TWO ESSAYS ON REAL ESTATE ECONOMICS AND FINANCE

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ABSTRACT

TWO ESSAYS ON REAL ESTATE ECONOMICS AND FINANCE

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This thesis presents two studies on real estate economics and finance which are separate but interrelated. The first chapter investigates the transmission of monetary policy to real estate-related industries in Turkey by estimating the effect of policy decisions on the stock prices of real estate-related industries. The study addresses endogeneity and omitted variable problems inherent in the relationship between stock prices and monetary policy by employing a heteroskedasticity based identification set-up. The empirical results indicate that the impact of monetary policy on the real estate-related industries is strong and the identification set-up employed in the study weakly improves the results obtained by using the straightforward event study approach which is widely used in the related literature. The second chapter assesses the short-run inflation hedging ability of Turkish real estate investment trusts (REIT) by estimating the response of REIT returns to changes in inflation using individual firm data, aggregated index data and panel data. The specification used in the study allows asymmetry in the responses of REIT returns to increases and decreases in the inflation. Empirical results indicate that allowing for asymmetric responses significantly improves the estimations and Turkish REITs act as perverse hedges against rising inflation. On the contrary, Turkish REITs depreciate when inflation decreases.

Keywords: Real Estate Markets, Monetary Policy, Identification through Heteroskedasticity, Real Estate Investment Trusts, Inflation Hedging.

ÖZ

EMLAK EKONOMİSİ VE FİNANSMANI ÜZERİNE İKİ ÇALIŞMA

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Bu tez emlak ekonomisi ve finansmanı üzerine farklı ancak birbiriyle ilişkili iki farklı çalışmadan meydana gelmiştir. İlk bölümde, para politikası kararlarının emlak piyasası ile ilişkili sektör hisse senedi fiyatlarına etkisi tahmin edilerek para politikasının emlak ile ilişkili sektörlere aktarımı incelenmiştir. Bu çalışmada hisse senedi fiyatları ile para politikası arasındaki ilişkinin ekonometrik olarak analizinde sıkça rastlanan içsellik ve dışlanmış değişken sorunları da dikkate alınarak değişen varyansa dayalı bir tanımlama yöntemi kullanılmıştır. Ampirik sonuçlar para politikasının emlakla ilişkili sektörlere aktarımının kuvvetli olduğunu ve çalışmada uygulanan tanımlama yaklaşımının benzer çalışmalarda sıkça kullanılan vaka çalışması yaklaşımına kıyasla, belirgin olmamakla birlikte, daha iyi sonuçlar verdiğini göstermiştir. İkinci bölümde, Türk gayrimenkul yatırım ortaklıklarının (GYO) eflasyona karşı kısa vadede koruma sağlayıp sağlamadığı firma verileri, toplulaştırılmış borsa endeksleri ve panel veriler kullanılarak GYO getirilerinin enflasyondaki değişimlere verdiği tepki tahmin edilerek araştırılmıştır. Çalışmada kullanılan spesifikasyon GYO getirilerinin enflasyondaki artışlar ve azalışlara farklı tepki vermesine imkan vermiştir. Ampirik sonuçlar bu asimetrik spesifikasyonun tahminde belirgin bir iyileşme sağladığını ve Türk GYO'ların artan enflasyona karşı koruma sağlamadığını göstermiştir. Öte yandan, enflasyonda azalış olması durumunda ise Türk GYO'ları değer kaybetmektedir.

Anahtar Kelimeler: Emlak Piyasaları, Para Politikası, Değişen Varyansa Dayalı Tanımlanma, Gayrimenkul Yatırım Ortaklığı, Enflasyona Karşı Koruma.

To My Mother Emel Who Resides at the Depths of My Heart

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CHAPTER 1

INTRODUCTION

1.1. Motivation and Summary of Results

This thesis presents two separate but interrelated empirical researches on Turkish real estate markets with a close relationship to the monetary policy of the Central Bank of Turkey. As changes in the monetary policy directly affect current and future interest rates and economic activity, both transactions and prices in the real estate markets react to monetary policy.

The first study in the thesis attempts to measure the impact of monetary policy on several industries in the economy that are associated with the real estate markets. It does so by analysing daily changes in stock prices of all real estate-related firms listed on the Borsa Istanbul (BIST), the only stock exchange in Turkey, on days when monetary policy actions such as interest decisions take place. By contrasting these dates with non-policy dates it identifies the magnitude of the reaction of different real estate-related industries to changes in monetary policy. This study contributes to the extant literature from the methodological framework. Unlike the earlier studies employing straightforward econometric techniques that fail to address feedback effects between monetary policy and asset prices, the present study applies an identification scheme based on the heteroskedasticity of the monetary policy shock on the days of monetary policy announcements.

In addition, to the best of my knowledge, Turkey or another emerging market country has not been examined in the present context previously. Hence, this study is the first attempt to measure the impact of monetary policy on real estate-related industries in Turkey. The empirical results indicate that, along the lines of existing studies in literature, monetary policy has strong effects on real estate-related firms as a whole. Besides, at the industry level, a non-negligible amount of heterogeneity is observed among the reactions of different industries to monetary policy. For instance, impact of monetary policy on real estate-related financial firms is quite strong but its impact on non-financial firms such as cement, construction materials, plastics and construction firms is rather weak. Some real estate-related non-financial industries such as paint and iron-steel-foundry industries are almost non-responsive to monetary policy.

The second study aims to investigate the effect of inflation, rather than monetary policy, on securitized real estate prices in Turkey. It is well known that most of the advanced and emerging country central banks formulate their monetary policy to achieve and sustain price stability. Especially in emerging countries which have comparably high and volatile inflation, economic decision making is more difficult. Higher and volatile inflation causes uncertainty and risk in financial markets. This leads economic agents to seek hedge against inflation and demand real assets more instead of financial assets. Most prominent assets that provide hedge against inflation are real estate assets along with commodities and treasury inflation-protected securities (TIPS). In this context, main question of the second chapter is whether real estate investment trust (REIT) shares, which can be regarded as securitized form of real estate assets, provide short-run (immediate or timely) hedge against inflation. This question is investigated using stock market index data, firm-level individual and panel data on stock prices along with monthly inflation data.

The econometric specification of the regressions in this study is structured in order to allow asymmetric responses of stock prices to increases and decreases in inflation. In the estimation process, this approach proves useful and significantly improves the results. This is one of the main contributions of the study to the literature since most of the empirical works failed to detect the response of REIT returns to changes in inflation due to their symmetric specifications. According to the results, Turkish REIT shares do not provide hedge against inflation when the inflation is on the rise. On the contrary, they act as hedges against decreasing inflation. Thus, these results imply that Turkish REIT shares behave like equities rather than real estate assets.

The plan of the remainder of the thesis is as follows. Chapter 2 presents the data, methodology and empirical results of the study that examines the effects of monetary policy on real estate-related industries in Turkey. Chapter 3 analyzes the inflation hedging ability of Turkish REITs using stock market data and employing an asymmetric specification. Chapter 4 concludes the thesis.

CHAPTER 2

TRANSMISSION OF MONETARY POLICY TO REAL ESTATE-RELATED INDUSTRIES IN TURKEY

2.1.Introduction

It is well-known that in advanced economies and in most of the emerging countries, real estate markets solely constitute a large portion of the overall economy. Understanding the structure of the real estate market and its linkages with the rest of the economy has important implications for economic agents such as individual investors, firms and policy makers in decision making. Households need houses primarily for dwelling reasons although people also use buildings to run their businesses or use them as investments. Besides individuals, firms also need buildings (sometimes only the land) to use as offices, plants, farms, hotels etc.

The real estate system is comprised of three elements, namely the space (usage) market, asset market and construction industry. In the space market, firms and households demand real estate assets to use. Together with the demand, the existing stock of real estate assets determines the rents as well as the occupancy or vacancy levels. From the owner's point of view, rents are the cash inflows that the real estate assets create. Since, fundamental values of financial assets are the discounted present value of their expected future cash flows, prices in the real estate markets are influenced by demand for and supply of these assets as well as the present and future discount rates. This is the main link between the space market and the asset market.

Once usage demand, usage supply and financial conditions of the economy dictate the real estate prices, construction firms compare these prices with building costs plus an appropriate level of profit in decision making. If the prices are high enough, building activities accelerate and subsequently real estate stock increases. These two facts complete the links between the construction industry and other two markets in the system. In addition, some other sectors in the economy are closely related to the real estate market. Major businesses of these sectors are closely associated with real estate usage, sales and construction activities. For instance, firms which produce and sell steel, paint, cement, isolation materials, glass, aluminium etc. are indirectly affected by the developments in the construction industry. A boom in the construction industry means stronger demand and larger profits for these firms. Other examples are financial firms such as banks and real estate investment trusts (REITs). Banks issue mortgage loans to customers, REITs own and rent out properties and both provide financing to construction activities. Hence, these firms have strong linkages with real estate markets.

Monetary policy primarily affects space demand and asset prices in the real estate system but it has also indirect effects and second-round effects on other parts of the system due to the linkages which are discussed before. Besides these effects, the economy-wide effects of monetary policy on all firms in the economy should also be taken into account to assess the transmission of monetary policy decisions to the real estate market. Note that, a real estate asset usually constitutes a significant portion of the wealth of a household or a small business. Consequently, changes in the prices of real estate assets may result in significant rises or falls in the wealth of economic agents. For instance, an increase in wealth boosts the consumption and investment in the economy and hence it affects inflation and growth. All firms in the economy are also affected by the discount rates which are primarily determined by the current and future short term interest rates. Thus, understanding the monetary transmission mechanism to the real estate markets has important implications for overall economy.

This study attempts to measure the impact of monetary policy on the real estate-related industries in Turkey by looking at the stock prices of various firms listed on the

Istanbul Stock Exchange (Borsa Istanbul - BIST). Next section presents a literature review. Section 2.3 discusses the monetary policy developments in the Turkish monetary policy from the beginning of 2000s in order to clarify the monetary policy framework of the Central Bank of Turkey (CBT). Section 2.4 focuses on the data and methodology. Section 2.5 presents the empirical results and robustness checks. Finally, Section 2.6 concludes.

2.2.Related Literature

The relationship between the monetary policy and the real estate market is one of the hot topics in the related literature. Several authors investigated this relationship using different questions, methodologies and datasets. However, prominent studies in this area are all carried out for advanced countries and although most of these studies provide evidence on strong relationship between monetary policy and real estate markets, there are also some studies that fail to document this relationship.

Some economists approach this issue from a business cycle view. For instance, Ahearne et al. (2005), using the data of 18 major industrial countries show that house prices are pro-cyclical and loose monetary policy leads to house price booms. However, in the same study, the authors can not document monetary policy reaction to house prices using a survey of official reports, speeches, and minutes of respective central banks. Iacoviello (2005) addresses the same issue in a DSGE framework and estimates a model with 1974-2003 U.S. data. The results indicate that housing prices should deliver a negative response to tight monetary policy. According to the model, with sticky prices, a monetary shock affects real rates. This increase discourages housing demand and borrowing as well as entrepreneurial housing investment and result in falls in the house prices and output.

In a similar attempt, using a structural VAR approach with 1986-2008 U.S. and Euro area data, Musso et al. (2010) examines the effects of monetary policy, credit supply and housing market shocks on housing market and broader economy. The authors find that monetary policy transmission to housing markets is stronger in the U.S. than in the Euro area. Furthermore, the main reason is the huge contraction in the mortgage debt in the U.S. compared to Euro area. Employing the same model with Italian data for 1990-

2008, Bulligan (2010) provides evidence that monetary policy have significant and long-lasting effects on real house prices and residential investment. Furthermore, the analysis indicates that house prices react faster and more strongly than the general price level and that the return to equilibrium in the housing market is significantly slower than in the rest of the economy. However, despite its influence on housing variables, monetary policy is not the predominant cause of the volatility of residential investment and house prices.

In another study, McDonald and Stokes (2011), using Granger causality analysis and VAR models with 1987-2010 U.S. data, provide evidence that interest rate policy of the Federal Reserve in the period 2001–2004 that pushed down the federal funds rate and kept it artificially low was a cause of the housing price bubble.

Apart from the studies that focus only on unsecuritized real estate assets, Chang et al. (2011) investigate the response of both the securitized and unsecuritized real estate assets to monetary policy, using a Markov regime-switching model with 1975-2008 U.S. data. The results indicate that housing and REIT returns respond to monetary policy but the response of REIT returns is much larger initially but less persistent than that of the housing returns. Hence, securitized and unsecuritized real estate assets are affected by monetary policy in different ways. Furthermore, the term structure of interest rates[1] amplifies the response of REIT returns where it dampens the response of housing returns. On the other hand, using the same set-up with 1997-2008 U.S. data, Anderson et al. (2012) find that response of REIT returns to monetary policy shocks are amplified during high volatility periods. According to the authors, policy reforms are usually more aggressive in recessions than in booms. Furthermore, during recessions, the economy operates along the horizontal segment of the supply curve. An expansionary monetary policy therefore increases the real level of output, without significantly increasing prices. In addition, financial constraints are more likely to be binding during the downturns of business cycles. Thus, expansionary monetary shocks during recessions can impact REITs by relaxing finance constraints. Recently, Chou and Chen (2013) arrive at similar results with 1972-2010 U.S. data. They conclude that

[1] Decreases in the short term interest rates generally do not lead to the same amount of decreases in long term interest rates, hence the spread between the long term and short term interest rates increases.

during economic boom periods, the response of REIT returns to monetary policy is stronger.

Trying to answer a similar question, Xu and Yang (2011) examine the impact of U.S. monetary policy surprises on securitized real estate markets in 18 countries, using 1993-2004 data. Using an event study approach and Seemingly Unrelated Regression (SUR) estimation methodology, they provide evidence that the U.S. REITs appreciate following an interest rate cut where the securitized real estate markets of other countries increase after a surprise easing in future direction in Fed's monetary policy. Furthermore, the authors examine potential asymmetries in the responses and find that for most of the countries, securitized real estate markets respond more strongly to U.S. monetary policy surprises, particularly when there is an unexpected cut, when the size of the surprise is big, and when the monetary policy is loosening. In addition to these results, the authors also show that the cross-country variation in the responses is mainly explained by exchange rate regimes and the degrees of real economic and financial integration of respective countries.

Besides these studies on the response of REITs to monetary policy, Bredin et al. (2007) attempt to examine the response of both the level and the volatility of REIT returns to monetary policy using GARCH models with 1996-2005 U.S. data. According to their results, an unanticipated monetary tightening decreases the REIT returns and increases their volatility.

Another interesting approach to the relationship between monetary policy and real estate assets is to examine the impact of monetary policy to all the industries that are much or less related with the real estate market. In this context, Goukasian and Majbouri (2010) study the impact of changes in U.S. monetary policy on the equity returns of real estate–related industries using event-study methodology with 1989–2005 U.S. data. The authors find that an unexpected 25-bp rate cut is associated with an increase of about 170 bps in the returns of real estate–related industries. They also construct sub-industry indices and examine the reaction of each sub-industry to monetary policy. Their results indicate that, Building Material Supply and Mortgage& Banking industries react to the monetary policy actions the most where REITs surprisingly react the least. According to the authors, the reason behind this puzzling result is that an interest rate cut leads to an increase in the affordability of real estate which in turn decreases the demand rents. This effect compensates the expansionary effects of the interest rate cut partly or completely. In the end, responses of REITs become weaker.

Apart from these studies that are focused on the transmission of monetary policy to real estate markets, the studies that assess the impact of monetary policy on other financial markets should be regarded as valuable benchmarks for the purposes of this study. Rigobon and Sack (2004) attempt to measure the impact of monetary policy decisions on treasury yields and stock indices using a heteroskedasticity-based generalized method of moments (GMM) methodology with 1994–2001 U.S. data. According to their findings, an increase in short-term interest rates results in a decline in stock prices and in an upward shift in the yield curve that becomes smaller at longer maturities. Using the same set-up with 2005-2009 Turkey data, Duran et al. (2012) find that increases in the policy rate lead to declines in stock prices, rises in treasury yields (especially in shorter maturities), and a statistically insignificant appreciation of the domestic currency.

2.3.Monetary Policy in Turkey

Turkey witnessed a high and volatile inflationary period after 1970s until the beginning of 2000s and the average annual inflation rate during that period was around 51 percent.[2] In the aftermath of the 2001 Crisis, an extensive economic stabilization program which granted independence to the Central Bank of Turkey (CBT) and disciplined the public sector and the banking sector was installed. Strictly adherence to this program brought the inflation rate down from almost triple digits to single digits between 2001 and 2005. Encouraged by this success, the Central Bank of Turkey (CBT) decided to implement a full-fledged inflation targeting regime (IT) at the beginning of 2006.[3] The main monetary policy tool of this regime was announced as

[2] The standard deviation of annual inflation rates during the same period was 27.6 percent. Source: Statistical Indicators 1923-2010, TurkStat, 2011, Publication No: 3641.

[3] Source: General Framework of Inflation Targeting Regime and Monetary and Exchange Rate Policy for 2006, Central Bank of the Republic of Turkey, 2005, Publication No: 2005-45

the overnight borrowing rate of the CBT. The institutional framework of the regime was designed to move towards the process of price stability from the disinflation process. In this regime, the inflation target was set as a point target and the Consumer Price Index (CPI) was the preferred means of defining the inflation target. In order to increase the accountability of the monetary policy, the CBT defined an uncertainty band around the point target (2-percentage point in both directions) and became obligated to explain the reasons behind the deviations to the public. In addition to accountability, the CBT increased the transparency of its monetary policy by sharing its inflation forecasts, other forecasts, assessment of current economic conditions and the rationale behind its decisions with public by its quarterly inflation report, the minutes of monthly MPC meetings along with other communication tools.

In 2005, the year before the IT regime to be officially implemented, the CBT began to hold Monetary Policy Committee (MPC) meetings at preset and preannounced dates and times, and interest rate decisions began to be made public at 9 a.m., the next day. Since 2006, the CBT has continued to hold MPC meetings each month at preset and preannounced dates and announce the interest rate decisions.

In May 2010, due to the conditions in the interbank money market, the CBT implemented a technical rate adjustment and adopted the 1-week repo auction rate as the key policy rate which was the overnight borrowing rate until then. In the last quarter of the year 2010, the aftermath of the global financial crisis which broke out in 2007, due to increased concerns related with financial stability, the CBT began to use required reserve ratios as an active policy tool besides the 1-week repo auction rate. The idea behind using multiple policy instruments was the so-called Tinbergen's Rule which states that for each policy target there must be at least one policy tool. In addition to these policy tools, in 2011 with the increased concerns on the Eurozone Debt Crisis, the CBT began to allow the interbank rates deviate from the key policy rates within the corridor between the overnight borrowing and lending rates to increase its flexibility in conducting the monetary policy. Hence, the de facto policy interest rate became the interest rate at which the CBT supplied liquidity to the banking system. Late in the same year, the CBT introduced yet another policy instrument, the reserve option mechanism (ROM), in order to reduce the adverse impact of volatile capital flows on macroeconomic and financial stability. This mechanism allows banks to keep a certain portion of their Turkish lira (TL) reserve requirements in foreign exchange (FX) and/or gold.[4] In 2012, the CBT redesigned the ROM and introduced reserve option coefficients (ROC), which are multipliers to be used to determine the amount of FX or gold that can be held per unit of Turkish lira reserve requirements.[5] By increasing ROCs, the CBT could and did implement additional tightening for banks and increase the cost of converting foreign currency funds to Turkish lira funds.

