The Spill-Over Impact of Liquidity Shocks in the Commercial Real Estate Market*

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Executive Summary

Considerable anecdotal evidence suggests that the effects of liquidity shocks spread quickly throughout the financial sector. This paper examines the liquidity spill-over impact across four markets: the stock (REIT) market, the derivative (CDS) market, and the corporate-bond market, and the private (property sale-based) market. Given the fundamental link between the underlying assets of the public and private real estate markets, liquidity shocks are more likely to spill over across these particular markets. We use the liquidity of the private market as a basis for discerning the impact of a liquidity shock across different markets. That is, by isolating the fundamental asset variation and liquidity in the private market, we answer a key research question pertaining to how fundamental asset liquidity affects other stock, bond, and derivative markets.

We propose to answer the following questions: Do liquidity shocks spill over across private and public real-estate markets? Is one market more likely to lead or follow a liquidity shock than the other? Does private market liquidity derive from public market liquidity or vice versa? Although numerous studies in the finance literature focus on the liquidity of derivative markets such as the Credit Default Swap (CDS) market, we contribute to this literature by studying how liquidity shocks evolve across the stock, bond, derivative, and private real-estate markets.

Our study contributes to the existing literature by concentrating on the dynamics of liquidity between the private and public real estate markets. The analysis of liquidity-shock patterns across the different real estate markets has important implications for investor asset allocation and portfolio management models. Specifically, we show that a liquidity shock has an interdependent effect on the private and public markets. Investors in possession of such knowledge could refine their risk-management strategies accordingly and could manage their portfolios based on correspondingly better predictions of the liquidity patterns across real estate markets.

Using VAR, we investigated liquidity-shock spill-over across the four markets. The VAR results show that bond-market liquidity shocks negatively impact CDS market-liquidity with a 2-month lag. Furthermore, a stock-market liquidity shock Granger Causes bond-market liquidity with a 2-month lag. Underlying asset liquidity (private-market liquidity) Granger Causes bond-market liquidity and the relation holds vice versa. However, the spill-over impact of underlying asset liquidity on the public real-estate market varies in accordance with different measures.

Variance decomposition analysis implies that bond-market liquidity fluctuates mainly due to the liquidity shocks in the stock market. Shocks to underlying-asset liquidity also have a moderate impact on fluctuations in bond-market liquidity. CDS-market liquidity fluctuates along with the shocks from bond-market liquidity in the long run. Underlying-asset liquidity fluctuates due to the shocks from CDS-market liquidity and from bond-market liquidity.

In future study, we will focus on determining the factors that cause the feedback impact between stock- and bond-market liquidity. Furthermore, we will test the factors that cause the negative impact of bond-market liquidity on CDS-market liquidity. Consistent with the previous literature, we conjecture that the private information available to investors in each market plays a role in creating different spill-over liquidity-shock patterns across real estate markets. Further research is required to test this information hypothesis in order to investigate the dynamics of liquidity shocks across real estate markets.

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abstract

Considerable anecdotal evidence suggests that the effects of liquidity shocks spread quickly throughout the financial sector. However, few studies have focused on the dynamics of liquidity across real-estate markets. This paper examines the liquidity spill-over impact across four markets linked by a common fundamental factor : the stock market, the derivative (Credit Default Swap (CDS)) market, the corporate-bond market, and the private real-estate (property sale–based) market. Given the fundamental link between the underlying assets of the private and public real-estate markets, liquidity shocks are especially likely to spill over across these particular markets—a point that has important implications for investment allocation and portfolio management. Employing a Vector Auto Regression (VAR) methodology, we investigate the liquidity-shock spill-over across the four markets. The VAR results show that bond-market liquidity Granger Causes CDS market-liquidity with a 2-month lag. Furthermore, stock-market liquidity Granger Causes bond-market liquidity with a 2-month lag. Variance decomposition analysis also supports that bond-market liquidity fluctuates mainly due to the liquidity shocks in the stock market. Shocks to underlying-asset liquidity also have a moderate impact on fluctuations in bond-market liquidity. Underlying asset liquidity (private-market liquidity) Granger Causes bond-market liquidity and the relation holds vice versa. However, the spill-over impact of underlying asset liquidity (private-market liquidity) on the public real-estate market varies in accordance with different measures.

Key words: Spill-over impact; Liquidity shocks; Commercial real estate market

JEL Classification: G01, G12

1 Introduction

During the recent financial crisis, the notion of liquidity and the factors that create it garnered significant academic attention. In general, a liquid market is one where an asset can be sold at a fair price—one that reflects its fundamental value regardless of overall market conditions. Numerous events including the Long Term Capital Management (LTCM) crisis, the collapse of Bear Stearns, and the subprime mortgage crisis provide considerable anecdotal evidence that once a liquidity shock has occurred, its effects spread quickly throughout the financial sector.

By definition, illiquidity arises from a wedge between the fundamental asset value and market price.[1] We posit that fundamental changes in asset markets do not occur in the short term, and thus, liquidity shocks are related to the short-term asset price fluctuation beyond the market fundamentals. Accordingly, we define liquidity shocks as short-term decreases in liquidity in one market generating a chain reaction in other markets.

Liquidity is associated with several interesting issues in the real estate area. First, real estate has a distinctive feature that may be responsible for amplifying the impact of any given liquidity shock; that is, the private real-estate (property sale-based) market and the public real-estate market share an underlying asset connection. As a result, we can use the liquidity of the private market as a basis for discerning the impact of a liquidity shock across different markets. That is, by isolating the fundamental asset variation and liquidity in the private market, we answer a key research question pertaining to how fundamental asset liquidity affects other stock, bond, and derivative markets.

Second, by identifying the liquidity impact of the private market, we obtain additional insights into the relationship between the private and public real-estate markets. While the risk and adjusted-return relationship between the private and public real-estate markets is well documented, few studies have concentrated on the dynamics of liquidity

[1] Cochrane (2011) documents that liquidity can refer to the ease of buying and selling an individual security and illiquidity can be systematic. In other words, assets can face a higher discount rate when the market as a whole is illiquid regardless of the fundamental asset value.

between the two markets.[2] Thus, our study has important implications for portfolio management and investment allocations given that any given liquidity shocks may have an interdependent effect on the private and public markets.

More specifically, we propose to answer the following questions: Do liquidity shocks spill over across private and public real-estate markets? Is one market more likely to lead or follow a liquidity shock than the other? Does private market liquidity derive from public market liquidity or vice versa? Although numerous studies in the finance literature focus on the liquidity of derivative markets such as the Credit Default Swap (CDS) market, we contribute to this literature by studying how liquidity shocks evolve across the stock, bond, derivative, and private real-estate markets.

The paper is organized as follows: First, section one presents a review of the literature relevant to market liquidity and its spill-over effects on respective markets. Next, we summarize the research methodology and offer a description of the data collected. This account is followed by a description of the liquidity measures used in the test models. In the subsequent sections, the main results obtained using the Vector Auto Regression (VAR) model are described, as are the robustness check tests. The concluding section offers a summary of the research and its implications.

2 Literature Review

In a perfectly liquid market, no market friction exists; that is, there is no wedge between an asset's transaction price and fundamental value (Brunnermeier & Pedersen, 2009). And, under such conditions, the efficient market hypothesis holds. However, realistically, market transactions are susceptible to various market frictions driven by asymmetric information, capital constraints, and transaction costs. Therefore, it is im-

[2] Pagliari, Scherer, and Monopoli (2005) investigate whether public and private real estate return series show the statistical differences. The authors showed that the average difference between two return series is very small and concluded that public- and private-market vehicles display a long-run synchronicity.

portant to understand the connection between underlying asset liquidity and its impact on the advanced securities derived from those underlying assets.

Brunnermeier and Pedersen (2009) present a theoretical framework for analyzing liquidity spirals in the security market. In their model, a shock to security prices (or volatility) during a market downturn restricts the ability of market makers to obtain necessary funding. Furthermore, this restriction causes a substantial drop in market liquidity. Taken together, funding liquidity and market liquidity reinforce each other to create liquidity commonality.

A significant number of papers have investigated liquidity commonality within and across multiple markets. For example, Acharya and Pederson (2005) provide a framework for considering how the risk arising from commonality in liquidity is priced in the stock return and show that the required return of a security is increasing in the covariance between its illiquidity and the market illiquidity. In addition, recent studies have shown that liquidity can spill over from one market to another. For example, Chorida, Sarkar, and Subrahmanyam (2005) investigate cross-market liquidity dynamics showing the co-movement of liquidity and volatility between the stock and Treasury-bond markets.

In general, the heterogeneous nature of real-estate assets leads to highly variable liquidity in private asset markets. For example, Fisher, Gatzlaff, Geltner, and Haurin (2003) focus on the impact of variable liquidity on the transaction-based index, showing that the liquidity factor might explain why the private-market index lags behind that of the public-market. Furthermore, Benveniste, Capozza, and Seguin (2001) suggest that liquidity in the underlying property market also plays a significant role in determining price changes and liquidity in the public REIT market. [3]

[3] Aligned with this research agenda, Clayton, MacKinnon and Peng (2008) show that real-estate investors place a greater value on the liquidity of REITs when private-market liquidity is low, expressing their priorities by shifting their holdings to the public market as the private real-estate market becomes increasingly illiquid. Brounen, Eichholtz, and Ling (2009) document the impact of the liquidity factor on the returns of the public real-estate market using global REITs stock and conclude that market capitalization, nonretail-share ownership, and dividend yields serve as drivers of liquidity across countries.

The interaction between market liquidity and capital constraints is a fairly new research topic. For example, Ling, Naranjo, and Scheick (2011) concluded that credit availability is a key factor in determining price movements in both the private- and the public-REIT markets, and they found a feedback effect between market liquidity and credit availability.

Our paper is also related to the burgeoning literature on contagion. Generally speaking, contagion is defined as a shock in one country that generates price movements in other countries. Accordingly, contagion provides a potential alternative to explain the spill-over phenomenon of market crashes.

