Liquidity Dynamics between REIT and Property Markets

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Abstract

This paper investigates the relationship between the liquidity of the real estate property market and that of the REIT market from the perspective of liquidity dynamics and transformation. Our results indicate that there is a lead-lag relationship between the liquidity of these two markets. The Granger Causality test shows that property market liquidity leads that of the REIT market. In addition, returns in the property market have a causal effect on the liquidity and returns of the REIT market. We estimate VAR models and compute impulse response functions to examine the dynamics of the cross-market relationships in liquidity and return between the two markets. The impulse responses show that REIT liquidity responds to property market liquidity, especially after the structure change in the REIT industry in the early 1990s. Our results also demonstrate that shocks to macroeconomic variables have significant effects on the liquidity of the two markets. Overall, our study sheds light on the contemporaneous commonality between the liquidity of the unsecuritized property market and that of the securitized REIT market.

Key words: real estate investment trust, liquidity, property market, VAR model

1. Introduction

Real Estate Investment Trusts (REITs) have a unique feature: on the one hand, they are real estate property investments; on the other, they trade on the secondary exchange-listed stock market in the same manner as common stocks. The real estate property market is well known for its friction and illiquidity, while the REIT market is liquid and forms a convenient avenue for investors who plan to gain exposure in real estate. Indeed, the REIT market has boomed in recent years and attracted considerable attention from both institutional and individual investors. Currently around 160 REITs are listed on major exchange markets such as NYSE, AMSE and NASDAQ, and the total market capitalization has increased to more than 450 billion[1]. A significant portion of their appeal stems from investors' desire for exposure and access to the real estate class of investments without the aforementioned disadvantages of investing in property market directly. Thus, the relationship dynamics between the liquidity of the real estate property market and that of the exchange traded REIT market are of great interests.

The question naturally arises as to whether linkages in the returns, risk, and liquidities across REIT and real estate markets can be expected. A detailed examination of liquidity linkage between these two markets is important for two reasons. First, asset pricing literature indicates that liquidity may be priced and REIT investors' returns may therefore be more related to microstructure characteristics than the real estate investment. For investors who access real estate for investment diversification, if the liquidity of the REIT stock market is predictable from its past liquidity or property market liquidity, then this may have implications on the cost and direction of asset allocation strategy. Second, by examining the cross-market movement between

[1] From NAREIT (National Association of Real Estate Investment Trusts) website http://www.reit.com/IndustryData/US-REIT-Industry-MarketCap.aspx

the two markets, we are able to better understand whether they are complements or substitutes for each other and whether there are concomitant factors influencing both markets.

Despite the importance of liquidity in property and REIT markets and the uniqueness of the REIT securities, currently little is known about the connection between these two markets, especially from the perspective of liquidity dynamics and transformation. Existing studies mostly look at the liquidity of the REIT market on a standalone basis. Early research reports REIT liquidity increased significantly through the early and mid-1990s as REIT market capitalizations and trading volumes grew rapidly (see Bhasin, Cole and Kiely, 1997; and Clayton and MacKinnon, 2000). Recognizing the importance of liquidity in affecting property price, Fisher et al (2003) argue that indices of changes in market value that are based on asset transaction prices will systematically reflect intertemporal differences in the ease of selling a property. They construct a constant-liquidity price index, and find that the constant-liquidity values tend to lead transaction-based and appraisal-based indices in time.

Other studies examine the link between the returns of REITs and the unsecuritized real estate market. Glascock, Lu, and So (2000) find that structural change may allow REITs to behave more like traditional stocks than real estate. Their empirical evidence reveals that REITs behave more like stocks after 1992, although REITs are co-integrated with the private real estate market during their whole study period. Their results imply that REITs do not offer more real estate exposure to investors after 1992. Clayton and Mackinnon (2003) provide evidence demonstrating that REITs become more akin to real estate and less like stocks. These studies focused on comparing the return dynamics of REITs with those of non-REIT stocks.

In this paper, we make an initial investigation on the joint dynamics across liquidity and return for REIT stock market and real estate property market. First, we calculate the liquidity and return measures averaged across all REIT stocks, in order to get the measures for the REIT stock market. To measure liquidity in the stock market, we employ Amihud's (2002) widely used illiquidity measure. We obtain the quarterly property market return based on the NPI index from National Council of Real Estate Investment Fiduciaries and the liquidity of the property market from U.S. Census Bureau. A VAR model is then employed to explore the dynamic movements and co-movements in liquidity, return and other macroeconomic variables. We employ a time-series of 128 quarterly data to estimate a four-equation VAR model, with four endogenous variables: the liquidity and returns of both the property market and REIT market.

The Granger Causality results indicate that property market liquidity has a significant causal effect on the liquidity of the REIT market during our sample period of 1978 to 2009. In other words, we find property market liquidity leads the liquidity in REIT stock market. In addition, return in the property market has a causal effect on the liquidity and return of REIT markets. Further, we look at the two different types of REIT firms, equity REITs and mortgage REITs, respectively, to investigate whether there is any difference in terms of Granger causality. We find that the Granger Causality results still apply to both types of REITs but is weaker for mortgage REITs, which is not surprising as equity REITs invest in and own properties, and their underlying assets are real estate properties. However, mortgage REITs are less straightforward, as they deal with investment and ownership of property mortgages. Hence it is to our expectation that the Causality is weaker for mortgage REITs. These REITs loan money for mortgages to owners of real estate, or purchase existing mortgages or mortgage-backed securities. Their revenues are generated primarily by interest on the mortgages.

Next, we plot the impulse response functions from the VAR estimation to uncover the dynamics of the cross-market relationships in liquidity and return between the two markets. We find that REIT liquidity responds negatively to property market liquidity, with the response peaking at the second quarter and decaying afterwards, whereas the return of the property market has consistently negative impact on the REIT market liquidity. This suggests that the private property market and REIT market are substitutes to each other. A booming real estate property market with a higher volume of transactions and higher levels of returns attracts more investors who want to gain exposure in real estate sector, and may take away some investors who had initially set their minds on REITs. Given good performance in the property market, investors who consider investing in real estate may go directly into the real estate market instead of investing in REITs. From the reverse direction, positive shocks in both the REIT market liquidity and return lead to a high level of property market liquidity. If investors believe the securitized real estate market is more efficient in discovering new information, a more liquid REIT market with better return indicates good prospects for investing in real estate in general; property market participants respond positively to the positive sentiment in the REIT market.

We augment the baseline VAR model by including another four exogenous variables to analyze the joint dynamics of some macroeconomic fundamentals on REIT and property market liquidities. Among the common forces that affect the general market, growth rate of industry production, inflation, real estate mortgage rate, and loans probably are the major determinants in real estate investments. Our Granger Causality test shows evidence that macroeconomic variables are linked to the REIT market as well as the property market. Impulse response plots indicate that mortgage rates have a negative impact on the liquidity of both the property market and the REIT market, suggesting a liquidity spillover between the two markets. Property returns

respond positively to shocks in industry production growth rate, while REIT returns do not. This demonstrates the important role of property market as a channel for transmitting the effects of economic policy into the REIT equity market.

Glascock, Lu, and So (2000) find REITs behave more like stocks and less like bonds after the structural changes in the early 1990s; the effects of structural changes on the liquidity dynamics of the two markets are also analyzed in our study. We investigate the relationship between REITs and the real estate property market before and after the structural change by dividing the sample into two sub-periods, and fitting the sample into two separate VAR models. Our evidence shows that liquidity of the REIT market has predictive power over liquidity of the property market before the structural change in the REIT industry in the 1990s; however, this linkage becomes much weaker after the structural change. Hence the liquidity spillover between REIT and property markets is more pronounced before the structure change, consistent with the Glascock, Lu, and So's (2000) assertion that REITs became more integrated with the stock market rather than the property market after the structural change.

Our paper complements the findings of Chordia, Sarkar, and Subrahmanyam (2005) Subrahmanyam (2007), and Goyenko and Ukhov(2009), by providing additional evidence of liquidity dynamics from the real estate market. Subrahmanyam (2007) explored the liquidity and order flow spillovers across non-REIT stocks and REITs. He finds that order flows and returns in the non-REIT stock market negatively forecast REIT order flows, which is consistent with the notion that real estate markets are viewed as substitute investments for the stock market, causing down-moves in the stock market to increase money flows to the REIT market. Instead of comparing REIT and non-REIT stocks, in this paper, we further investigate the property market that underlies REIT investment and show that REIT and property markets are integrated via

liquidity. Our study allows us to shed light on the economic question of whether REIT stock investments are substitutes or complements in relation to the property market investment. In particular, our study is able to provide important implications as to whether property market increases affect order flows in REITs, whether property market liquidity helps forecast the liquidity of REITs, whether there is contemporaneous commonality between the liquidity and return of REITs and that of property market. To the best of our knowledge, the preceding questions have yet to be answered in the literature.

The rest of the paper is organized as follows. Section 2 poses the hypotheses and provides a brief literature review. Section 3 describes how liquidity data is measured and sample construction, while Section 4 presents basic time-series properties of the data, and describes the correlation of variables. Section 5 reports the results of vector autoregression analysis., and section 6 concludes..

2. Related Literature and Hypothesis Development

The real estate property market is full of frictions which make it especially illiquid. Real estate properties are thinly traded over relatively long holding periods and through a transactions process that is typically not a simultaneous-bid auction but instead is a sequential bid process without recall that may involve significant transaction costs. Hence, due to the stochastic arrival of potential buyers and the uncertainty of their offer prices, sellers cannot sell their real estate assets immediately at any given price (Lin and Vandell, 2007). This kind of market friction or risk is termed as liquidity risk in the financial market, meaning that real estate is an asset that is not readily saleable due to uncertainty about its value or the lack of a market in which it is

regularly traded. Thus, the pricing system of the property market tends to be associated with high levels of transaction cost and information leakage. Compared to other product markets, the real estate market is associated with significantly lower liquidity and less ease of trading.

With the creation of REITs, it is possible to trade real estate in the exchange listed stock market. Investors can buy REIT stocks from the stock market with the intention of investing in a pool of real properties. Thus, the REIT concept made it possible and convenient for small investors to invest in real estate (Chan, Erickson, and Wang, 2003). An REIT can be defined as a security that sells like a stock on the major exchanges and invests in real estate directly, through either properties or mortgages. Unlike direct property ownership, a REIT offers liquidity and daily price quotations. For example, Clayton and MacKinnon (2002) assert that most of the explosive growth in the REIT stock market could be attributed to the increasing institutional investors' involvement stemming from the desire for liquid access to the real estate investments in times of stock market downturns such as the mild recession of the 1990s and the technology stock decline of the early 2000s. Liquidity in the REIT markets plays a large role in investment strategies and asset allocation.

The market for REITs, as well as the relation between real estate markets and REIT stock market, has been analyzed extensively. Previous research finds segmentation between unsecuritized real estate and stock markets (e.g., Liu, Hartzell, Greig, and Grissom, 1990; Giliberto, 1990). Nevertheless, securitized real estate (REIT) is found to be closely related to stock markets (e.g., Gyourko and Linneman, 1988; Liu et al., 1990; Ambrose et al., 1992; Myer and Webb, 1993; Liu and Mei, 1992; Glascock et al., 2000).

However, there is controversy over whether REITs actually provide exposure to the private real estate asset class or simply represent additional exposure to equity stocks. Some studies suggest that these types of real estate are unrelated (e.g., Gyourko and Linneman, 1988; Scott, 1990; Ross and Zisler, 1991), while others document that these assets are linked by the same common factors in real estate (e.g., Giliberto, 1990; Gyourko and Keim, 1992; Clayton and Mackinnon, 2003).

Facing the seemingly contradictory evidence presented in the early studies, we are motivated to investigate the relationship between these two markets from the perspective of liquidity dynamics. A crucial step towards understanding the dynamics of liquidity and return across the property market and the REIT stock market is to explore whether there are spillover effects across the two different markets despite one being securitized and exchange-traded and the other private.

Prior studies on liquidity focused principally on its cross-sectional determinants and were restricted to equity or fixed-income markets. The literature on liquidity of REIT markets has restricted itself to examining liquidity within this market or linking liquidity of REIT stocks to non-REIT stocks. For example, Ghosh, Miles and Sirmans (1996) report that REIT liquidity may not be as large as comparably sized non-REIT stocks. Bertin et al. (2005) reexamine this problem using intraday REIT liquidity. Other works try to link REITs with different markets, such as bond markets (see Glascock, Lu and So, 2000).

To fill the gap in the literature, our paper investigates the relationship between the liquidity of the real estate property market and that of the REIT market. We ask whether the liquidity or

illiquidity of the property market transmits to the REIT market and what are the transmission mechanisms and the implications for the REIT investors.

As shown in Fleming and Remolona (1999), major macroeconomic news has a strong impact on financial market liquidity and price formation. Goyenko and Ukhov (2009) also report there is a connection between macroeconomic variables and financial market illiquidity. We also examine the effect of common macroeconomic variables on the liquidity dynamics of the REIT and property markets. Furthermore, it is well documented that REITs in the 1990s experienced significant structural changes. For instance, when compared to REITs in the 1980s, REITs in the 1990s were on average more liquid and larger in size (see Clayton and McKinnon, 2000; Beneveniste, Capozza and Seguin, 2001; Chan, Erickson and Wang, 2003). We examine the effect of the structural change on the liquidity dynamics between the REIT and the property market.