2.4.Data and Methodology

In my empirical set-up, I attempt to measure the impact of monetary policy announcements on the prices of real estate-related companies following the methodology used by Rigobon and Sack (2003). As far as I am aware, this is the first study to employ the theoretically reliable heteroskedsticity-based GMM technique which will be presented in detail in Section 2.4.2., instead of Ordinary Least Squares (OLS) in the analysis of the effects of monetary policy on real estate related industries. In addition, this is also the first study on this issue using Turkish or other emerging country data.

2.4.1. Data

I use short term interest rates as a proxy for the monetary policy rate. Note that the short term interest rates reflect expectations of monetary policy rate changes over the following months and adjust daily according to changes in expectations of monetary policy over the near term (Rigobon and Sack. 2003). Among the alternative short term interest rates (repo rates, cross-currency swap rates, deposit rates etc.), yields on government bonds with short term maturity are priced in a relatively more liquid market and hence I prefer to use treasury bond yields as the short term interest rates.[6]

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[4] For a detailed discussion of ROM, see Küçüksaraç and Özel (2012).

[5] For instance, suppose that a bank operating in Turkey has 2,000 TL reserve requirements. If, the CBT allows the banks to hold half of their TL reserve requirements as FX, reserve option coefficient for FX is 1.4 and USD=1.80 TL; the bank may hold USD 1.4*1,000/1.80 = USD 780 instead of half of its TL reserve requirements.

[6] Trading of treasury bonds with the same value date on the BIST closes at 2.00 p.m. On the other hand, Policy dates and non-policy

But since these series are not available in a regular time-series format across each maturity, I calculate 1-month and 3-month treasury bond yields by linear interpolation.[7] Besides the short rates calculated by linear interpolation, I also use 3-month fixed maturity treasury bond yields calculated by Bloomberg in order to perform robustness checks.

I obtain daily closing price data of all companies listed on the BIST from the BIST website and construct different indices that involve real estate-related industries following the approach used by Goukasian and Majbouri. 92 companies from Turkish aluminium, banking, cement, ceramic, construction, construction materials, copper, duct, electricity, foundry, glass, iron-steel, isolation, paint, plastics, refractory and REIT sectors are included in the analysis and by using these data, *Cement, Construction, Construction Materials, Iron-Steel-Foundry, Paint, Plastics, Bank, REIT, Real Estate-Related Non-Financial and Real Estate-Related Financial* indices are constructed[8]. Moreover, current market values of the companies are obtained from the BIST website and using this data, the indices are calculated on a value-weighted basis. However, for each index, an equally-weighted index is also calculated as a robustness check. In addition to these indices, there are some indices calculated and published by the BIST which are more or less relevant for to the Turkish real estate markets. Among these indices, BIST Financials, BIST Banks, BIST REITs, BIST Non-Metal Mineral Products and BIST Basic Metal indices along with BIST 100 index are used in the empirical analysis to compare with the results of the value-weighted indices.[9] The sample covers 87 monetary policy committee meetings and 24 inflation report announcements between January 2005 and January 2012.

Correlations of all indices with 1-month treasury bond yield on both the policy and non-policy dates are reported in Table 2.1. For almost all indices, correlation between

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[7] For instance, I calculate 1-month yield as; $r_1 = r_L + \frac{30-T_L}{T_L-T_U}(r_L - r_U)$, where T_L denotes the maturity and r_L denotes the annually compounded yield of the bond whose maturity is closest to 30 days from downside; T_U denotes the maturity and r_U denotes the annually compounded yield of the bond whose maturity is closest to 30 days from upside. An example of fixed term treasury bond yield calculation by linear approximation is given in the appendix.

[8] Details of these indices are explained rigorously in appendix.

[9] The scatterplots of value-weighted indices vis-à-vis equally-weighted indices and vis-à-vis BIST constructed indices are given in the appendix.

the real estate equity returns and the policy rate changes is stronger on policy dates and even stronger when inflation report dates are excluded from the sample. This indicates that monetary policy announcements have some effects on real estate-related companies. Moreover, the relationship between the equity returns and the policy rate are stronger for financial firms than non-financial firms on both the policy dates and non-policy dates. This makes sense since the operations of financial firms are more involved with interest rates. When it comes to the non-financial firms, the relationship is statistically significant only in the construction materials and the cement sectors.

Table 2.1. Correlations with the Policy Rate

	Policy Dates		**Non-Policy Dates**	
Indices	**Full sample**	**Only MPC Meetings**[10]	**Full sample**	**Only MPC Meetings**
All Real Estate-Related Industries	-0.274***	-0.308***	-0.139	0.121
Real Estate-Related Non-Financial Industries	-0.144	-0.170	-0.081	0.107
Real Estate-Related Financial Industries	-0.292***	-0.328***	-0.144	0.119
Individual Industries				
Banking	-0.292***	-0.328***	-0.142	0.122
REIT	-0.247***	-0.259**	-0.075	0.011
Construction Materials	-0.211**	-0.249**	-0.127	0.065
Iron-Steel-Foundry	-0.047	-0.050	-0.109	0.084
Plastics	-0.151	-0.185*	-0.090	0.084
Cement	-0.293***	-0.307***	0.003	0.096
Construction	-0.053	-0.094	-0.039	0.074
Paint	0.010	-0.037	-0.096	0.009

Sample period: Jan.2005 – Jan.2012
The interest rates are daily changes in basis points, the stock market indices are in daily percent changes.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Variances of all indices and 1-month treasury bond yield on both the policy and non-policy dates are reported in Table 2.2. As expected, variances of the real estate equity returns and the policy rate are usually higher on policy dates. A quick examination of the percentage increases in the variance on policy dates which is reported in the last two columns of Table 2.2. indicates that the monetary policy shock is much stronger

[10] Excludes the data observed on inflation report announcement dates and covers only the Monetary Policy Committee (MPC) meeting dates.

for the policy rate and the financial firms. More interestingly, the monetary policy shock seems to be weaker for most of the non-financial real estate-related firms when compared to BIST 100 and BIST All Shares indices.

Table 2.2. Variances

	Policy Dates		Non-Policy Dates		Increase in Variance on P.Dates	
Policy Rate	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**
1-month T-bill Rate	0.072	0.083	0.027	0.017	171%	378%
Indices						
All Real Estate-Related Industries	5.949	6.564	4.439	3.787	34%	73%
Real Estate-Related Non-Financial Industries	3.976	4.538	2.948	3.116	35%	46%
Real Estate-Related Financial Industries	7.118	7.795	5.485	4.517	30%	73%
Individual Industries						
Banking	7.304	8.000	5.621	4.614	30%	73%
REIT	4.009	4.531	3.151	3.576	27%	27%
Construction Materials	2.616	2.948	2.562	2.700	2%	9%
Iron-Steel-Foundry	8.091	7.699	7.821	6.865	3%	12%
Plastics	4.715	5.486	5.243	6.092	-10%	-10%
Cement	2.324	2.526	2.251	2.452	3%	3%
Construction	7.884	9.049	4.969	5.879	59%	54%
Paint	4.922	5.200	5.289	5.351	-7%	-3%

Sample period: Jan.2005 – Jan.2012
The interest rates are daily changes in basis points, the stock market indices are in daily percent changes.

2.4.2. Methodology

In this study, I attempt to measure the impact of monetary policy on prices of the common stocks of various real estate-related industries following the approach used by Rigobon and Sack (2004) for the U.S. market and Duran *et al.* (2012) for the Turkish market. In any case, the dynamics of short term interest rates and asset prices can be expressed as follows:

$$\Delta i_t = \beta \Delta s_t + \gamma z_t + \varepsilon_t \quad (1)$$

$$\Delta s_t = \alpha \Delta i_t + z_t + \eta_t \quad (2)$$

where Δi_t is the change in the policy rate and Δs_t is the change in the asset price. Equation (1) can be interpreted as a monetary policy reaction function, where the policy rate responds to the asset price and a set of variables z_t, which may or may not be observed. Equation (2) is the asset price equation, which reflects the response of asset price to the monetary policy and other variables z_t. In my setup, z_t is taken as a single unobservable variable, which represents all the omitted common factors.[11] The variable ε_t is the monetary policy shock and η_t is the asset price shock. The shocks ε_t and η_t are assumed to be serially uncorrelated and to be uncorrelated with each other and with the common shock z_t.

In this study, the parameter of interest is α, which measures the impact of a change in the policy rate Δi_t on the asset price Δs_t. The straightforward approach to estimate Equation (2) using OLS is the event study (ES) approach. Therefore, the ES estimate of α is as follows:

$$\hat{\alpha}_{ES} = (\Delta i_t ' \Delta i_t)^{-1} \Delta i_t ' \Delta s_t \quad (3)$$

The expected value of $\hat{\alpha}_{ES}$ is:

$$E(\hat{\alpha}_{ES}) = \alpha + (1 - \alpha\beta) \frac{\beta\sigma_\eta + (\beta + \gamma)\sigma_z}{\sigma_\varepsilon + \beta^2\sigma_\eta + (\beta+\gamma)^2\sigma_z} \quad (4)$$

where σ_x represents the variance of shock x. According to Equation (4), estimating Equation (2) using OLS may suffer from both the presence of simultaneity bias (if $\beta \neq 0$ and $\sigma_\eta > 0$) and omitted variables bias (if $\gamma \neq 0$ and $\sigma_z > 0$). To overcome these

[11] Since z_t is an unobservable variable, its coefficient is normalized to one in Equation (2). The setup is flexible enough to include observable common factors as well.

problems, researchers applying the ES approach use the asset price changes directly after the announcement of the monetary policy committee (MPC) decision. In that case, the assumption required by the ES approach is that, in the limit, the variance of the policy shock becomes infinitely large relative to the variance of other shocks, i.e. $\sigma_{\varepsilon}/\sigma_{\eta} \to \infty$ and $\sigma_{\varepsilon}/\sigma_{z} \to \infty$ on policy dates. In other words, it is assumed that within the policy day, the effects of the asset price shock and the common shock (simultaneity and omitted variables problems) on the monetary policy decision are negligible.

The heteroskedasticity-based identification method suggested by RS does not require such strong assumptions. To apply the heteroskedasticity-based identification method, only a rise in the variance of the policy shock is needed when the MPC decision is announced, while the variances of other shocks remain constant. This enables establishing causality from policy to the asset price on the policy dates, which is the basis for identification. Since the GMM technique requires much weaker assumptions, it can give more reliable estimates than the ES approach.

Two subsamples, denoted by *P* and *N* are essential to implement the heteroskedasticity-based GMM technique. *P* stands for the policy dates (days when the MPC decisions are announced) and *N* stands for the non-policy dates (days immediately preceding the policy days). Two assumptions necessary for the heteroskedasticity-based identification method are as follows:

i. The parameters of the model, α, β and γ are stable across the two subsamples.
ii. The policy shock is heteroskedastic and other shocks are homoskedastic, which are represented by the following equations:

$$\sigma_{\varepsilon}^{P} > \sigma_{\varepsilon}^{N} \quad (5)$$

$$\sigma_{z}^{P} = \sigma_{z}^{N} \quad (6)$$

$$\sigma_{\eta}^{P} = \sigma_{\eta}^{N} \quad (7)$$

Under the assumptions (i) and (ii), a detailed analysis of the heteroskedasticity-based identification approach is presented below.

Reduced form of equations (1) and (2) are as follows:

$$\Delta i_t = \frac{1}{1-\alpha\,\beta}\left[(\beta+\gamma)z_t + \beta\eta_t + \varepsilon_t\right] \tag{1'}$$

$$\Delta s_t = \frac{1}{1-\alpha\,\beta}\left[(1+\alpha\beta)z_t + \eta_t + \alpha\varepsilon_t\right] \tag{2'}$$

The covariance matrices of the variables in each subsample are the following:

$$\Omega_P = \frac{1}{(1-\alpha\beta)^2}\begin{bmatrix} \sigma_\varepsilon{}^P + (\beta+\gamma)^2\sigma_z{}^P + \beta^2\sigma_\eta{}^P & \alpha\sigma_\varepsilon{}^P + (\beta+\gamma)(1+\alpha\gamma)\sigma_z{}^P + \beta\sigma_\eta{}^P \\ . & \alpha^2\sigma_\varepsilon{}^P + (1+\alpha\gamma)^2\sigma_z{}^P + \sigma_\eta{}^P \end{bmatrix}$$

$$\Omega_N = \frac{1}{(1-\alpha\beta)^2}\begin{bmatrix} \sigma_\varepsilon{}^N + (\beta+\gamma)^2\sigma_z{}^N + \beta^2\sigma_\eta{}^N & \alpha\sigma_\varepsilon{}^N + (\beta+\gamma)(1+\alpha\gamma)\sigma_z{}^N + \beta\sigma_\eta{}^N \\ . & \alpha^2\sigma_\varepsilon{}^N + (1+\alpha\gamma)^2\sigma_z{}^N + \sigma_\eta{}^N \end{bmatrix}$$

The heteroskedasticity-based GMM technique uses a comparison of the covariance matrices on the policy and the non-policy dates.[12] Under the assumptions (i) and (ii), the difference between the covariance matrices Ω_P and Ω_N is as follows:

$$\Delta\Omega = \Omega_P - \Omega_N = \frac{(\sigma_\varepsilon{}^P - \sigma_\varepsilon{}^N)}{(1-\alpha\beta)^2}\begin{bmatrix} 1 & \alpha \\ \alpha & \alpha^2 \end{bmatrix} \tag{8}$$

Denoting $\lambda = \frac{(\sigma_\varepsilon{}^P - \sigma_\varepsilon{}^N)}{(1-\alpha\beta)^2}$, equation (8) becomes the following:

$$\Delta\Omega = \lambda\begin{bmatrix} 1 & \alpha \\ \alpha & \alpha^2 \end{bmatrix} \tag{8′}$$

Thus, the impact of policy changes on the asset prices, namely the parameter α, can be identified from the change in the covariance matrix $\Delta\Omega$.

[12] For more details on the heteroskedasticity-based identification methods, see Rigobon (2003).

Rigobon and Sack estimate the coefficient α in two different ways: by GMM estimation and Instrumental Variables (IV) regression. However, as shown in RS, IV estimation makes use of only two equations in (8′) at a time, resulting in multiple estimates of α. On the other hand, GMM utilizes all three orthogonality conditions in (8′). That is, there is an improvement in efficiency from incorporating the additional moment conditions into the estimation in the GMM approach compared to the IV approach. Thus, in this study, only the GMM estimation is used to obtain an estimate of the asset price response to the monetary policy changes. Besides, in the GMM approach, the overidentification restrictions enable testing the model as a whole, which is a very useful robustness check.

2.4.2.1.GMM Estimation

In equation (8), there are two parameters to be estimated, namely, α, the parameter of interest, and $\lambda = \frac{(\sigma_{\varepsilon}{}^{P} - \sigma_{\varepsilon}{}^{N})}{(1-\alpha\beta)^2}$, a measure of the degree of heteroskedasticity that is present in the data. The latter coefficient can be used to test whether the change in the volatility is enough to identify the former. Hence, in order to estimate α with this approach, λ has to be statistically significant.

Under assumptions (i) and (ii) of the heteroskedasticity-based identification, the sample estimate of the difference in the covariance matrix is:

$$\Delta\hat{\Omega} = \hat{\Omega}_P - \hat{\Omega}_N \tag{9}$$

where

$$\hat{\Omega}_j = \frac{1}{T_j} \sum_{t \in T} \delta_t{}^{j} \left[\Delta i_t \quad \Delta s_t\right]' \left[\Delta i_t \quad \Delta s_t\right] \text{ for } j = P, N,$$

δ_t^j are dummy variables taking the value 1 for the days in each subsample and $T^j = \sum_{t \in (1,T)} \delta_t^j$ are sample sizes of the subsamples, for $j = P, N$. The assumptions imply that the following moment conditions hold:

$$E[b_t] = 0$$

where

$$b_t = vech(\Delta\hat{\Omega} - \Delta\Omega) \text{, or}$$

$$b_t = vech\left(\left(\frac{T}{T^P}\delta_t^{\ P} - \frac{T}{T^N}\delta_t^{\ N}\right)[\Delta i_t \quad \Delta s_t]^{'}[\Delta i_t \quad \Delta s_t] - \lambda[1 \quad \alpha]^{'}[1 \quad \alpha]\right)$$

The GMM estimator is based on the condition that $\lim_{T\to\infty} \frac{1}{T}\Sigma t\in(1,T)\, b_t = 0$. The intuition behind GMM is to choose an estimator for $\Delta\Omega$, $\Delta\hat{\Omega}$, that sets the three sample moments as close to zero as possible. Since there are more moment conditions than unknown parameters, (8′) is overidentified and it may not be possible to find an estimator that sets all three moment conditions to zero. In this case, I take a 3x3 weighting matrix W_3 and use it to construct a quadratic form in the moment conditions. The estimates of α and λ will be obtained by minimizing the following loss function:

$$[\hat{\alpha}_{GMM}, \hat{\lambda}] = \arg\min\left[\sum_{t\in[1,T]} b_t\right]^{'} W_3 \left[\sum_{t\in[1,T]} b_t\right] \tag{10}$$

Practically, GMM estimation proceeds in two steps. Initially GMM estimation with an identity-weighting matrix, i.e. taking $W_3 = I_{3,}$ is conducted to obtain a consistent estimator of coefficients. In the second step, W_3 is formed based on obtained residuals. Accordingly, W_3, the optimal weighting matrix is equal to the inverse of the estimated covariance matrix of the moment conditions. The efficient GMM estimator is obtained based on (10).

2.5. Empirical Results

The effect of changes in the 3-month treasury bond yield on each of the real estate-related equity indices are estimated using both the event study approach and the heteroskedasticity-based GMM approach. In addition, the models are estimated by using both the full sample which covers all MPC meeting dates and inflation report announcements, and the short sample which covers only the MPC meeting dates, in order to examine if the results differentiate according to the type of monetary policy action. Table 2.3. reports the event study and the heteroskedasticity-based GMM estimates of α for each real estate-related industry index along with BIST 100 index which represents the general equity market. Estimates in the second and the fourth column of Table 2.3 are obtained using all MPC meetings and inflation report announcements in the sample period where the third and the fifth columns report the estimates obtained by using only the MPC meeting dates in the sample.

According to the heteroskedasticity-based GMM method, which seems theoretically more reliable due to weaker assumptions, overall real estate-related industries index responds to changes in short term interest rates significantly and in the opposite direction. Moreover, the response is greater when only MPC meetings are taken into account. On average, a 25 basis points interest rates hike in a MPC meeting decreases the prices of real estate-related company shares by 1.03%.[13] When it comes to the real estate-related financial firms, especially the banks, the response of asset prices to monetary policy changes is even higher. In contrast, response of the prices of real estate-related non-financial firms to monetary policy changes is almost one third of that of the financial firms. This is mainly due to the fact that interest rate sensitivity of the assets and the liabilities of banks and other financial institutions is higher than those of the non-financial firms (Flannery and James, 1984). Among the real estate-related non-financial industries, paint sector and iron-steel-foundry sector are found to be less responsive to monetary policy changes. Furthermore, construction sector, construction materials sector and plastics sector respond to MPC interest rate decisions but their responses become less clear when inflation report announcements are taken into account. Finally, unlike the other real estate-related non-financial industries, response of cement sector to the monetary policy changes is as strong as the sectors classified under financial industries. Compared with the general equity market as a whole, real estate-related financial industries are generally more responsive to monetary policy but

[13] -4.107x0.25%=1.03%

the responses of real estate-related non-financial industries to changes in monetary policy are not as large.