There are four branches of literature that focus on explaining contagion. One branch emphasizes the "flight-to-quality" effect according to which investors holding multiple assets intend to switch their portfolios from "poor-quality" to "high-quality" markets in terms of market performance. For example, Hartmann, Straetmans, and de Vries (2004) investigate the contagion phenomenon of market returns as it applies to the stock and bond markets. They demonstrate that a crash in the stock market is accompanied by a boom in the government bond market and conclude that this is a result of the flight-to-quality effect. We focus on the flight-to-quality effect driven by the liquidity conditions of each market and show that investors' tendency to seek highly liquid markets leads the outcome; that is, a liquidity crash in one market is accompanied by a liquidity boom in another. We also demonstrate that the liquidity channel in each market is a key element in determining the extent to which shocks spread across multiple asset markets. For example, investors prefer selling in a more liquid rather than a less liquid market, as illiquidity lowers liquidation values. The role of the liquidity channel in transmitting shocks across multiple asset markets is well demonstrated in the literature.[4]

A second branch emphasizes the information effect, which is related to the vulnerability of imperfect financial markets. Under the correlated information channel, price changes in one market are perceived as having implications for the values of assets in

[4]Calvo and Mendoza (2000) and Yuan (2002) document that when some investors choose to liquidate some of their assets in a number of markets due to a call for additional collateral, sales in these multiple markets generate the spill-over of market crashes.

other markets such that price changes in the former actually give rise to price changes in the latter (King & Wadhwani, 1990).

A third branch emphasizes the "portfolio rebalancing" effect, which is based on the rational expectations model. Kodres and Pritsker (2002) propose that investors transmit idiosyncratic shocks from one market to others by adjusting their portfolios' exposure to shared macroeconomic risks. In turn, shared macroeconomic risks compose the liquidation value of assets in each market and determine the pattern and severity of financial contagion in addition to the amount of information asymmetry in each market.

A fourth branch emphasizes the role of the "wealth effect" in causing self-fulfilling crises. Goldstein and Pauzner (2004) posit that if two countries have independent fundamentals but share the same group of investors, investors will withdraw their investments fearing other investors' reaction. A crisis in country A reduces investors' wealth in that country, and this makes them more averse to the strategic risks associated with the unknown behavior of other investors in country B. Thus, the investors in country A become more motivated than in the pre-crisis period to withdraw their investments from both countries.

However, the majority of the literature on contagion focuses on analyzing price movements across different countries and stops short of cross-asset market analysis. We distinguish our research topic from previous literature in that we investigate the spill-over impact of liquidity shocks across multiple real estate markets.

From the perspective of methodology, we build on Jacoby, Jiang, and Theocharides (2010), who investigate cross-market liquidity shocks as they affect general firms in the CDS, corporate bond, and equity markets. They find evidence of a 3- month time lag for the liquidity shocks spill-over from the CDS to both the bond and equity markets, but no clear spill-over of liquidity shocks between the equity and bond markets.

We advance the work of the previous literature in several ways. First, by focusing on the real-estate markets, we are able to incorporate the liquidity of underlying assets in the private market. The commercial real-estate market is considered relatively illiquid because market segmentation reflects heterogeneous locations and property types. Accordingly, liquidity shocks and their patterns in the real-estate market require a specific analysis—one that focuses only on the real estate markets.

Second, by including private-market liquidity in our analysis, we provide another perspective on the relationship between the private and public real-estate markets at least in terms of liquidity shock spill-over. The existence and direction of the spill-over of liquidity shocks between the private and public real-estate markets is a long-standing open question. To our knowledge, few papers directly test the liquidity-shock spill-over across the private and public real-estate markets.

3 Liquidity Measures

In order to study the effects of liquidity shocks across multiple markets, we utilize the unique feature of commercial real estate: observable trading prices on different financial claims on the underlying asset in multiple markets. Thus, we utilize multiple data sources to collect information on market prices of financial contracts that are based on commercial real estate.

3.1 Stock Market

To test the effects of liquidity shocks in the stock market, we employ two liquidity measures. First, we modify Amihud's (2002) illiquidity measure (AIL) as a proxy for stock market liquidity. AIL is the monthly average ratio of each REIT's daily absoulte return to its daily dollar trading volume:

$$AIL_{i,m} = 1/D_{i,m} \sum_{d=1}^{D_{i,m}} |R_{i,d}|/VOL_{i,d} \qquad (1)$$

where $R_{i,d}$ is the daily return for REIT i, $VOL_{i,d}$ is the daily REIT i dollar volume, and $D_{i,m}$ is the number of days for which data are available for REIT i in month

m. We collected daily stock returns for the REITs from the Center for Research in Security Prices (CRSP). We then create an aggregate stock market liquidity measure by taking the equally weighted average of the individual REIT monthly Amihud measures (multiplied by 10^6):

$$LIQ_m^{REIT} = 1/N_m \sum_{i=1}^{N_m} AIL_{i,m} * 10^6 \tag{2}$$

where N_m represents the number of REITs in month m.

Our second stock market liquidity measure is based on the common share price bid–ask spread. We calculate the average of the monthly quoted spread $(BidAskSP_{i,m})$ for each REIT i based on the daily ask price $(P^{Ask}{}_{i,d})$ and bid price $(P^{Bid}{}_{i,d})$ from the CRSP daily database:

$$BidAskSP_{i,m}=1/D_{i,m} \sum_{d=1}^{D_{i,m}} \left[P^{Ask}{}_{i,d}-P^{Bid}{}_{i,d}\right] \tag{3}$$

We then create the second stock market liquidity measure by taking the equally weighted average of the individual REIT monthly bid–ask spreads:

$$LIQ_m^{BidAskSP} = 1/N_m \sum_{i=1}^{N_m} BidAskSP_{i,m} \tag{4}$$

where again N_m represents the number of REITs in month m.

3.2 CDS Market

In order to measure CDS market liquidity, we use the magnitude of price movement, a relatively new measure for capturing transitory price movements (Bao, Pan, & Wang, 2011). According to Kyle (1985), market liquidity comprises three transactional characteristics: the cost of liquidating a position over a short period of time (tightness), the ability to buy or sell large numbers of shares with minimal price impact (depth), and the propensity of prices to recover quickly from a random uninformative shock to the market (resiliency). Bao, Pan, and Wang (2011)'s measure is aligned with the depth of liquidity. Using their method, we construct the following measure for capturing negative covariances in CDS spread changes:

$$\Upsilon^{cds}_{i,d} = -cov(\Delta Spread_{i,d}, \Delta Spread_{i,d+1}) \tag{5}$$

where $\Delta Spread_{i,d} = Spread_{i,d} - Spread_{i,d-1}$ and $\Delta Spread_{i,d+1} = Spread_{i,d+1} - Spread_{i,d}$ We then create the average monthly covariance for each REIT i based on the REIT i daily covariance:

$$\Upsilon^{cds}_{i,m} = 1/D_{i,m} \sum_{d=1}^{D_{i,m}} \Upsilon^{cds}_{i,d} \tag{6}$$

where $D_{i,m}$ is the number of days for which data are available for REIT i in month m. We then create a CDS market liquidity measure by taking the equally weighted average of the individual REIT monthly Υ^{cds}:

$$LIQ^{cds}_{m} = 1/N_{m} \sum_{i=1}^{N_{m}} \Upsilon^{cds}_{i,m} \tag{7}$$

We used Bloomberg to obtain the daily prices for all the 5-year CDS contracts traded on REITs during the period from January 2005 to December 2010. During this period, Bloomberg reported CDS prices on 33 REITs. Appendix A provides a list of the REITs with CDS contracts.

3.3 Bond Market

To construct the liquidity measure for the bond market(Υ^{BOND}), we employ the same methodology as we do in constructing Υ^{cds}. Since Bao, Pan, and Wang(2011)'s measure is aligned with the depth of liquidity, and we use their method to construct a measure for capturing negative covariances in bond prices:

$$\Upsilon^{BOND}_{i,d} = -cov(\Delta P^{bond}{}_{i,d}, \Delta P^{bond}{}_{i,d+1}) \tag{8}$$

and

$$\Upsilon_{i,m}^{BOND} = 1/D_{i,m} \sum_{d=1}^{D_{i,m}} \Upsilon_{i,d}^{BOND} \tag{9}$$

where $\Delta P^{bond}{}_{i,d} = P^{bond}{}_{i,d} - P^{bond}{}_{i,d-1}$, $\Delta P^{bond}{}_{i,d+1} = P^{bond}{}_{i,d+1} - P^{bond}{}_{i,d}$ and $D_{i,m}$ is the number of days for which data are available for REIT i in month m. We then create the bond market liquidity measure by taking the equally weighted average of the individual REIT monthly Υ^{BOND}:

$$LIQ_{m}^{BOND} = 1/N_m \sum_{i=1}^{N_m} \Upsilon_{i,m}^{BOND} \tag{10}$$

We collected daily bond prices for the REITs from TRACE database. During the sample period, Trace reported bond prices on 20 REITs. Appendix B provides a list of the REITs with traded bonds. We match our sample with the CDS and bond transaction data and restrict our analysis to those REITs having both traded CDS contracts and bonds.

3.4 Underlying Assets (Private Market)

We use the monthly commercial real estate capitalization rates (cap rates) available from Real Capital Analytics as the proxy for the valuation of the underlying real asset held by REITs. We employ two liquidity measures for the underlying private asset market: the offered–closed cap rate (i.e., the difference between the offered and closed cap rates) and the cap rate spread (i.e., the difference between the average cap rate and the 10-year Treasury bill yield). The offered-closed cap rate spread is very similar to the bid–ask spread in the stock market since both measures are common in capturing the reservation price difference between sellers and buyers. The cap rate is proportional to the inverse of the market price, and buyers prefer a high cap rate whereas sellers prefer a low one.