A group of recent studies have paid special attention to the cross-market dynamics of liquidity, return and volatility. Chordia, Sarkar and Subrahmanyam (2005) explore cross-market liquidity dynamics of the stock and bond market and find that innovations to liquidity and volatility in these two markets are significantly correlated, implying that common factors drive liquidity and volatility in these markets. Goyenko and Ukhov (2009) establish liquidity linkage between stock and Treasury bond markets, finding that stock and bond markets are integrated via liquidity, and that liquidity of one market has a predictive power for liquidity of the other. Along the same vein, Subrahmanyam (2007) examines the linkage between REITs and non-REIT stock markets, and finds REIT markets liquidity can be forecasted from non-REIT markets. However, this research focuses on exchanged traded stock markets without looking at the market for the underlying property assets.

In summary, this study is the first to attempt to establish the liquidity linkage between real estate property markets and REIT markets. Our finding of liquidity spillover across two types of real estate markets is closely connected to the literature that treats liquidity as a risk factor in each market. If liquidity is a systematic factor that investors take into account when they invest in real estate industry, then portfolio allocations can be expected to change to take liquidity conditions into account. In this case, we can also expect liquidity to have an effect across both the property market and the REIT equity market. For investor who would like to have exposure in the real estate market, a change in liquidity of one market will affect its attractiveness relative to the other market: a liquidity shock in the real estate property market may result in an investor's adjustment in the REIT market as well. By focusing on how the liquidity in the real estate property market is associated with the liquidity in the actively-traded REIT market, especially during the recent financial crisis, this paper makes a special contribution to the REIT liquidity literature.

3. Data and Sample

In this section, we describe the data collection and sample construction procedures. Our study requires three main sets of data: data on liquidity and return of the property market, data on liquidity and return of the REIT market, and data on macroeconomic variables.

3.1 Data on Property Market

We use NCREIF Property Index returns as the measure of property market return. On the private property side where information is difficult to obtain, the National Council of Real Estate Investment Fiduciaries (NCREIF) is the primary source of performance information. NCREIF

has compiled a unique, proprietary database of property-level income and appraised values on a quarterly basis dating back to 1978. Data is reported by most of the large investment managers and plan sponsors in the private real estate industry. This information is used to construct the NCREIF Property Index (NPI), an index that is often used as the performance benchmark for private real estate.[2] This index is widely used in property market research, such as Geltner (1998), Seiler, Webb and Myer (2001), Clayton and MacKinnon (2001), and many others. Geltner (1998) uses repeat measures regressions as well as an unsmoothing technique to show that the NCREIF database is informative and the NPI provides a reasonably good proxy for quarterly private market changes.

For the data on property market liquidity, monthly real estate property transaction data from 1979 to 2009 are collected from U.S. Census Bureau New Residential Sales Statistics Release. These statistics are estimated from sample surveys. Due to the limitation on the availability of time-series commercial real estate transaction data, we assume the residential property market liquidity gives a reasonable representation for the liquidly to the overall property market. There are three variables of interest: number of houses for sale, number of houses sold, and the house for sale ratio, which compares the two. We use the transaction volume, i.e., the number of houses sold in each quarter, as the proxy for property market liquidity.

3.2 Data on REIT Markets

REIT trading data is collected from the CRSP Daily File (1978-2009). As liquidity is an intangible attribute of the REIT market, choosing the optimal measure of liquidity has proven

[2] The NPI index might suffer from problem associated with appraisal soothing bias, due to the appraisal based nature of the property value data. The transaction based version of the NCREIF index may suffer less from this problem, however, it only began much later than 1978. Hence we still use appraisal based NPI index in our study.

elusive even though the concept of liquidity is well understood. Based on earlier literature (e.g., Amihud and Mendelson, 1986; and Hasbrouck, 1991), we adopt four widely used liquidity measures to proxy for REIT market liquidity: (1) Amihud Illiquidity, (2) bid-ask spread, (3) turnover ratio and (4) trading volume. All four measures of liquidity are based on daily trading and return data and are calculated for each REIT stock. We provide detailed descriptions of each of the four measures below.

A. Amihud Illiquidity Ratio:

Our first liquidity measure is the Amihud Illiquidity ratio proposed by Amihud (2002). As defined by Amihud (2002), the illiquidity of stock *i* in period *t* is

$$Illiquidity_{i,t} = \frac{1}{Days\ during\ period\ t} \sum_{d} \frac{|Ret_{i,d}|}{Dol\_Vol_{i,d}}$$

where $Ret_{i,d}$ is the daily return of stock i on day d, $Dol\_Vol_{i,d}$ is the dollar volume of stock i on day d, and $Days\ during\ period\ t$ is the number of trading days during period *t.* By this measure, a stock is illiquid (i.e., has a high value of $Illiquidity_{i,t}$) if the stock price moves a lot in response to little volume. For convenience, the ratio is multiplied by 10^7.

B. Bid-Ask Spread:

In this study, we also adopt the bid-ask spread as one of our liquidity measures. Bid-ask spread has been considered a good proxy for liquidity, among numerous others, since as early as Demsetz (1968). In this study, bid-ask spread was, for the first time, formally treated as a

transaction cost of the investor for immediate deals since it reflects the cost to trade with the dealer instead of waiting for another investor to take the opposite position of a transaction. Specifically, a smaller bid-ask spread implies a lower cost of immediacy and higher level of liquidity. Amihud and Mendelson (1986) find that there is a positive relation between bid-ask spread and equity return and interpreted it as the compensation for investors' higher transaction cost. Grossman and Miller (1988) and Vijh (1990) both adopt the bid-ask spread as their liquidity measures following the same logic.

In addition, since the prices of REIT stocks vary such that absolute bid-ask spread may not fully reflect the liquidity character of a specific REIT stock, we further scaled down the bid-ask spread with the REIT closing price. To be more specific, the bid-ask spread measure of liquidity, or the percentage spread in the rest of this study, is calculated as

$$Spread = \frac{Ask_{i,t} - Bid_{i,t}}{Price}$$

Since markets usually charges high spread for illiquid REIT stocks, the lower the spread ratio is, the more liquid the REIT is.

C. Trading Volume:

The third liquidity measure used in our study, also commonly used in the finance field, is trading volume, which should be the most direct index of liquidity since the higher the trading volume, the easier for investors to buy or sell their shares quickly without much cost.

D. Turnover Ratio:

The last liquidity measure is the turnover ratio, which is derived from the trading volume. More specifically, we define daily share turnover ratio as the trading volume of the individual REIT stock divided by the total shares outstanding for that stock.

For all four measures, we first calculate daily liquidity measures. Then we average the quarterly liquidity value for each REIT stock and aggregate to arrive at the REIT market liquidity. Figure 1 displays the time series plot of Amihud Illiquidity and quoted bid-ask spread. The two measures of liquidity show a consistent picture for the liquidity of the REIT market. From the plots, we can see that in 1992, there was a sudden increase in liquidity into the REIT market. This can be explained by the Tax Reform Act in 1993 which lead to a structural change and the phenomenal growth of the REIT market. For parsimony of reporting, we use Amihud's liquidity as our main liquidity measure. We show the time series plots of the liquidity of the REIT market and the property market in Figure 2. We can see that the 1990s structural change affects the liquidity of the REIT market rather than the property market, and it appears that the property market appears to lead the REIT market. For the period of the recent subprime crisis, property market liquidity decreases substantially as early as in 2006, and the REIT market starts to react in mid-2008. We use Principal Component Analysis technique to extract the most important factor from the four liquidity measures, which is known as the first principal component. We regenerate our main result using the first principal component of the four liquidity measures as a robustness check.

3.3 Macroeconomic Variables

We use four main macroeconomic variables: the growth rate of industrial production (IP), inflation (the growth rates of the consumer price index (CPI)), 30-Year Conventional Mortgage Rate (Mortg) and Real Estate Loans at All Commercial Banks (REloan). The quarterly data of these four variables are from the Federal Reserve Bank of St. Louis.

Industrial production growth rate has long been used as a proxy for macroeconomic activity. Tainer (1993) shows that the industrial production index is pro-cyclical: it rises during economic expansion and falls during a recession. It is typically used as a proxy for the level of real economic activity, that is, a rise in industrial production would signal economic growth. Fama (1990) and Geske and Roll (1983) hypothesized a similar positive relationship through the effects of industrial production on expected future cash flows. The productive capacity of an economy provides a measure of real economic activity.

We use growth rate of CPI as inflation affects investors' real returns and is a major risk concern. In the literature, a positive relationship between unsecuritized real estate and inflation is documented (e.g., Gyourko and Linneman, 1988); nonetheless, negative association is observed for REITs and inflation in other studies (e.g., Liu, Hartzell, and Hoesli, 1997).

The 30-Year Conventional Mortgage Rate is the contract interest rates on commitments for fixed-rate first mortgages and is from Primary Mortgage Market Survey data provided by Freddie Mac. The Real Estate Loans at All Commercial Banks is from the H.8 release of Assets and Liabilities of Commercial Banks in the United States by the Board of Governors of the Federal Reserve System. Tightening liquidity may push mortgage rates up, as seen in the Hong Kong housing market[3]. We use the growth rate of real estate loans by all commercial banks as a

[3] See detailed news report from http://hongkongbusiness.hk/commercial-property/in-focus/property-shocker-tightening-liquidity-may-push-mortgage-rates

measure of the credit supply and liquidity provision to the real estate sector. The credit supply to the real estate sector by commercial banks may lead to a higher level of liquidity of both REIT and property market.

4. Summary Statistics

We exclude observations with missing values for return, trading volume or price. As a result, the final sample size is 128 quarters for aggregate market data. Table 1 presents summary statistics of REIT stock and property market return and liquidity. The average return of the REIT market is 4.204%, and the average quarterly property market return obtained from the NPI index is 2.087%. The house for sale ratio, a measure of the turnover of the property market, is defined as the ratio of the number of houses for sale over the number of houses sold during the specific quarter. The average of the house for sale ratio is 5.497, and there are 210 houses on the market for sale during each quarter. The turnover of the REIT market, which is defined as trading volume over total shares outstanding, is 4.916 on average. During the sample period, inflation is about 0.647% quarterly. Industry production growth rate is commonly used as a business cycle indicator which measures changes in the aggregate output of industry, and averages 0.547% per quarter over our sample.

We report the correlation among REIT stock liquidity measures in Table 2 Panel A. All five measures of the REIT market liquidity are significantly correlated with each other, but not perfectly. The Amihud illiquidity measure for REIT stocks is highly negatively correlated with REIT stock turnover, trading volume and dollar volume at 1% significance level. It is highly positively correlated with bid-ask spread with correlation values ranging from 0.16 to 0.97 in

magnitude, and are all significant at 1% level. For instance, the correlation between the Amihud illiquidity measure and the quoted spread is 0.553, and is significant at 1% level.

In Table 2 Panel B, we present the correlation matrix in REIT stock and property market liquidity and return, together with four other macroeconomic variables. The results for liquidity and return across the two markets are reported in the upper-left of this panel. Correlation between the liquidity of the REIT market and that of the property market is 0.377 and significant at 1% level, which supports a strong cross-market liquidity linkage and co-movement of the two markets. Cross-market liquidity and return are shown to be closely correlated. The correlation between property return and REIT stock return is -0.045, and is significant at 1% level. REIT return has negative correlation with REIT liquidity, consistent with the findings in Amihud and Mendelson (1986) that investors require a premium in return for holding illiquid stocks. On the other hand, property market return is positively correlated with the liquidity in the property market, supporting the notion that in a booming property market investors are able to realize better return. A more liquid real estate market will attract more participants, as the pool of potential buyers and sellers further expands. For instance, buyers who wish to sell their properties on good terms later would enter the market, and this leads to higher level of liquidity. Also, as liquidity rises, the possibility of reselling to one of the many new buyers also increases. This in turn increases the realized return in the future.

The results for correlations with macroeconomic variables are reported in the lower part of this panel. Mortgage rate is negatively correlated with the liquidity of the property market, suggesting fewer transactions on properties when mortgage loans become more expensive. Real estate loan lending is positively correlated with property market liquidity, which is again

consistent with the notion that ease of financing for real estate loans leads to high volume of transaction in the property market.

5. Vector Auto-regression Model Estimation Result

We use a vector auto-regression model to explore inter-temporal associations between market liquidity and return in both the private property market and the REIT stock market. If there are leads and lags in trading activity in response to systematic shocks, then trading activity in one market may affect trading activity and liquidity in another. Given that there are reasons to expect cross-market effects and bi-directional causalities, we use a four equation vector auto-regression that incorporates the following four endogenous variables:

1) ***liq_reit***: Liquidity of the REIT stock market, measured using Amihud illiquidity.

2) ***liq_prop***: Liquidity of the property market, measured using the number of new houses sold.

3) ***ret_reit***: Return of the REIT stock market.