Table 2.3. Estimation Results

	Event Study		Heteroskedasticity-based GMM	
Indices	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**
All Real Estate-Related Industries	-2.496***	-2.731***	-2.902**	-4.107***
	(0.816)	(0.912)	(1.393)	(0.973)
Real Estate-Related Non-Financial Industries	-1.074	-1.247	-1.158	-1.982***
	(0.686)	(0.786)	(0.871)	(0.610)
Real Estate-Related Financial Industries	-2.909***	-3.169***	-3.426**	-4.769***
	(0.888)	(0.986)	(1.586)	(1.119)
Individual Industries				
Banking	-2.945***	-3.209***	-3.486**	-4.854***
	(0.899)	(0.999)	(1.612)	(1.138)
REIT	-1.845***	-1.909**	-2.328**	-2.374***
	(0.674)	(0.769)	(1.020)	(0.848)
Construction Materials	-1.283**	-1.485**	-1.284	-2.08***
	(0.551)	(0.622)	(0.906)	(0.706)
Iron-Steel-Foundry	-0.521	-0.47	0.382	-0.993
	(0.990)	(1.036)	(1.196)	(0.725)
Plastics	-1.228	-1.488*	-1.233	-2.307***
	(0.747)	(0.862)	(0.973)	(0.740)
Cement	-1.671***	-1.695***	-2.538***	-2.347***
	(0.507)	(0.566)	(0.858)	(0.770)
Construction	-0.548	-0.949	-0.899	-1.806**
	(0.975)	(1.124)	(1.151)	(0.834)
Paint	0.085	-0.269	0.800	-0.422
	(0.771)	(0.855)	(1.242)	(0.983)
General Equity Market				
BIST 100	-2.339***	-2.598***	-2.868**	-3.897***
	(0.752)	(0.831)	(1.303)	(0.924)

Sample period: Jan.2005 – Jan.2012
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Response of all series to a 100 basis points interest rate cut estimated using both heteroskedasticity-based GMM and event study techniques are represented in Figure 2.1. and Figure 2.2. respectively. Moreover, the fact that the empirical findings are all in the same direction and quantitatively similar under both the ES and the heteroskedasticity-based GMM methods, indicates that the results are statistically reliable. These results imply that the pass-through of policy rates to real estate-related asset prices functions well in Turkey. However, almost in all cases, the responses measured using heteroskedasticity-based GMM are greater than those estimated under the event study approach. This pattern implies that the event study approach fails to take the feedback effects of asset prices on monetary policy into account since it cannot solve the endogeneity problem. Thus, the event study estimates become downward biased. An interest rate cut boosts the prices of assets at first which in turn increase the wealth of households and financial strength of firms. Subsequently, aggregate consumption and aggregate investment will increase and central bank will tighten its monetary policy. In the end, this will curb the initial impact of the interest rate cut on asset prices. Since the parameter α in Equation (2) measures the contemporaneous impact of a change in the policy rate Δi on the change in the asset price Δs, study approach captures does not fully reflect what α represents.

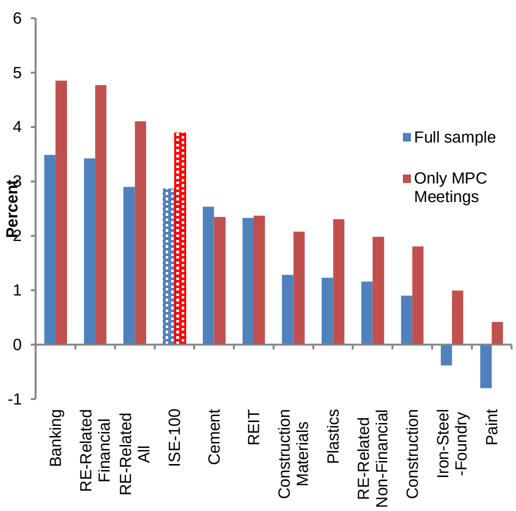

Figure 2.1. Responses to a 100 bps Interest Rate Cut (GMM)

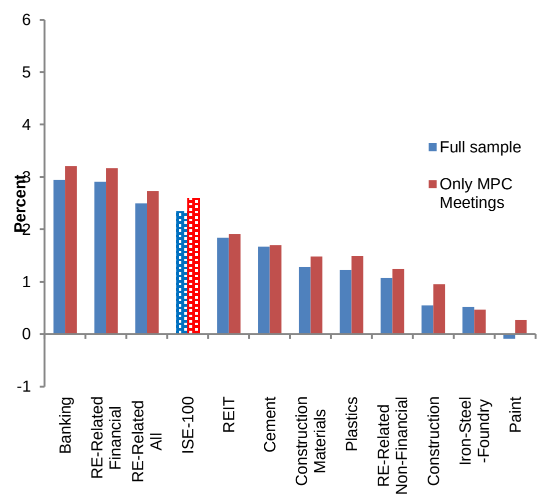

Figure 2.2. Responses to a 100 bps Interest Rate Cut (Event Study)

2.5.1. Robustness Checks

As part of this study, several robustness checks ranging from testing of the assumptions of the identification through heteroskedasticity approach to using alternative data sources or definitions are performed in order to enhance the reliability of the findings.

These checks indicate that the assumptions of the identification through heteroskedasticity approach are not violated and the results above are robust to changes in data definitions.

2.5.1.1.Robustness Checks Related to Assumptions

Identification through heteroskedasticity approach requires that the variance of monetary policy shock increases on policy dates. Recall that it is shown in Section 2.4.2. that the identification of α is based on the increase in the monetary policy shock and the stability of all other variables on policy dates. Change in the monetary policy shock can be tested by a t-test on the significance of the coefficient λ. If λ is significantly different than zero there exists heteroskedasticity between policy and non-policy dates. In addition, stability of all other parameters can be verified by testing the over-identifying restrictions on the model. Since there are more moment conditions than necessary to estimate λ and α, the remaining condition can be used to test the consistency of the GMM estimates. If the assumptions of the model are realistic, GMM estimates will be consistent. Thus, over-identifying restrictions should be close to zero. Table 2.4. reports the results on the significance of λ and the over-identifying restrictions along with the results of a Hausman test on the biasedness of event study estimates compared to heteroskedasticity-based GMM estimates. The latter test is performed as an additional robustness check that indicates whether the GMM estimates improve significantly upon event study estimates.

According to t-test results on the significance of λ, change in the variance of the monetary policy shock on policy dates is always significant at 1% level. In addition, results of the test of over-identifying restrictions, shown in the third and fourth columns of Table 2.4., indicate that the GMM estimates are consistent. These two results jointly enable the use of identification through heteroskedasticity approach. When it comes to the biasedness of the event study estimates, Hausman test results indicate that there are some cases where GMM estimates significantly improve upon event study but in most cases the difference between GMM and event study estimates is not significant. But as discussed in the previous section, the overall pattern of GMM and event study estimates justifies the use of identification through heteroskedasticity approach since the GMM estimates are almost always larger than event study estimates.

Table 2.4. Robustness Checks

Test	**Heteroskedasticity Between Regimes (t-test)**		**Over-Identifying Restrictions**		**Biasedness of Event Study (Hausman)**	
Indices	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**
All Real Estate-Related Industries	0.047*** (0.015)	0.069*** (0.019)	0.367	0.492	0.130	16.296***
Real Estate-Related Non-Financial Industries	0.046*** (0.015)	0.066*** (0.019)	0.589	0.471	0.024	2.206
Real Estate-Related Financial Industries	0.047*** (0.015)	0.07*** (0.019)	0.271	0.461	0.155	9.172***
Individual Industries						
Banking	0.047*** (0.015)	0.07*** (0.019)	0.276	0.470	0.163	9.124***
REIT	0.047*** (0.015)	0.067*** (0.019)	0.344	0.182	0.399	1.686
Construction Materials	0.045*** (0.015)	0.065*** (0.019)	0.001	0.002	0.000	3.156*
Iron-Steel-Foundry	0.045*** (0.015)	0.065*** (0.019)	0.013	0.071	1.811	0.498
Plastics	0.045*** (0.015)	0.064*** (0.019)	0.162	0.242	0.000	3.460*
Cement	0.044*** (0.015)	0.064*** (0.018)	0.086	0.086	1.568	1.562
Construction	0.046*** (0.015)	0.066*** (0.019)	1.541	0.907	0.328	1.298
Paint	0.046*** (0.015)	0.065*** (0.019)	0.114	0.014	0.539	0.099

Sample period: Jan.2005 – Jan.2012
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

2.5.1.2.Robustness Checks Related to Data

As discussed in Section 2.4.1., 1-month treasury bill yield is used as the monetary policy rate since this rate reflects the monetary policy expectations regarding the following one month period. But there are other short term interest rates which are also good indicators of the monetary policy expectations.[14] In this regard, I also estimate the responses of real estate-related industry indices to monetary policy by using 3-month treasury bill yield instead of 1-month treasury bill yield. Table 2.5. reports the event study and heteroskedasticity-based GMM estimates of the responses of real estate-related industry indices to changes in the 3-month treasury bill yield along with results of the tests of heteroskedasticity between regimes.

According to the last two columns on Table 2.5., changes in the variance of the monetary policy shock on policy dates are not sufficient to employ the identification through heteroskedasticity approach. This is not a surprising result since 3-month treasury bill yield reflects the monetary policy expectations regarding not only the following month but also additional two months. Hence, it includes information on the expectations regarding at least three more monetary policy actions other than the current monetary policy action (three MPC meetings or one inflation report announcement and two more MPC meetings). Thus, the transmission of current monetary policy actions to 3-month treasury yields may be limited compared to 1-month treasury yields.

On the other hand, real estate-related industry indices are constructed by using the market values of the individual companies as weights. So, the rate of change in an index represents the rate of change in the total market value of all companies included in that index. However, this approach gives more importance to the response of the large firms to changes in short term rates. In extreme cases, value-weighted indices may exhibit misleading movements. For instance, if there are 6 firms in an index where the market value of the largest firm is TL 50 million and the market values of the rest are each TL 10 million. Suppose that, the first firm depreciates by 1% in response to a 25 basis point interest rate cut where the latter ones each appreciate by 0.5%. Change in the value-weighted index will be $\frac{50\times0.99+5\times10\times1.005-100}{100}=-0.25\%$ which can not be regarded as a representative figure for most of the companies. Thus, I also construct

[14] Currency swap rates, repo rates, deposit rates, TRLIBOR rates of 1 to 3-month tenures are among the best alternatives to treasury bond yields. However, deposit rates, 1-month or longer term repo transactions and swap rates are not easy to observe since these transactions are usually made over-the-counter. Moreover, TRLIBOR rates are not determined by market transactions but quotations.

equally-weighted indices for each industry and carry out the same analysis using these indices. Event study and heteroskedasticity-based GMM estimates of α along with the tests of heteroskedasticity between regimes are reported in Table 2.6.

Results on Table 2.6. are broadly in line with those on Table 2.3. GMM estimates are usually larger than event study estimates and responses of financial industries to changes in monetary policy are generally larger than those of non-financial industries. Moreover, responses to MPC meetings are even stronger than the responses to other monetary policy announcements. But in some industries, use of equally weighted indices leads to noticeably smaller or larger responses. For instance, response of equally weighted overall real estate-related index is about one third smaller than its value-weighted counterpart. In real estate-related financial industries, the response of equally-weighted index is smaller than the response of value-weighted index as well. When it comes to iron-steel-foundry and construction sectors, equally-weighted indices are more responsive to monetary policy than value-weighted indices. This is also the case in real estate-related non-financial index. Note that, all of these indices have one or more very large firms and lots of small firms. For instance, as of January 31, 2012, Enka İnşaat constitutes 99% of total market value of the four firms under the construction index.[15] Also Ereğli Demir Çelik constitutes 77% of total market value of the eleven firms under the iron-steel-foundry index. Moreover, five largest banks, namely Garanti, İş Bankası, Akbank, Halkbank and Yapı Kredi constitute 67% of total market value of the thirty eight firms under the real estate-related financial index and 52% of total market value of the ninety four firms under the real estate-related all industries index. Hence, in some indices, calculation method of indices has the potential to affect the results significantly. However, the general pattern of the responses is quite similar.

Besides the equally-weighted indices, the response of value-weighted indices to monetary policy may also be compared with those of the similar equity indices calculated by the BIST. Currently the BIST calculates lots of equity indices on a daily basis. Among them, BIST All Shares, BIST Financials, BIST Banks, BIST REITs,

[15] Market values of the firms listed on the BIST are published on a daily basis on the BIST website. See Table A.2.1.

BIST Non-Metal Mineral Products and BIST Basic Metal indices are related to Turkish real estate markets to some extent. Table 2.7. reports the event study and heteroskedasticity-based GMM estimates of the responses of these indices to monetary policy changes along with the tests of heteroskedasticity between regimes.

Table 2.5. Estimation Results - 3-month T-bill Yield as Policy Rate

	Event Study		Heteroskedasticity-based GMM		Heteroskedasticity Between Regimes (t-test)	
Indices	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**
All Real Estate-Related Industries	-2.067**	-2.048*	3.417	-5.157**	0.006	0.018
	(1.001)	(1.132)	(6.643)	(2.125)	(0.011)	(0.014)
Real Estate-Related Non-Financial Industries	-1.212	-1.372	-4.429	-5.798**	0.009	0.018
	(0.825)	(0.948)	(8.176)	(2.648)	(0.012)	(0.014)
Real Estate-Related Financial Industries	-2.267**	-2.194*	5.180	-4.567*	0.006	0.018
	(1.095)	(1.235)	(6.294)	(2.327)	(0.011)	(0.014)
Individual Industries						
Banking	-2.281**	-2.214*	5.499	-4.757*	0.006	0.018
	(1.109)	(1.251)	(6.265)	(2.404)	(0.011)	(0.014)
REIT	-2.332***	-2.045**	0.248	-0.719	0.008	0.019
	(0.807)	(0.933)	(5.262)	(2.603)	(0.012)	(0.014)
Construction Materials	-1.385**	-1.523**	0.441	-3.234**	0.009	0.019
	(0.665)	(0.756)	(4.020)	(1.552)	(0.011)	(0.014)
Iron-Steel-Foundry	-1.623	-1.861	-1.811	-8.059**	0.009	0.019
	(1.182)	(1.233)	(13.440)	(3.715)	(0.012)	(0.014)
Plastics	-0.554	-0.691	4.489	0.330	0.010	0.019
	(0.906)	(1.053)	(3.841)	(1.915)	(0.011)	(0.014)
Cement	-1.327**	-1.376*	-2.378	-2.708**	0.009	0.019
	(0.625)	(0.700)	(2.409)	(1.358)	(0.011)	(0.014)
Construction	-0.537	-0.700	-5.307	-3.996	0.009	0.018
	(1.172)	(1.357)	(7.053)	(3.331)	(0.011)	(0.014)
Paint	0.454	0.100	8.614***	3.679**	0.011	0.018
	(0.926)	(1.030)	(3.184)	(1.845)	(0.011)	(0.014)
General Equity Market						
BIST 100	-1.811*	-1.827*	5.009	-3.668*	0.006	0.018
	(0.925)	(1.037)	(5.107)	(1.943)	(0.011)	(0.014)

Sample period: Jan.2005 – Jan.2012
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Table 2.6. Estimation Results for Equally Weighted Indices

	Event Study		Heteroskedasticity-based GMM		Heteroskedasticity Between Regimes (t-test)	
Indices	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**	**Full sample**	**Only MPC Meetings**
All Real Estate-Related Industries	-1.706***	-1.921***	-1.962*	-2.726***	0.045***	0.065***
	(0.555)	(0.641)	(1.003)	(0.776)	(0.015)	(0.018)
Real Estate-Related Non-Financial Industries	-1.41***	-1.61***	-1.549*	-2.218***	0.045***	0.064***
	(0.511)	(0.598)	(0.891)	(0.718)	(0.015)	(0.019)
Real Estate-Related Financial Industries	-2.324***	-2.598***	-2.876**	-3.825***	0.046***	0.067***
	(0.686)	(0.768)	(1.261)	(0.924)	(0.015)	(0.018)
Individual Industries						
Banking	-2.791***	-3.051***	-3.322**	-4.615***	0.046***	0.068***
	(0.793)	(0.876)	(1.565)	(1.105)	(0.015)	(0.018)
REIT	-1.611***	-1.878***	-2.029**	-2.555***	0.045***	0.064***
	(0.590)	(0.679)	(0.877)	(0.704)	(0.015)	(0.018)
Construction Materials	-1.308**	-1.561**	-1.212	-2.151***	0.045***	0.065***
	(0.545)	(0.638)	(0.934)	(0.721)	(0.015)	(0.019)
Iron-Steel-Foundry	-1.43**	-1.535*	-1.244	-1.984***	0.046***	0.066***
	(0.671)	(0.780)	(0.901)	(0.698)	(0.015)	(0.019)
Plastics	-1.323*	-1.656**	-1.002	-2.272***	0.045***	0.064***
	(0.676)	(0.770)	(1.002)	(0.718)	(0.015)	(0.019)
Cement	-1.603***	-1.81***	-2.048**	-2.523***	0.044***	0.065***
	(0.509)	(0.594)	(0.934)	(0.807)	(0.015)	(0.018)
Construction	-1.478**	-1.565*	-2.051**	-2.399***	0.044***	0.064***
	(0.685)	(0.809)	(1.025)	(0.828)	(0.015)	(0.019)
Paint	-0.474	-0.576	0.197	-0.741	0.045***	0.065***
	(0.772)	(0.882)	(1.092)	(0.882)	(0.015)	(0.019)

Sample period: Jan.2005 – Jan.2012
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Table 2.7. Estimation Results for the BIST Indices

Indices	Event Study		Heteroskedasticity-based GMM		Heteroskedasticity Between Regimes (t-test)	
	Full sample	Only MPC Meetings	Full sample	Only MPC Meetings	Full sample	Only MPC Meetings
BIST Financials	-2.835***	-3.043***	-3.325**	-4.501***	0.047***	0.069***
	(0.869)	(0.952)	(1.538)	(1.069)	(0.015)	(0.019)
BIST Banks	-3.12***	-3.307***	-3.800**	-4.916***	0.047***	0.069***
	(0.956)	(1.051)	(1.663)	(1.167)	(0.015)	(0.019)
BIST REITs	-1.856***	-1.922**	-2.273**	-2.325***	0.047***	0.067***
	(0.678)	(0.773)	(1.022)	(0.839)	(0.015)	(0.019)
BIST Non-Metal Mineral Prod.	-1.483***	-1.609***	-1.851**	-2.131***	0.044***	0.065***
	(0.485)	(0.564)	(0.850)	(0.746)	(0.015)	(0.018)
BIST Basic Metal	-0.732	-0.696	-0.029	-1.282**	0.045***	0.065***
	(0.939)	(0.989)	(1.105)	(0.644)	(0.015)	(0.019)

Sample period: Jan.2005 – Jan.2012
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Similar to previous results, the responses of equity indices to changes in monetary policy are estimated to be higher in identification through heteroskedasticity approach than in event study approach. Moreover, responses are larger in MPC meeting dates. The BIST Banks index has the largest response to changes in monetary policy and the BIST Basic Metal index has the lowest. In addition, some of the individual BIST indices are very closely related to some individual value-weighted indices. Table 2.8. summarizes and compares the GMM estimates for some individual BIST indices and corresponding value-weighted indices.