We calculate the offered–closed cap rate for each month as:

$$OfferClosedSP_{im} \quad = \quad ClosedCapRate_{im} - OfferedCapRate_{im} \tag{11}$$

where i represents each property type (apartment, industry, office, and retail) for month m. We then create a underlying-asset market liquidity measure by taking the equally weighted average of monthly $OfferClosedSP$ for each property type.

$$LIQ_m^{OfferClosedSP} \quad = \quad 1/4 \sum_{i=1}^{4} OfferClosedSP_{im} \tag{12}$$

Our second liquidity measure is the cap rate spread. Cap rate spread is generally considered as a partial measure of liquidity risk in the real estate market, similar to the bond yield spread. This liquidity measure captures the risk premium after subtracting the risk-free rate:

$$CapRateSP_{im} \quad = \quad AvgeCapRate_{im} - 10YrTBILL_m \tag{13}$$

where i again represents each property type (apartment, industry, office, and retail) for month m. We then create a underlying-asset market liquidity measure by taking the equally weighted average of monthly $CapRateSP$ for each property type.

$$LIQ_m^{CapRateSP} \quad = \quad 1/4 \sum_{i=1}^{4} CapRateSP_{im} \tag{14}$$

All the liquidity measures referenced show that a small number represents a liquid market, whereas a large number represents an illiquid market.

4 Study Design

Our hypothesis predicts that, consistent with the classical microstructure liquidity model, liquidity shocks spill over between the private- and the public real estate markets(CDS, bond, and stock markets). To test this hypothesis, we use the following Vector Auto Regression(VAR) model to investigate liquidity shock spill-over across the four asset markets:

$$
\begin{aligned}
LIQ_t^{cds} &= \alpha^{cds} + \sum_{i=1}^{2} \beta_i^{bond} LIQ_{t-i}^{BOND} + \sum_{i=1}^{2} \beta_i^{cds} LIQ_{t-i}^{cds} + \sum_{i=1}^{2} \beta_i^{REIT} LIQ_{t-i}^{REIT} \\
&\quad + \sum_{i=1}^{2} \beta_i^{Private} LIQ_{t-i}^{Private} + \sum_{j=1}^{11} \beta_j M_{j,t} + \beta_{20} CrisisDum + \varepsilon_t^{cds} \\
LIQ_t^{BOND} &= \alpha^{bond} + \sum_{i=1}^{2} \delta_i^{bond} LIQ_{t-i}^{BOND} + \sum_{i=1}^{2} \delta_i^{cds} LIQ_{t-i}^{cds} + \sum_{i=1}^{2} \delta_i^{REIT} LIQ_{t-i}^{REIT} \\
&\quad + \sum_{i=1}^{2} \delta_i^{Private} LIQ_{t-i}^{Private} + \sum_{j=1}^{11} \delta_j M_{j,t} + \delta_{20} CrisisDum + \varepsilon_t^{bond} \\
LIQ_t^{REIT} &= \alpha^{REIT} + \sum_{i=1}^{2} \pi_i^{bond} LIQ_{t-i}^{BOND} + \sum_{i=1}^{2} \pi_i^{cds} LIQ_{t-i}^{cds} + \sum_{i=1}^{2} \pi_i^{REIT} LIQ_{t-i}^{REIT} \\
&\quad + \sum_{i=1}^{2} \pi_i^{Private} LIQ_{t-i}^{Private} + \sum_{j=1}^{11} \pi_j M_{j,t} + \pi_{20} CrisisDum + \varepsilon_t^{REIT} \\
LIQ_t^{Private} &= \alpha^{Private} + \sum_{i=1}^{2} \theta_i^{bond} LIQ_{t-i}^{BOND} + \sum_{i=1}^{2} \theta_i^{cds} LIQ_{t-i}^{cds} + \sum_{i=1}^{2} \theta_i^{REIT} LIQ_{t-i}^{REIT} \\
&\quad + \sum_{i=1}^{2} \theta_i^{Private} LIQ_{t-i}^{Private} + \sum_{j=1}^{11} \theta_j M_{j,t} + \theta_{20} CrisisDum + \varepsilon_t^{Private} \qquad (15)
\end{aligned}
$$

where LIQ_t^{BOND}, LIQ_t^{cds}, LIQ_t^{REIT}, and $LIQ_t^{Private}$ respectively describe the bond, CDS, REIT, and private real-estate market liquidity in month t, $M_{j,t}$ constitutes a system of dummy variables defined by the months of the year, and *CrisisDum* is a dummy variable with the value 1 for a sub-period before 2008 and otherwise, 0. The number of lags was selected based on the lag-length tests in our empirical analysis. We include monthly dummy variables in order to control seasonal effects. For example, the January effect is well known as the stock market return anomaly in that the returns on common stocks in January are much higher than in other months due to investors' tax-loss selling. Our stock market liquidity measure is related to the stock return and as a result, it is reasonable to control seasonal effects. In addition to seasonality, we also include a time dummy variable incorporating the 2008 financial crisis in order to see if our sample period affects the evolution of liquidity shocks before (2005-2007) and after the financial crisis (2008-2010).

5 Descriptive Statistics

Table 1 shows the descriptive statistics of our measures of market liquidity during the sample period from January 2005 to December 2010. We see that the CDS market liquidity measure (Υ^{cds}) is more volatile than the bond market liquidity measure (Υ^{BOND}): that is, the standard deviation of Υ^{cds} is twice that of Υ^{BOND}. The mean and median in the bond market are larger than those in the CDS market. This result is consistent with the previous literature showing that on average the CDS market is more liquid than the bond market due to the former's relatively low transaction costs, minimal short-selling costs, and information symmetry (Lien & Shrestha, 2011).

Regarding stock market liquidity, we see that the standard deviation of *BidAskSP* is much larger than LIQ^{REIT}. The underlying asset liquidity measures (*CapRateSP* and *OfferClosedSP*) also show a difference in volatility; *CapRateSP* is more volatile than *OfferClosedSP*.

The *OfferClosedSP* is calculated based on the difference between the offered- and closed cap rate. According to Real Capital Analytics, both the offered- and closed cap rates are the average level of cap rates given each month. Thus, both cap rates can be considered as a market proxy for buyer and seller reservation prices under the efficient market hypothesis. The mean and median of *OfferClosedSP* are negative because the cap rate is proportional to the inverse of the market price; that is, buyers prefer a high cap rate whereas sellers prefer a low one.

The negative value of *OfferClosedSP* represents excess demand given the limited supply during the real estate bubble period. It is intriguing that *Figure 1* shows a general pattern consistent with a boom and bust cycle in the commercial real estate market; the *OfferClosedSP* remains negative during a 2006-2007 period. In December 2008, the *OfferClosedSP* is positive and remains so until December 2010. This pattern corresponds with the general trend in the U.S. real estate market, which experienced a boom until 2007 followed by a profound downturn that has endured until the present.

Table 2 reports the correlations among our measures of market liquidity. Generally speaking, CDS-market liquidity is not significantly correlated with the liquidity of the stock, bond and underlying-asset markets at the 5% significance level. Both bond- and stock- market liquidity are highly correlated (either 32% or 48% using the LIQ^{REIT} and *BidAskSP*, respectively) at the 5% significance level. However, when we use the changes in the stock and bond markets liquidity in the correlation analysis, the correlation between the stock and bond markets decreases to a low level (either 5% or -11% using ΔLIQ^{REIT} and Δ*BidAskSP*, respectively).

Prior to our regression analysis, we conducted the augmented Dickey-Fuller (ADF) (Dickey & Fuller, 1981) unit-root test in order to exclude the possibility that two or more non-stationary time series have a spurious relationship. After taking the difference between consecutive liquidity measures in the stock and bond market– ΔLIQ^{REIT}, Δ*BidAskSP*, and $\Delta\Upsilon^{BOND}$, we were able to reject the non-stationary null hypothesis.

6 Results

6.1 Vector Auto Regression

Our unconstrained VAR specification allows us to examine whether liquidity shocks spill over from one market to another. Table 3 presents the estimates of our unconstrained VAR model for both the public and the private real estate markets in which aggregate private-market liquidity (Δ*OfferClosedSP)*, REIT stock-market liquidity (ΔLIQ^{REIT}), CDS-market liquidity ($\Delta\Upsilon^{cds}$), and bond-market liquidity ($\Delta\Upsilon^{BOND}$) are specified as endogenous variables. Economically, if investors invest across multiple asset markets, then those who have private information about the future of market liquidity are likely to decide to trade actively in the more liquid market. With other conditions equal, investors may pursue a strategy of rebalancing their portfolios to take account of current market-liquidity conditions by switching the weight of their investments from an illiquid market to a liquid market.

6.1.1 CDS Market

Bao, Pan, and Wang (2011) comment that Υ, the negative covariance of price changes in securities over the consecutive periods, captures the magnitude of the transitory price components that characterize the level of illiquidity in the market: that is, a high Υ measure means that the price has fluctuated significantly and that the market has become significantly less liquid. Aligned with their interpretation, a large change in Υ^{cds} (i.e., positive $\Delta\Upsilon^{cds}$) indicates that the CDS market has become less liquid. The reason is that when the CDS market is less liquid, the CDS price volatility increases, and as a result, Υ^{cds} increases over two consecutive periods. This trend leads to the positive $\Delta\Upsilon^{cds}$. In Table 3, by focusing on the first equation (column 1), we can see that the estimated coefficient for the $\Delta\Upsilon^{BOND}$ on the $\Delta\Upsilon^{cds}$ at the 2-month lag is negative and significant at the 5% significance level, implying that a positive shock that reduces liquidity in the bond market results in a more liquid CDS market.

Why does the CDS market become more liquid two months after the bond market has become less liquid? Given that investors tend to shift from illiquid to liquid markets, our results are consistent with previous literature. For example, Lien and Shrestha (2011) show that the low transaction costs and the high liquidity associated with the CDS market attract informed traders such that this market is the first to reflect private information. As a result, when informed traders anticipate that the bond market will become less liquid they trade correspondingly more in the CDS market. The implication of this result suggests that investors may be able to predict the effects of liquidity shocks. Our results suggest that liquidity shocks spill over between the CDS market and the bond market indicating a flight-to-liquidity: that is, CDS market liquidity improves following a liquidity crunch in the bond market. The flight-to-liquidity phenomenon between the CDS and bond markets demonstrates that investors follow the asset market that has the greatest liquidity. Because the CDS market is more active when the default risks of firms are high, liquidity between the bond and CDS markets moves in the opposite direction with a certain time lag. This result suggests that the role of the CDS market in buffering the default risk of firms is more valuable after the bond market has experienced a liquidity crunch.