4) ***ret_prop***: Return of property index (quarterly, from 1978 Q1 to 2011 Q2)

Define $X_t = (lip\_reit_t, ret\_reit_t)$; $Y_t = (lip\_reit_t, ret\_reit_t)$;

where X_t is a vector that represents liquidity and return of the REIT stock market, and Y_t is a vector that represents liquidity and returns of the property market. The following system is used:

$$X_t = \sum_{j=1}^{k} a_{1j} X_{t-j} + \sum_{j=1}^{k} b_{1j} Y_{t-j} + u_t \; ; \quad Y_t = \sum_{j=1}^{k} a_{2j} X_{t-j} + \sum_{j=1}^{k} b_{2j} Y_{t-j} + v_t$$

Besides estimating a VAR model with four endogenous variables, we augment it by adding four exogenous macroeconomic variables, including IP, CPI, Mortgage Rate and Real Estate

Loans. In addition, we use Principal Component Analysis to extract the most important component from various liquidity measures for the REIT market, and regenerate the VAR result to check for robustness.

5.1 VAR Estimation Result

We present results from a VAR with endogenous variables ***liq_reit***, ***ret_reit, liq_prop***, ***ret_prop***. The number of lags is chosen on the basis of the Akaike Information Criterion (AIC). The VAR is estimated with 6 lags and uses 128 observations. Table 3 reports pairwise Granger-Causality tests between the endogenous variables in the VAR. Panel A reports the result when the REIT market includes all REIT firms, Panel B only reports equity REITs, and Panel C mortgage REITs. Given the null hypothesis that the row variables do not Granger Cause column variables, we test whether the lag coefficients of i are jointly zero when j is the dependent variable in the VAR. The cell associated with the i^{th} row variable and the j^{th} column variable shows the χ^2 statistics and corresponding p-values in parentheses.

The implications from the Granger Causality test can be summarized as follows. There is strong directional causality observed from liquidity of the property market to the liquidity of REIT market. Within the REIT market, there is two-way causation between liquidity and return. Within the real estate property market, liquidity Granger Causes return, but not the other way around. In terms of cross-market causality, liquidity of the property market Granger Causes both liquidity and return of the REIT market with significance at 1%. However, the liquidity of the stock market has only marginal causality on the property return. Return of the property market Granger Causes both liquidity and return of the REIT stock market with significance at 1%.

Overall, the results in Table 3 Panel A indicate that liquidity of the property market has influence on the REIT market. However, the reverse does not hold, which suggests that the property market liquidity leads the property market liquidity.

The two main types of REITs, i.e., equity REITs and mortgage REITs, have a distinctive underlying operating mechanism. Equity REITs invest in and own real estate properties that form their underlying assets. However, mortgage REITs are less straightforward, as mortgage REITs deal with investment and ownership of property mortgages. We focus on the Granger Causality for the two different types of REIT firms separately. Table 3 Panel B shows the Granger Casualty result for equity REITs only and Panel C is the Granger Casualty result when we consider mortgage REITs only. Comparing the result in the two panels, we can see that the liquidity and return of the property markets still have significant Granger Causality onto the REIT market for both types of REITs. However, the effect is weaker for mortgage REITs. This result is consistent with the fact that in that mortgage REITs do not own properties directly, but loan money for mortgages to owners of real estate, or purchase existing mortgages or mortgage-backed securities. Their revenues are generated primarily by the interest that they earn on the mortgage loans, not directly from the management of the properties. It is not surprising that the linkage is slightly weaker for this type of REIT firm.

Notably, the Granger Causality results are based on the analysis of the coefficients from a single equation and do not account for the joint dynamics implied by the VAR system. A clearer picture can potentially emerge by the use of impulse response functions (IRFs). The IRF traces the impact of a one-time, unit standard deviation, positive shock to one variable on the current and future values of the endogenous variables. Innovations are orthogonalized using standard Cholesky decompositions of the VAR residuals. Table 4 Panel A reports VAR estimation result

with the ordering ret_prop, liq_prop, ret_REIT, liq_reit. From the VAR result on REIT liquidity, we can see that property market liquidity in different lags is quite significantly related to REIT liquidity measures.

Figure 4 Panel A illustrates the impulse response of REIT stock liquidity and property market liquidity to a unit standard deviation shock in the four endogenous variables, i.e., ret_prop, liq_prop, ret_REIT, liq_reit, for a period of 12 periods. Monte Carlo two-standard-error bands are provided to determine the statistical significance of the responses.

The upper four plots in Figure 4 Panel A present the response of REIT market liquidity to a unit standard deviation shock in the four endogenous variables. The impulse response function of REIT liquidity to this shock indicates that the REIT stock liquidity increases by about 0.2 standard deviation units in the first period, with the response peaking on the second day then decaying gradually. An innovation in REIT stock returns forecasts an increase in REIT liquidity. This is consistent with Chordia, Roll, and Subrahmanyam (2001), which show that up-market moves have a positive effect on stock liquidity, and also is consistent with the positive and significant correlation of 0.184 between REIT return and REIT liquidity shown in Table 2 Panel B.

There is also evidence of cross-market dynamics in the impulse response function plots in Figure 4. In particular, the impulse response function of property liquidity on REIT liquidity shows that an innovation in property market liquidity forecasts a decrease of REIT stock market liquidity in the first few periods, followed by an increase. This suggests negative correlation of the liquidity of the two markets in short term and positive correlation in the longer term. The impulse response function of REIT liquidity to property return shows that an innovation in

property market returns is associated with a lasting decrease in REIT market liquidity. This suggests that the private property market and REIT market are substitutes for each other. A booming real estate property market with a higher volume of transactions and higher levels of returns attracts more investors who want to gain exposure in real estate sector and may take away some investors who initially set their mind on REITs. Given good performance in the property market, investors who consider investing in real estate may go directly into the real estate market instead of investing in REITs.

The lower four plots in Figure 4 Panel A present the response of property market liquidity to a unit standard deviation shock in the four endogenous variables. The response plot of property market liquidity to shocks in REIT market liquidity shows a positive association between the liquidity of the two markets, which suggests cross-market liquidity co-movement. In addition, innovation in the REIT stock market return consistently has positive effects on the liquidity of the property market. We also notice that the liquidity in the property market is positively related to its own shock; The response plot of property market liquidity to its own shock indicates that the property market liquidity increases by 16.24 standard deviation units on the first day in response to its own shock. If investors believe the securitized real estate market is more efficient in discovering new information, a more liquid REIT market with better return indicates good prospect for investing in real estate in general. Property market participants respond positively to the positive sentiment in the REIT market.

Figure 4 Panel B illustrates the responses of REIT stock return and property market return to a unit standard deviation shock in the four endogenous variables. It is observed in the first plot that a shock to the REIT market liquidity is associated with an increase in the future REIT return,

with the response decaying from period one to period two and changing direction from period three onwards.

The impulse response function of REIT return to the shocks of itself indicates the efficiency of the REIT market. The response to its own innovation is positive and significant in the first period, and becomes close to zero and insignificant afterwards, consistent with our earlier argument that the REIT market is highly liquid and highly efficient. On the contrary, the impulse response function of the property market return to its own shocks shows the inefficiency of the property market. Property market return increases by 1.22 standard deviation units on the first period in response to its own shock, with the response decaying gradually afterwards. The responses remain consistently positive and significant for about 8 periods, consistent with the notion that property market is thinly traded and slowly responds to its return shocks. Shocks in REIT liquidity have a positive impact on property market return, as shown in the fifth plot. We also observe that the shocks in the liquidity of the property market have positive impact on property market return.

As an alternative way of characterizing liquidity dynamics, Panel B of Table 4 shows the variance decompositions of REIT market and property market liquidities. The fraction of the error variance in forecasting the REIT market liquidity, due to innovations in itself, is more than 60 percent in the first period and declines steadily to about 30 percent after 12 periods. Innovation in REIT return explains about 22 percent of the initial forecast error variance and accounts for almost 40 percent after 10 periods. For cross-market influence, the innovation in property liquidity explains about 4 percent of the short-term forecast error variance, and increases with time to 17 percent after 12 periods.

For forecasting the property market liquidity, innovation in itself is again the most important variable. Specifically, the fraction of the error variance in forecasting the property market liquidity, due to innovations in itself, is about 99 percent in the first period and declines steadily to 88 percent after 12 periods. Together with the result on own-market innovation above, these results show that innovations in own-market liquidity explain most of the liquidity dynamics, especially at shorter horizons. The inter-market result is that REIT market liquidity explains about 1 percent of the error variance in property market liquidity, which suggests that the liquidity of the REIT market does not influence the liquidity of the property market in a significant manner, and the direction of influence is from the property market to the REIT market. Own-market return and cross-market return explain about 7 percent and 3 percent of the error variance, respectively.

Our results can be summarized as follows. There are significant cross-correlations in liquidity innovations after accounting for the effect of returns. The impulse response results suggest that liquidity shock in the property market predicts liquidity movements both within and across markets. For example, innovations to property market liquidity forecast an increase in REIT market liquidity and also its own market liquidity. Further, shocks to return in the REIT equity market forecast an increase in that market's liquidity. This result is consistent with recent theoretical models where binding capital constraints lead to sudden liquidity dry-ups, and is also consistent with the empirical findings in Hameed et al. (2010) that negative market returns decrease stock liquidity. Overall, we demonstrate that liquidity of the property market has predictive power over the liquidity of the REIT market. This establishes liquidity linkage between the two asset classes.

5.2. VAR Estimation with Macroeconomic Variables

We now estimate the effect of macroeconomic factors on REIT stock market and property market liquidities. Following Goyenko and Ukhov (2009), we use the growth rate of industrial production (IP) and inflation (the growth rates of the consumer price index (CPI)) as the main proxy for macroeconomic conditions. The quarterly data on IP, CPI, mortgage rates and growth rate of real estate loans at all commercial banks are from the Federal Reserve Bank of St. Louis. The series on IP, CPI and growth rate of real estate loans are seasonally adjusted. The Granger Causality results reported in Table 5 Panel A indicate that shocks to CPI, IP, mortgage rate and growth rate of real estate loans are informative in predicting REIT stock market liquidity and returns. Shocks to these four factors are also informative in property market return, though significant causality is observed for property market liquidity. Thus, there is evidence that macroeconomic variables are linked to REIT markets as well as to property markets, though with a weaker link.

The correlation matrix of the resulting VAR innovations is reported in Table 5 Panel B. Innovations in liquidity of the REIT market are positively correlated with innovations in CPI growth rate, industrial production, and growth rate of real estate loans but are negatively associated with mortgage rate, which suggests increased liquidity of REIT stocks during good economies. Property market liquidity is negatively correlated with mortgage rate, which is quite intuitive as an increase in mortgage rate is normally intended to cool down the property market. Interestingly, innovations in liquidity of the property market are negatively correlated with CPI and IP.

In Table 5 Panel C, we report the variance decompositions of the REIT market and property market liquidities and returns. For the REIT market liquidity, CPI growth rate explains about 1% of the variation over the short term; this percentage increases to 9% after 10 periods. The proportion of variation explained by IP growth rate also increases over time. The proportions explained by mortgage rate and growth rate of real estate loans peaks at the second period, and declines afterwards. For property market liquidity, shocks in CPI explains more than 25% after 10 periods, lower in magnitude only to the own shocks in property market liquidity which account for about 58% in the long term, and much more than the fraction explained by property return shocks which account for about 8% in the long term. Both IP and mortgage rate explain about 3% of the variation in property market liquidity.

Panel A of Figure 5 presents the impulse response functions of property market liquidity and REIT stock liquidity to shocks in macroeconomic variables. As for the liquidity of the REIT stock market, an innovation to CPI forecasts a decrease in REIT liquidity, which indicates that an increase in inventory-holding and order-processing costs due to inflation is reflected in higher transaction costs. An innovation in mortgage rate also predicts a decrease in REIT liquidity, with the response peaking in the second period, and decaying afterward. A shock in the growth rate in real estate loans is also associated with a decrease in REIT liquidity. The effect of mortgage rate on REIT stock liquidity begins with a lag of three months, and decays afterwards. This suggests that tightening of mortgage rate policy forecasts an increase in REIT stock market liquidity.

The lower four graphs in Panel A are responses of property market liquidity. We find that property market liquidity is negatively associated with CPI, suggesting increased liquidity and more active trading in the property market is correlated to at a mature stage of the economy with a slower growth rate in CPI. Shocks in mortgage rate are associated with decrease in property

liquidity, suggesting property investments become more difficult to acquire when mortgages become more expensive. From the impulse response plots, we can see that shocks in IP and real estate loans do not seem predict property market liquidity.

Next, we look at the impulse response functions of property market return and REIT stock market return to macroeconomic variables. Shocks to the mortgage rate have a negative effect on both REIT return and property market return, which is consistent with the notion that returns on REITs, particularly mortgage REITs, are related to changes in interest rates. Shocks in industrial production have a positive impact on property return, and shocks in the total amount of real estate loans in all commercial banks have a negative impact on property return.