According to the comparison given in Table 2.8., GMM estimates for the value-weighted indices and the BIST indices are very close to each other in the banking sector, the REIT sector and the overall financial sector. Moreover, GMM estimates for BIST Non-Metal Mineral Products index are in-between the cement index and the construction materials index. Likewise, GMM estimates for BIST Basic Metal index are in-between the iron-steel-foundry index and the construction materials index. Thus, these findings support the main results of the study.

Table 2.8. Comparison of GMM Estimates of the BIST Indices and the Value-Weighted Indices

BIST Indices	**Full sample**	**Only MPC Meetings**	**Corresponding Value-Weighted Indices**	**Full sample**	**Only MPC Meetings**
BIST Financials	-3.325	-4.501	Real Estate-Related Financial Industries	-3.426	-4.769
BIST Banks	-3.8	-4.916	Banking	-3.486	-4.854
BIST REITs	-2.273	-2.325	REIT	-2.328	-2.374
BIST Non-Metal Mineral Products	-1.851	-2.131	Cement	-2.538	-2.347
			Construction Materials[16]	-1.284	-2.08
BIST Basic Metal	-0.029	-1.282	Iron-Steel-Foundry	0.382	-0.993
			Construction Materials	-1.284	-2.08

2.6.Conclusion

This study estimates the impact of monetary policy on real estate-related industries in Turkey using the heteroskedasticity-based GMM method suggested by Rigobon and Sack (2004), which takes into account both the simultaneity and the omitted variables problems. To the best of my knowledge this is the first study on this issue carried out using Turkish data. This study's main contribution to the literature on the effect of monetary policy on real estate markets is its theoretically reliable econometric methodology instead of OLS which requires strong assumptions.

The empirical results are compared with the results using the most popular approach in the literature, the event study analysis. The results are in line with the literature. Both methods indicate that increases in the policy rate lead to a decline in stock prices of real estate-related firms. Although statistical tests suggest that the methods do not yield different estimates, the estimates obtained from the event study approach are almost always smaller than those obtained from the heteroskedasticity-based GMM method. This weakly implies that event-study approach fails to take the feedback effects of asset prices on monetary policy into account since it cannot solve the endogeneity problem. Moreover, when the inflation report announcement dates are excluded from the sample

[16] Companies under the construction materials index are of secondary but significant importance in both the BIST Non-Metal Mineral Products index and the BIST Basic Metal index.

so that only the MPC meetings are left as the policy dates, the response becomes greater. This implies that the MPC meetings are perceived as more effective monetary policy events than the inflation reports.

The empirical results on industry-specific sub-indices constructed in the study indicate that responses of financial firms to monetary policy are much stronger than those of non-financial firms. This is not surprising since the interest rate sensitivity of financial firms is greater. These findings provide evidence that the monetary policy transmission to real estate-related industries is usually strong but heterogeneous.

CHAPTER 3

DO TURKISH REITS PROVIDE HEDGE AGAINST RISING INFLATION?

3.1.Introduction

A Real Estate Investment Trust (REIT) is essentially a closed-end investment company that owns real estate-related assets. Ownership of such shares allows investors to "participate" in large real estate investments selected and managed by professionals (Park et al., 1990).

REIT shares are said to be effective hedges against inflation because as CPI increases, rents, the main source of the revenues of REITs, also increase. Furthermore, in times of increasing inflation, many investors move their money to real assets such as real estate and hence increased demand for real estate produces an almost real time increase in REIT share prices. Note that the fact that an asset is a complete hedge against expected and/or unexpected inflation does not imply that the real return on the asset has zero variance or even a small variance (Fama and Schwert, 1977). Thus, inflation can only account for some portion of the variation in the prices of financial assets even if they are complete inflation hedges. In other words, variation also exists in the real prices of financial assets.

According to Scott Crowe from Cohen&Steers, a portfolio manager, Treasury Inflation Protected Securities (TIPS) and commodities are also considered as inflation hedges along with REITs but TIPS provide hedge against inflation with a lag (2 to 8 months) and commodities have very volatile returns (Cohen&Steers 2010). Moreover, REITs have overperformed TIPS and commodities in terms of risk and return over the last 10 years.

One important discussion regarding the inflation hedging ability of real estate assets is the speed of the adjustment of rents to inflation changes. This mainly depends on the amount of excess capacity (existing vacancies and new supply) of real estate assets. If the existing supply of commercial real estate is low, excess vacancy is absorbed quickly once demand picks up. Because building new supply can take years, landlords in a tight market have the power to increase rents timely and significantly (Cohen&Steers 2010). Hence, the inflation hedging ability of real estate assets is expected to be stronger in the short run if the vacancy rates are low. Considering this fact, this study focuses on the short-run relationship between REIT share prices and inflation in Turkey.

REITs in Turkey have some important characteristics. In Turkey, financial regulations regarding REITs are less tight than most of the other countries. Compared to their counterparts in developed countries, Turkish REITs have some important tax incentives and they have the freedom to choose their dividend policies so that the Turkish REITs to enjoy the financial flexibility to accumulate dividends, if needed, for further investments (Erol and Tırtıroğlu 2008).

In this study, I aim to investigate the short-run inflation hedging ability of Turkish REITs especially against increases in inflation. In this context, firstly, some empirical findings of the previous works are presented and the theoretical background of complete inflation hedging ability is discussed. Then, the data on REIT returns, inflation and monetary policy in Turkey are introduced and empirical studies using these data are carried out. After the empirical analyses, the final section concludes.

3.2.Related Literature

There are various papers that examine the inflation hedging ability of REITs, common stocks and real estate assets. Majority of the studies are carried out for the U.S. and the other advanced countries and most of them fail to support the hypothesis that financial assets and more specifically REITs provide hedge against inflation. Even in some papers, REITs and common stocks are found to be perverse inflation hedges. One possible explanation is that results from spurious regressions reverse the causal relationship between inflation and REIT returns. Contrary to REITs and common stocks, some studies provide evidence that unsecuritized real estate investments serve as hedges against inflation. But due to the fact that the valuation of unsecuritized real estate assets are generally based on appraisal data and it is very common for appraisers to adjust the value estimates by an inflation factor, the estimated regressions are more likely to be spurious and coefficients are probably biased.

Fama and Schwert (1977) find that US government bonds and bills provide a complete hedge against expected inflation and private residential real estate is a complete hedge against both expected and unexpected inflation using 1953-1971 US data. They also find that common stock returns are negatively related to the expected component of the inflation rate.

Park et al. (1990) find that returns on REITs generally tend to behave like equities with respect to their hedging characteristics. However, they provide evidence that REITs are partial hedges against anticipated inflation when survey results are used as expected inflation.

Westerheide (2006), Hoesli et al. (2008) and Chatrath and Liang (2008) analyze the long run inflation hedging ability of real estate assets and other investments by cointegration approach. Westerheide (2006) does not obtain significant coefficient estimates for the inflation hedging ability of real estate securities of US, Canada, Australia, Japan, the Netherlands, Belgium, France and Germany. However, the point estimates of coefficients of long run equilibria between the development of consumer price indices and real estate stock/REIT indices are positive in most countries so the author concludes that there exists at least some weak evidence for inflation hedging ability. Hoesli et al. (2008) also employ the cointegration approach for US and UK markets but add real and monetary variables to their error correction models in order to avoid a spurious relationship between inflation and asset returns and find that in the long run, once real activity and monetary changes are included, REIT and common stock returns are generally positively linked to expected inflation, but not to inflation shocks. Chatrath and Liang (2008) find that unsecuritized reals estate and REITs provide a long run hedge against inflation using the Johansen tests for cointegration. However, the more standard residual based cointegration techniques fail to provide similar evidence for REITs. They conclude that REITs tend to behave like other equities to some extent but also have some inflation hedging ability since they hold real assets in their portfolios.

Hoesli et al. (1997) analyze the short-term inflation hedging characteristics of U.K. stocks, bonds, appraisal-based real estate and real estate stocks. On the one hand, they can not draw clear conclusion on the inflation hedging capability of real estate since the real estate series used is appraisal-based. On the other hand, they estimate negative but insignificant coefficients for stocks, bonds and real estate stocks. So they provide only weak evidence that these assets are perverse hedges against inflation. Liu et al. (1997) obtain similar results for Australia, France, Japan, South Africa, Switzerland, the U.K. and the U.S. that real estate stocks act as weak perverse hedges against inflation and its expected and unexpected components. Yobaccio et al. (1995) find that REITs provide some hedging capability against expected inflation but act as perverse hedges against unexpected inflation. Glascock et al. (2002) test for the causal relationships among REIT returns, real activity, monetary policy, and inflation through a vector error correction model and conclude that observed negative relationship between REIT returns and inflation is spurious and monetary policy has important impact on price movement of REITs.

Bond and Seiler (1998) investigate the inflation hedging effectiveness of residential real estate for the U.S. market over the 1969-1994 period by regressing percentage change in median home sales price on a set of variables that contains expected and unexpected inflation along with some unobserved variables obtained from a principal components analysis of several other variables that may affect the returns. The results indicate that residential real estate is a significant hedge against both expected and unexpected inflation.

Simpson et al. (2007) employ a panel data estimation methodology to a set of 195 publicly traded equity REITs for the period 1981–2002, and detect a strong asymmetry in the response of equity REIT returns to inflation. Specifically, when the expected and unexpected inflation are separated into positive and negative changes, their results indicate that equity REIT returns rise in response to both increases and decreases in inflation. However, one important feature or perhaps a deficiency of the study is that the models estimated in the study are dynamic panel data models since they include the lagged REIT returns among the explanatory variables but they estimate the regressions by OLS instead of an appropriate method such as the one proposed by Arrelano and Bond (1991). In dynamic panel data models, OLS yields biased and inconsistent estimates (Baltagi, 2010). Based on their estimates, the authors conclude that the failure of earlier empirical work to document such a positive relationship might perhaps due to the fact that the relationship between REIT returns and inflation were treated in specifications which impose symmetric responses to positive and negative changes in inflation.

Erol and Tırtıroğlu (2008) test the inflation hedging ability of Turkish REITs in comparison to the indices of common stocks listed on the Istanbul Stock Exchange (Borsa Istanbul - BIST) and find that REITs provide a better hedge against both actual and expected inflation than do the common stocks. Moreover, they split the sample period into the high and moderate inflation sub-periods and find that the hedging ability of REITs is better under high inflation and disappear in the moderate inflation period.

3.3.Theoretical Discussion of the Effects of Inflation on Asset Returns

According to the Fisher Hypothesis, expected nominal return on an asset is equal to its expected real return plus the expected rate of inflation (Fisher 1930). As a quantity theorist, Fisher felt that the monetary and real sectors of the economy are largely independent and hence the expected real return is determined by real factors and that the expected real return and expected inflation are unrelated (Fama and Schwert 1977). But this is only the case if the asset has the inflation hedging ability. Thus, according to Fama and Schwert (1977), an asset is said to be a complete inflation hedge, if and only if the nominal return of the asset compensates both expected and unexpected inflation.

Consider a security, future cash flows of which are adjusted one-to-one to the price level changes i.e. the security provides a complete hedge against inflation. Without loss of generality, assume that there is no real growth in future cash flows so that the cash flows are constant in real terms;

$$CF_t = CF_0 \frac{P_t}{P_0}$$

Let the discount rate be not a function of the inflation rate. In this case, value of a share of a REIT that invested all of its funds to real estate assets is determined as;

$$V = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{CF_0 \, {}^{P_t}/_{P_0}}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{CF_0 (1+\pi^e)^t}{(1+r)^t}$$
$$= CF_0 \sum_{t=1}^{\infty} \left(\frac{1+\pi^e}{1+r}\right)^t = \frac{CF_0(1+\pi^e)}{r-\pi^e}$$

i) Let the inflation expectations in the economy be unmoored so that the inflationary shocks are persistent. In this case, an increase in inflation rate at t=0 leads to a same amount of change in all future inflation expectations. Thus, the future inflation expectations can be written as;

$$\pi_t^e = \pi + \Delta\pi$$

where $\Delta\pi$ is the change in inflation rate at t=0 after the inflationary shock. Substituting $\pi + \Delta\pi$ for π^e in the present value formula of the asset;

$$V' = \frac{CF_0(1+\pi+\Delta\pi)}{r-\pi-\Delta\pi}$$

In this case, the return of the asset is;

$$r_a = \frac{V'}{V} - 1 = \frac{(1+r)\Delta\pi}{(r-\pi-\Delta\pi)(1+\pi)}$$

Assuming that $r > \pi + \Delta\pi$ so the real discount rate is positive, $r_a > 0$.

ii) Let the inflation expectations in the economy be anchored so that the transmission of inflationary shocks to future periods is zero. In this case, an increase in inflation rate at t=0 does not affect the future inflation expectations. Thus, the value of the asset becomes:

$$V' = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{CF_0 \, {}^{P_t}/_{P_0}}{(1+r)^t} = \sum_{t=1}^{\infty} \frac{CF_0(1+\pi+\Delta\pi)(1+\pi)^{t-1}}{(1+r)^t}$$

$$= \frac{CF_0(1+\pi+\Delta\pi)}{1+r} \sum_{t=1}^{\infty} \frac{(1+\pi)^{t-1}}{(1+r)^{t-1}} = \frac{CF_0(1+\pi+\Delta\pi)}{r-\pi}$$

In this case, the return of the asset is;

$$r_a = \frac{V'}{V} - 1 = \frac{1+\pi+\Delta\pi}{1+\pi} - 1 = \frac{\Delta\pi}{1+\pi}$$

This is less than but quite close to $\Delta\pi$ assuming that the inflation rate is low.

Now, let the discount rate is a function of the inflation rate, and the inflation expectations are anchored. In this case, after an increase in inflation rate at t=0, value of a common stock of a REIT that invested all of its funds to real estate assets is determined as;

$$V' = \sum_{t=1}^{\infty} \frac{CF_t}{(1+r_t)^t} = \frac{CF_0(1+\pi+\Delta\pi)}{(1+r_1)} + \sum_{t=2}^{\infty} \frac{CF_0(1+\pi+\Delta\pi)(1+\pi)^{t-1}}{(1+r_0)^t}$$

$$= \frac{CF_0(1+\pi+\Delta\pi)}{(1+r_1)} + \frac{CF_0(1+\pi+\Delta\pi)(1+\pi)}{(r_0-\pi)(1+r_1)} = \frac{CF_0(1+\pi+\Delta\pi)}{(1+r_1)}\left(\frac{1+r_0}{r_0-\pi}\right)$$

In this case, the return of the asset is;

$$r_a = \frac{V'}{V} - 1 = \frac{1+\pi+\Delta\pi}{1+\pi} \cdot \frac{1+r_0}{1+r_1} - 1 = \frac{\Delta\pi}{1+\pi} \cdot \frac{1+r_0}{1+r_1} + \frac{r_0-r_1}{1+r_1}$$

If the discount rate is not responsive to changes in inflation rate, then $r_0 = r_1$ and the return becomes equal to $\frac{\Delta\pi}{1+\pi}$ as in the previous case. If the discount rate is updated to fully reflect the change in inflation, then $r_1 = r_0 + \Delta\pi$ and the return becomes;

$$r_a = \frac{\Delta\pi}{1+\pi} \cdot \frac{1+r_0}{1+r_1} + \frac{r_0 - r_0 - \Delta\pi}{1+r_1} = \frac{\Delta\pi}{1+r_1}\left(\frac{1+r_0}{1+\pi} - 1\right) = \frac{\Delta\pi}{1+\pi} \cdot \frac{r_0-\pi}{1+r_0+\Delta\pi}$$

This result is important since it implies that if the interest rates are adjusted to account for the inflation change, then the asset return becomes lower. Moreover, the denominator of the second part, $1 + r_0 + \Delta\pi$ is greater than but close to 1 and if the nominator, $r_0 - \pi$ is small enough, the asset return becomes close to zero. Thus, if the monetary policy stance is adjusted for changes in inflation (as is expected in the real world) and if the effect of monetary policy stance is omitted in the empirical setting, the estimated coefficient of an asset which is a complete inflation hedge will most likely be insignificant.

In light of this, following model will be useful in testing the inflation hedging ability of

$$\Delta r_t = \alpha + \beta \Delta\pi_t^e + \gamma \Delta\pi_t^u + \varphi MPS_t + \varepsilon_t \qquad (3.1.1)$$

Financial theory states that both β and γ should be positive ex ante and if β (γ) is equal to 1, the asset provides hedge against expected (unexpected) inflation.

At this point, following Simpson et al. (2007) I also separate increases and decreases in both expected inflation and unexpected inflation to allow asymmetric response of REIT returns to inflation. For this reason, Model (3.1.1) becomes;

$$\Delta r_t = \alpha + \beta_+ \Delta\pi_{+t}^{e} + \beta_- \Delta\pi_{-t}^{e} + \gamma_+ \Delta\pi_{+t}^{u} + \gamma_- \Delta\pi_{-t}^{u} + \varphi MPS_t + \varepsilon_t \qquad (3.1.2)$$

Coefficient estimates of β_+, β_-, γ_+ and γ_- indicate the inflation hedging ability of REIT returns against increases in expected inflation, decreases in expected inflation, increases in unexpected inflation and decreases in unexpected inflation, respectively.

3.4.Data

I obtain monthly price and return data of all REITs which are available on the BIST website. These returns not only reflect the capital gains but also income gains since they are adjusted for the dividend payments and stock splits. There are 23 REITs as of September 30, 2011 and these constitute 100% of the REITs in BIST REIT Index.[17] Total market value of these REITs is USD 11.7 billion. Emlak Konut GYO solely constitutes about one-half of all REITs market but it is a relatively newly established company and hence it is not reflected in the first 90% portion of the sample period. I also obtain the monthly price and return data of the equity indices BIST 100, BIST Financials and BIST REIT from the same source.

[17] Detailed information on the REITs listed on the BIST is given in the appendix.

Table 3.1. Descriptive Statistics of Monthly Returns of REIT and Equity Indices

Equity Id	Average Monthly Return[18]	Standard Deviation of Monthly Returns	Minimum Monthly Return	Maximum Monthly Return	Count
PEGYO	-0.38	21.77	-45.94	66.38	117
OZGYO	0.56	18.03	-35.56	107.87	117
AVGYO	-0.58	19.28	-41.29	75.31	117
VKGYO	1.09	15.39	-25.10	63.93	117
ALGYO	1.02	14.25	-38.64	40.50	117
DGGYO	1.22	18.65	-35.54	74.48	117
EGYO	-0.55	17.77	-50.00	82.86	117
YKGYO	0.56	20.51	-62.11	46.55	117
ISGYO	0.82	14.19	-34.44	43.06	117
YGYO	0.17	22.41	-40.28	128.92	117
NUGYO	0.99	17.53	-32.57	66.19	117
AGYO	0.92	15.66	-33.10	47.48	116
AKMGY	1.12	13.01	-25.64	57.44	78
SAGYO	1.68	19.32	-28.93	74.73	55
SNGYO	-0.19	19.32	-35.14	65.03	52
TSGYO	-2.71	8.21	-20.00	9.30	18
RYGYO	-0.52	8.90	-14.16	18.75	15
IDGYO	10.52	46.74	-51.05	102.88	15
MRGYO	-4.22	8.61	-16.67	13.00	13
TRGYO	-2.91	10.47	-14.93	18.75	12
EKGYO	3.78	16.50	-13.18	43.43	10
KLGYO	-10.48	11.87	-21.34	2.61	6
AKFGY	-8.03	5.20	-12.72	0.00	5
BIST 100	1.44	10.25	-26.29	26.03	117
BIST Financials	1.47	12.12	-28.41	30.71	117
BIST REIT	0.96	12.34	-38.16	32.03	117

Descriptive statistics of monthly returns of REITs and equity indices are reported in Table 3.1. During the sample period of approximately 9 years, the overall return of the BIST REIT index was well below BIST 100 and BIST Financials indices. Furthermore, its variance was higher than BIST 100 and BIST Financials as well. When we look at the returns of individual REITs (with at least 50 observations) we see that some of them fall below the average monthly inflation rate which is 0.89% per month in the

[18] Arithmetic mean and standard deviation are calculated at first by transforming the monthly returns into continuously compounded returns since arithmetic mean and standard deviation calculations involve addition and subtraction operations. These operations are only suitable when the rates of returns are expressed as continuously compounded returns. At the end, calculated values for continuously compounded series are transformed back and reported as monthly compounded returns.

sample period. Doğuş, Vakıf, Alarko, Akmerkez and Sağlam's overall returns were reasonably better than the others. Moreover, variations in the monthly returns of Atakule, Akmerkez, Alarko, İş and Vakıf were rather low compared to others. But neither of the individual REITs provides better returns or lower risk than BIST 100 or BIST Financials.