6.1.2 Stock and Bond Markets

Focusing on the second equation (column 2) in Table 3, we find that the coefficient for the ΔLIQ^{BOND} on the ΔLIQ^{REIT} at the 1-month lag is positive and significant at the 5% significance level, implying that stock market liquidity increases one month after bond market liquidity increases. We also see in the third equation (column 3) in Table 3, the coefficient for the ΔLIQ^{REIT} on the ΔLIQ^{BOND} at the 1-month and 2-month lag respectively is positive and significant at the 5% significance level, implying that bond market liquidity increases when stock market liquidity increases. This result shows the presence of a feedback liquidity effect between the stock and bond markets. The decrease in stock-market liquidity predicts a decrease in bond-market liquidity one month later and furthermore stock- and bond-market liquidity reinforce each other in the short term. The implication of these results is that a liquidity crunch in the stock market will be followed by a liquidity crunch in the bond market.

The liquidity contagion between the stock market and the bond market can be explained potentially by portfolio-rebalancing: investors rebalance their portfolios in order to minimize their risk exposure to each asset market and by doing so they can affect liquidity-shock spill-over trends across asset markets.[5] For example, suppose that an investor holds an investment portfolio composed of stocks, bonds, and CDS that share two macroeconomic risk factors: macro risk factor 1, f1, is stock-specific, and risk factor 2, f2, is bond-specific. Given that CDS is related to the default risk of each firm, it is rational to assume that the CDS market is related to both risk factors, i.e., f1 and f2. If investors receive information that causes them to lower the liquidation value of stock, the rational response would be to sell stocks. As a result, the exposure to risk factor f1 is below its optimal level. To balance the risk exposure, investors adjust their exposure to f1 by buying CDS, but this raises exposure to risk factor f2 above its optimal level. Thus, the exposure to risk factor f2 is adjusted by selling bonds. Accordingly, portfolio rebalancing affects the way in which liquidity shocks move in the same direction between the stock and bond markets.

6.1.3 Underlying-Asset Market

In the third equation (column 3) in Table 3, underlying-asset liquidity negatively affects bond-market liquidity at the 5% significance level. This result implies that there is a flight-to-liquidity phenomenon between the private and public real estate market as well. For example, Ling, Naranjo, and Scheick (2011) suggest that a decrease in private-market liquidity results in an increase in the share turnover of publicly traded REITs because investors may prefer to shift their holdings to the public market when the private real estate market becomes illiquid. We find a similar effect in the bond market.

[5] Kodres and Pritsker (2002) demonstrate that investors transmit idiosyncratic shocks from one country to other country by adjusting their portfolio' exposures to shared macroeconomic risks. Building on their approach, we expand the dimension of macroeconomic risks channels from different countries to different asset markets.

Focusing on the fourth equation (column 4) in Table 3, only bond-market liquidity positively impacts underlying asset liquidity with a 2-month lag at the 10% significance level. Other securitized-market liquidity factors do not show any significant impact on underlying-asset liquidity. This result is expected since our liquidity measures for the CDS and bond markets (Υ^{cds} and Υ^{BOND}) capture the time-varying price movements in each market, not the change in the fundamental value of asset.[6]

6.2 Granger Causality Test

To be explicit about the existence of the liquidity spill-over impacts across multiple markets, we conduct the Granger Causality test. In Table 4, the test results show that stock-market liquidity affects bond-market liquidity. We reject the null hypothesis that $\Delta\Upsilon^{REIT}$ does not Granger Cause ΔLIQ^{BOND} with a 2-month lag at the 5% significance level. We fail to reject the null hypothesis that ΔLIQ^{BOND} does not Granger Cause ΔLIQ^{REIT} with a 2-month lag at the 10% significance level. Taken together, these results suggest that a shock to the stock market liquidity Granger Causes bond-market liquidity, but not vice versa. In addition to the bond market, the test results show that the null hypothesis whereby $\Delta\Upsilon^{BOND}$ does not Granger Cause $\Delta\Upsilon^{cds}$ is rejected with a 2-month lag at the 10% significance level. However, we are unable to reject the null hypothesis that $\Delta\Upsilon^{cds}$ does not Granger Cause $\Delta\Upsilon^{BOND}$. Taken together, these results suggest that bond-market liquidity Granger Causes CDS market liquidity, but not vice versa. We also investigate the impact of underlying-asset liquidity on the CDS market. We reject the null hypothesis that $\Delta OfferClosedSP$ does not Granger Cause $\Delta\Upsilon^{BOND}$ at the 10% significance level. The result holds vice versa. Taken together, we find that private-market liquidity involving the transactions of underlying assets Granger Causes bond-market liquidity.

[6] Bao, Pan, and Wang (2011) assume that an individual asset price consists of two components: its fundamental value and the impact of illiquidity. They assume that fundamental asset value, i.e. the price in the absence of market frictions, follows a random walk and the impact of illiquiidty is only related to the magnitude of the transitory price component.

6.3 Impulse Response Function

The impulse response function allows us to see the general trend in the evolution of shocks during a certain period. The VAR generalized impulse response functions presented in Figures 2-6 provide further evidence regarding the impact of liquidity spillover across markets. The impulse response function graphically analyzes each variables' response to a unit shock to the innovation of each equation in the VAR system. The solid line in each figure represents the estimated diffusion of the monthly liquidity changes to the shock in impulse market liquidity. The ordering of the variables is based on two assumptions: a shock to the underlying-asset liquidity is transmitted to public market liquidity, and CDS market liquidity is affected by both bond market and stock market liquidity. The latter assumption is associated with previous literature in which the value of the CDS contract is demonstrated to be highly related to both credit risk and firm value relevant to the bond market and the stock market, respectively.

Figure 2 and Figure 3, respectively, depict the response of monthly changes in bond-market liquidity to unit shocks in stock-market liquidity and vice versa. As we predicted based on the VAR and Granger Causality analysis, the stock and bond markets respectively show evidence of a mutual feedback effect. One standard deviation change in bond-market liquidity increases stock-market liquidity after one month and induces a decrease in stock-market liquidity one month later. Subsequently, stock-market liquidity increases for the next two months followed by a decrease in the third month. This pattern repeats until the response of stock market liquidity tapers to zero. Furthermore, one standard deviation change in stock-market liquidity increases bond-market liquidity after one month and induces a decrease in stock-market liquidity in each of the next two months. Subsequently, bond-market liquidity repeats the trend whereby an increase in one month is followed by a decrease in the next month. In the long run, this trend tapers to zero.

In Figure 4, we see that one month after one standard deviation change in bond-market liquidity has taken place, CDS market liquidity increases; however, after this initial increase, CDS-market liquidity decreases in the following month. After this, CDS-market liquidity increases in each of the next two months. Subsequently, CDS-market liquidity repeats the trend whereby an increase in one month is followed by a decrease in the next month, with this trend tapering to zero in the long run.

In Figure 5, one standard deviation change in the $\Delta OfferClosedSP$ results in a decrease in $\Delta\Upsilon^{BOND}$ after the first period followed by a large spike in the response of the $\Delta\Upsilon^{BOND}$ for the next period. After the third period, the response of bond-market liquidity is insignificant and in the long term the response of bond-market liquidity to the shock to underlying-asset market liquidity diminishes to zero.

In Figure 6, one standard deviation change in the$\Delta\Upsilon^{BOND}$ leads to an increase in $\Delta OfferClosedSP$ for the first two periods and then a decrease in each of the next two periods. After these initial movements, the response of the underlying-asset liquidity tapers to zero. Consistent with Bao, Pan, and Wang (2011), both $\Delta\Upsilon^{BOND}$ and $\Delta\Upsilon^{cds}$ capture the transitory impact of a liquidity shock on the market rather than its fundamental impact.

6.4 Variance Decomposition

Variance decomposition analysis helps us to see which portion of the forecast error of each variable can be explained by the shocks from the rest of the variables. Overall, the variance decomposition results show that liquidity fluctuation in each market originates from its own shocks. However, liquidity shocks in one market have a significant inter-dependent effect on other markets in the long run. Table 3 and Figure 7 suggest that a shock to bond-market liquidity is a significant source of liquidity fluctuation in the CDS market, accounting for 9.9% of the shocks in the CDS market after 24 months, whereas its own shocks accounted for 85.9%, and the effects from liquidity shocks in both the stock market and the underlying-asset market are relatively minor, such as 2.37% and 1.82%, respectively.

Table 4 and Figure 8 suggest that liquidity shocks to the stock market are a very important source of fluctuations in bond-market liquidity as are the bond markets own shocks. In more detail, 18.64% of the bond-market liquidity shocks after four months are due to stock-market liquidity shocks. Another explanatory source of fluctuation in bond-market liquidity originates from underlying-asset liquidity, which accounts for 7.3% of the bond-market liquidity shocks after four months. Liquidity shocks to the CDS market play a minor role (4.34%) in the fluctuations of bond-market liquidity. The impact of its own shocks on bond-market liquidity accounts for 69.71% and remain a major source of its own fluctuations.

In Table 5 and Figure 9, stock-market liquidity fluctuates mainly due to its own shocks. The variance in the forecast errors of the stock market can be principally explained by the markets own shocks at 89% after 24 months, whereas bond, stock, and underlying-asset market liquidity accounts for 5.49%, 3.84%, and 1.24% of stock market liquidity fluctuation, respectively. This result implies that the significance of underlying-asset liquidity for stock-market liquidity may be limited. Table 6 and Figure 10 suggest that underlying-asset liquidity fluctuates through both CDS- and bond-market liquidity channels. After four months, CDS market liquidity accounts for 7.78% of forecast error variance in underlying-asset liquidity, whereas bond-market liquidity accounts for 7.56%. The shocks to stock-market liquidity have only a minor impact (3%).

In conclusion, other than its own shocks, after four months approximately 19% of the fluctuation in bond-market liquidity can be explained by liquidity shocks originating in the stock market. This result suggests that bond-market liquidity fluctuates mainly due to the liquidity shocks in the stock market. Shocks to underlying-asset liquidity also have a moderate impact on fluctuations in bond-market liquidity such that 7% of the fluctuation in bond-market liquidity can be explained by liquidity shocks from the underlying-asset market. CDS-market liquidity fluctuates along with the shocks from bond-market liquidity in the long run. Underlying-asset liquidity fluctuates due to shocks from both CDS- and bond-market liquidity.