Overall, our results point to a connection between macroeconomic variables and liquidity conditions in the REIT stock and property markets. Generally, a shock to macroeconomic variables has significant effects on the liquidity of the two markets. Our impulse response analyses with exogenous macroeconomic variables suggest that inflation (growth rate in CPI) forecasts a decrease in property market liquidity and an increase in REIT stock market liquidity. In addition, we also observe from the IRF plots that economic growth (growth in IP) is associated with an increased level of property market liquidity and a decreased level of REIT liquidity.

5.3 VAR Estimation with Principal Components of REIT Liquidity

The discussion of sources of market liquidity enters the realm of market microstructure theory, which is concerned with how trading mechanisms affect the price formation process. There are four variables commonly used for proxy of stock market liquidities, including Amihud

(2002) illiquidity, bid-ask spread, turnover ratio and trading volume. Each of these measures might capture a certain aspect of trading liquidity and has been researched in various studies. Bid-ask spreads reflect the cost of transacting in the market, which is a proxy for trading friction. Amihud and Mendelson (1986) use bid-ask spreads to examine liquidity premium and clientele effect in the stock market. Chalmers and Kadlec (1998) find that stocks with similar spreads can have a vastly different share turnover. Demsetz (1968) suggests that trading volume is an important determinant of liquidity. Barclay, Kandel, and Marx (1998) emphasize volume measures as better indicators of liquidity than price discounts.

In section 5.1 we estimate a VAR model using Amihud (2002) measure for REIT market liquidity. By using only one of these liquidity measures, there is a risk that we might lose valuable information contained in alternative liquidity measures. Principal Component Analysis (PCA) allows us to extract the most important factor impacting the market liquidity, with the benefit of reducing the number of dimensions without much loss of information. As a robustness check of our previous result, we re-estimate the VAR model using the first principal component extracted from all four liquidity measures using PCA techniques. Impulse response functions are estimated and presented in Figure 6, and variance decomposition result is presented in Table 6.

Qualitatively similar results on market dynamics are obtained using the principal component of REIT liquidity obtained from PCA for majority of the liquidity and return pairs. We examine the cross-market dynamics between the two markets. Again we find that a unit of positive innovation in the liquidity of the property market has a negative impact on the liquidity of the REIT market, which suggests lower future liquidity of the REIT market. However, this does not hold in the reverse direction. Comparing the impulse response function plots in Figure 4 and Figure 6, if the inverse of Amihud illiquidity is used as a proxy for REIT liquidity measure, the

shocks in REIT liquidity have a positive effect on the liquidity in the property market; whereas, if the principal component extracted from a list of liquidity measures is used as a liquidity measure of the REIT market, we can see from the fifth plot in Figure 6 Panel A that shocks in the liquidity of the REIT market are found to be irrelevant in influencing the liquidity of the property market. This result is in consistency with the Granger Causality result, which also indicates that the direction of influence is from the property market to the REIT market, but not the other way around.

Another distinction from the results in Table 4 compared with those in Table 6 Panel B is the effect of shocks in REIT market liquidity and return on property market return. When using the principal component as a REIT liquidity proxy, we observe that shocks in REIT market liquidity predict a decrease in future property return, and this effect gradually diminishes in about three quarters. An innovation in the REIT stock market return has significantly positive and long-lasting effect on the return of the property market, whereas the response is not significant using Amihud illiquidity measures.

5.4 VAR Estimation Before and After the REIT Structural Change in 1990s

The REIT market experienced a structural change in early 1990s, as institutional investment increased remarkably in this market (Gloscock, Lu, and So, 2000), especially on equity REITs (Chan, Leung and Wang, 1998). Glascock, Lu, and So (2000) find that REITs behave more like stocks and less like bonds after the structural changes in the early 1990s, and their results suggest that the benefits of diversification by including REITs in multi-asset portfolios diminish after 1992. However, Clayton and Mackinnon (2001) report that during the 1990s, REITs began to

exhibit a direct link to real estate returns, indicating that REITs do provide portfolios with some exposure to the real estate asset class, and the strength of this link is cyclical in nature. Motivated by this puzzling result in these two papers, we intend to ascertain the relationship between REITs and real estate property market before and after the structural change in our study. We divide our sample into two periods with the first periods from 1978 to 1992, and the second period from 1993 to 2009.

Two separate VAR models are estimated employing methods similar to our previous estimations. Figure 7 Panel A shows the estimation result prior to 1992, and Panel B reports the result for the period from 1993 onwards. First, we look at the result for the earlier period. From the graph we can see that across markets, REIT market liquidity is not very sensitive to the shock in the liquidity of the property market, whereas shocks in REIT market liquidity have significantly positive effect on the liquidity of the property market. This suggests that the liquidity linkage between the REIT market and property market is uni-directional. The liquidity and return of the REIT markets have predictive power over that of property market.

Besides liquidity linkage, we also look at the return and liquidity dynamics across these two markets. While we do not see strong causality between the return of the property market and the liquidity of the REIT market, we do observe that a positive shock to REIT market return is associated with an increased level of liquidity in the property market. In addition, we also notice that an innovation in REIT stock return forecasts an increase in the liquidity of the REIT market itself. This is consistent with the view that price changes in one market can trigger changes in investor expectations and in optimal portfolio composition. This can lead to a wave of trading in both markets, which would eventually positively affect REIT and property market liquidity (Goyenko and Ukhov, 2009).

For the period after the REIT market structural change, it is interesting to note that cross-market liquidity dynamics become much weaker. The liquidity and return of the REIT market no long have any significant causal effect on those of the property market. This evidence lends support to the finding in Glascock, Lu, and So (2000) that the link between REIT and real estate property markets becomes weaker, and REITs behave more like stocks after the structural change.

Overall, we demonstrate that liquidity of the REIT market has predictive power over liquidity of the property market before the structural change in the REIT industry in the 1990s. And after the structure change, this linkage between the two markets becomes much weaker. Consistent with Giliberto (1990), our sub-period results demonstrate that REIT market provides positive exposure to the real estate property market in the period prior to the structural change. However, contrary to Clayton and Mackinnon (2003), our analysis does not show that REITs began to exhibit a direct link to real estate returns after 1992.

6. Conclusion

Despite the importance of liquidity in the property and REIT markets and the uniqueness of REIT securities, little is known about the connection between the liquidity of the two markets. This paper investigates the relationship between the liquidity of the real estate property market and that of the REIT market from the perspective of liquidity dynamics and transformation. The REIT market is unique in the sense that it transforms from the underlying illiquid real estate properties to an exchange-traded market, which has much higher liquidity and efficiency.

Our results indicate that there is a lead-lag relationship between the liquidity of two markets. The Granger Causality test shows property market liquidity leads liquidity in the REIT market, and not the other way around. In addition, return in the property market has causal effect on the liquidity and return of REIT markets. We estimate VAR models and compute impulse response functions to examine the dynamics of the cross-market relationships in liquidity and returns between the two markets. The impulse responses show that generally REIT liquidity responds to property market liquidity, especially after the structure change in the REIT industry in the early 1990s. Our results also demonstrate that a shock to macroeconomic variables has significant effect on the liquidity of the two markets. In conclusion, our study sheds light on the contemporaneous commonality between the liquidity of the unsecuritized property market and the securitized REIT market.

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Table 1: Summary Statistics of REIT Stock and Property Market Return and Liquidity
(Quarterly 1978Q1:2009Q4)

Amihud illiquidity is Amihud's (2002) illiquidity measure, defined as the average value of absolute daily stock return over dollar volume. *Bid-ask spread* is also called percentage spread, and is defined as the difference between ask price and bid price, scaled by the closing price. *Turnover Ratio* is the daily trading volume of the individual REIT stock divided by the total shares outstanding for that stock. *Volume* is the daily trading volume of the REIT stock in the unit of thousands. *Dol_vol* is the dollar volume in the unit of millions, defined as the price multiplied by the trading volume. *House for sale ratio* is the quarterly turnover for the property market, measured as the ratio of the number of houses for sale over the number of houses sold. *Number of houses sold* is the number of houses sold during a specific quarter. *IP_gr* is the seasonally adjusted percentage growth rate of industry production each quarter obtained from Federal Reserve Bank of St. Louis. *NPI return* is the quarterly return calculated based NPI property index. *IP_gr* is the seasonally adjusted percentage growth rate of industry production each quarter obtained from Federal Reserve Bank of St. Louis. *CPI_gr* is the seasonally adjusted percentage growth rate of the consumer price index. We obtain the quarterly data of CPI_gr from Federal Reserve Bank of St. Louis. *REloan* is the growth rate of Real Estate Loans at All Commercial Banks. It is used as a measure of the credit supply and liquidity provision to the real estate sector. *Mortgage Rate* is the 30-Year Conventional Mortgage Rate, defined as the contract interest rates on commitments for fixed-rate first mortgages. It is collected from Primary Mortgage Market Survey data provided by Freddie Mac.

	mean	min	p5	p25	median	p75	p95	Max	stdDev
REIT Stock Market									
Amihud illiquidity	3.055	0.000	0.001	0.004	0.018	0.259	8.426	1883.695	32.899
Turnover	4.916	0.010	0.398	1.411	2.816	5.222	16.211	204.312	8.259
Spread	0.025	0.000	0.001	0.004	0.014	0.028	0.092	1.019	0.043
Volume (thousand)	252.933	0.017	0.965	11.852	55.297	194.223	1046.549	20157.650	796.288
dol_vol (million)	5.851	0.000	0.006	0.113	0.974	3.957	26.248	467.623	17.991
REIT return	4.204	-212.879	-20.981	-3.514	3.896	11.701	29.848	481.647	20.021
Principal Component of Liquidity	0.000	-6.535	-1.384	-1.081	0.642	0.438	3.494	6.484	1.592
Property Market									
House for sale ratio	5.497	3.418	3.486	4.022	4.935	6.137	10.128	13.000	2.011
Number of houses sold	209.873	83.000	104.000	169.000	211.000	248.000	326.000	351.000	59.789
NPI return	2.087	-8.290	-2.810	1.600	2.400	3.420	4.660	5.430	2.325
Macroeconomic Variables									
CPI (growth rate)	0.647	-3.438	-0.352	0.494	0.666	0.909	1.303	2.633	0.623
IP (growth rate)	0.547	-6.101	-2.008	0.240	0.816	1.269	2.600	4.185	1.471
Mortgage rate	7.038	4.930	5.330	6.140	7.010	7.680	9.040	14.420	1.185
Growth rate Real Estate loan (%)	2.205	-2.216	0.071	1.045	2.117	3.199	5.021	6.470	1.587

Table 2: Correlations in REIT Stock and Property Market Liquidity and Return
This table presents the correlation matrix for the time series of quarterly liquidity measures and return measures.

Panel A: Correlation among REIT Stock Liquidity Measures

Amihud_illiq is Amihud's (2002) illiquidity measure, defined as the average value of absolute daily stock return over dollar volume. *Turnover* is the daily trading volume of the individual REIT stock divided by the total shares outstanding for that stock. *Spread* is defined as the difference between ask price and bid price, scaled by the closing price. *Volume* is the daily trading volume of the REIT stock in the unit of thousands. *Dol_vol* is the dollar volume in the unit of millions, defined as the price multiplied by the trading volume.

	Amihud_illiq	turnover	spread	Volume (thousand)	dol_vol (million)
Amihud _illiq	1				
turnover	-0.231***	1			
spread	0.553***	-0.544***	1		
Volume (thousand)	-0.164***	0.973***	-0.444***	1	
dol_vol (million)	-0.221***	0.968***	-0.524***	0.964***	1

Panel B: Correlation of Liquidity and Return of Property and REIT Market with Macroeconomic Variables

IP_gr is the seasonally adjusted percentage growth rate of industry production. We obtain the quarterly data of IP_gr from Federal Reserve Bank of St. Louis. *CPI_gr* is the seasonally adjusted percentage growth rate of the consumer price index. We obtain the quarterly data of CPI_gr from Federal Reserve Bank of St. Louis. *REloan* is the growth rate of Real Estate Loans at All Commercial Banks. It is used as a measure of the credit supply and liquidity provision to the real estate sector. *Mortgage Rate* is the 30-Year Conventional Mortgage Rate, defined as the contract interest rates on commitments for fixed-rate first mortgages. It is collected from Primary Mortgage Market Survey data provided by Freddie Mac. *Retp* is return of the property market. *Rets* is quarterly return of the REIT stock market, calculated as the quarterly average value of daily REIT stock return. *Liqp* is the liquidity of the property market. It is proxied by houses sold during the specific quarter. *Liqs* is the liquidity of the REIT stock market, measured using the negative of Amihud (2002) illiquidity.

	Liqs	Rets	Liqp	Retp	CPI_gr	IP_gr	Mortg_rate	Reloan
Liqs	1							
Rets	-0.184***	1						
Liqp	0.377***	0.0326***	1					
Retp	0.356***	-0.0453***	0.601***	1				
CPI_gr	-0.0621***	0.00732	0.00638	0.280***	1			
IP_gr	0.0735***	0.0428***	0.153***	0.385***	0.0294***	1		
Mortg_rate	-0.173***	-0.0210**	-0.417***	0.106***	0.344***	0.135***	1	
Reloan	0.269***	-0.196***	0.364***	0.314***	0.0541***	0.0595***	0.110***	1

p<0.10, ** p<0.05, *** p<0.01

Table 3: Granger Causality Test Result

This table presents Chi-square statistics and p-values of pair-wise Granger Causality tests between endogenous VAR variables. Null hypothesis is that row variable does not Granger Cause column variable.