I use the monthly rate of change in Consumer Price Index (CPI) announced by Turkstat as the inflation rate. Moreover, following the definition of Fama and Schwert (1977) I separate the expected and unexpected components of inflation. In order to obtain the expected inflation, there are three main approaches. First one is to use time series models such as filters, exponential smoothing models or ARIMA models. Second is to use financial market data such as the treasury bond yields, inflation-indexed bond yields, inflation-indexed swap rates etc. and calculate the inflation expectations implied by these yields. Third is to use survey results. I prefer the third way and obtain the expected monthly inflation rates from the Bloomberg's survey of inflation expectations. Bloomberg conducts this survey among economists regarding the monthly CPI inflation expectations in the last days of each month. I test the forecasting ability of Bloomberg's survey data by running a regression of the actual monthly inflation rate on the expected monthly inflation rate. OLS estimation results are given in Table 3.2.

Table 3.2. OLS Estimation Results of Inflation Forecasting Ability of Bloomberg Survey

Actual Inflation	Intercept	Expected Inflation (Survey)
Coefficient	-0.001	0.978***
St. Error	0.001	0.056
t-stat	-0.792	17.592
R-squared	0.727	

*** denotes significance at 0.01 level. Sample period Jan-2002 to Oct-2011, number of observations is 118

According to the estimation results, slope coefficient is close to 1 and intercept is close to zero, and also the coefficient of determination is quite high. This implies that the survey data can be used as the expected inflation conveniently. Using these data, I calculated the expected and unexpected change in inflation as follows:

$$\Delta\pi_t^e = \pi_t^e - \pi_{t-1}$$

$$\Delta\pi_t^u = \pi_t - \pi_t^e$$

Where π is the monthly CPI inflation rate, π^e is the expected component of the monthly inflation rate, π^u is the unexpected component of the monthly inflation rate. Sum of the expected and unexpected changes in inflation is equal to the actual change in inflation;

$$\Delta\pi_t^e + \Delta\pi_t^u = \pi_t - \pi_{t-1} = \Delta\pi_t$$

I use short term interest rates as a proxy for monetary policy stance. Note that the short term interest rates reflect expectations of monetary policy rate changes over the following months and adjust daily according to changes in expectations of monetary policy over the near term (Rigobon and Sack. 2003). Among the alternative short term interest rates (repo rates, cross-currency swap rates, deposit rates etc.), yields on government bonds with short term maturity are priced in a relatively more liquid market and hence I prefer to use treasury bond yields as the short term interest rates. But since these series are not available in a regular time-series format across each maturity I obtain 1, 2 and 3 month treasury bond yields by linear interpolation.[19] Descriptive statistics of inflation and monetary policy variables are reported in Table 3.3. During the sample period of approximately 9 years, the inflation rate was on a decreasing trend and hence the average monthly change in inflation was 0.02%. Not surprisingly, in line with this trend, monetary policy rates were also on a decreasing trend. For instance, the three-month treasury yield went down from 68.7% in December 31, 2001 to 7.4% in September 30, 2011. In 60 of the months in the sample period actual inflation increased (by an average of 0.75%) and in 55 of the months it decreased (by an average of 0.86%). It also remained the same in two months. The highest increase was in October 2008 (from 0.50% to 2.60%) and the highest decrease was in June 2011 (from 2.42% to -1.43%).

[19] Details on the calculation of linear interpolation is discussed in Section 2.4.1.

Table 3.3. Descriptive Statistics of Change in Monthly Inflation and Treasury Yields

Series	Average	Standard Deviation	Minimum Monthly Change	Maximum Monthly Change	Count
Change in Inflation	-0.02	1.02	-3.85	2.10	117
Exp. Change in Inflation	0.07	0.78	-3.19	1.80	117
Unexp. Change in Inflation	-0.09	0.53	-1.60	1.42	117
Increase in Inflation	0.75	0.52	0.02	2.10	60
Decrease in Inflation	-0.86	0.74	-3.85	-0.01	55
Exp. Increase in Inflation	0.59	0.43	0.02	1.80	66
Unexp. Increase in Inflation	0.40	0.31	0.01	1.42	49
Exp. Decrease in Inflation	-0.66	0.57	-3.19	-0.05	47
Unexp. Decrease in Inflation	-0.47	0.34	-1.60	-0.02	64
Change in 1M Yield	-0.48	1.80	-7.83	5.84	117
Change in 2M Yield	-0.51	1.86	-7.60	5.66	117
Change in 3M Yield	-0.52	2.37	-11.47	6.69	117

3.5.Empirical Results

I conduct the empirical analysis of the inflation hedging ability of the REITs by first running OLS regressions of the return series on inflation and monetary policy variables using specifications nested in Model (3.1.2). Then I repeat the same procedure using panel data that include all the individual return series. Results of the analysis of the individual series are reported in Section 3.5.1 and the results of the panel data are reported in Section 3.5.2.

3.5.1. Individual Data Estimation Results

In this part of the study, I test the inflation hedging ability of the equity indices, BIST 100, BIST Financials, BIST REIT and then that of the individual REITs. For the equity indices, I test the inflation hedging ability by the following three specifications.

$$\Delta r_t = \alpha + \beta \Delta\pi_t^e + \gamma \Delta\pi_t^u + \varepsilon_t \quad (3.2.1)$$

$$\Delta r_t = \alpha + \beta_+ \Delta\pi_{+t}^{\ e} + \beta_- \Delta\pi_{-t}^{\ e} + \gamma_+ \Delta\pi_{+t}^{\ u} + \gamma_- \Delta\pi_{-t}^{\ u} + \varepsilon_t \quad (3.2.2)$$

$$\Delta r_t = \alpha + \beta_+ \Delta\pi_{+t}^{\ e} + \beta_- \Delta\pi_{-t}^{\ e} + \gamma_+ \Delta\pi_{+t}^{\ u} + \gamma_- \Delta\pi_{-t}^{\ u} + \varphi MPS_t + \varepsilon_t \quad (3.2.3)$$

Here r denotes the rate of return of the asset, π is the monthly CPI inflation rate, π^e is the expected component of the monthly inflation rate, π^u is the unexpected component of the monthly inflation rate, subscripts (+) and (-) denote the positive and negative changes respectively and MPS denotes the change in monetary policy stance proxied by the monthly change in 3-month treasury bond yield. Specifications (3.2.1) and (3.2.2) are nested in Specification (3.2.3). Specification (3.2.3) takes into account the monetary policy stance and asymmetric response of returns to increases and decreases in inflation. Specification (3.2.2) does not take into account the monetary policy stance and Specification (3.2.1) does not take into account the monetary policy stance and asymmetry. In any specification, significant and positive estimates for β, β_+ and/or β_- (γ, γ_+ and/or γ_-) indicate hedging against expected (unexpected) inflation. OLS estimation results along with the coefficient of determination, number of observations and the Durbin Watson statistics[20] are given in Table 3.4. These findings indicate that when the asymmetry is not taken into account, the coefficients of both the expected and the unexpected change in inflation are insignificant for each equity index. On the other hand, when the increases and decreases in inflation are separately included in the model, coefficients become significantly different from zero at least at 10% level. Both the expected and the unexpected increases in inflation lead to decreases in BIST 100, BIST Financials and BIST REIT returns. Moreover, the expected and the unexpected decreases in inflation also lead to decreases in BIST 100, BIST Financials and BIST REIT returns. This is also the case when the change in monetary policy stance is also included in the model as a control variable. In all cases, responses of asset returns are larger against unexpected inflation and the coefficient of monetary policy is always negative and significant as expected. A monetary expansion leads to increase in returns and a monetary contraction leads to a decrease in returns. In addition to the coefficient estimates, DW statistics do not indicate that there is autocorrelation in the regressions. Note that the coefficients of determination in all models are very low. But this is not surprising since non-inflation factors can generate variation in nominal returns as well (Fama and Schwert, 1977).

[20] In time series models it is quite likely to encounter autocorrelation. DW statistics are given in order to test the first order autocorrelation in these time series models. Autocorrelation is also important since it is a rough indicator of spurious regressions and omitted variables.

Table 3.4. OLS Estimation Results of the Regressions of Equity Indices

Model	**Model I**	**Model II**	**Model III**	**Model I**	**Model II**	**Model III**	**Model I**	**Model II**	**Model III**
Dependent Variable	**BIST 100**	**BIST 100**	**BIST 100**	**BIST Financials**	**BIST Financials**	**BIST Financials**	**BIST REIT**	**BIST REIT**	**BIST REIT**
Intercept	1.910**	8.174***	6.771***	2.073*	8.716***	7.075***	1.439	8.815***	7.099***
	(0.928)	(1.531)	(1.286)	(1.097)	(1.804)	(1.46)	(1.12)	(1.888)	(1.685)
Exp. Change in Inflation	0.088			0.328			0.915		
	(0.95)			(1.176)			(1.139)		
Unexp. Change in Inflation	0.01			-0.368			-1.597		
	(1.652)			(1.848)			(2.268)		
Exp. Increase in Inflation		-4.277***	-4.084***		-4.215**	-3.988**		-4.377*	-4.141*
		(1.628)	(1.502)		(1.983)	(1.792)		(2.311)	(2.225)
Unexp. Increase in Inflation		-11.23***	-9.225***		-12.418***	-10.073***		-14.608***	-12.16***
		(3.164)	(2.334)		(3.497)	(2.309)		(3.596)	(2.533)
Exp. Decrease in Inflation		3.038**	3.074*		3.369**	3.411*		4.543***	4.587**
		(1.477)	(1.678)		(1.695)	(1.896)		(1.554)	(1.776)
Unexp. Decrease in Inflation		8.367***	7.405***		8.612***	7.487***		8.039**	6.863*
		(2.69)	(2.329)		(3.189)	(2.662)		(3.607)	(3.481)
Change in 3M Treasury Yield			-1.456***			-1.703***			-1.780***
			(0.406)			(0.43)			(0.489)
$\mathbf{R^2}$	0	0.143	0.264	0.001	0.115	0.233	0.007	0.144	0.27
n	117	117	117	117	117	117	117	117	117
DW	2.095	2.245	2.252	2.038	2.142	2.162	1.885	1.968	1.922

Sample period: Jan.2002 – Sep.2011
Standard errors are estimated using the Newey-West covariance matrix estimation[21] and are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

[21] As stated before, it is quite likely to encounter autocorrelation in time series models. In the presence of autocorrelation, covariance matrix of residuals obtained by OLS becomes biased and hence standard errors and hypothesis tests become incorrect. In this case Newey-West estimator of the covariance matrix is a useful alternative since this estimator yields an inefficient but yet an unbiased estimate of the covariance matrix. Thus, I used Newey-West standard errors for convenience.

These empirical results are in contradiction to the proposition that common stocks are inflation hedges. They only appear as hedges during disinflationary periods. When inflation (expected or unexpected) falls, probably due to the contraction in economic activity, investors' expectations regarding future dividends of the firms deteriorate and hence the returns also fall. This is somewhat sensible since a large portion of the sample period witnessed the Global Financial Crisis of 2007-2010. Moreover, when the inflation increases, investors think that both the short and long term interest rates will increase and the asset prices fall. On the other hand, when inflation is on the rise, REIT shares behave like equities and depreciate.

After testing the inflation hedging ability of equity indices, I also test the same hypothesis for individual REIT returns using only Specification (3.2.3) in order to avoid excessive analysis. OLS estimation results along with the coefficients of determination are given in Table 3.5. These results are generally in line with previous findings. Coefficients of expected and unexpected increases in inflation are generally negative and significant where the coefficients of expected and unexpected decreases in inflation are generally positive and significant. In most of the cases, REITs are found to be perverse hedges against inflation. But, there are some cases where the coefficients are found to be insignificant and even have the expected signs according to the hypothesis that REITs provide hedge against inflation (these cases are highlighted in the table). Nevertheless, these insignificant estimates do not provide strong evidence for the existence of inflation hedging ability of REITs. In addition to the coefficient estimates, DW statistics do not indicate that there is autocorrelation in the regressions.

In order to complement the empirical results, the scatterplots of returns of equity indices and individual REITs vs. the increases and decreases in actual, expected, unexpected inflation are presented in the appendix. The patterns indicating negative (positive) but weak relationship between REIT returns and increases (decreases) in inflation can be seen from the scatterplots. But this is not the case when increases and decreases in inflation are not separated.

3.5.2. Panel Data Estimation Results

In this part of the study, I test the inflation hedging ability of the REITs by using panel data approach and use all observations together. Since the returns of all REITs are not available at every date, I have to use an unbalanced panel. Note that the use of traditional estimators developed for the balanced panel data models in unbalanced panel data models reduces the efficiency of the estimates but does not cause bias (Baltagi, 2010). For robustness I also construct another panel which excludes TSKB, Reysaş, İdealist, Martı, Torunlar, Emlak Konut, Kiler, Akfen, Akmerkez, Sağlam and Sinpaş along with the date January 2002 from the sample so that the remaining data constitute a balanced panel of 12 REITs and 116 months. I estimate each model using these two different panels.

By using the panel data, I test the inflation hedging ability of REITS by the following four specifications.

$$\Delta r_{it} = \alpha_i + \beta\Delta\pi_t + \varepsilon_{it} \quad (3.3.1)$$

$$\Delta r_{it} = \alpha_i + \beta\Delta\pi_t^e + \gamma\Delta\pi_t^u + \varepsilon_{it} \quad (3.3.2)$$

$$\Delta r_{it} = \alpha_i + \beta_+\Delta\pi_{+t}^{\ e} + \beta_-\Delta\pi_{-t}^{\ e} + \gamma_+\Delta\pi_{+t}^{\ u} + \gamma_-\Delta\pi_{-t}^{\ u} + \varepsilon_{it} \quad (3.3.3)$$

$$\Delta r_{it} = \alpha_i + \beta_+\Delta\pi_{+t}^{\ e} + \beta_-\Delta\pi_{-t}^{\ e} + \gamma_+\Delta\pi_{+t}^{\ u} + \gamma_-\Delta\pi_{-t}^{\ u} + \varphi MPS_t + \varepsilon_{it} \quad (3.3.4)$$

Specifications (3.3.1), (3.3.2) and (3.3.3) are nested in Specification (3.3.4). Specification (3.3.4) takes into account the monetary policy stance, asymmetric response of returns to increases and decreases in expected and unexpected inflation. Specification (3.3.3) does not take the monetary policy stance into account and Specification (3.3.2) does not take the monetary policy stance and asymmetry into account. Specification (3.3.1) is the most reduced version of all models and does not separate the expected and unexpected changes in inflation. All models are estimated by (cross-section) fixed-effects OLS estimation and the results along with the coefficients of determination, number of observations and the Durbin Watson statistics are reported in Tables 3.6 and 3.7.

Table 3.5. OLS Estimation Results of the Regressions of Individual REITs

Dep. Variable	Intercept	Exp. Increase in Inflation	Unexp. Increase in Inflation	Exp. Decrease in Inflation	Unexp. Decrease in Inflation	Change in 3M T-yield	R^2
PEGYO	4.654	-6.179	-6.351	2.558	2.759	-2.630***	0.128
	(3.885)	(3.935)	(7.256)	(1.717)	(7.265)	(0.524)	
OZGYO	5.957**	-4.927	-11.062***	**-0.123**	4.532	-1.389	0.069
	(2.778)	(3.325)	(3.291)	(3.625)	(7.390)	(0.876)	
AVGYO	3.229	**0.539**	-12.012*	**-6.851**	10.565**	-0.924	0.086
	(2.512)	(3.496)	(6.750)	(4.288)	(4.815)	(0.575)	
VKGYO	4.33**	**2.223**	-6.100	5.928***	4.606	-1.621***	0.143
	(2.042)	(4.133)	(4.122)	(2.180)	(3.721)	(0.526)	
ALGYO	8.962***	-6.316*	-15.881***	5.021*	5.972*	-1.106**	0.185
	(2.381)	(3.239)	(3.555)	(2.808)	(3.413)	(0.437)	
DGGYO	11.258***	-8.610***	-12.751**	6.336**	12.179**	-2.355***	0.218
	(2.854)	(3.167)	(5.651)	(2.783)	(5.021)	(0.531)	
EGYO	6.069	-2.854	-12.809*	**-0.327**	10.028*	-0.584	0.062
	(3.991)	(3.621)	(7.421)	(1.904)	(5.655)	(0.428)	
YKGYO	8.852***	-4.341	-16.309***	6.833**	7.285*	-2.260***	0.209
	(2.369)	(3.850)	(5.508)	(2.999)	(4.319)	(0.613)	
ISGYO	7.240***	-4.143	-13.066***	4.387**	7.441*	-2.109***	0.256
	(1.988)	(2.575)	(2.944)	(1.678)	(4.170)	(0.534)	
YGYO	5.430	-0.903	-15.541**	**-0.207**	6.623	-2.765**	0.129
	(4.351)	(5.603)	(7.819)	(2.874)	(6.744)	(1.319)	
NUGYO	7.782***	-1.251	-14.042***	1.748	10.365***	-0.886	0.078
	(2.531)	(3.304)	(5.175)	(2.064)	(3.535)	(0.600)	
AGYO	10.257***	-7.324***	-14.643***	4.006*	12.855***	-1.676***	0.213
	(2.665)	(2.531)	(5.170)	(2.215)	(4.622)	(0.420)	
AKMGY	6.377**	-6.565	-7.272*	2.314	3.292	-1.591	0.084
	(2.788)	(4.355)	(4.254)	(3.101)	(8.025)	(1.163)	
SAGYO	7.422	**5.851**	-19.635**	1.950	10.546	-1.268	0.116
	(5.282)	(9.107)	(9.394)	(3.513)	(10.525)	(2.496)	
SNGYO[22]	6.468	-4.273	-14.052**	4.235	**-1.063**	-1.165	0.083
	(4.917)	(6.627)	(5.977)	(3.303)	(13.118)	(2.760)	

Sample period: Jan.2002 – Sep.2011
Standard errors are estimated using the Newey-West covariance matrix estimation and are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

These empirical results presented in Tables 3.6. and 3.7.are completely in line with the results obtained from the regressions reported in Section 3.5.1. and coefficients and standard errors from both the balanced and the unbalanced panel approaches are very close to each other. When asymmetry is not taken into account, the coefficients are insignificant in both samples except for the coefficient of unexpected inflation in the unbalanced sample. Hence, the unbalanced panel estimates indicate that REITs provide perverse hedges against unexpected inflation. Both samples do not provide evidence regarding the hedging ability of REITs against expected inflation. On the contrary,

[22] DW statistic for the regression of SNGYO falls into the inconclusive region for positive autocorrelation. But since the estimates are in line with other REITs and the sample size is limited, I do not investigate the presence of autocorrelation further for this regression.

when the asymmetry is taken into account, coefficients become significantly different from zero at least at 5% level. Both the expected and the unexpected increases in inflation lead to a decrease in REIT returns. Moreover, the expected and the unexpected decreases in inflation also lead to a decrease in REIT returns. This is also the case when the change in monetary policy stance is included in the model as a control variable. In all cases, the coefficient of monetary policy is negative as expected and significant. In addition to the coefficient estimates, DW statistics do not indicate autocorrelation in the regressions.