7 Robustness Check

We conduct various robustness exercises by employing different liquidity measures and adding exogenous variables. As we expected, the main results are consistent with the previous findings. In Table 7, instead of the $\Delta OfferClosedSP$, $\Delta CapRateSP$ is shown as a proxy for underlying-asset liquidity. The $\Delta CapRateSP$ is constructed as the difference between the average cap rate and a 10-year Treasury bill rate. In the fourth equation (column 4) in Table 7, bond-market liquidity negatively affects CDS-market liquidity. In the second and third equations (columns 2 and 3) in Table 7, stock-market liquidity positively affects bond-market liquidity with a 2-month lag while the bond-market effect on the stock market is no longer substantial.

We find the reason for this weaker relation between bond and stock market from the effect of underlying asset market. In the fourth equation (column 4) in Table 7, we see that the estimated coefficient for the $\Delta\Upsilon^{BOND}$ on the $\Delta CapRateSP$ at a 1-month lag is positive at the 1% significance level. Accordingly, we posit that the strong connection between bond-market and underlying-asset liquidity dilutes the impact of bond-market liquidity on stock market liquidity.

In Table 8, the $\Delta BidAskSP$ is used as a proxy for stock-market liquidity instead of the ΔLIQ^{REIT}. The $\Delta BidAskSP$ is constructed as the aggregated average of the monthly quoted spread for each stock based on the close ask price and the bid price from the CRSP daily database. In the third equation (column 3) in Table 8, stock-market liquidity positively affects bond-market liquidity as the previous analysis suggested. However, the relation does not hold vice versa. The liquidity spill-over between the bond market and the CDS market still holds as shown previously.

Finally, we test the robustness of our results by extending the previous VAR regression through the addition of exogenous variables. The interest rate affects the general economic condition of the market. Thus, we added a 5-year Treasury bill yield as an exogenous variable to the existing VAR model in order to control general economic conditions. Overall, despite the addition of exogenous variables, the main results hold as before. In the second and third equation (column 2 and 3) of Table 9, stock-market liquidity positively affects bond-market liquidity at the 1-month and 2-month lag.

8 Conclusion

Considerable anecdotal evidence suggests that the effects of liquidity shocks spread quickly throughout the financial sector. This paper examines the liquidity spill-over impact across real estate capital markets: the stock (REIT) market, the derivative (CDS) market, and the corporate-bond market, and the private (property sale-based) market. Given the fundamental link between the underlying assets of the public and private real estate markets, liquidity shocks are more likely to spill over across these particular markets.

Our study contributes to the existing literature by concentrating on the dynamics of liquidity between the private and public real estate markets. The analysis of liquidity-shock patterns across the different real estate markets has important implications for investor asset allocation and portfolio management models. Specifically, we show that a liquidity shock has an interdependent effect on the private and public markets. Investors in possession of such knowledge could refine their risk-management strategies accordingly and could manage their portfolios based on correspondingly better predictions of the liquidity patterns across real estate markets.

Using VAR, we investigated liquidity-shock spill-over across the four markets. The VAR results show that bond-market liquidity shocks negatively impact CDS market-liquidity with a 2-month lag. Furthermore, a stock-market liquidity shock Granger Causes bond-market liquidity with a 2-month lag. Underlying asset liquidity (private-market liquidity) Granger Causes bond-market liquidity and the relation holds vice versa. However, the spill-over impact of underlying asset liquidity on the public real-estate market varies in accordance with different measures.

Variance decomposition analysis implies that bond-market liquidity fluctuates mainly due to the liquidity shocks in the stock market. Shocks to underlying-asset liquidity also have a moderate impact on fluctuations in bond-market liquidity. CDS-market liquidity fluctuates along with the shocks from bond-market liquidity in the long run. Underlying-asset liquidity fluctuates due to the shocks from CDS- market liquidity and from bond-market liquidity.

In future study, we will focus on determining the factors that cause the feedback impact between stock- and bond-market liquidity. Furthermore, we will test the factors that cause the negative impact of bond-market liquidity on CDS-market liquidity. Consistent with the previous literature, we conjecture that the private information available to investors in each market plays a role in creating different spill-over liquidity-shock patterns across real estate markets. Further research is required to test this information hypothesis in order to investigate the dynamics of liquidity shocks across real estate markets.

References

Acharya, V.V., & Pedersen, L.H. (2005). Asset pricing with liquidity risk. *Journal of Financial Economics*, 77(2), 375–410.

Amihud, Y.I. (2002). lliquidity and stock returns: Cross-section and time-series effects. *Journal of Financial Markets*, 5(1), 31–56.

Bao, J., Pan, J., & Wang, J. (2011). The illiquidity of corporate bonds. *Journal of Finance*, 66(3), 911–946.

Benveniste, L., Capozza, D.R., & Seguin, P.J. (2001). The value of liquidity. *Real Estate Economics*, 29(4), 633–660.

Brounen, D., Eichholtz, P., & Ling, D.T. (2009). The liquidity of property shares: An international comparison. *Real Estate Economics*, 37(3), 413–445.

Brown, D.T. (2000). Liquidity and liquidation: Evidence from real estate investment trusts. *Journal of Finance*, 55(1), 469–485.

Brunnermeier, M., & Pedersen, L. (2009). Market liquidity and funding liquidity. *Review of Financial Studies*, 26(6), 2201–2238.

Calvo, G.A., & Mendoza, E.G. (2000). Rational contagion and the globalization of securities markets. *Journal of International Economics*, 51, 79-113.

Chorida, T., Sarkar, A., & Subrahmanyam, A. (2005). An empirical analysis of stock and bond market liquidity. *Review of Financial Studies*, 18, 85–129.

Clayton, J., MacKinnon, G., & Peng, L. (2008). Time variation of liquidity in the private real estate market: An empirical investigation. *Journal of Real Estate Research*, 30(2), 125–160.

Cochrane, J.H. (2011). Presidential address: Discount rates. *Journal of Finance*, 66(4), 1047–1108.

Collin-Dufresne, P., Goldstein, R.S., & Martin, J.S. (2001). The determinants of credit spread changes. *Journal of Finance*, 56(6), 2177–2207.

Fisher, J., Gatzlaff, D., Geltner, D., & Haurin, D. (2003). Controlling for the impact of variable liquidity in commercial real estate price indices. *Real Estate Economics*, 31(2), 269–303.

Goldstein,I., & Pauzner, A. (2004). Contagion of self-fulfilling financial crises due to diversification of investment portfolios. *Journal of Economic Theory*, 119, 151–183.

Hartmann, P., Straetmans, S., & C.G. de Vries (2004). Asset market linkages in crisis periods. *The Review of Economics and Statistics*, 86(1), 313–326.

Huang, X., Zhou, H., & Zhu, H. (2009). A framework for assessing the systemic risk of major financial institutions. *Journal of Banking & Finance*, 33(11), 2036–2049.

Jacoby, G., Jiang, G.J., & Theocharides, G. (2010). Cross-market liquidity shocks: Evidence from the CDS, corporate bond and equity market. Working Paper.

King, M., and Wadhwani, S. (1990). Transmission of volatility between stock markets. *Review of Financial Studies*, 3, 5-33.

Kodres, L., and Pritsker, M. (2002). A rational expectations model of financial contagion. *Journal of Finance*, 57, 769-799.

Kumar, P., & Seppi, D. (1994). Information and index arbitrage. *Journal of Business*, 67(4), 481–509.

Lien, D. & Shrestha, K. (2011). Price Discovery in Interrelated Markets. Working paper.

Lin, Z., & Vandell, K.D. (2007). Illiquidity and pricing biases in the real estate market. *Real Estate Economics*, 35(3), 291–330.

Ling, D.C., Naranjo, A. & Scheick, B. (2011). Funding constraints and commercial real estate pricing spirals. Working paper.

O'Hara, M. (1995). *Market microstructure theory*, Malden, MA: Blackwell.

Pan, J., & Singleton, K. (2008). Default and recovery implicit in the term structure of sovereign CDS spreads. *Journal of Finance*, 63(5), 2345–2384.

Pagliari, J.L., Scherer, K.A., & Monopoli, R.T. (2005). Public versus private real estate equities: A more refined, long-term comparison. *Real Estate Economics*, 33(1), 147–187.

Yuan, K.(2002). Asymmetric price movements and borrowing constraints: a rational expectations equilibrium model of crises, contagion and confusion. Working paper.

Zhang, B.Y., Zhou, H., & Zhu, H. (2009). Explaining credit default swap spreads with the equity volatility and jump risks of individual firms. *Review of Financial Studies*, 22(12), 5099–5131.

Table 1: Descriptive Statistics

This table represents the descriptive statistics of our measures of market liquidity. Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *CapRateSP* is the monthly difference between the average cap rate and a 10-year Treasury bill. *OfferClosedSP* is the monthly average difference between the offered and closed cap rate of each property type. *BidAskSP* is the monthly aggregate stock-market liquidity measure based on the difference between the bid and ask price of an individual REIT.

	N	MEAN	MEDIAN	MAX	MIN	SD
Υ^{cds}	79	6.3981	1.9519	211.5157	-125.12	39.2351
LIQ^{REIT}	74	0.0207	0.0188	0.0437	0.0090	0.0078
Υ^{BOND}	77	13.7450	10.8898	89.7029	-9.3423	15.4120
CapRateSP	77	3.1893	3.0580	5.0302	1.3407	1.0973
OfferClosedSP	76	-0.0006	-0.0012	.0073	-.0042	.0024
Bid-Ask SP	74	1.0584	0.9194	4.5429	0.2576	0.7439

Figure 1: Monthly Time-Series of the $OfferClosedSP$

The $OfferClosedSP$ is the aggregate average difference between the offered and closed cap rate across four property types (apartment, industry, office and retail).