Panel A: All REITs

	REIT Liquidity	REIT Return	Property Liquidity	Property Return
REIT Liquidity		15.53***	0.19	5.87*
		(0.0004)	(0.9094)	(0.0531)
REIT Return	22.61***		2.29	2.64
	(<.0001)		(0.3174)	(0.2678)
Property Liquidity	232.92***	283.78***		10.39***
	(<.0001)	(<.0001)		(0.0055)
Property Return	19.49***	102.93***	0.01	
	(<.0001)	(<.0001)	(0.9952)	

Panel B: Equity REITs

	REIT Liquidity	REIT Return	Property Liquidity	Property Return
REIT Liquidity		16.85***	0.04	0.02
		(0.0002)	(0.978)	(0.9887)
REIT Return	14.15***		0.04	0.16
	(0.0008)		(0.9808)	(0.9211)
Property Liquidity	142.01***	117.11***		2.62
	(<.0001)	(<.0001)		(0.2693)
Property Return	32.73***	78.66***	0.08	
	(<.0001)	(<.0001)	(0.9628)	

Panel C: Mortgage REITs

	REIT Liquidity	REIT Return	Property Liquidity	Property Return
REIT Liquidity		14.93***	2.49	27.66***
		(0.0006)	(0.2879)	(<.0001)
REIT Return	1.68		2.15	0.92
	(0.4328)		(0.3412)	(0.6324)
Property Liquidity	13.85***	1.49		2.06
	(0.001)	(0.4755)		(0.3575)
Property Return	8.06**	0.26	0.04	
	(0.0178)	(0.8792)	(0.9783)	

Table 4: VAR Estimation Result and Variance Decomposition

Panel A: VAR Estimation Result

	Property Return (t)		Property Mkt Liquidity (t)		REIT Return (t)		REIT Illiquidity(t)	
	Estimate	S. E.	Estimate	S. E.	Estimate	S. E.	Estimate	S. E.
Prop Return (t-1)	0.509***	0.114	-4.275***	1.516	-1.482**	0.714	0.053**	0.020
Prop Mkt Liquidity (t-1)	-0.003	0.007	0.688***	0.098	-0.062	0.046	0.004***	0.001
REIT_Return (t-1)	0.008	0.020	0.847***	0.261	-0.091	0.123	-0.018***	0.004
REIT_Illiquidity (t-1)	-0.889	0.707	-11.853	9.423	-12.225***	4.438	1.036***	0.126
Prop Return (t-2)	0.145	0.131	3.057*	1.741	-1.218	0.820	-0.006	0.023
Prop Mkt Liquidity (t-2)	0.010	0.009	0.170	0.118	0.114**	0.056	-0.006***	0.002
REIT_Return (t-2)	0.016	0.023	-0.152	0.312	-0.314**	0.147	-0.006	0.004
REIT_Illiquidity (t-2)	0.496	0.906	15.203	12.075	6.014	5.687	-0.324**	0.162
Prop Return (t-3)	-0.032	0.116	-1.409	1.542	-0.294	0.726	-0.020	0.021
Prop Mkt Liquidity (t-3)	0.003	0.008	0.093	0.104	0.053	0.049	0.002	0.001
REIT_Return (t-3)	-0.028	0.025	0.244	0.336	-0.078	0.158	-0.004	0.004
REIT_Illiquidity (t-3)	-0.755	0.897	-1.512	11.963	8.143	5.635	0.320**	0.160
Prop Return (t-4)	0.415***	0.114	0.460	1.513	0.354	0.713	-0.004	0.020
Prop Mkt Liquidity (t-4)	-0.004	0.007	0.754***	0.100	0.003	0.047	-0.003**	0.001
REIT_Return (t-4)	0.023	0.024	-0.169	0.323	0.024	0.152	-0.002	0.004
REIT_Illiquidity (t-4)	1.546*	0.914	0.433	12.191	4.576	5.742	-0.095	0.163
Prop Return (t-5)	-0.216	0.135	3.415*	1.801	0.647	0.848	-0.012	0.024
Prop Mkt Liquidity (t-5)	0.006	0.009	-0.503***	0.118	0.061	0.055	0.000	0.002
REIT_Return (t-5)	0.011	0.023	-0.452	0.305	0.004	0.143	0.007*	0.004
REIT_Illiquidity (t-5)	-1.010	0.914	-24.260**	12.189	-12.381**	5.741	0.352**	0.163
Prop Return (t-6)	-0.024	0.126	-1.978	1.685	1.495*	0.794	0.015	0.023
Prop Mkt Liquidity (t-6)	-0.009	0.008	-0.196*	0.101	-0.112**	0.048	0.003*	0.001
REIT_Return (t-6)	-0.002	0.020	-0.099	0.261	-0.016	0.123	0.000	0.003
REIT_Illiquidity (t-6)	0.675	0.747	23.244**	9.963	8.127*	4.693	-0.287**	0.134

Panel B: Variance Decompositions

Variance Decomposition (Percentage) of REIT Market Liquidity

Forecast Horizon	Property Return	Property Liquidity	REIT Return	REIT Liquidity
1	0.128	0.036	0.216	0.619
2	0.066	0.014	0.465	0.455
4	0.037	0.023	0.540	0.400
8	0.097	0.099	0.476	0.328
10	0.110	0.139	0.440	0.311
12	0.121	0.170	0.412	0.297

Variance Decomposition (Percentage) of Property Market Liquidity

Forecast Horizon	Property Return	Property Liquidity	REIT Return	REIT Liquidity
1	0.005	0.995	0.000	0.000
2	0.007	0.882	0.102	0.008
4	0.050	0.829	0.109	0.011
8	0.079	0.855	0.055	0.011
10	0.071	0.882	0.038	0.009
12	0.075	0.883	0.034	0.008

Table 5: Analysis including Four Macroeconomic Variables to VAR

Panel A: Granger Causality Test Result with Macroeconomic Variables

This table presents chi-square statistics and p-values of pair-wise Granger Causality tests between endogenous VAR variables. Null hypothesis is that row variable does not Granger Cause column variable. Chi-square statistics are reported and the corresponding p-values in parentheses. REIT market liquidity is measured with the negative of Amihud (2002) illiquidity. REIT return is measured using equal-weighted market return. Property Liquidity is the liquidity of the property market, measured using the number of new house sold in that quarter. Property Return is the quarterly NPI property index return. IP is industrial production growth, CPI is the CPI inflation, and Mortgage Rate is the contract interest rate on 30-Year Conventional Mortgage. Real Estate Loan is the total amount of Real Estate Loans at All Commercial Banks in the United States. The sample spans the period from July 1962 to December 2003 (498 months).

	REIT Liquidity	REIT Return	Property Liquidity	Property Return
CPI_gr	299.28***	249.79***	2.15	2.91*
	(<.0001)	(<.0001)	(0.1423)	(0.0882)
IP_gr	32.34***	66.35***	0.16	7.19***
	(<.0001)	(<.0001)	(0.6916)	(0.0073)
Mortgage Rate	524.95***	392.34***	1.19	3.15*
	(<.0001)	(<.0001)	(0.2754)	(0.0759)
Real Estate Loan	180.15***	141.41***	0.36	5.95**
	(<.0001)	(<.0001)	(0.5472)	(0.0147)

Panel B: Correlation between VAR Innovations

	CPI_gr	IP_gr	mortg	reloan	retp	liqp	rets	liqs
CPI_gr	1.000	-0.163	0.350	-0.172	0.277	-0.137	-0.112	-0.105
IP_gr	-0.163	1.000	0.288	-0.065	0.353	-0.029	-0.043	-0.101
mortg	0.350	0.288	1.000	0.147	0.133	-0.009	-0.339	0.010
reloan	-0.172	-0.065	0.147	1.000	-0.185	0.038	-0.266	0.264
retp	0.277	0.353	0.133	-0.185	1.000	0.060	0.200	-0.369
liqp	-0.137	-0.029	-0.009	0.038	0.060	1.000	0.341	-0.261
rets	-0.112	-0.043	-0.339	-0.266	0.200	0.341	1.000	-0.587
liqs	-0.105	-0.101	0.010	0.264	-0.369	-0.261	-0.587	1.000

Panel C: Variance Decompositions

C1: Variance Decomposition (Percentage) of REIT Market Liquidity

Forecast Horizon	CPI_gr	IP_gr	Mortg_rate	reloan	Retp	liqp	rets	liqs
1	0.011	0.014	0.010	0.048	0.094	0.061	0.208	0.553
2	0.017	0.007	0.062	0.094	0.065	0.045	0.286	0.424
4	0.035	0.007	0.040	0.093	0.072	0.066	0.289	0.398
8	0.082	0.048	0.038	0.080	0.072	0.096	0.251	0.332
10	0.091	0.068	0.043	0.076	0.070	0.092	0.244	0.317
12	0.095	0.080	0.045	0.074	0.067	0.086	0.243	0.310

C2: Variance Decomposition (Percentage) of Property Market Liquidity

Forecast Horizon	CPI_gr	IP_gr	Mortg_rate	reloan	retp	liqp	rets	liqs
1	0.019	0.003	0.004	0.000	0.021	0.953	0.000	0.000
2	0.101	0.006	0.043	0.009	0.031	0.800	0.002	0.007
4	0.165	0.020	0.045	0.007	0.071	0.674	0.010	0.007
8	0.224	0.018	0.032	0.007	0.083	0.622	0.009	0.005
10	0.243	0.025	0.030	0.007	0.081	0.600	0.008	0.005
12	0.255	0.033	0.029	0.007	0.080	0.584	0.008	0.005

C3: Variance Decomposition (Percentage) of REIT Stock Market Return

Forecast Horizon	CPI_gr	IP_gr	Mortg_rate	reloan	retp	liqp	rets	liqs
1	0.013	0.004	0.102	0.047	0.055	0.099	0.681	0.000
2	0.016	0.004	0.092	0.075	0.069	0.095	0.609	0.040
4	0.060	0.022	0.114	0.074	0.060	0.084	0.534	0.051
8	0.059	0.035	0.115	0.072	0.062	0.092	0.513	0.052
10	0.060	0.035	0.114	0.071	0.063	0.096	0.509	0.051
12	0.061	0.036	0.114	0.071	0.063	0.098	0.505	0.051

C4: Variance Decomposition (Percentage) of Property Market Return

Forecast Horizon	CPI	IP	Mortg_rate	reloan	retp	liqp	rets	liqs
1	0.077	0.163	0.015	0.005	0.741	0.000	0.000	0.000
2	0.077	0.282	0.013	0.018	0.538	0.030	0.030	0.013
4	0.075	0.303	0.010	0.019	0.399	0.117	0.049	0.028
8	0.174	0.212	0.009	0.021	0.300	0.218	0.040	0.026
10	0.204	0.203	0.010	0.020	0.278	0.223	0.037	0.025
12	0.222	0.202	0.010	0.020	0.265	0.220	0.036	0.025

Table 6 VAR Estimation Result using Principal Component Analysis

Panel A: Variance Decomposition (Percentage) of REIT Market Liquidity

Forecast Horizon	retp	liqp	rets	liqs_pca
1	0.206	0.005	0.004	0.785
2	0.266	0.006	0.017	0.710
4	0.298	0.031	0.096	0.576
8	0.316	0.025	0.092	0.567
10	0.321	0.037	0.125	0.518
12	0.299	0.036	0.168	0.497

Panel B: Variance Decomposition (Percentage) of Property Market Liquidity

Forecast Horizon	retp	liqp	rets	liqs_pca
1	0.015	0.985	0.000	0.000
2	0.009	0.926	0.064	0.001
4	0.014	0.907	0.077	0.003
8	0.020	0.896	0.043	0.040
10	0.040	0.890	0.031	0.039
12	0.037	0.866	0.026	0.070