Table 3.6. Estimation Results of the Unbalanced Panel of REITs

Sample	**Unbalanced Panel of 23 REITs**			
Model	**Model I**	**Model II**	**Model III**	**Model IV**
Intercept	1.858*** (0.427)	1.743*** (0.433)	8.154*** (0.839)	6.692*** (0.835)
Change in Inflation	-0.466 (0.409)			
Exp. Change in Inflation		0.116 (0.544)		
Unexp. Change in Inflation		-1.627** (0.824)		
Exp. Increase in Inflation			-3.767*** (1.056)	-3.510*** (1.032)
Unexp. Increase in Inflation			-13.832*** (1.598)	-11.793*** (1.577)
Exp. Decrease in Inflation			1.998** (0.891)	2.021** (0.870)
Unexp. Decrease in Inflation			8.422*** (1.451)	7.381*** (1.422)
Change in 3M Treasury Yield				-1.694*** (0.188)
R^2	0.014	0.016	0.065	0.109
N	1682	1682	1682	1682
DW	1.912	1.909	1.928	1.923

Sample period: Jan.2002 – Sep.2011
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

Table 3.7. Estimation Results of the Balanced Panel of REITs

Sample	**Balanced Panel of 12 REITs**			
Model	**Model I**	**Model II**	**Model III**	**Model IV**
Intercept	1.862*** (0.469)	1.75*** (0.479)	9.068*** (0.923)	7.353*** (0.920)
Change in Inflation	-0.431 (0.469)			
Exp. Change in Inflation		0.019 (0.615)		
Unexp. Change in Inflation		-1.310 (0.908)		
Exp. Increase in Inflation			-4.384*** (1.158)	-4.030*** (1.128)
Unexp. Increase in Inflation			-16.548*** (1.876)	-13.807*** (1.854)
Exp. Decrease in Inflation			2.476** (1.049)	2.496** (1.022)
Unexp. Decrease in Inflation			9.443*** (1.526)	8.241*** (1.492)
Change in 3M Treasury Yield				-1.655*** (0.190)
R^2	0.002	0.002	0.067	0.116
N	1392	1392	1392	1392
DW	1.952	1.950	1.982	1.971

Sample period: Jan.2002 – Sep.2011
Standard errors are given in parenthesis.
(*): significant at 10% level, (**): significant at 5% level, (***): significant at 1% level.

3.6. Conclusion

It is generally believed that REITs act as hedges against inflation. However, most of the empirical works failed to provide evidence for this hypothesis. In this context, using both individual data, aggregate equity index data and panel data of REIT returns along with some general equity indices, this study attempts to analyze the short-run inflation hedging ability of Turkish REITs taking into account the monetary policy stance and allowing for asymmetric response of REIT returns to increases and decreases in expected and unexpected inflation.

According to the results, almost in all cases, empirical results for individual data, aggregated index data and panel data are in line with each other. Changes in monetary policy stance, proxied by monthly changes in 3-month treasury bond yields have significant negative effects on REIT returns. Moreover, allowing for asymmetry in the response of REIT returns to increases and decreases in inflation dramatically alters the findings. When response of REIT returns to changes in inflation is imposed to be symmetric, estimated coefficients become insignificant. On the other hand, once the specifications are adjusted to allow asymmetric responses, all coefficients become significant and results provide evidence that REIT shares behave like equities and act as perverse hedges against both expected and unexpected inflation when the inflation is on the rise. On the contrary, REITs depreciate against declining inflation so they behave like hedges. Probably, when decreases in inflation caused by contraction in economic activity, expectations regarding future dividends of the firms deteriorate and hence the returns also fall. On the other hand, increases in inflation lead to higher interest rates and this affects all firms via the discount rate channel. If rent increases can not compensate the increases in inflation sufficiently in a short period of time, the expected increase in future dividends of REITs will not dominate the discount rate effect. Thus, REIT stocks will not provide hedge against inflation.

CHAPTER 4

CONCLUSION

4.1.Concluding Remarks

This thesis is comprised of two empirical studies on Turkish real estate-related industries. First study attempts to measure the impact of monetary policy on real estate-related industries in Turkey employing a heteroskedasticity-based identification approach which addresses both the simultaneity and the omitted variables problems which are extant in the previous studies. This theoretically reliable econometric methodology is the main contribution of this study to the literature. On the other hand, the second study focuses on real estate investment trusts instead of various real estate-related industries and attempts to answer whether shares of these firms act as timely and effective hedges against inflation. In this context, using different datasets which contain firm-level data, aggregate equity index data and panel data, the study employs an asymmetric econometric specification in order to reveal potential dissimilarities in the reaction of REIT shares to decreases and increases in inflation. This specification proves useful in the estimation and significantly improves the results. Hence, allowing for asymmetry is one of the main contributions of the study to the literature.

When it comes to the findings of the thesis, empirical results of the first study indicate that monetary policy has strong effects on real estate-related firms. However, at the industry level, a non-negligible amount of heterogeneity is observed among the reactions of different industries to monetary policy. Especially, impact of monetary policy on real estate-related financial firms is much stronger than its impact on non-financial firms. Furthermore, according to the empirical results of the second study, shares of Turkish REITs behave like equities rather than real estate assets since they can not provide hedge against rising inflation.

When these two studies are discussed together, empirical findings indicate that monetary policy, inflation and real estate industry are closely associated with each other in Turkey. According to the findings in Chapter 3, inflation has adverse effects on REITs and on the overall economy. When inflation rises, common stocks of real estate investment trusts, other financial firms as well as the rest of the firms listed on the BIST depreciate. Likewise, empirical results in Chapter 2 indicate that these industries react to hikes in interest rates by negatively. Note that inflation affects monetary policy decisions since one of the main goals of monetary policy is price stability. Hence, the findings of these two studies are in line with each other.

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APPENDICES

A. AN EXAMPLE ON FIXED TERM TREASURY BOND YIELD CALCULATION BY INTERPOLATION

Consider the yields on treasury bonds on April 14, 2010. I ignore the floating rate bonds, inflation-indexed bonds, foreign currency denominated bonds and I only use the conventional (nominal) bonds with same value date. The data regarding the treasury bills/bonds as of April 14, 2010 are given in Table A.2.1. (only the securities with time to maturity less than 1 year are given). The bond with closest maturity to 30 days from down is TRT050510T16 whose maturity is 21 days and yield is 6.40%. The bond with closest maturity to 30 days from up is TRT230610T13 whose maturity is 70 days and yield is 6.88%. Using these data, 30-day yield is then calculated as $r_1 = 6.40 + \frac{30-21}{21-70}(6.40 - 6.88) = 6.4882$. Since 30-days is closer to 21-days than 70-days, r_1 is closer to 6.40% than 6.88%.

Table A.2.1. Companies Included in the Real Estate-Related Industry Indices

BIST Listing Code	Company Name	Industry	Market Value as of Jan.31, 2012 (millions of TL)	Cement Index	Construction Index	Construction Materials Index	Iron-Steel-Foundry Index	Paint Index	Plastics Index	Bank Index	REIT Index	Non-Financial Index	Financial Index
ADNAC	Adana Çimento (C)	Cement	112.43	**x**								**X**	
AFYON	Afyon Çimento	Cement	295.50	**x**								**X**	
AKCNS	Akçansa	Cement	1,428.20	**x**								**X**	
BTCIM	Batı Çimento	Cement	422.21	**x**								**X**	
BSOKE	Batısöke Çimento	Cement	103.95	**x**								**X**	
BOLUC	Bolu Çimento	Cement	199.10	**x**								**X**	
BUCIM	Bursa Çimento	Cement	462.42	**x**								**X**	
CMBTN	Çimbeton	Cement	78.23	**x**								**X**	
CMENT	Çimentaş	Cement	519.19	**x**								**X**	
CIMSA	Çimsa	Cement	1,156.32	**x**								**X**	
GOLTS	Göltaş Çimento	Cement	374.40	**x**								**X**	
KONYA	Konya Çimento	Cement	1,476.65	**x**								**X**	
MRDIN	Mardin Çimento	Cement	690.00	**x**								**X**	
NUHCM	Nuh Çimento	Cement	1,674.88	**x**								**X**	
UNYEC	Ünye Çimento	Cement	481.99	**x**								**x**	
ASLAN	Aslan Çimento	Cement	3,460.20	**x**								**x**	
BROVA	Borova Yapı	Construction	25.79		**x**							**x**	
EDIP	Edip Gayrimenkul	Construction	62.00		**x**							**x**	
ENKAI	Enka İnşaat	Construction	12,175.00		**x**							**x**	
DOGUB	Doğusan	Construction	27.60		**x**							**x**	
OZBAL	Özbal Çelik Boru	Isolation	56.90			**x**	**x**					**x**	
CBSBO	Çbs Boya	Paint	7.09			**x**		**x**				**x**	
DYOBY	Dyo Boya	Paint	93.00			**x**		**x**				**x**	
MRSHL	Marshall	Paint	505.00			**x**		**x**				**x**	
BRSAN	Borusan Mannesmann	Duct	635.04			**x**			**x**			**x**	
ERBOS	Erbosan	Duct	103.88			**x**			**x**			**x**	
EPLAS	Egeplast	Plastics	12.20			**x**			**x**			**x**	
PIMAS	Pimaş	Plastics	75.06			**x**			**x**			**x**	
EGPRO	Ege Profil	Plastics	362.17			**x**			**x**			**x**	
ANACM	Anadolu Cam	Glass	1,028.36			**x**						**x**	
DENCM	Denizli Cam	Glass	50.76			**x**						**x**	
ECYAP	Eczacıbaşı Yapı	Construction materials	340.75			**x**						**x**	

EGSER	Ege Seramik	Ceramic	123.00	**x**			**x**	
FENIS	Feniş Alüminyum	Aluminum	59.45	**x**			**x**	
IZOCM	İzocam	Glass	1,050.06	**x**			**x**	
SARKY	Sarkuysan	Copper	204.50	**x**			**x**	
TRKCM	Trakya Cam	Glass	1,598.48	**x**			**x**	
USAK	Uşak Seramik	Ceramic	33.22	**x**			**x**	
HZNDR	Haznedar Refrakter	Refractory	36.65	**x**			**x**	
BRKSN	Berkosan Yalıtım	Isolation	57.36	**x**			**x**	
GENTS	Gentaş	Construction materials	146.30	**x**			**x**	
BURCE	Burçelik	Iron-Steel	55.43		**x**		**x**	
BURVA	Burçelik Vana	Iron-Steel	18.03		**x**		**x**	
COMDO	Componenta Dökümcülük	Foundry	403.74		**x**		**x**	
CELHA	Çelik Halat	Iron-Steel	53.96		**x**		**x**	
CEMTS	Çemtaş	Iron-Steel	133.29		**x**		**x**	
DMSAS	Demısaş Döküm	Foundry	35.28		**x**		**x**	
EREGL	Ereğli Demir Celik	Iron-Steel	8,363.50		**x**		**x**	
IZMDC	İzmir Demir Çelik	Iron-Steel	1,122.00		**x**		**x**	
KRDMD	Kardemir (D)	Iron-Steel	499.19		**x**		**x**	
CEMAS	Çemaş Döküm	Foundry	109.50		**x**		**x**	
ANELE	Anel Elektrik	Electricity	213.40				**x**	
EMKEL	Emek Elektrik	Electricity	22.11				**x**	
GEREL	Gersan Elektrik	Electricity	44.88				**x**	
AKBNK	Akbank	Bank	26,720.00			**x**		**x**
ALBRK	Albaraka Türk	Bank	889.35			**x**		**x**
ALNTF	Alternatifbank	Bank	309.00			**x**		**x**
ASYAB	Asya Katılım Bankası	Bank	1,521.00			**x**		**x**
DENIZ	Denizbank	Bank	9,201.89			**x**		**x**
FINBN	Finansbank	Bank	10,004.00			**x**		**x**
GARAN	Garanti Bankası	Bank	26,964.00			**x**		**x**
ISCTR	İş Bankası (C)	Bank	16,694.89			**x**		**x**
SKBNK	Şekerbank	Bank	970.00			**x**		**x**
HALKB	T. Halk Bankası	Bank	14,625.00			**x**		**x**
KLNMA	T. Kalkınma Bankası	Bank	969.60			**x**		**x**
TEBNK	T.Ekonomi Bankası	Bank	3,593.16			**x**		**x**
TSKB	T.S.K.B.	Bank	1,720.00			**x**		**x**
TEKST	Tekstilbank	Bank	298.20			**x**		**x**
VAKBN	Vakıflar Bankası	Bank	7,225.00			**x**		**x**

YKBNK	Yapı Ve Kredi Bankası	Bank	14,345.27	x		x
AKFGY	Akfen GMYO	REIT	268.64		x	x
AKMGY	Akmerkez GMYO	REIT	633.49		x	x
ALGYO	Alarko GMYO	REIT	169.35		x	x
AGYO	Atakule GMYO	REIT	85.68		x	x
AVGYO	Avrasya GMYO	REIT	66.96		x	x
DGGYO	Doğuş GMYO	REIT	165.05		x	x
EKGYO	Emlak Konut GMYO	REIT	5,300.00		x	x
IDGYO	İdealist GMYO	REIT	28.40		x	x
ISGYO	İş GMYO	REIT	678.00		x	x
KLGYO	Kiler GMYO	REIT	238.88		x	x
MRGYO	Martı GMYO	REIT	68.20		x	x
NUGYO	Nurol GMYO	REIT	73.60		x	x
OZGYO	Özderici GMYO	REIT	87.00		x	x
PEGYO	Pera GMYO	REIT	57.02		x	x
RYGYO	Reysaş GMYO	REIT	139.40		x	x
SAFGY	Saf GMYO	REIT	1,170.31		x	x
SNGYO	Sinpaş GMYO	REIT	672.00		x	x
TRGYO	Torunlar GMYO	REIT	954.24		x	x
TSGYO	Tskb GMYO	REIT	91.50		x	x
VKGYO	Vakıf GMYO	REIT	293.00		x	x
YKGYO	Yapı Kredi Koray GMYO	REIT	55.60		x	x
YGYO	Yeşil GMYO	REIT	296.25		x	x

Table A.3.1. Treasury Bills/Bonds as of April 14, 2010

ISIN Code	Security Type	Value Date	Days To Maturity	Closing Yield (Compound)
TRT050510T16	Bond	15.04.2010	20	6.43
TRT050510T16	**Bond**	**14.04.2010**	**21**	**6.40**
TRT230610T13	**Bond**	**14.04.2010**	**70**	**6.88**
TRB140710T13	Bill	14.04.2010	91	7.21
TRB280710T17	Bill	14.04.2010	105	7.27
TRB180810T18	Bill	14.04.2010	126	7.21
TRB080910T19	Bill	14.04.2010	147	7.38
TRT031110T10	Bond	15.04.2010	202	7.69
TRT031110T10	Bond	14.04.2010	203	7.69
TRT081210T14	Bond	14.04.2010	238	7.75
TRT190111T13	Bond	14.04.2010	280	7.93
TRT020211T11	Bond	15.04.2010	293	7.87
TRT020211T11	Bond	14.04.2010	294	7.84
TRT130411T16	Bond	14.04.2010	364	7.97

Table A.3.2. Additional Information on Individual REITs Listed on the BIST

Company Name	BIST Ticker	Observations available from	# of Obs.	Market Value (millions of TL)	Share in BIST REIT Index(%)
Pera GMYO	PEGYO	Jan-2002	117	65.04	1.34
Özderici GMYO	OZGYO	Jan-2002	117	95.00	1.06
Avrasya GMYO	AVGYO	Jan-2002	117	166.32	0.67
Vakıf GMYO	VKGYO	Jan-2002	117	56.10	0.83
Alarko GMYO	ALGYO	Jan-2002	117	197.04	2.26
Doğuş GMYO	DGGYO	Jan-2002	117	129.42	0.31
EGS GMYO	EGYO	Jan-2002	117	12.00	0.00
Yapı Kredi Koray GMYO	YKGYO	Jan-2002	117	68.00	0.90
İş GMYO	ISGYO	Jan-2002	117	702.00	11.38
Yeşil GMYO	YGYO	Jan-2002	117	239.82	1.13
Nurol GMYO	NUGYO	Jan-2002	117	73.60	0.50
Atakule GMYO	AGYO	Feb-2002	116	92.40	0.50
Akmerkez GMYO	AKMGY	Apr-2005	78	817.94	0.55
Sağlam GMYO	SAGYO	Mar-2007	55	84.56	1.37
Sinpaş GMYO	SNGYO	Jun-2007	52	870.00	10.87
TSKB GMYO	TSGYO	Apr-2010	18	96.00	0.94
Reysaş GMYO	RYGYO	Jul-2010	15	156.40	1.64
İdealist GMYO	IDGYO	Jul-2010	15	46.60	0.39
Martı GMYO	MRGYO	Sep-2010	13	83.60	1.36
Torunlar GMYO	TRGYO	Oct-2010	12	1,137.92	5.38
Emlak Konut GMYO	EKGYO	Dec-2010	10	6,000.00	50.66
Kiler GMYO	KLGYO	Apr-2011	6	274.75	3.25
Akfen GMYO	AKFGY	May-2011	5	276.00	2.70