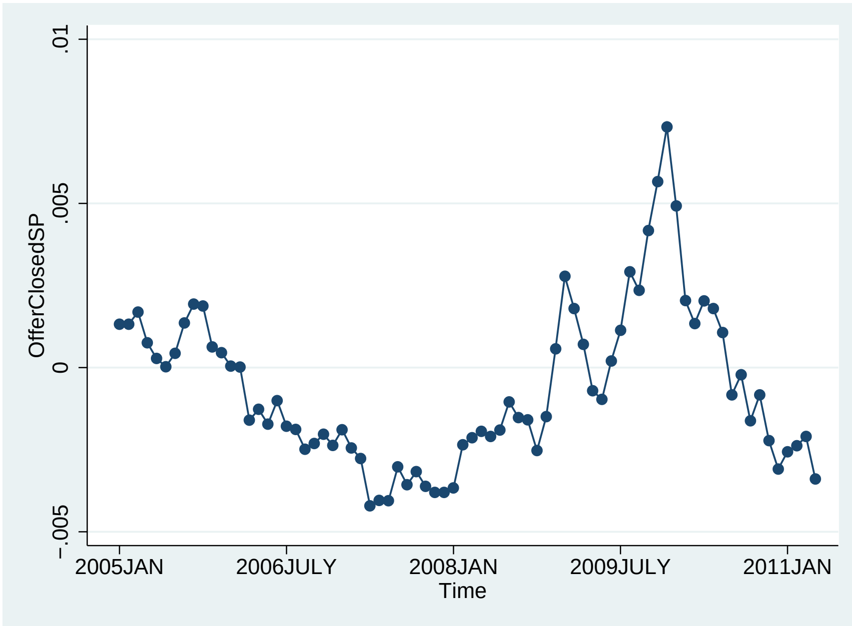


Table 2: Correlations

This table reports the contemporaneous correlations of our measures of market liquidity. Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *CapRateSP* is the monthly difference between the average cap rate and a 10-year Treasury bill. *OfferClosedSP* is the monthly average difference between the offered and closed cap rate of each property type. *BidAskSP* is the monthly aggregate stock-market liquidity measure based on the difference between the bid and ask price of an individual REIT.

	Υ^{cds}	Υ^{BOND}	LIQ^{REIT}	BidAskSP	OfferClosedSP	CapRateSP
Υ^{cds}	1					
Υ^{BOND}	0.0504	1				
LIQ^{REIT}	0.0864	0.3234**	1			
BidAskSP	0.1863	0.4832**	0.3130**	1		
OfferClosedSP	-0.1308	-0.0407	-0.0179	-0.4075**	1	
CapRateSP	-0.0791	0.0677	-0.3910**	-0.3283**	0.5796**	1

* p<0.1, ** p<0.05, *** p<0.01

Table 3. VAR using the OfferClosedSP with a 2-month lag

This table represents the results from estimating four unrestricted VAR models for the underlying-asset, CDS, bond, and stock markets. An unrestricted p^{th} order Gaussian VAR model can be represented as:

$$Y_t=\mu+\varphi_1 Y_{t-1}+\varphi_2 Y_{t-2}+\ldots+\varphi_p Y_{t-p}+e_t$$

The lag-length of the VAR is chosen by looking at the FPE, AIC, HQIC, SBIC, and the likelihood ratio for various choices of p. Our measure of liquidity, Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *OfferClosedSP* is the monthly average difference between the offered and closed cap rate of each property type. *Monthly-Dummy* constitute a system of dummy variables defined by the months of the year. *CrisisDum* is a dummy variable with the value 1 for a sub-period before 2008 and otherwise, 0.

(t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01)

	$\Delta\Upsilon_t^{cds}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
$\Delta\Upsilon_{t-1}^{cds}$	**-0.814*****	0.00000979	0.00849	-0.00000195
	(-6.82)	(0.97)	(0.38)	(-0.74)
$\Delta\Upsilon_{t-2}^{cds}$	**-0.511*****	0.00000573	0.00104	-0.00000175
	(-4.28)	(0.57)	(0.05)	(-0.67)
ΔLIQ_{t-1}^{REIT}	568.1	**-0.744*****	**767.2****	-0.0120
	(0.36)	(-5.54)	(2.55)	(-0.34)
ΔLIQ_{t-2}^{REIT}	-522.2	**-0.350****	**791.6****	-0.0128
	(-0.33)	(-2.61)	(2.64)	(-0.37)
$\Delta\Upsilon_{t-1}^{BOND}$	0.375	**0.000122****	0.0921	0.0000186
	(0.54)	(2.08)	(0.70)	(1.22)
$\Delta\Upsilon_{t-2}^{BOND}$	**-1.648****	0.0000173	-0.200	**0.0000277***
	(-2.45)	(0.30)	(-1.57)	(1.87)
$\Delta OfferClosedSP_{t-1}$	-1350.7	0.344	**-2576.4****	0.106
	(-0.21)	(0.63)	(-2.12)	(0.75)
$\Delta OfferClosedSP_{t-2}$	8665.4	0.119	-963.2	0.0829
	(1.28)	(0.21)	(-0.75)	(0.56)
$CRISISDUM$	3.187	0.0000210	-0.605	-0.000180
	(0.28)	(0.02)	(-0.28)	(-0.71)
Constant	6.117	-0.00213	-0.272	0.0000898
	(0.28)	(-1.15)	(-0.07)	(0.19)
$MonthlyDummy$	Yes	Yes	Yes	Yes
Observations	69			
R^2	0.62	0.53	0.44	0.26

Table 4: Granger Causality

These tables report the results of Granger Causality test corresponding to the 2-month lagged VAR model in Table 3. Each table represents the test result against the null hypothesis respectively.

Null Hypothesis: ΔLIQ^{REIT} does not Granger Cause $\Delta \Upsilon^{BOND}$

Lag	F	P-value
2	4.28	0.0195

Null Hypothesis: $\Delta \Upsilon^{BOND}$ does not Granger Cause ΔLIQ^{REIT}

Lag	F	P-value
2	2.33	0.1080

Null Hypothesis:$\Delta \Upsilon^{BOND}$ does not Granger Cause $\Delta \Upsilon^{cds}$

Lag	F	P-value
2	3.01	0.0584

Null Hypothesis:$\Delta \Upsilon^{cds}$ does not Granger Cause $\Delta \Upsilon^{BOND}$

Lag	F	P-value
2	0.09	0.9160

Null Hypothesis:ΔOfferClosedSP does not Granger Cause $\Delta \Upsilon^{BOND}$

Lag	F	P-value
2	2.80	0.0705

Null Hypothesis:$\Delta \Upsilon^{BOND}$ does not Granger Cause ΔOfferClosedSP

Lag	F	P-value
2	2.83	0.0691

Generalized Impulse Response Functions

Figures 2–6 plot the generalized cumulative impulse response functions corresponding to the estimated VAR models in Table 3. Impulse response function graphically analyzes how each variable reacts to a unit shock to the innovation of each equation in the VAR system. The solid line in each figure represents the estimated diffusion of monthly liquidity changes to the shock in impulse market liquidity. Our measure of liquidity, Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond.