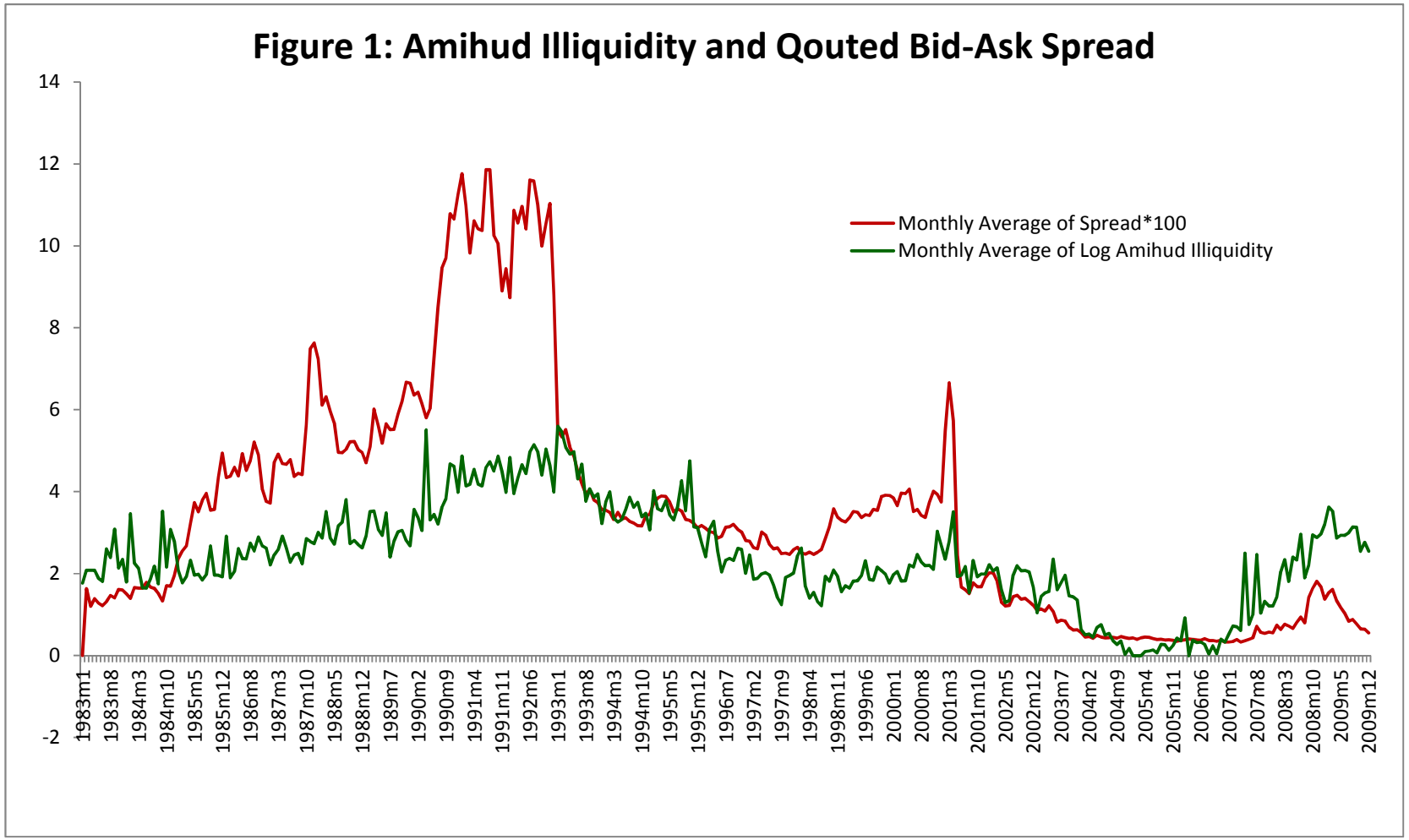
Figure 1: Amihud Illiquidity and Qouted Bid-Ask Spread
Monthly Average of Spread*100
Monthly Average of Log Amihud Illiquidity
14
12
10
8
6
4
2
0
-2
1983m1
1983m8
1984m3
1984m10
1985m5
1985m12
1986m8
1987m3
1987m10
1988m5
1988m12
1989m7
1990m2
1990m9
1991m4
1991m11
1992m6
1993m1
1993m8
1994m3
1994m10
1995m5
1995m12
1996m7
1997m2
1997m9
1998m4
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2001m10
2002m5
2002m12
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2007m1
2007m8
2008m3
2008m10
2009m5
2009m12

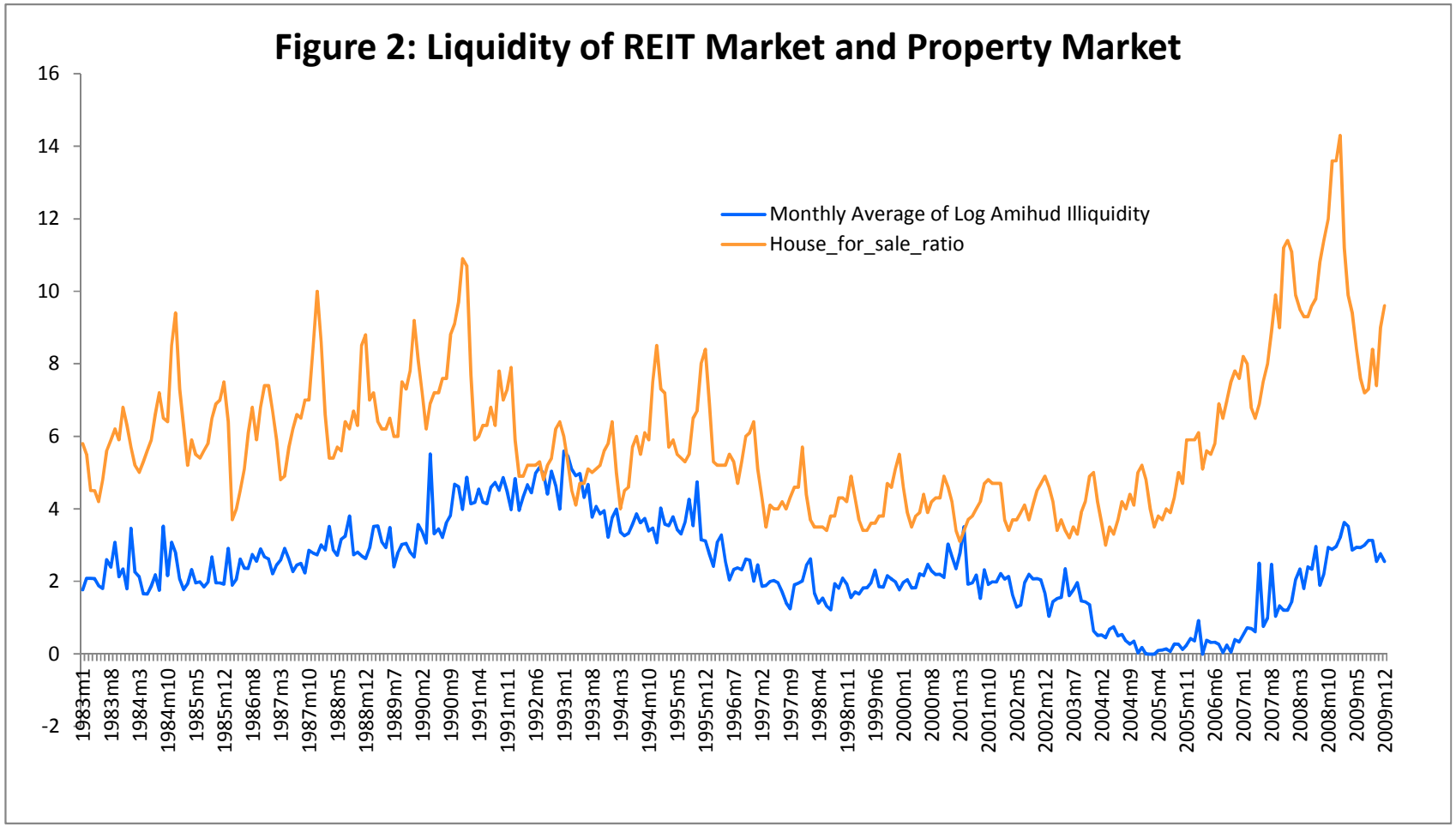


Figure 2: Liquidity of REIT Market and Property Market
Monthly Average of Log Amihud Illiquidity
House_for_sale_ratio
16
14
12
10
8
6
4
2
0
-2
1983m1
1983m8
1984m3
1984m10
1985m5
1985m12
1986m8
1987m3
1987m10
1988m5
1988m12
1989m7
1990m2
1990m9
1991m4
1991m11
1992m6
1993m1
1993m8
1994m3
1994m10
1995m5
1995m12
1996m7
1997m2
1997m9
1998m4
1998m11
1999m6
2000m1
2000m8
2001m3
2001m10
2002m5
2002m12
2003m7
2004m2
2004m9
2005m4
2005m11
2006m6
2007m1
2007m8
2008m3
2008m10
2009m5
2009m12

Figure 3: REIT Stock and Property Market Returns

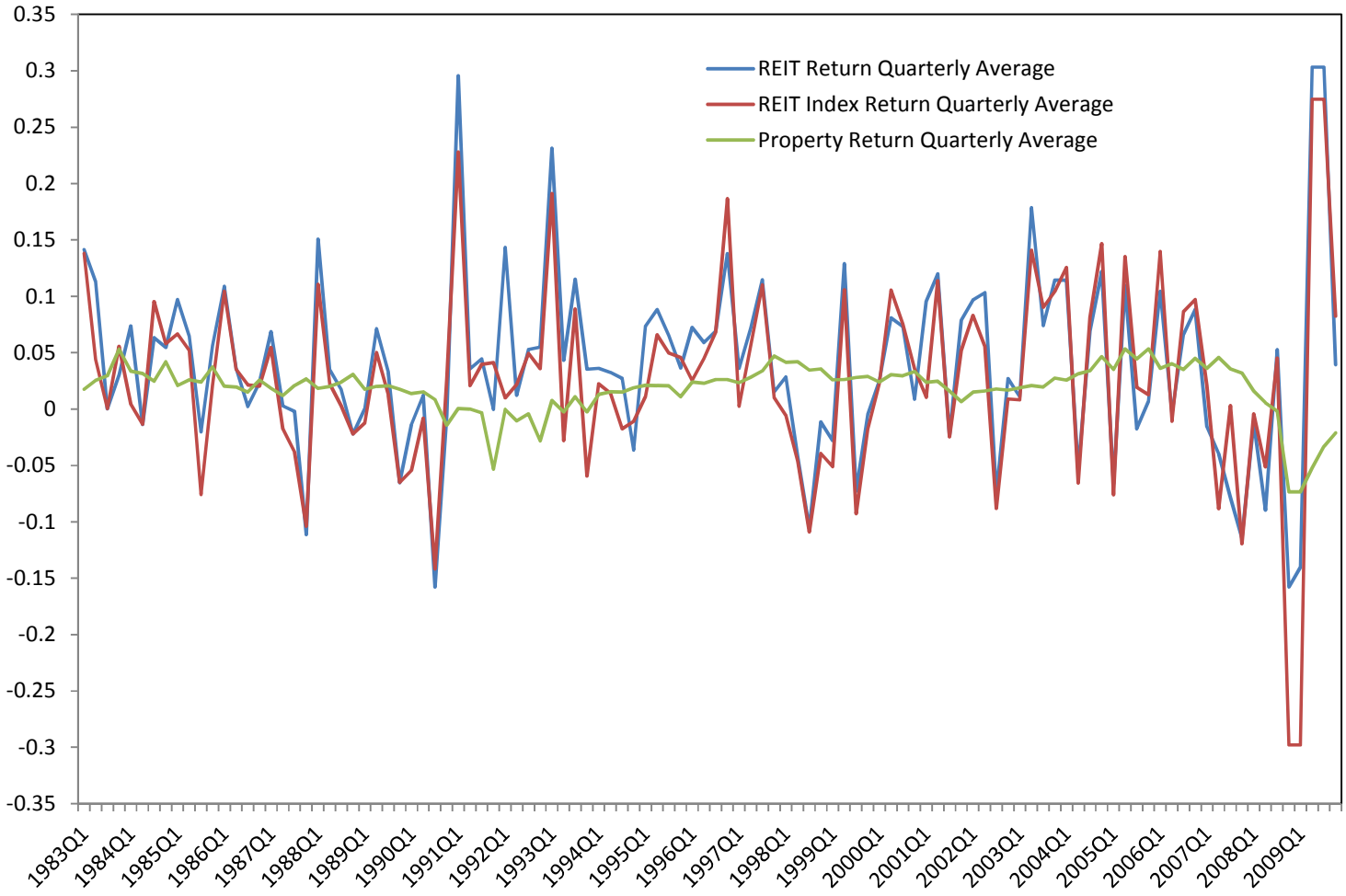
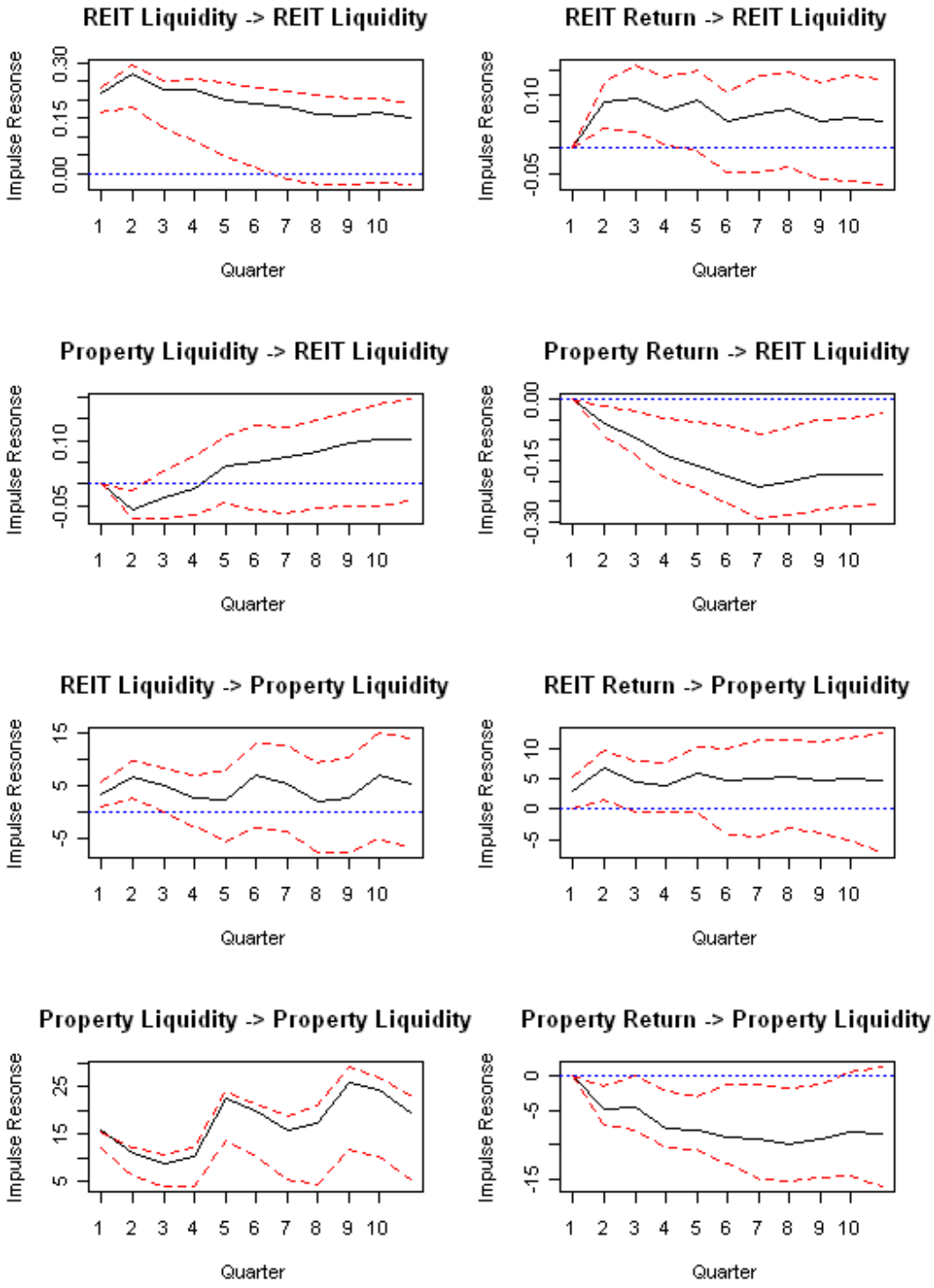


