı Kredi Koray GYO	+	+		+	+
Yeşil GYO				-	+

Table 6: Estimation Results of GARCH(1,1) Model

Model	Mean - [ω]	ARCH(1) – [α]	GARCH(1) – [θ]
GDP_Growth_SA	2.66E-05 (0.0000)	0.181500 (0.0338)[**]	0.742067 (0.0000)[***]
Exp_INF	2.50E-05 (0.0084)[***]	1.316532 (0.0338)[**]	0.277960 (0.0000)[***]
IPI_Growth_SA	0.000416 (0.0002)[***]	0.490784 (0.1157)	0.300932 (0.1137)
UnExp_INF	3.12E-05 (0.0232)[**]	0.260896 (0.0150)[***]	0.674831 (0.0000)[***]
Stock_MRKT	0.001238 (0.2307)	0.142360 (0.3113)[*]	0.760104 (0.0000)[***]
ER(REIT)	0.008542 (0.0272)	0.360438 (0.0183)[**]	0.304960 (0.0322)[**]

Note: Each GARCH(1,1) model includes two equations Equation (3): $F_t = a * F_{t-1} + \varepsilon_t$ and Equation (4): $\sigma_t^2 = \omega + \alpha \varepsilon_{t-1}^2 + \theta \sigma_{t-1}^2$

[*] stands for 10% significance level
[**] stands for 5% significance level,
[***] stands for 1% significance level for the two-tailed t-test.

Table 7: GMM Estimation Results for REIT Index

	Coefficient						
	Constant	GDP_Growth _SA	IPI_Growth _SA	Stock_ MRKT	UnExp_INF	Exp_INF	R^2
ER(REIT)	-0.153	2.002	0.627	1.662	-8.912	-8.215	
(Prob)	(0.000)	(0.138)	(0.475)	(0.000)	(0.000)	(0.000)	
t-Statistic	-17.799***	1.495	0.717	11.177***	-9.242***	-9.694***	0.459

Estimated Equation (1): $ER(REIT)_{jt} = \alpha_{jt-1} + \sum_{k=1}^{N} \beta_{jk} F_{kt} + \varepsilon_{jt}$

*** stands for 1% significance level for the two-tailed t-test.

Table 8: Effects of Estimated Conditional Variance and Covariance Terms on Excess REIT Returns and Variance of REIT Returns

	ER(REIT)	Variance(ER) [Var$_{t-1}$]
VAR(GDP_Growth_SA)	475.548 (0.455)	-83.431 (0.205)
VAR(IPI_Growth_SA)	**73.409** (0.049)**	2.893 (0.448)
VAR(Stock_MRKT)	-4.006 (0.736)	1.894 (0.124)
VAR(UnExp_INF)	-37.699 (0.577)	**-16.957** (0.016)**
VAR(Exp_INF)	9.031 (0.722)	-1.346 (0.607)
COV(IPI_Growth_SA, Exp_INF)	93.589 (0.412)	-9.049 (0.441)
COV(IPI_Growth_SA, UnExp_INF)	**-397.347** (0.077)*	-10.925 (0.634)
COV(IPI_Growth_SA, GDP_Growth_SA)	-75.907 (0.759)	9.841 (0.700)
COV(IPI_Growth_SA, Stock_MRKT)	-7.899 (0.842)	-0.608 (0.881)
COV(GDP_Growth_SA, UnExp_INF)	**1006.567** (0.062)*	39.156 (0.477)
COV(GDP_Growth_SA, Exp_INF)	-287.070 (0.301)	**48.446** (0.092)*
COV(GDP_Growth_SA, Stock_MRKT)	-179.611 (0.239)	3.637 (0.816)
COV(UnExp_INF, Exp_INF)	-9.674 (0.883)	**12.878** (0.059)*
COV(UnExp_INF, Stock_MRKT)	38.098 (0.400)	4.264 (0.361)
COV(Exp_INF, Stock_MRKT)	-16.269 (0.465)	-5.775 (0.013)

* stands for 10% significance level
** stands for 5% significance level,
*** stands for 1% significance level for the two-tailed t-test.