Figure 2

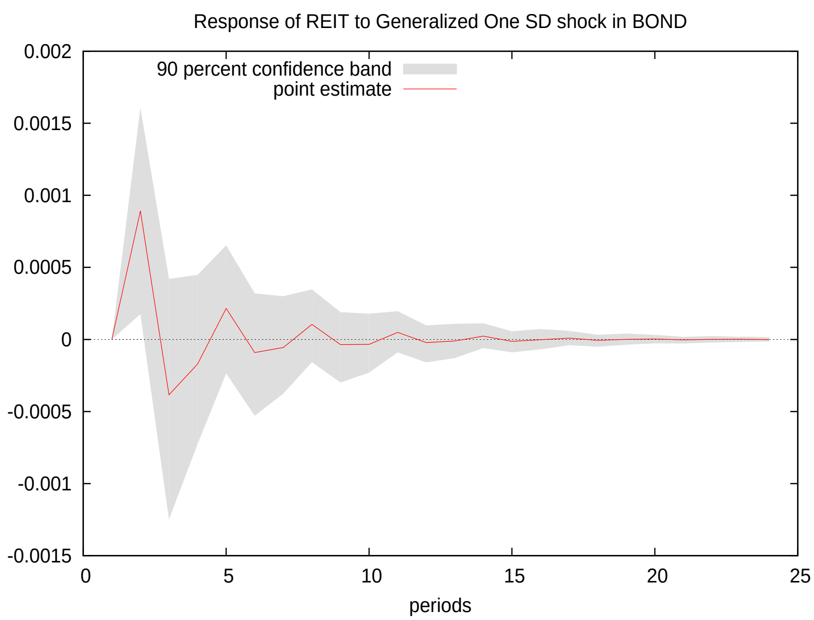


Figure 3

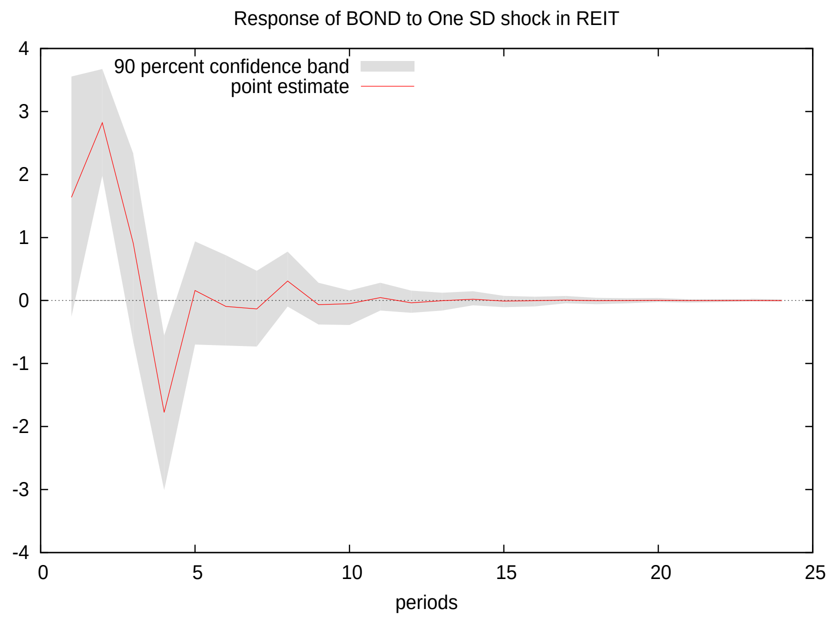


Figure 4

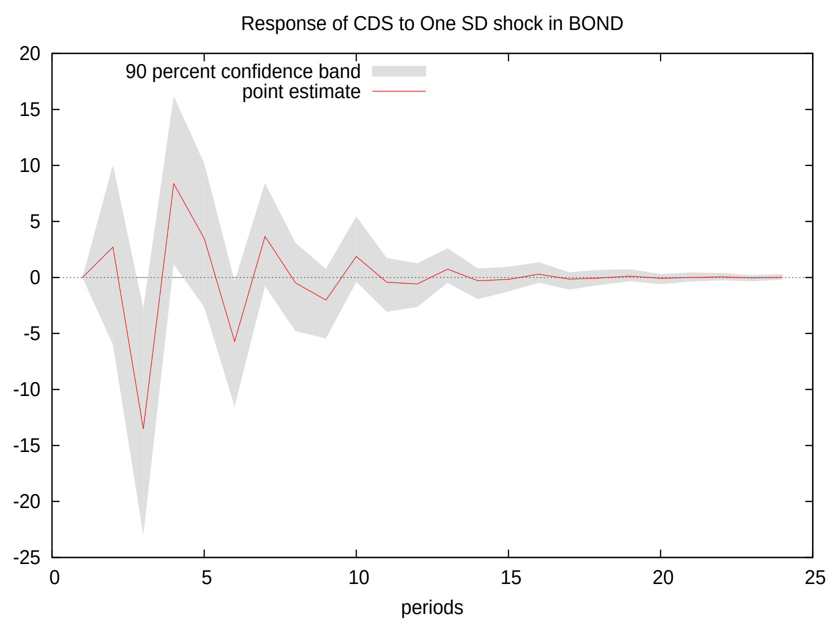


Figure 5

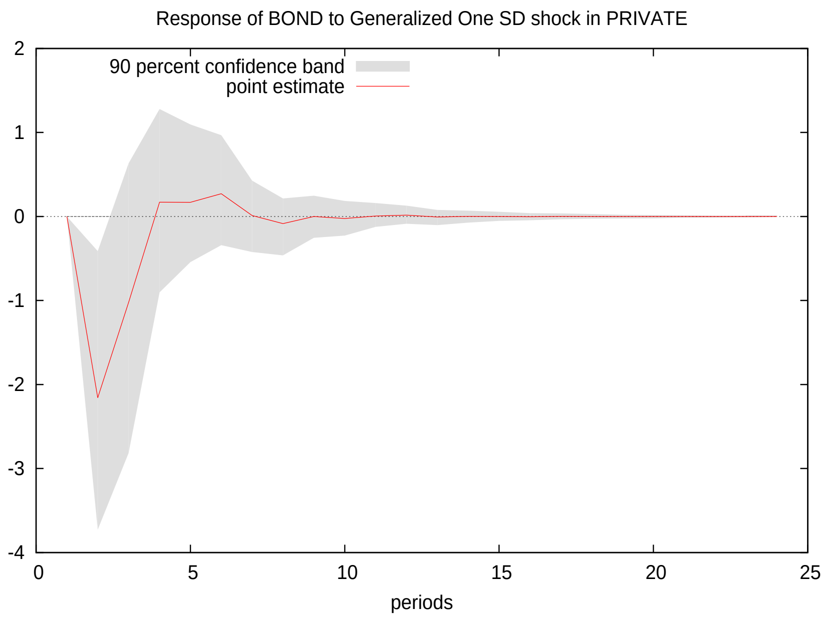
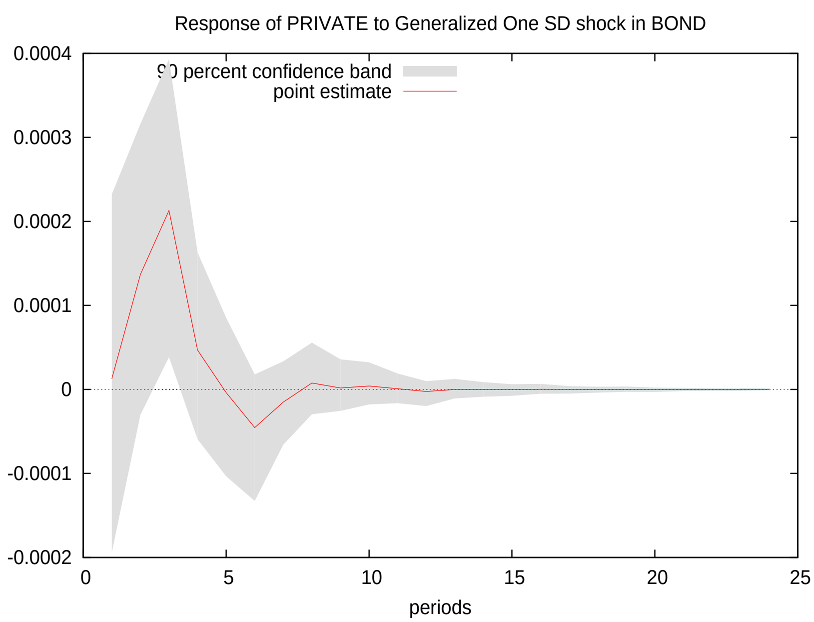


Figure 6



Forecast Error Variance Decomposition

Tables 3–6 represent the results from forecast error variance decomposition (FEVD) for each variable. FEVD helps us to see what percentage of the forecast error variance of each variable is explained by the shocks from the rest of the variables.

Table 3: Decomposition of variance for $\Delta\Upsilon_t^{CDS}$

period	std.error	$\Delta\Upsilon_t^{CDS}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
1	39.459	100.0000	0.0000	0.0000	0.0000
2	50.4271	99.4052	0.2560	0.2885	0.0503
3	53.2905	89.2363	2.0975	6.6875	1.9786
4	55.0763	87.3847	2.0664	8.5759	1.9730
5	56.3726	87.5728	1.9738	8.5689	1.8844
6	56.9558	86.6251	2.1302	9.3986	1.8461
7	57.1415	86.1922	2.2118	9.7498	1.8461
8	57.2996	86.2575	2.2025	9.7032	1.8367
9	57.3995	86.1159	2.2598	9.7935	1.8309
10	57.4517	85.9608	2.3296	9.8820	1.8276
11	57.4725	85.9556	2.3377	9.8803	1.8264
12	57.486	85.9444	2.3438	9.8861	1.8257
13	57.4959	85.9147	2.3610	9.8992	1.8250
14	57.5005	85.9086	2.3662	9.9003	1.8248
15	57.5023	85.9084	2.3662	9.9006	1.8248
16	57.5038	85.9039	2.3686	9.9028	1.8247
17	57.5047	85.9022	2.3700	9.9031	1.8247
18	57.505	85.9022	2.3700	9.9030	1.8247
19	57.5053	85.9017	2.3703	9.9034	1.8247
20	57.5054	85.9013	2.3705	9.9035	1.8247
21	57.5055	85.9013	2.3705	9.9035	1.8247
22	57.5055	85.9012	2.3706	9.9035	1.8247
23	57.5056	85.9012	2.3706	9.9035	1.8247
24	57.5056	85.9012	2.3706	9.9035	1.8247

Table 4: Decomposition of variance for $\Delta\Upsilon_t^{BOND}$

period	std.error	$\Delta\Upsilon_t^{CDS}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
1	7.47085	0.5698	4.8004	94.6298	0.0000
2	8.4407	3.8290	14.9382	74.7008	6.5319
3	8.6478	4.3742	15.3478	72.6552	7.6227
4	8.85806	4.3401	18.6419	69.7157	7.3023
5	8.88475	4.4653	18.5621	69.6781	7.2944
6	8.88999	4.4603	18.5516	69.6097	7.3785
7	8.89606	4.4579	18.5485	69.6250	7.3686
8	8.902	4.4549	18.6452	69.5322	7.3678
9	8.90273	4.4642	18.6475	69.5218	7.3666
10	8.90293	4.4640	18.6498	69.5193	7.3669
11	8.90336	4.4679	18.6507	69.5151	7.3663
12	8.90355	4.4698	18.6515	69.5123	7.3663
13	8.90361	4.4699	18.6513	69.5125	7.3662
14	8.90365	4.4702	18.6516	69.5120	7.3662
15	8.90369	4.4708	18.6516	69.5115	7.3661
16	8.9037	4.4709	18.6515	69.5115	7.3661
17	8.90371	4.4709	18.6515	69.5114	7.3661
18	8.90371	4.4710	18.6515	69.5114	7.3661
19	8.90371	4.4711	18.6515	69.5113	7.3661
20	8.90372	4.4711	18.6515	69.5113	7.3661
21	8.90372	4.4711	18.6515	69.5113	7.3661
22	8.90372	4.4711	18.6515	69.5113	7.3661
23	8.90372	4.4711	18.6515	69.5113	7.3661
24	8.90372	4.4711	18.6515	69.5113	7.3661

Table 5: Decomposition of variance for $\Delta\Upsilon_t^{REIT}$

period	std.error	$\Delta\Upsilon_t^{CDS}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
1	0.00333008	5.5011	94.4989	0.0000	0.0000
2	0.00412277	3.8284	91.0105	4.6737	0.4873
3	0.0042557	3.6150	90.0174	5.2024	1.1652
4	0.0042668	3.6223	89.8356	5.3354	1.2066
5	0.0043246	3.5733	89.7913	5.4415	1.1939
6	0.00435159	3.7030	89.6615	5.4184	1.2171
7	0.00435405	3.7303	89.5964	5.4288	1.2444
8	0.0043573	3.7447	89.5320	5.4779	1.2454
9	0.00436089	3.8036	89.4760	5.4756	1.2448
10	0.00436188	3.8268	89.4470	5.4794	1.2468
11	0.00436224	3.8264	89.4351	5.4910	1.2475
12	0.00436269	3.8376	89.4228	5.4924	1.2473
13	0.0043629	3.8453	89.4149	5.4925	1.2473
14	0.00436298	3.8454	89.4120	5.4951	1.2474
15	0.00436305	3.8466	89.4102	5.4959	1.2473
16	0.00436309	3.8482	89.4087	5.4958	1.2473
17	0.0043631	3.8484	89.4081	5.4962	1.2473
18	0.00436312	3.8484	89.4078	5.4964	1.2473
19	0.00436312	3.8487	89.4076	5.4964	1.2473
20	0.00436313	3.8488	89.4074	5.4965	1.2473
21	0.00436313	3.8488	89.4074	5.4965	1.2473
22	0.00436313	3.8488	89.4074	5.4965	1.2473
23	0.00436313	3.8488	89.4073	5.4965	1.2473
24	0.00436313	3.8488	89.4073	5.4965	1.2473