Figure 4: Impulse Response Functions

Panel A: Impulse Response of REIT Stock Liquidity and Property Market Liquidity.



Panel B: Impulse Response of REIT Stock Return and Property Market Return.

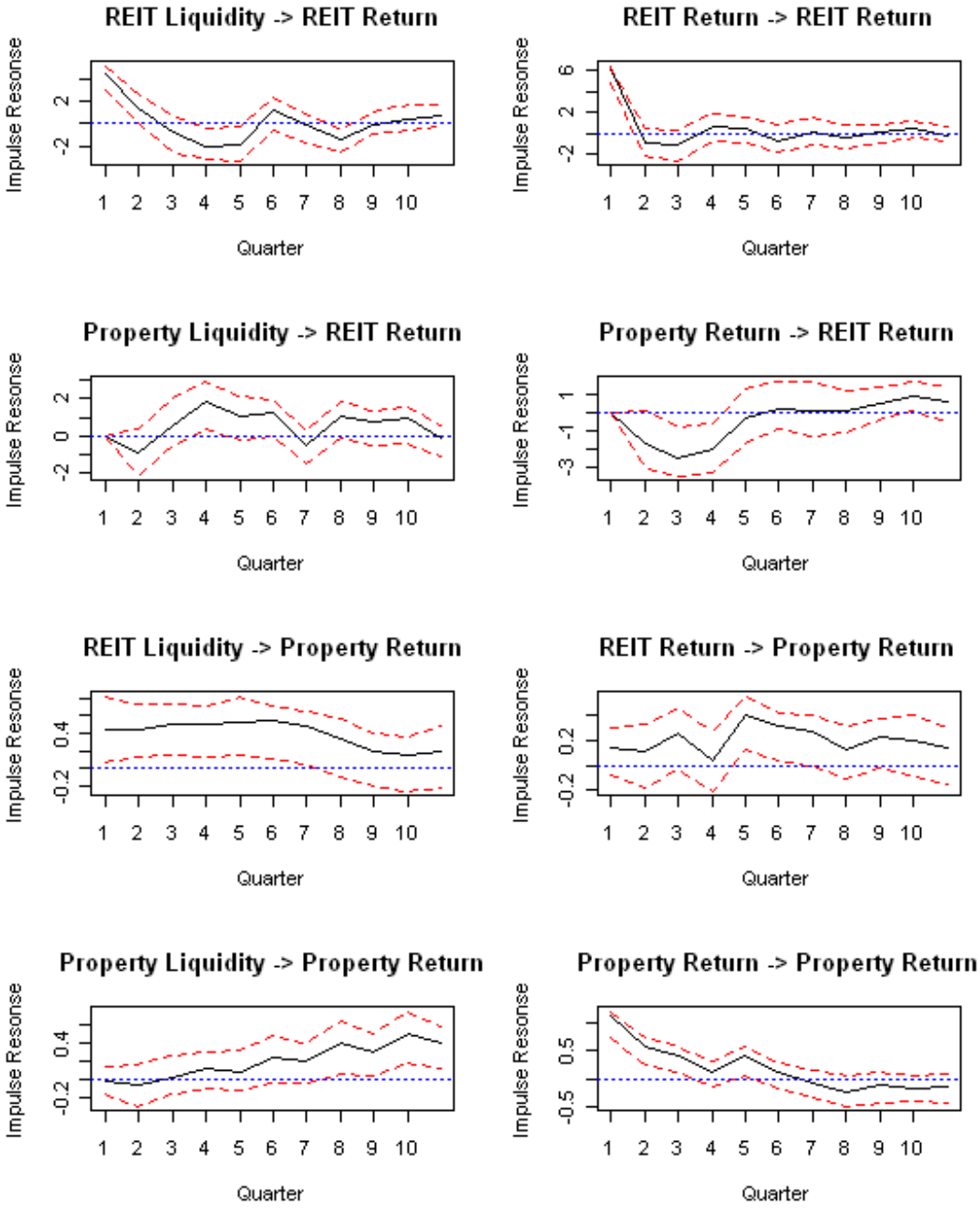
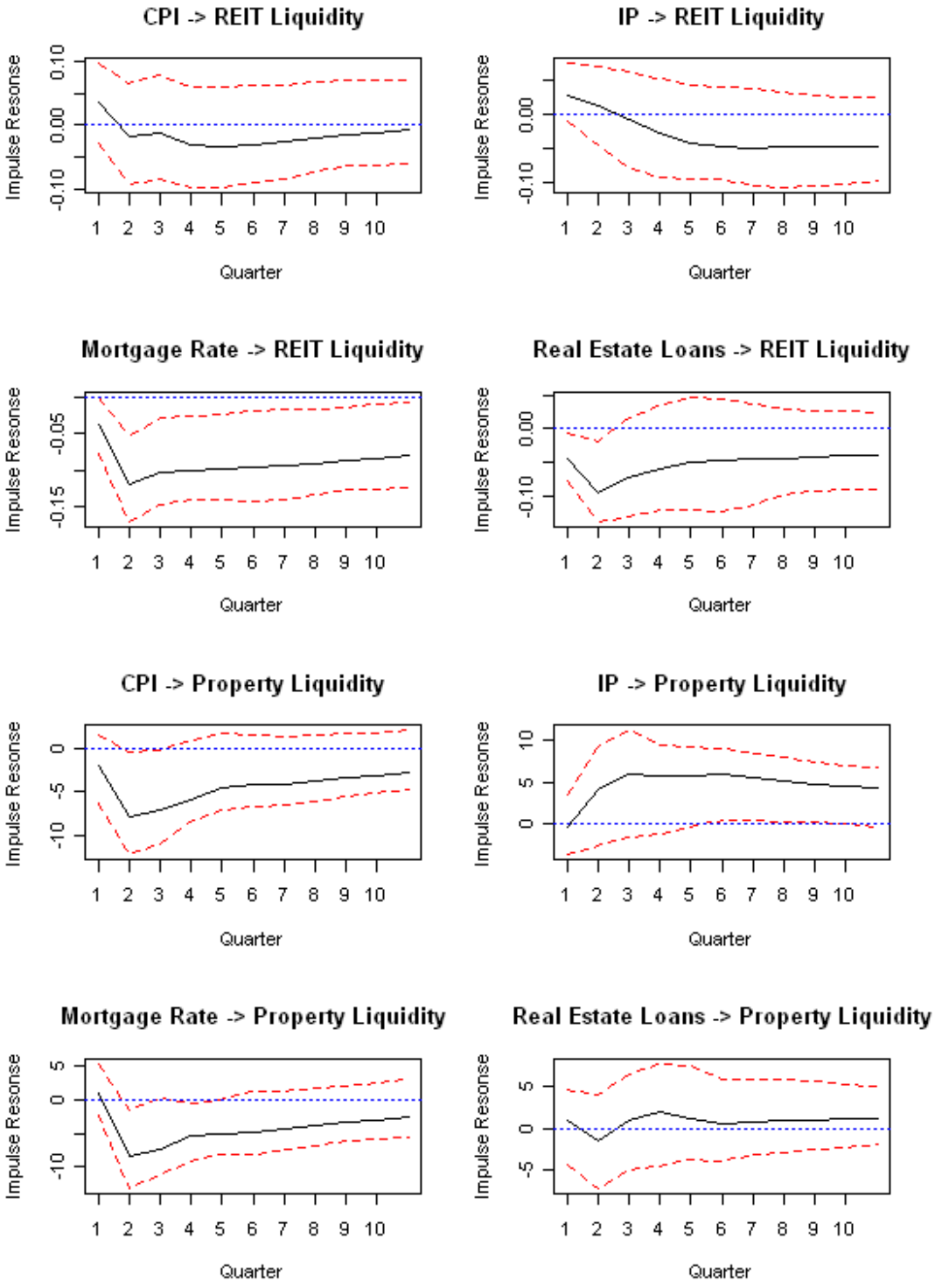


Figure 5: Impulse Response Functions (with 4 Exogenous Macroeconomic Variables Added)

Panel A: Impulse Response of REIT Market and Property Market Liquidity to Macroeconomic Variables



Panel B: Impulse Response of REIT Market and Property Market Return to Macroeconomic Variables