Figure 1: Portfolio Value of Turkish REIT Industry between 1997 and September 2011
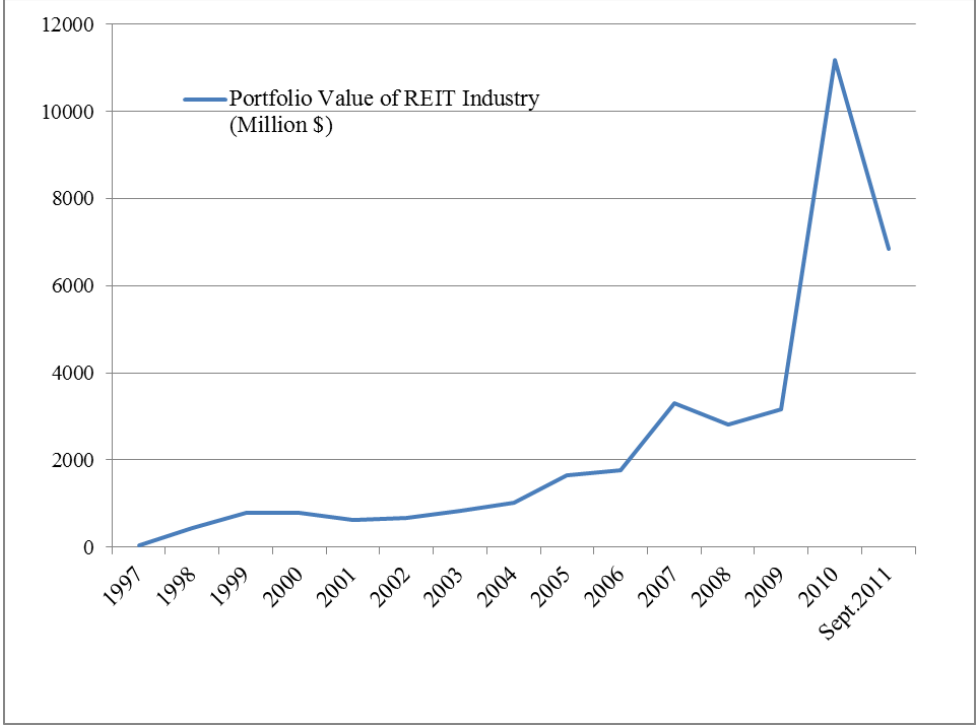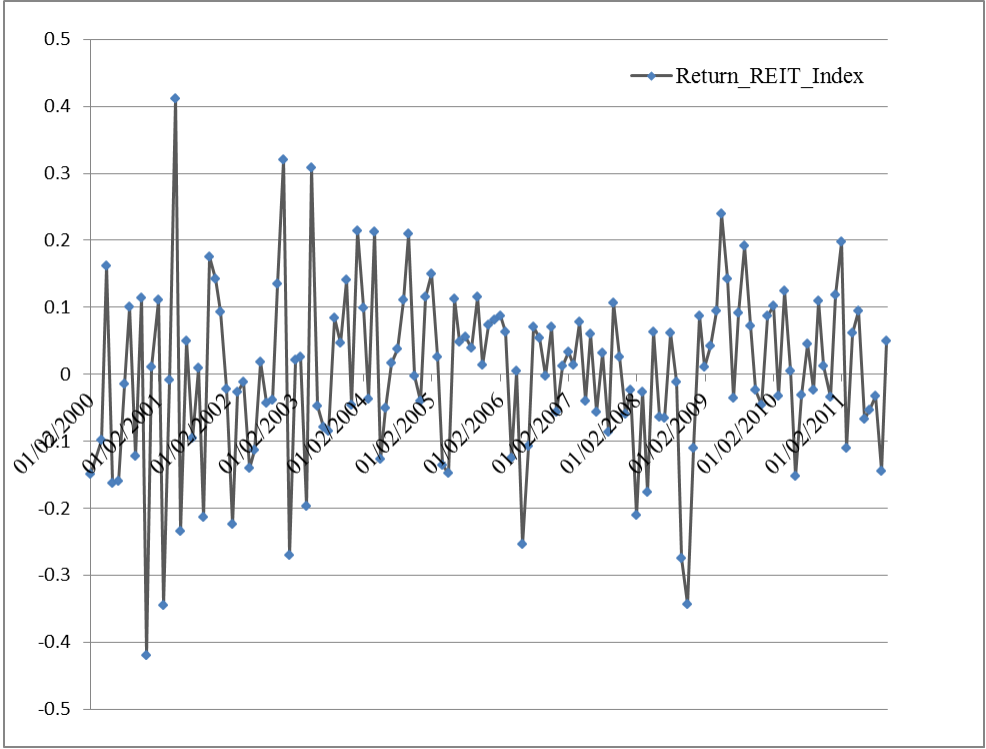