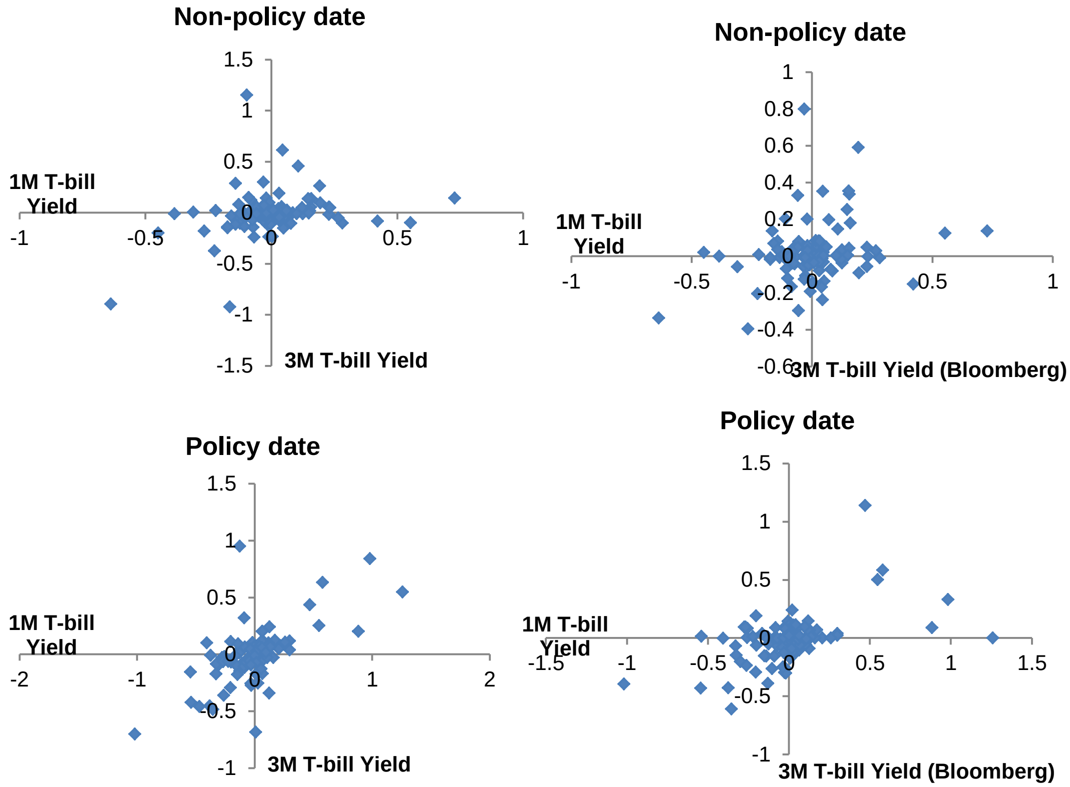

Figure A.2.1. Scatterplots of Policy Rate

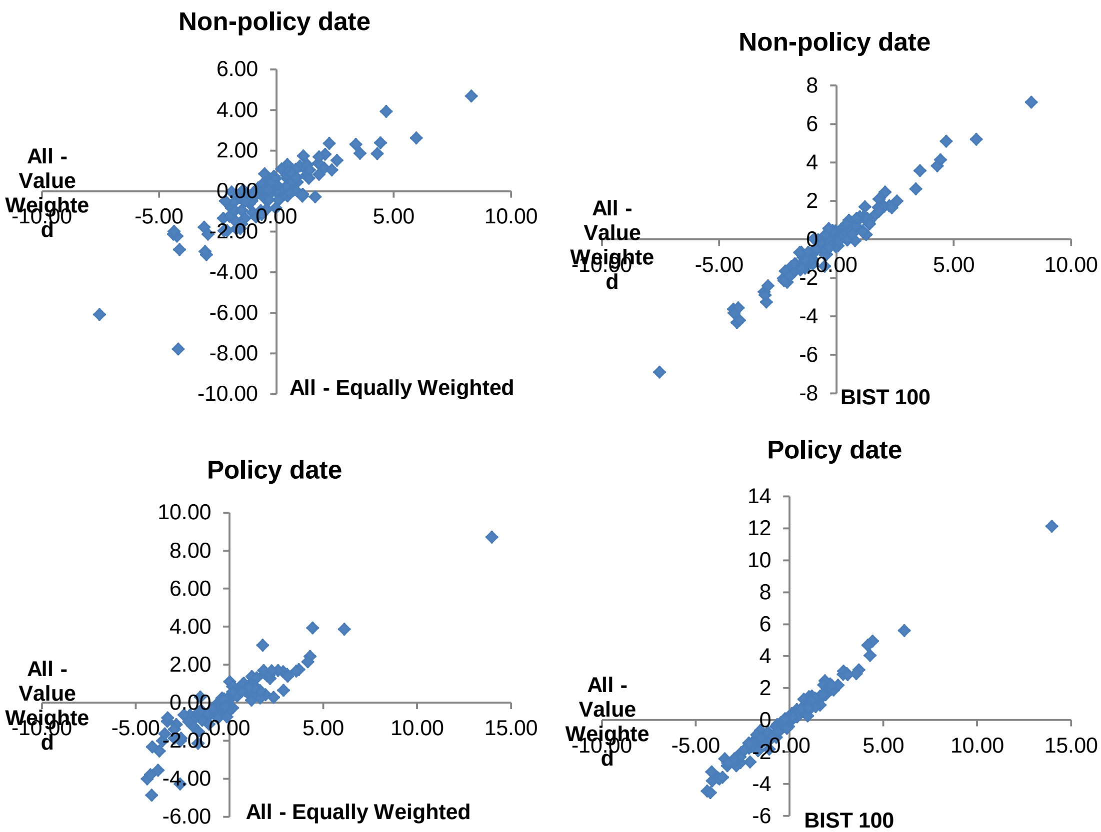

Figure A.2.2. Scatterplots of All Real Estate Related Industries

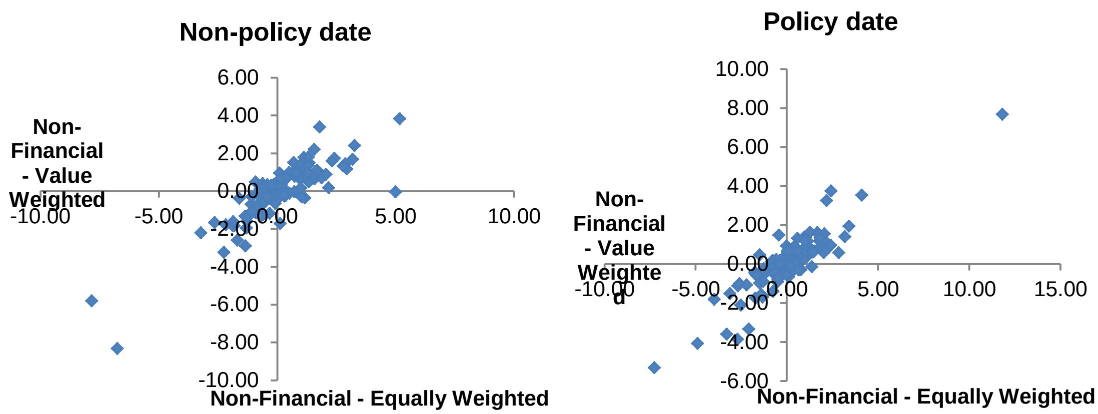

Figure A.2.3. Scatterplots of Real Estate Related Non-Financial Industries

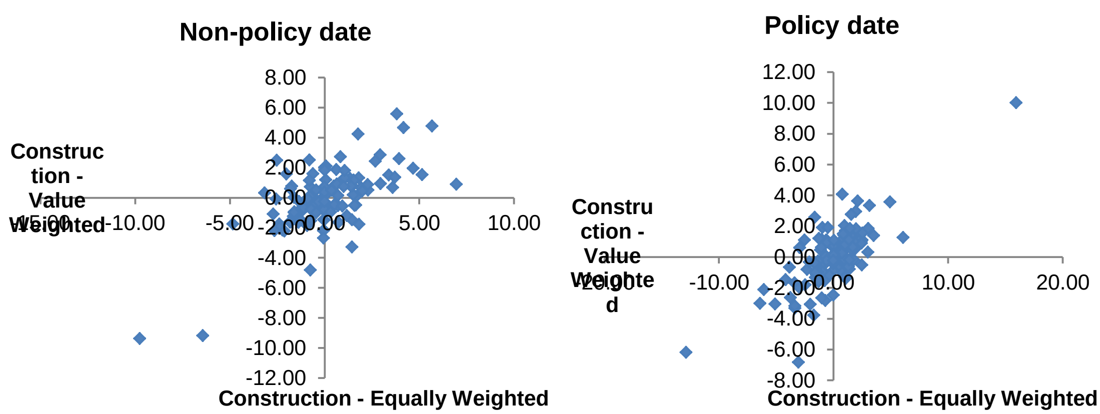

Figure A.2.4. Scatterplots of Construction Industry

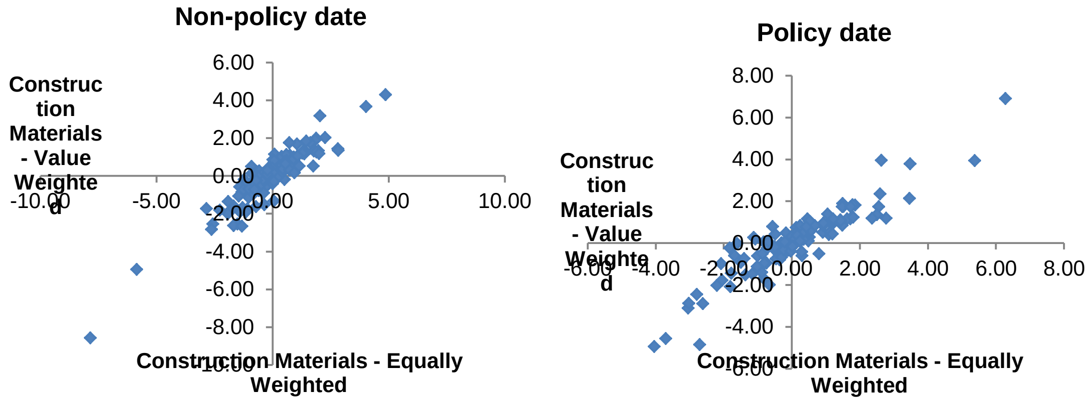

Figure A.2.5. Scatterplots of Construction Materials Industry

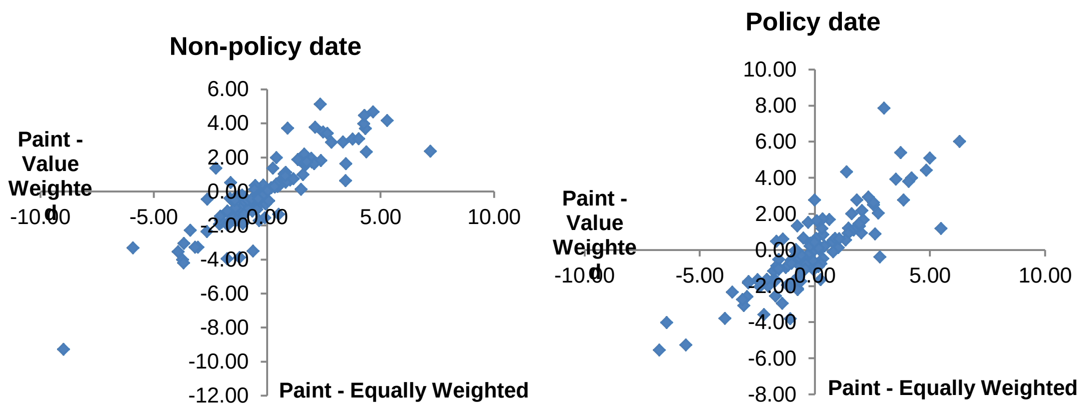

Figure A.2.6. Scatterplots of Paint Industry

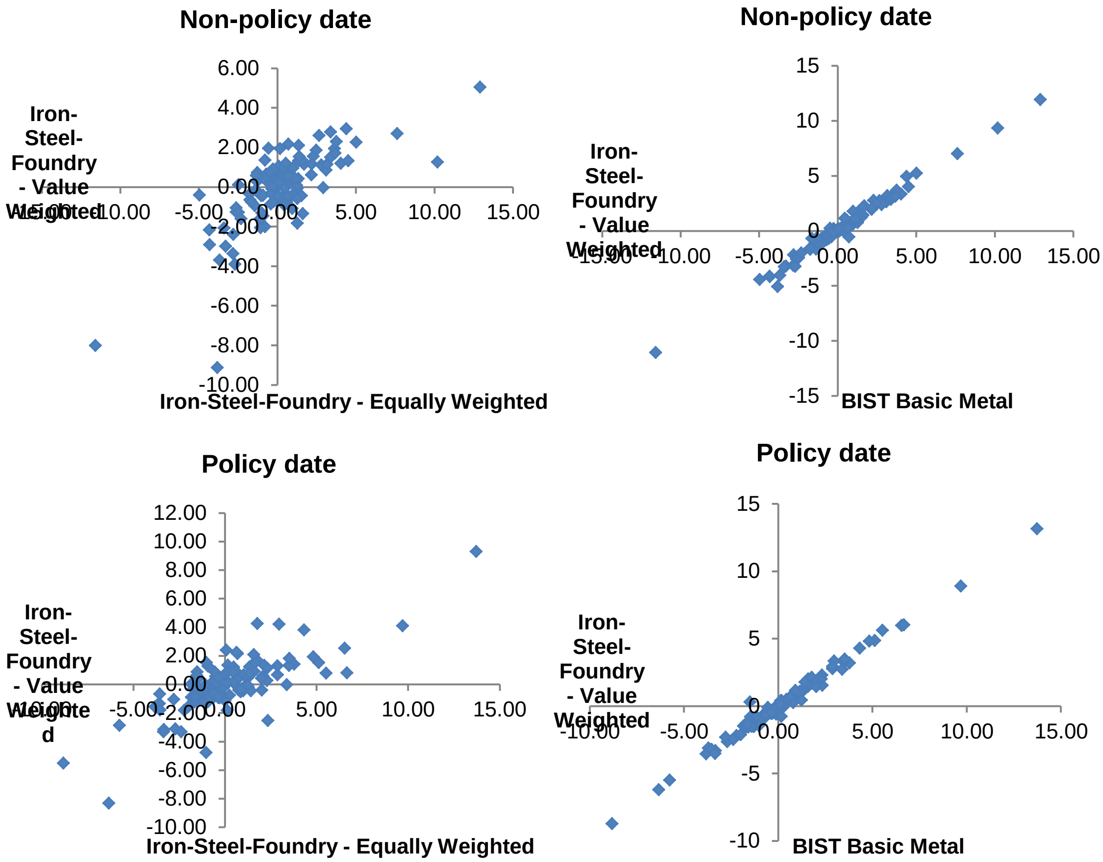

Figure A.2.7. Scatterplots of Iron – Steel – Foundry Industry

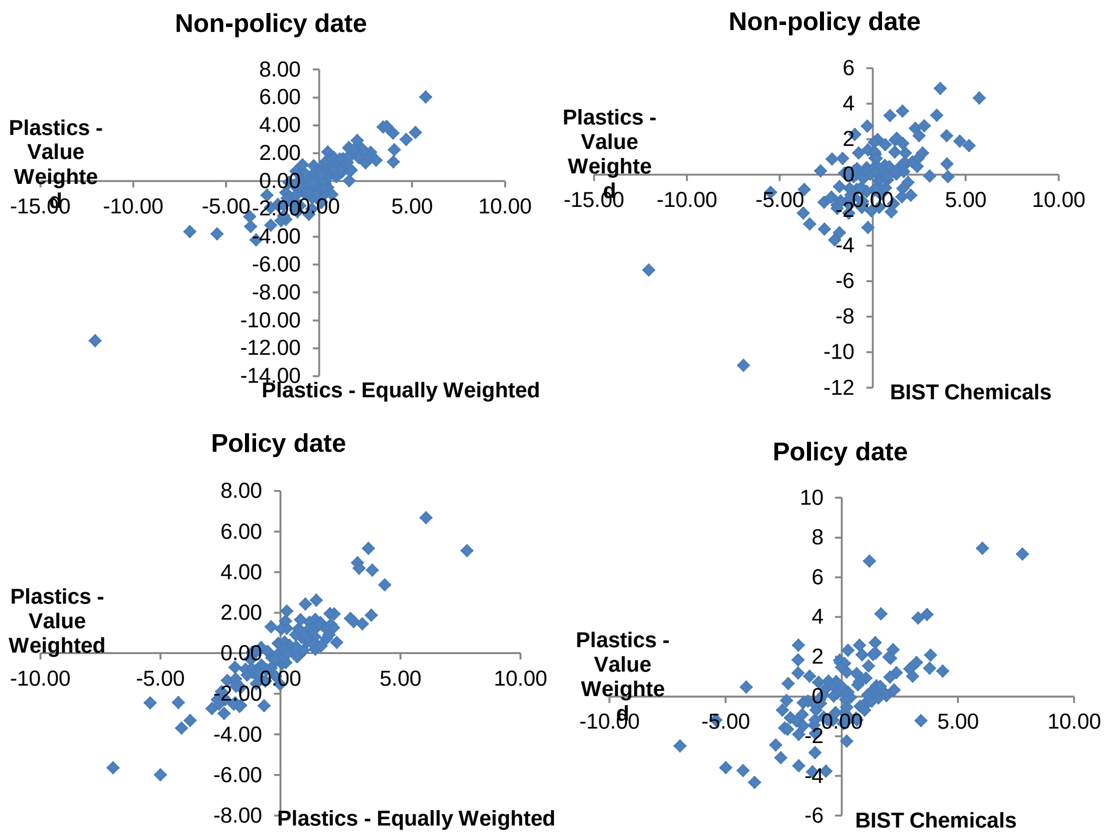

Figure A.2.8. Scatterplots of Plastics Industry

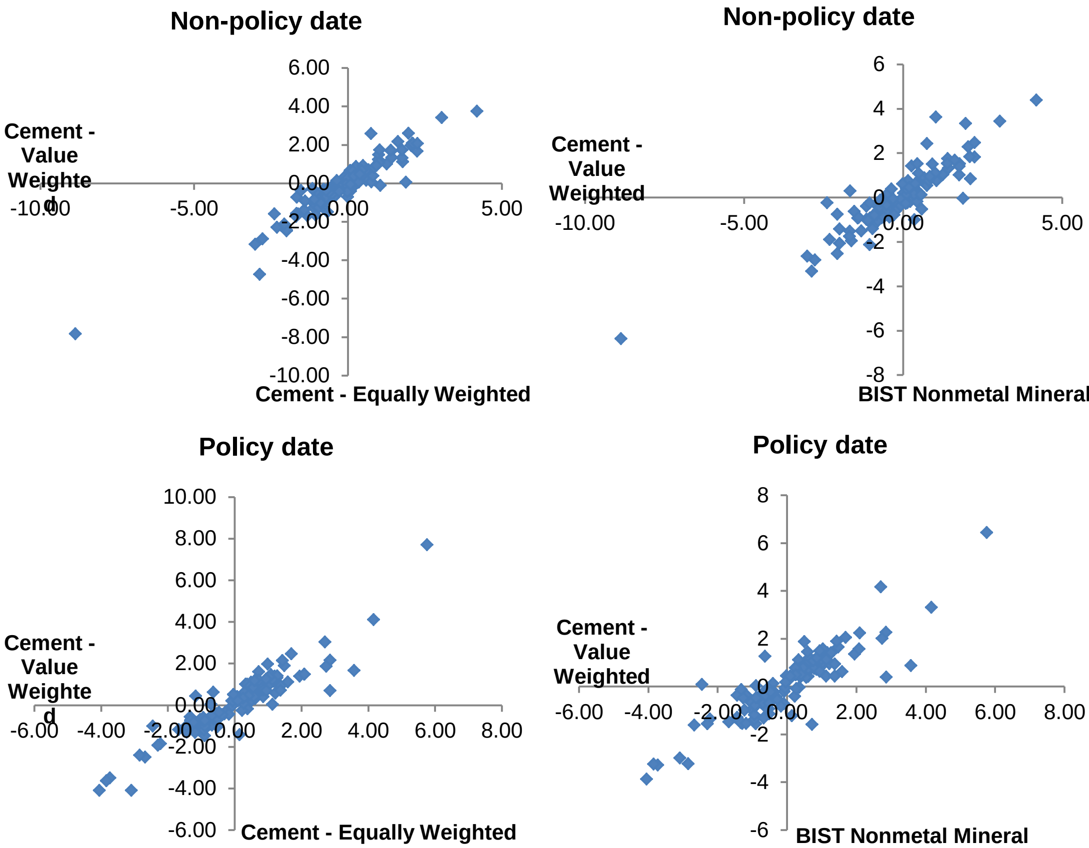

Figure A.2.9. Scatterplots of Cement Industry