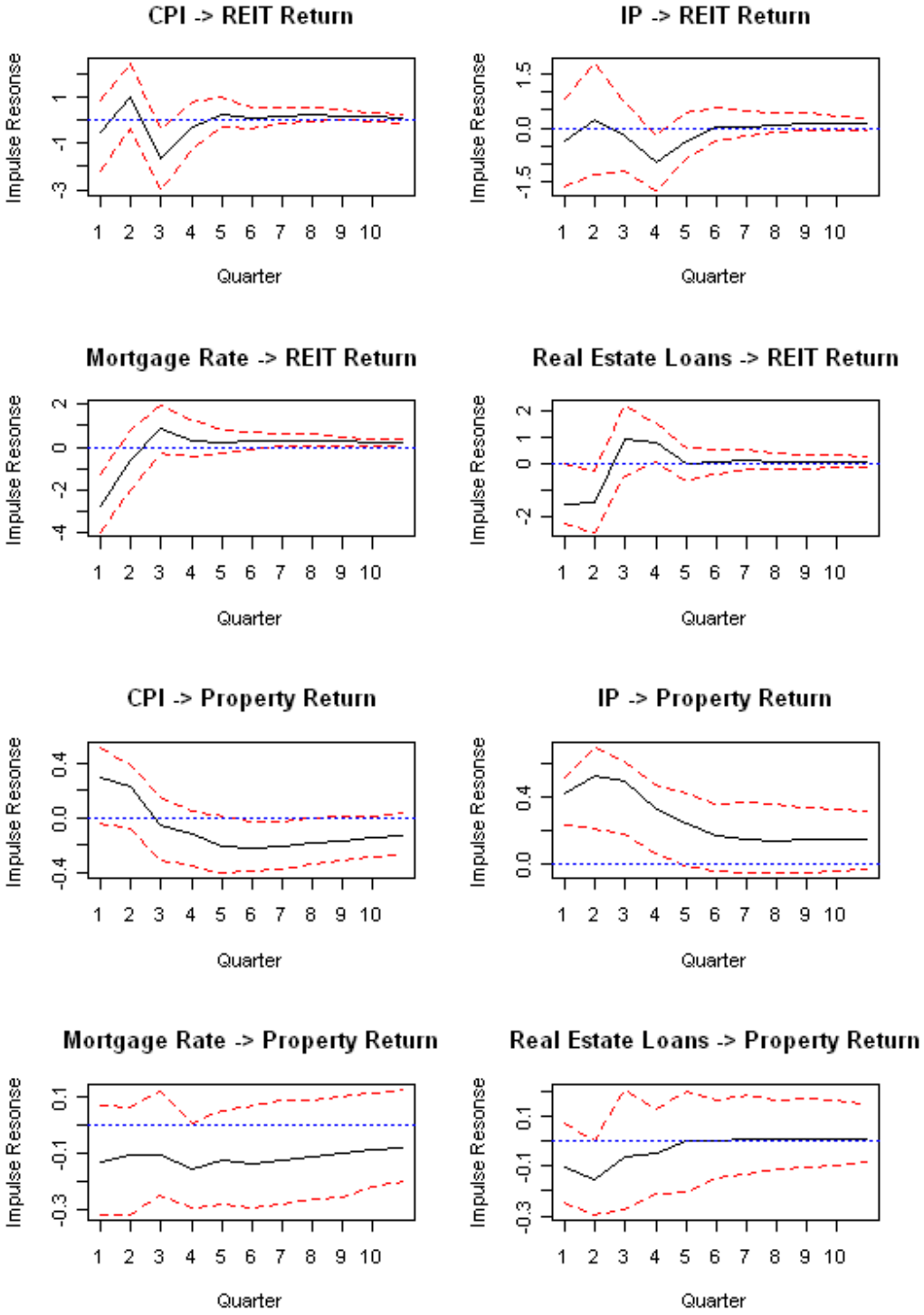
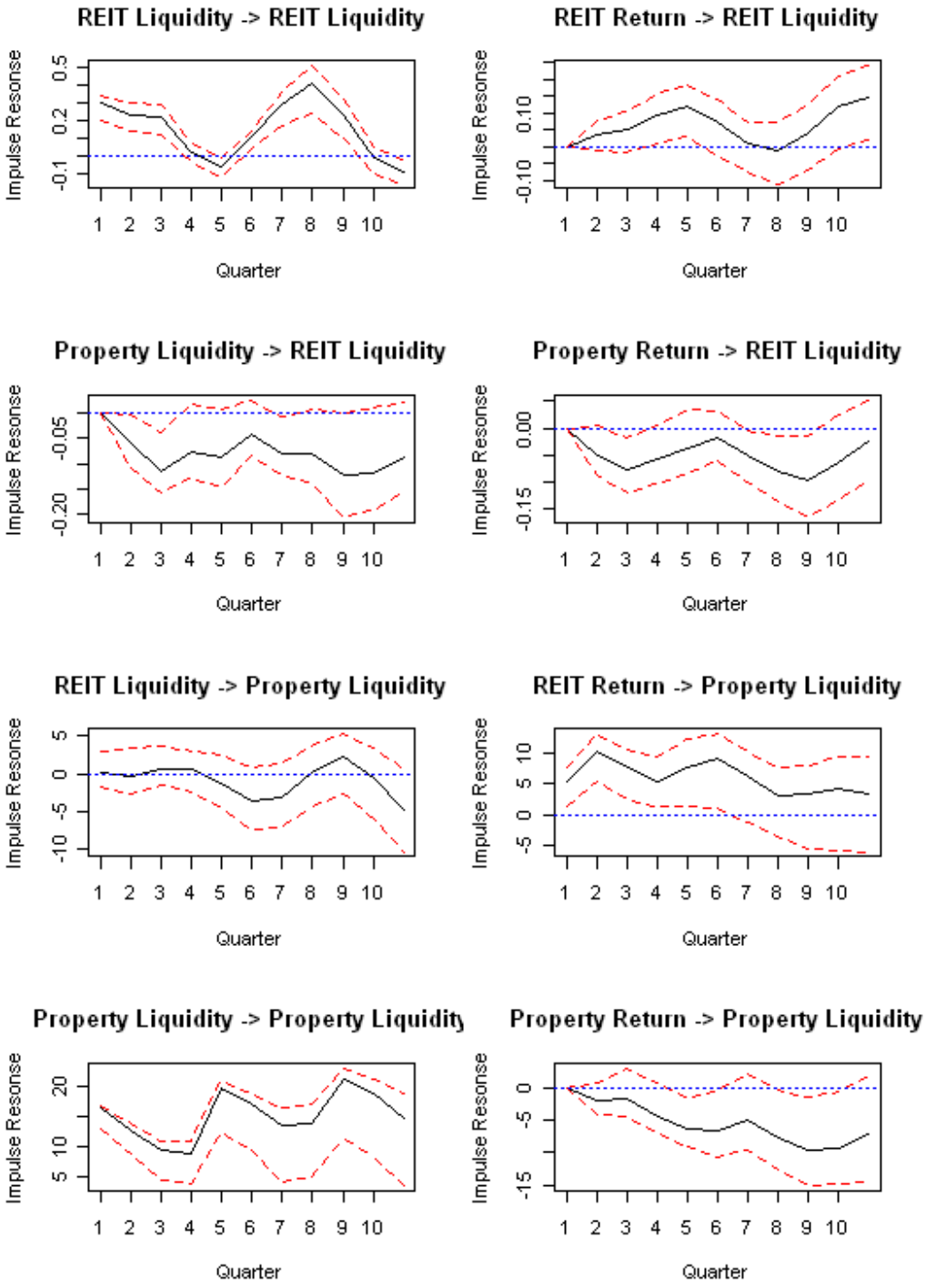


Figure 6: Impulse Response Functions (Using Principal Component)

Panel A: Impulse Response of REIT Market and Property Market Liquidity



Panel B: Impulse Response of REIT Market and Property Market Return

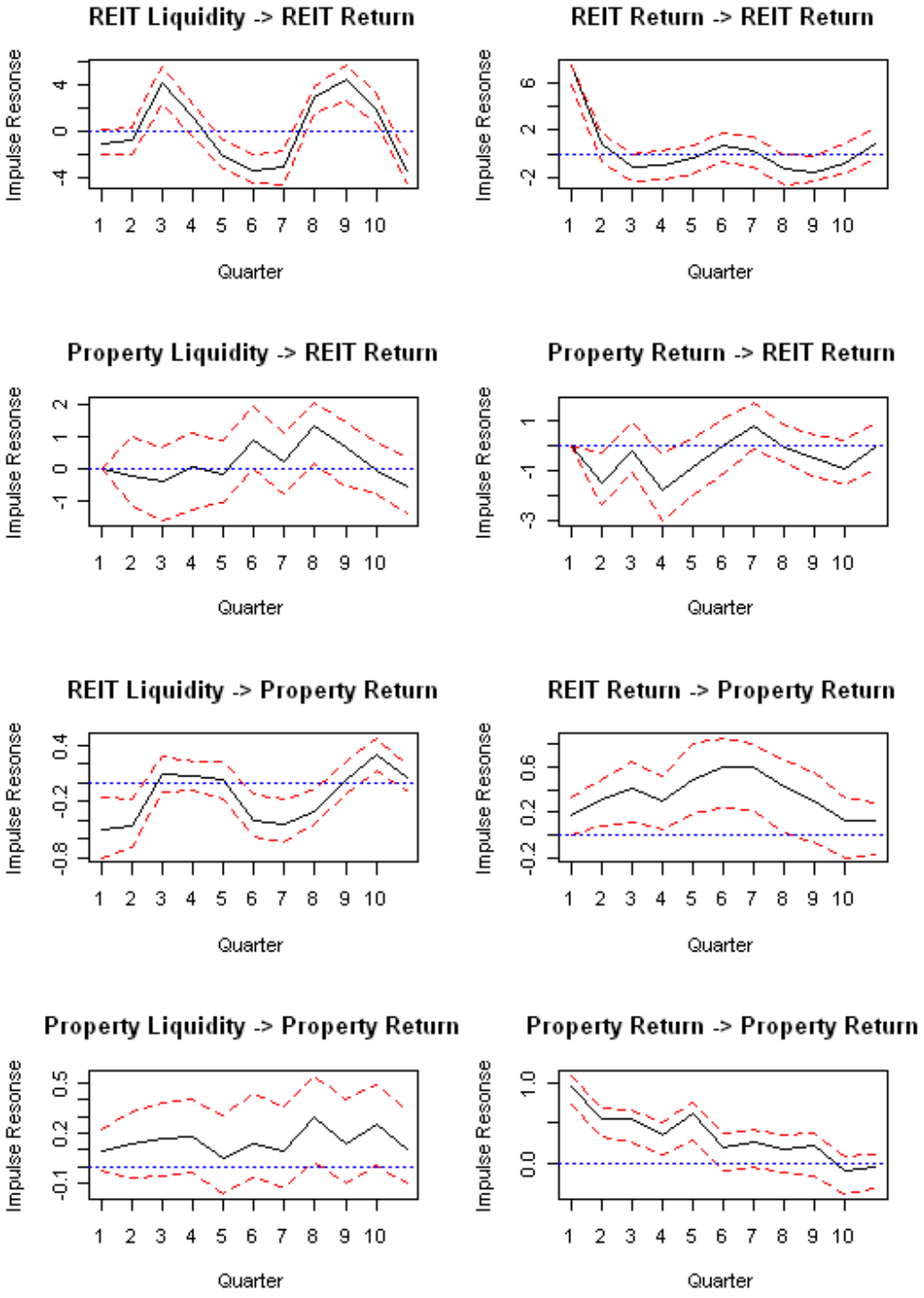
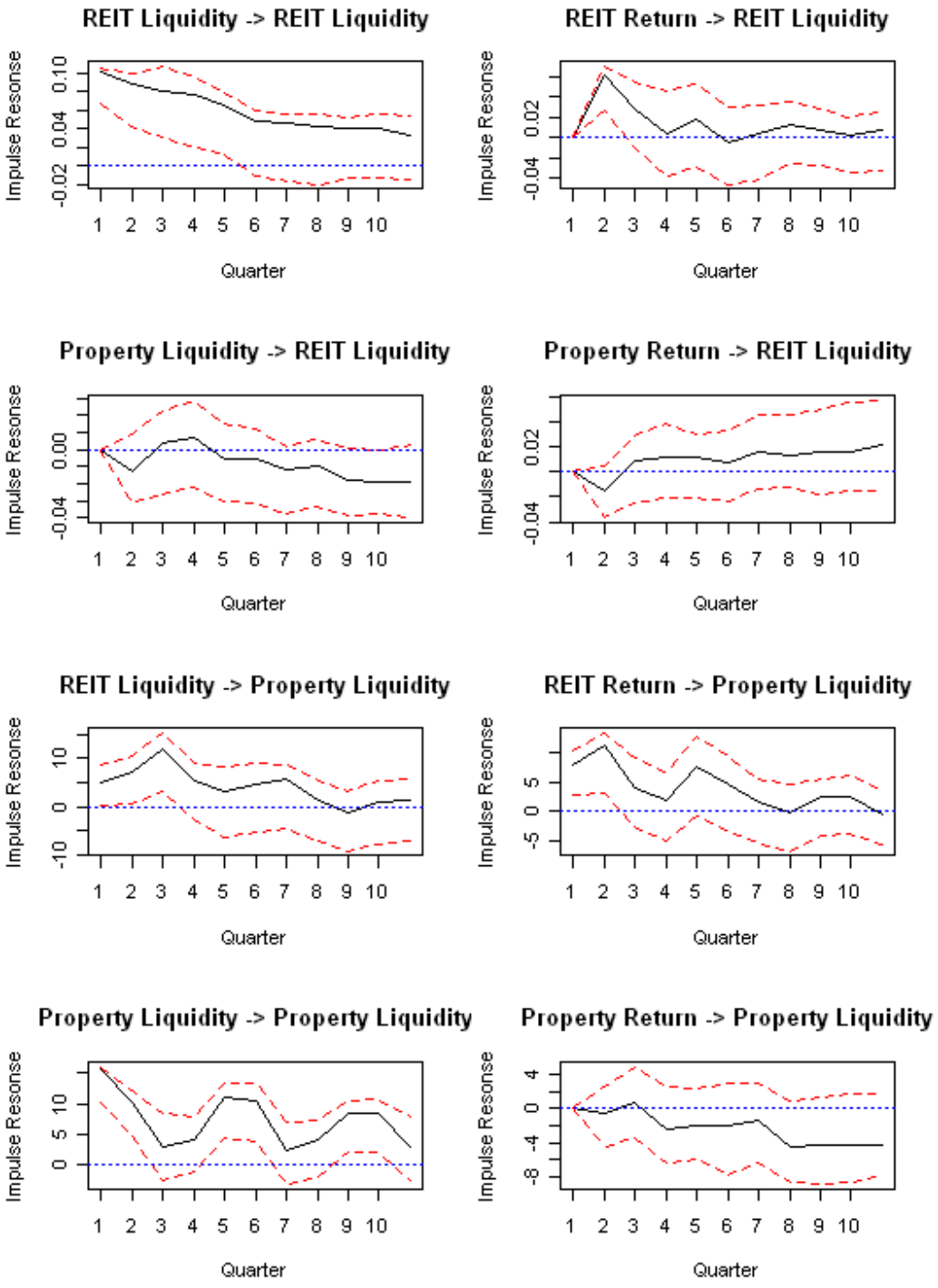


Figure 7: Impulse Response of REIT Market and Property Market Liquidity (Using Principal Component) Before and After REIT Structure Change in 1992

Panel A: Before 1992Q4



Panel B: After 1992Q4