Source: Web-site of the Capital Markets Board: **www.spk.gov.tr**

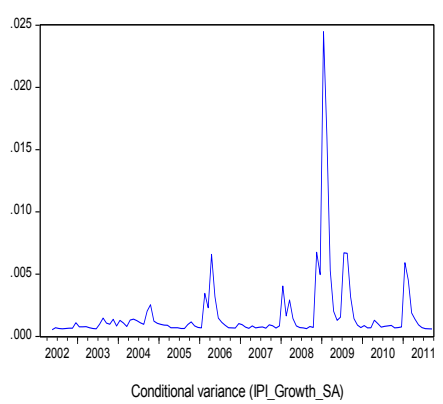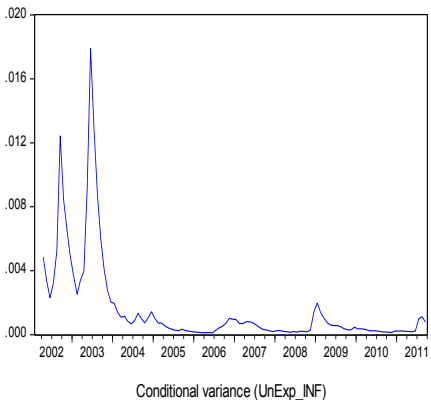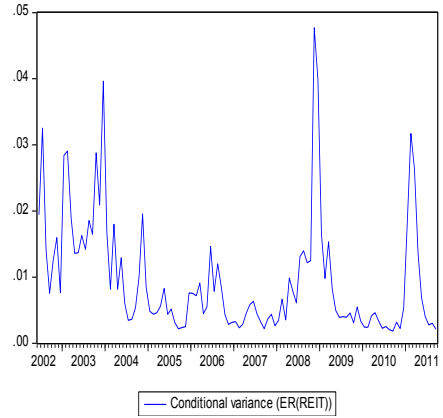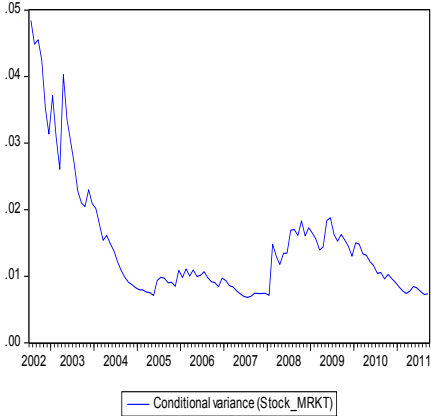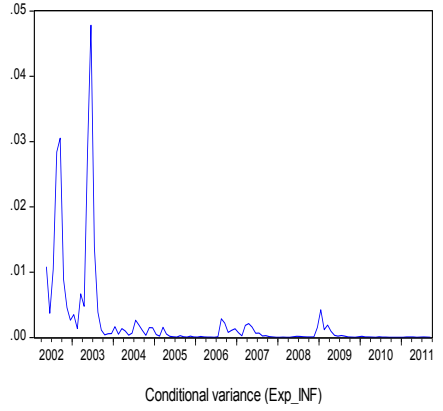**Figure 2:** Portfolio Value and Net Asset Value of Individual REITs (TRY), 30 June 2011
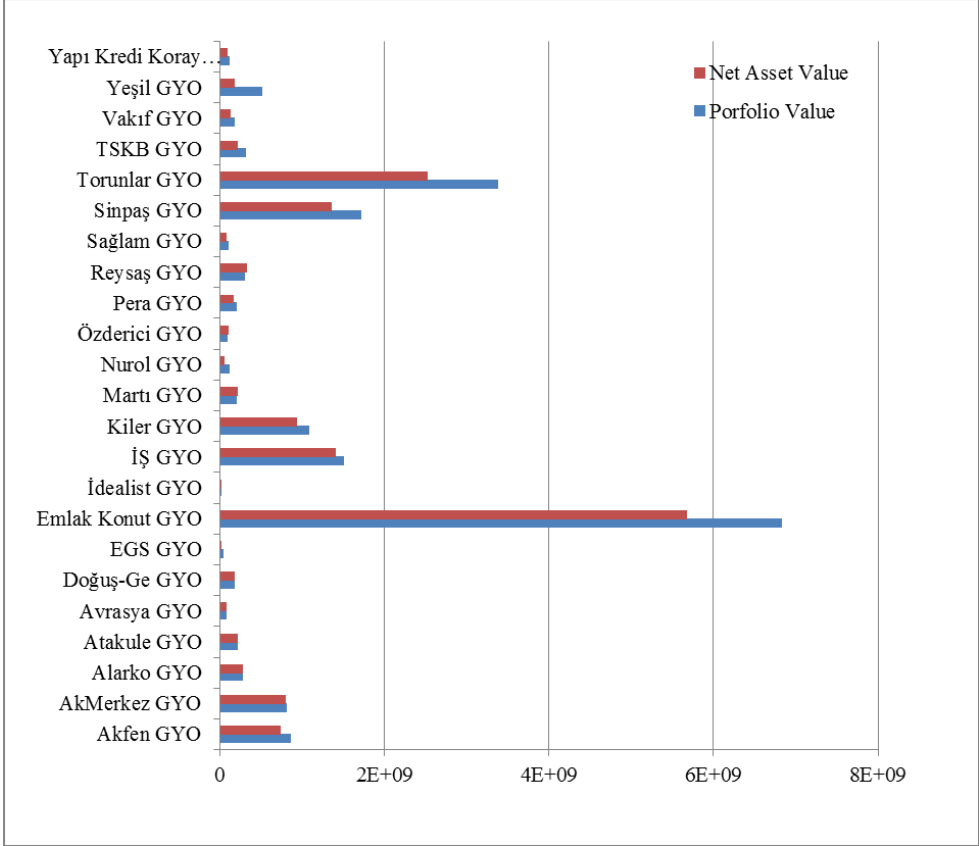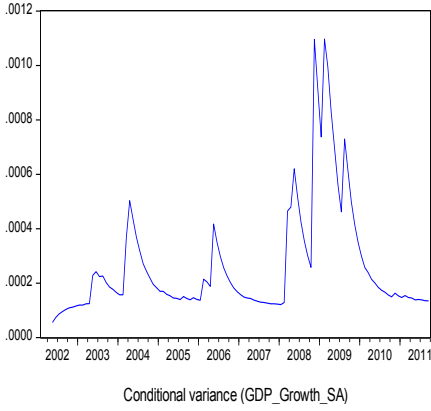

Source: The Association of Real Estate Investment Companies, REIT Sector Information: www.gyoder.org.tr

Figure 3: REIT Index Returns between February 2000 and September 2011

Source: Web-site of Istanbul Stock Exchange: www.ise.org

Figure 4: The Graphs for Conditional Variance of Macroeconomic Factors

Conditional variance (GDP_Growth_SA)

Conditional variance (Exp_INF)

Conditional variance (Stock_MRKT)

Conditional variance (ER(REIT))

Conditional variance (UnExp_INF)

Conditional variance (IPI_Growth_SA)