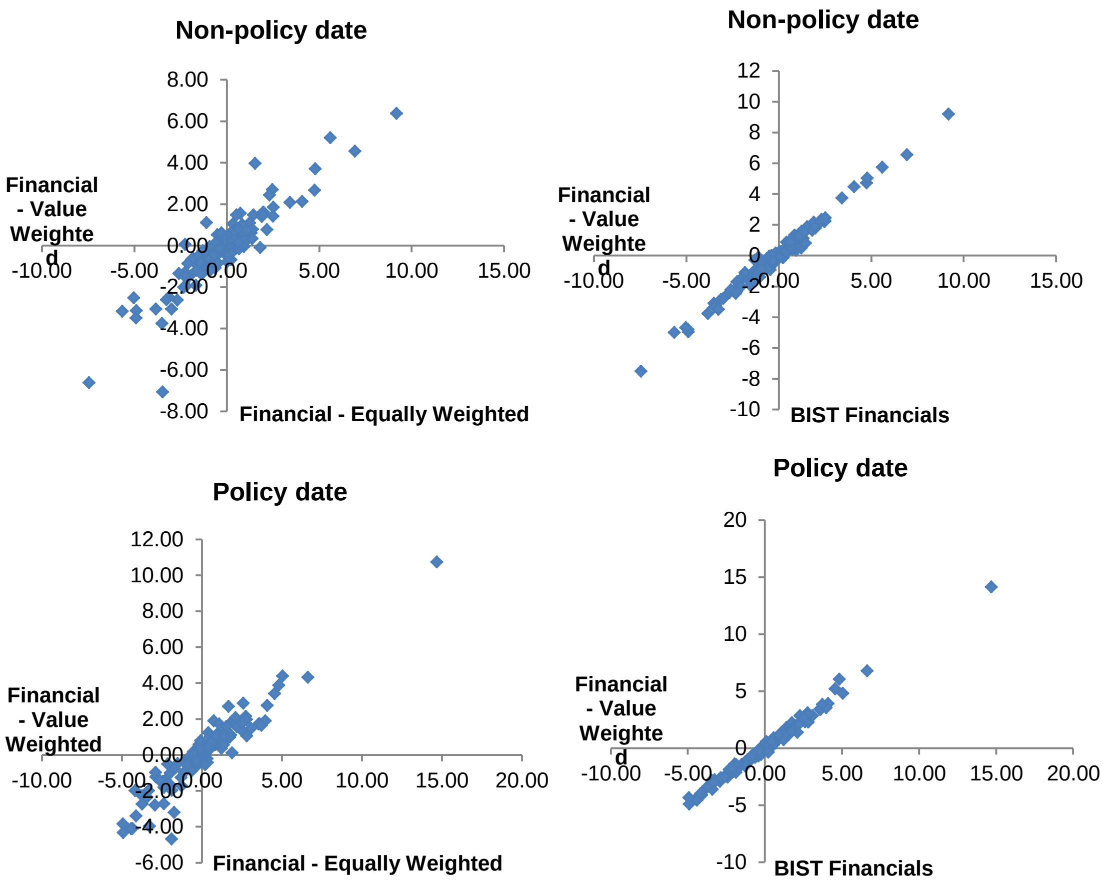

Figure A.2.10. Scatterplots of Real Estate Related Financial Industries

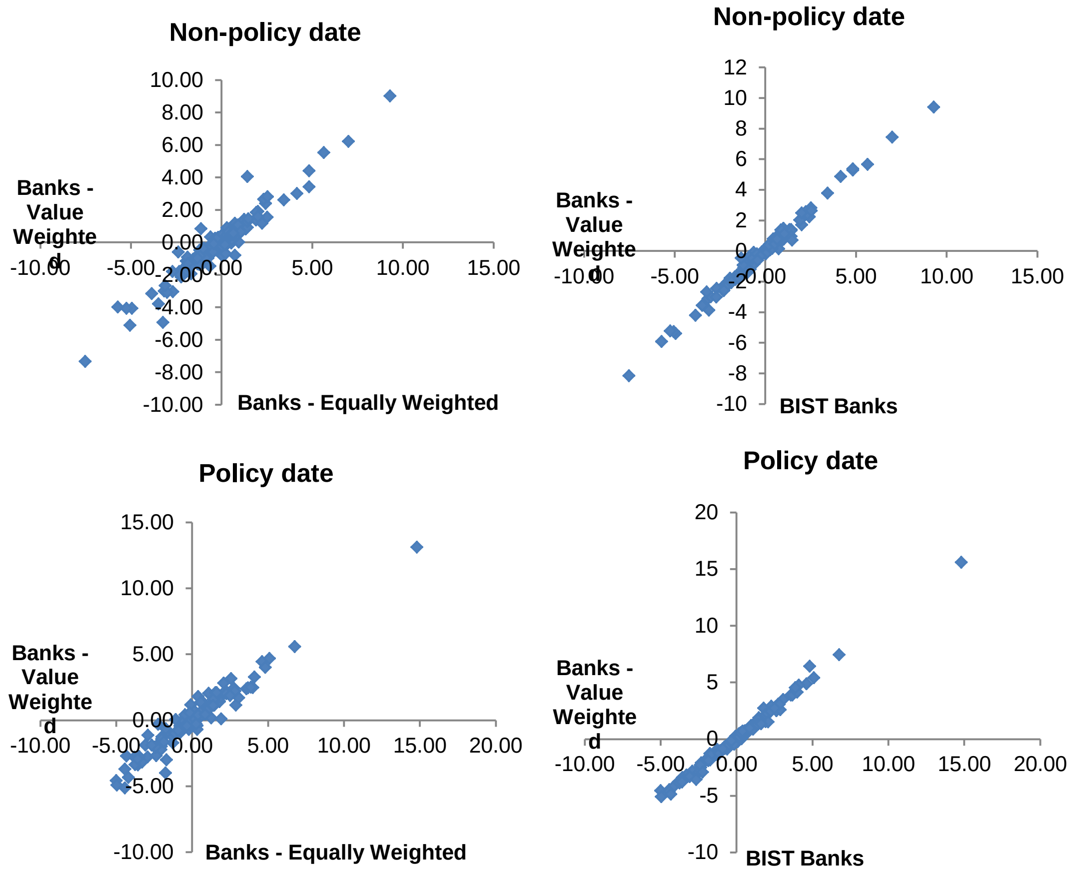

Figure A.2.11. Scatterplots of Banking Industry

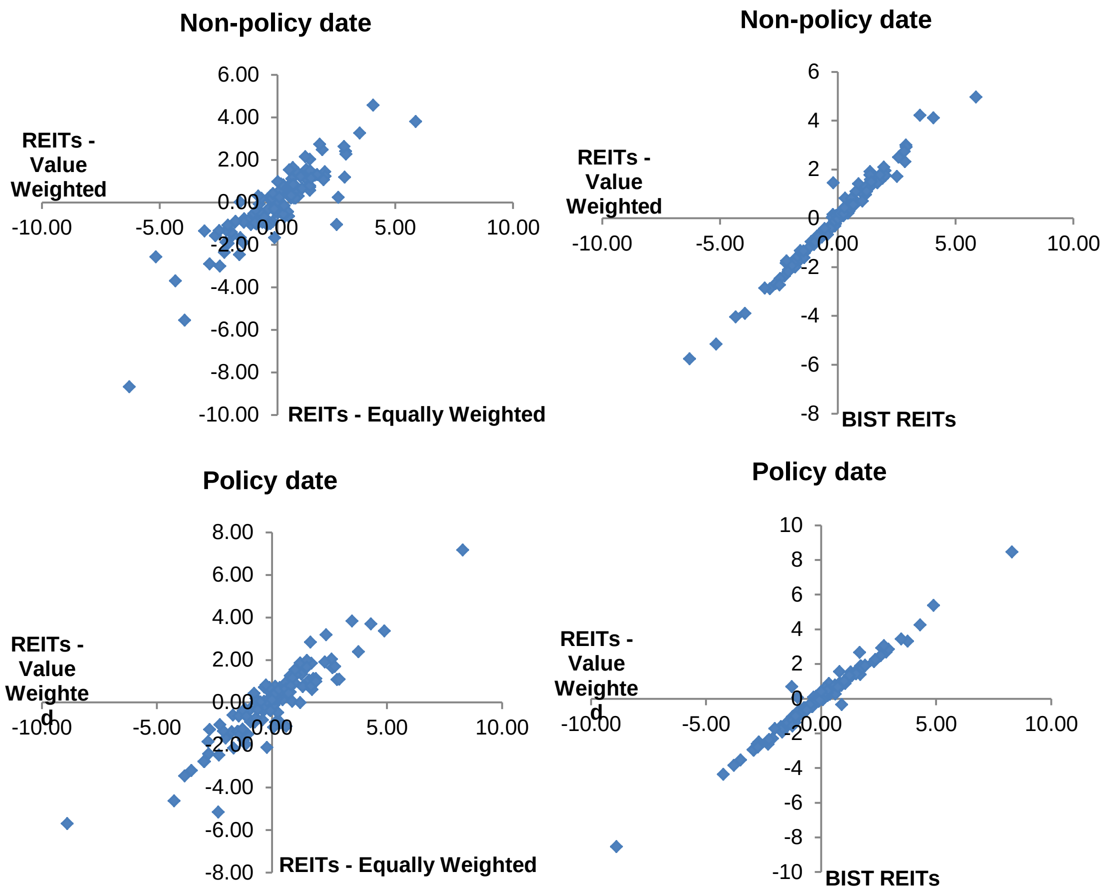

Figure A.2.12. Scatterplots of REIT Industry

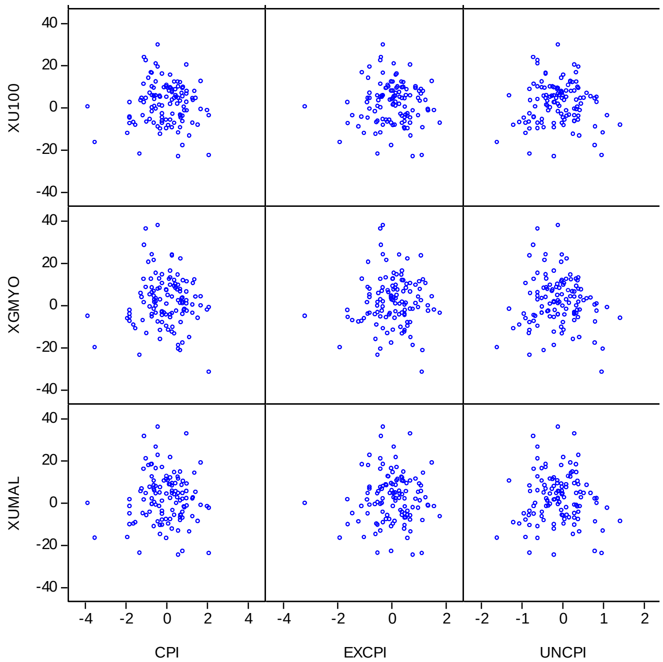

Figure A.3.1. Scatterplots of Returns of Equity Indices vs. Changes in Inflation

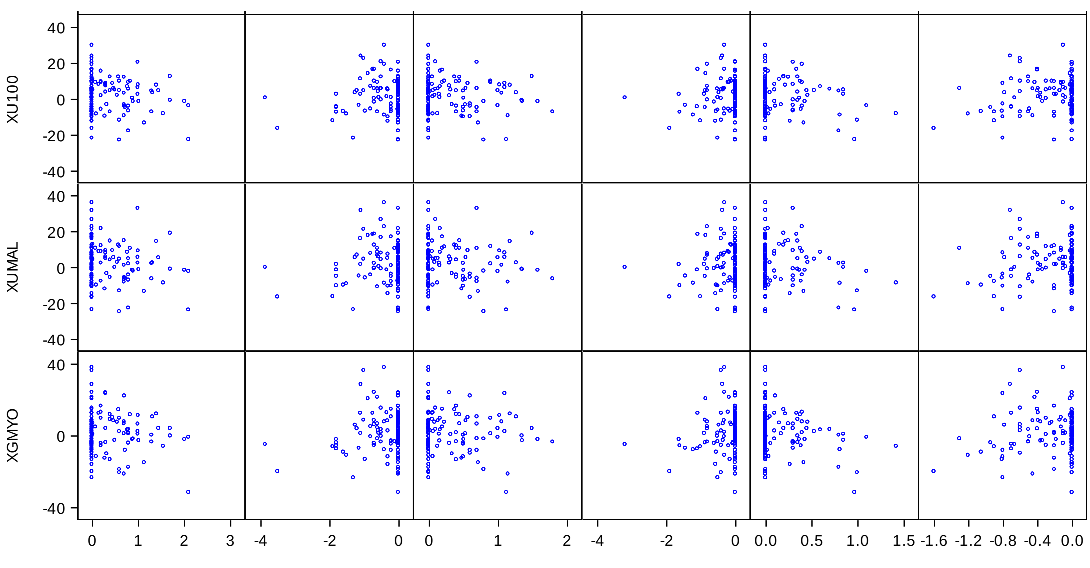

Figure A.3.2. Scatterplots of Returns of Equity Indices vs. Increases and Decreases in Inflation

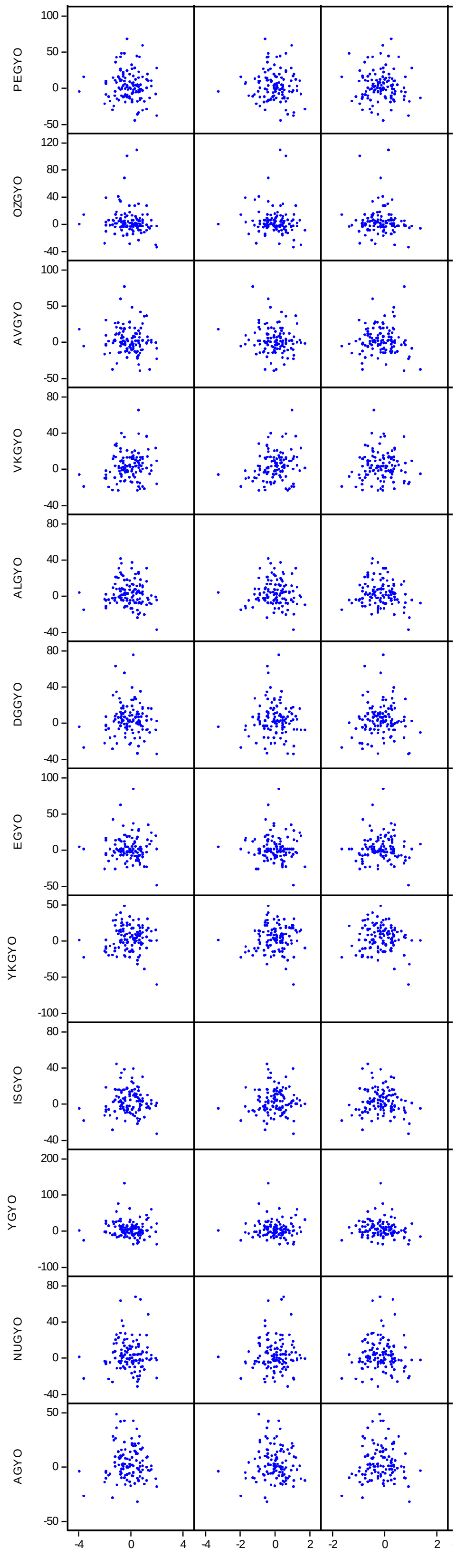

Figure A.3.3. Scatterplots of Returns of Individual REITs vs. Changes in Inflation

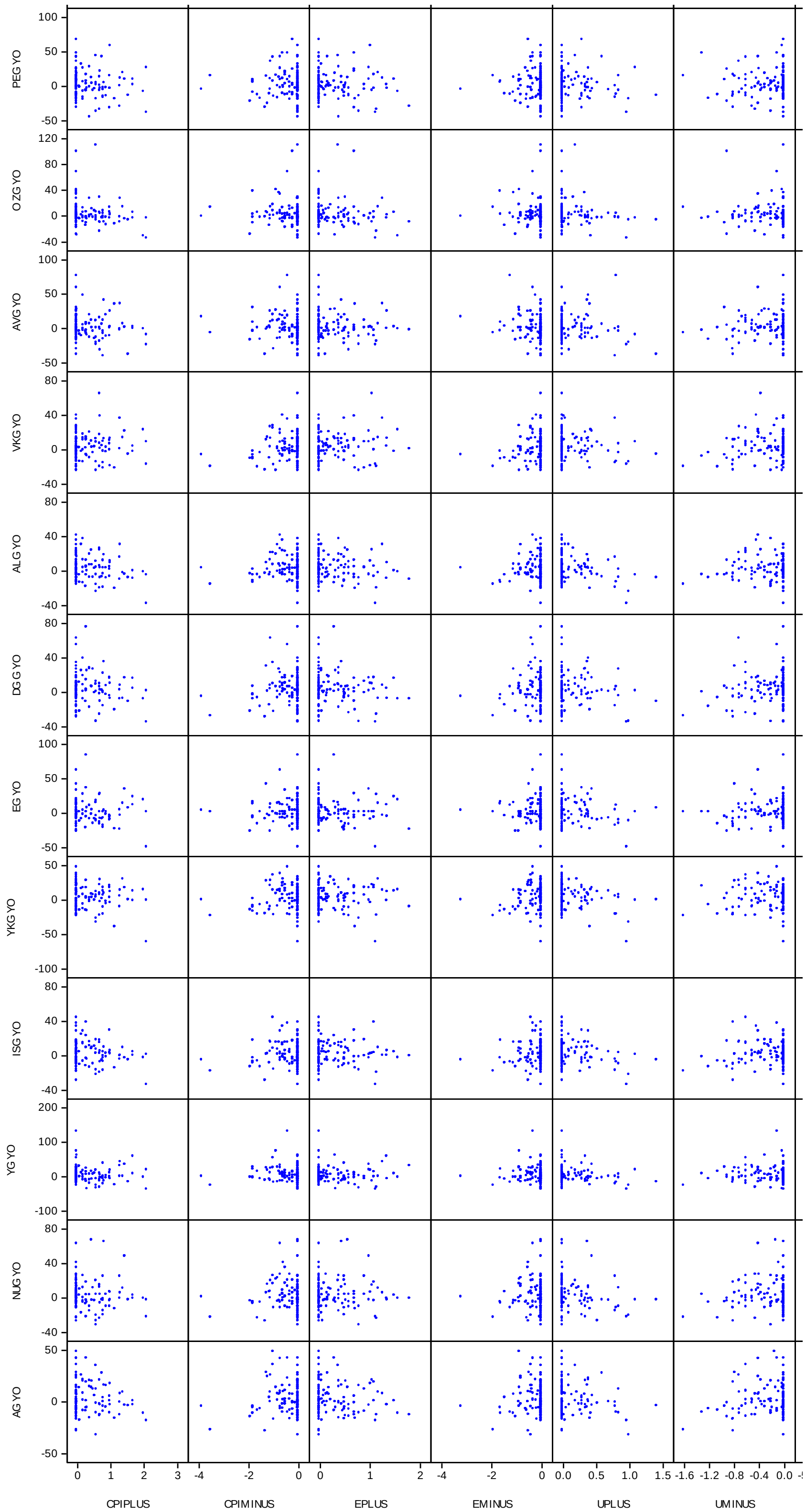

Figure A.3.4. Scatterplots of Returns of Individual REITs vs. Increases and Decreases in Inflation

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