Table 6: Decomposition of variance for $\Delta OfferClosedSP_t$

period	std.error	$\Delta\Upsilon_t^{CDS}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
1	0.000868845	6.3998	0.7026	0.0216	92.8761
2	0.000889734	7.3453	0.7026	2.3850	89.5672
3	0.000918362	6.8945	1.2515	7.6177	84.2364
4	0.000937425	7.7884	3.0892	7.5600	81.5623
5	0.000938159	7.7764	3.0895	7.5497	81.5844
6	0.000939874	7.7532	3.2039	7.7557	81.2872
7	0.00094002	7.7508	3.2036	7.7788	81.2668
8	0.000940273	7.7619	3.2228	7.7813	81.2340
9	0.0009403	7.7621	3.2275	7.7812	81.2293
10	0.000940326	7.7627	3.2296	7.7827	81.2250
11	0.000940331	7.7627	3.2302	7.7827	81.2244
12	0.000940336	7.7626	3.2307	7.7833	81.2235
13	0.000940338	7.7626	3.2309	7.7832	81.2233
14	0.000940338	7.7626	3.2309	7.7832	81.2232
15	0.000940339	7.7626	3.2310	7.7832	81.2231
16	0.000940339	7.7626	3.2310	7.7832	81.2231
17	0.000940339	7.7626	3.2310	7.7832	81.2231
18	0.000940339	7.7626	3.2310	7.7832	81.2231
19	0.000940339	7.7626	3.2311	7.7832	81.2231
20	0.000940339	7.7626	3.2311	7.7832	81.2231
21	0.000940339	7.7626	3.2311	7.7832	81.2231
22	0.000940339	7.7626	3.2311	7.7832	81.2231
23	0.000940339	7.7626	3.2311	7.7832	81.2231
24	0.000940339	7.7626	3.2311	7.7832	81.2231

Forecast Error Variance Decomposition

Figure 7–10 represent the results from forecast error variance decomposition (FEVD) for each variable. FEVD helps us to see what percentage of the forecast error variance of each variable is explained by the shocks from the rest of the variables.

Figure 7

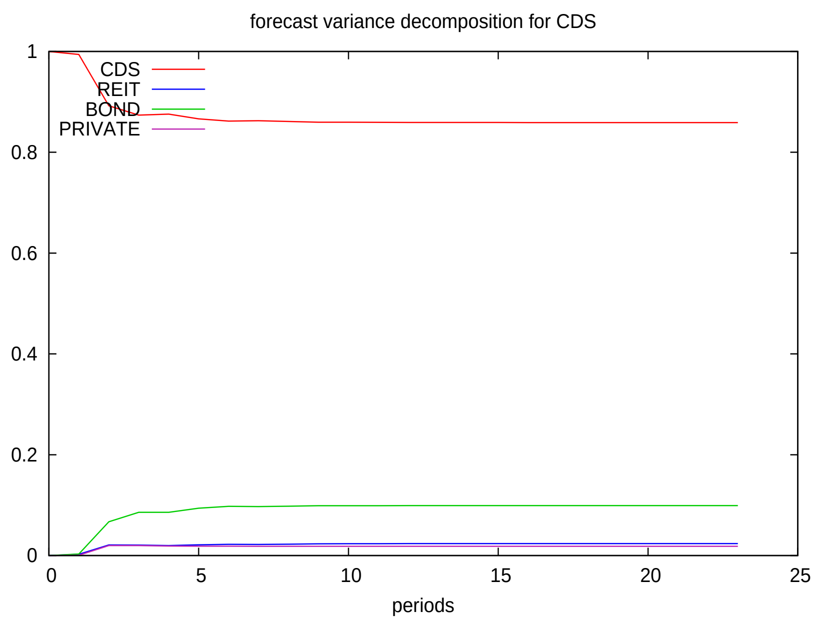


Figure 8

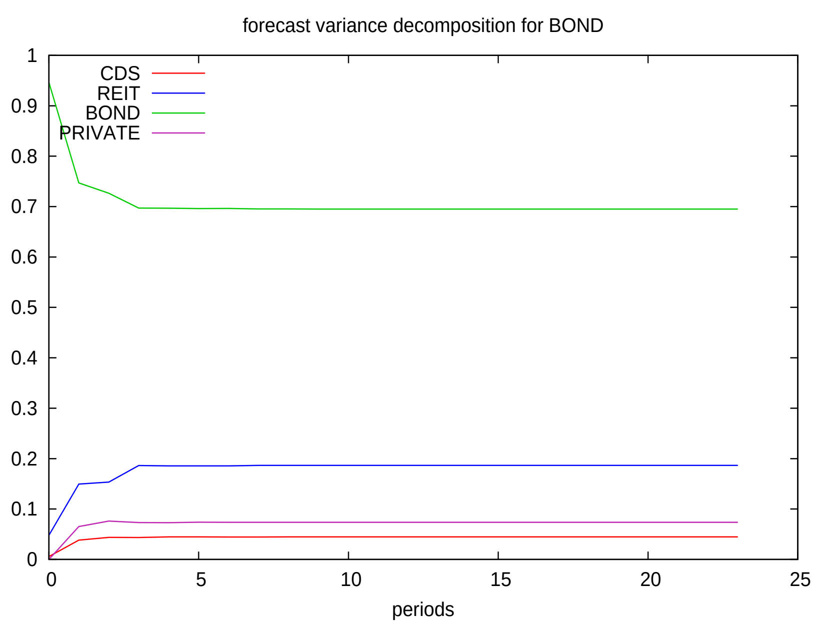


Figure 9

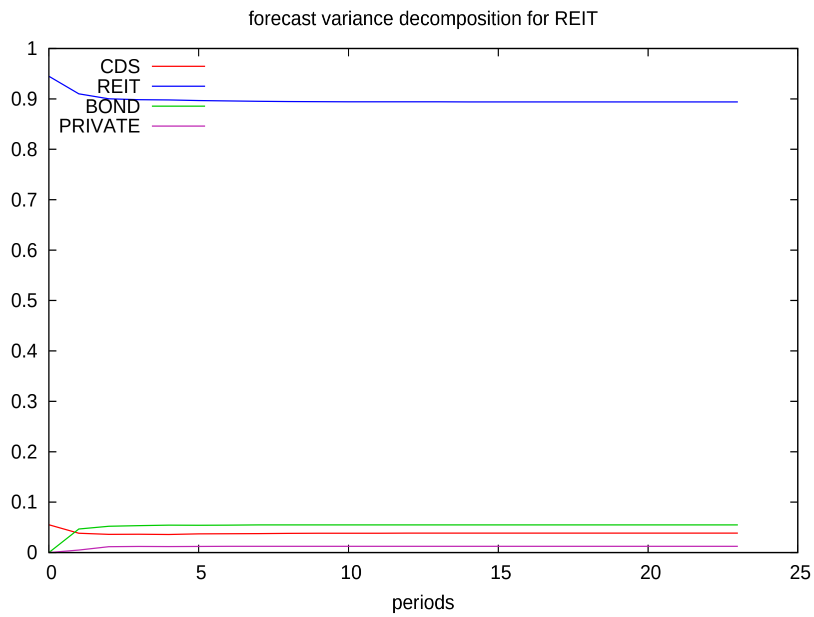


Figure 10

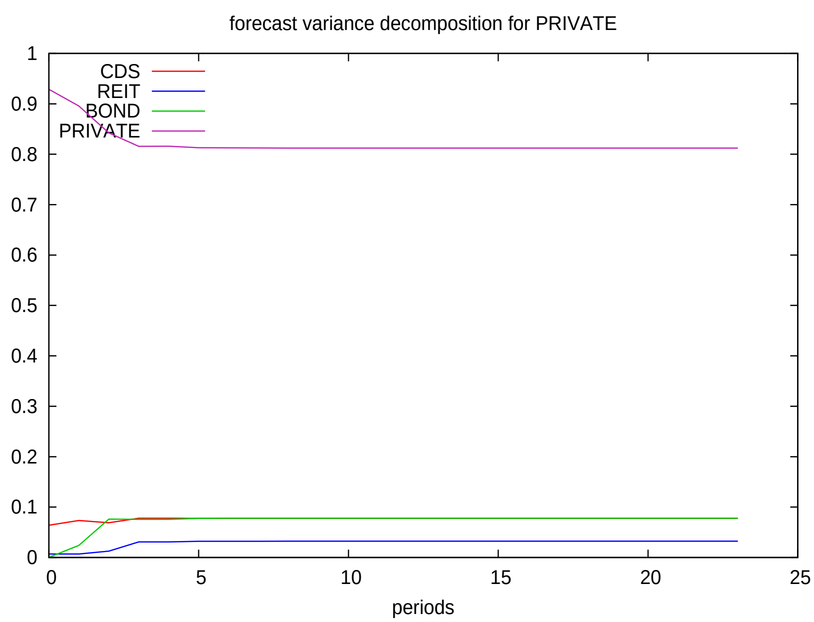


Table 7: VAR using the CapRateSP with a 2-month lag

This table represents the results from estimating four unrestricted VAR models for the underlying asset, CDS, bond, and stock markets. An unrestricted p^{th}order Gaussian VAR model can be represented as:

$$Y_t = \mu + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \ldots + \varphi_p Y_{t-p} + e_t$$

The lag-length of the VAR is chosen by looking at the FPE, AIC, HQIC, SBIC, and the likelihood ratio for various choices of p. Our measure of liquidity, Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *CapRateSP* is the monthly difference between the average cap rate and a 10-year Treasury bill. *MonthlyDummy* constitutes a system of dummy variables defined by the months of the year. *CrisisDum* is a dummy variable with the value 1 for a sub-period before 2008 and otherwise, 0.

(t statistics in parentheses * p<0.1, ** p<0.05, *** p<0.01)

	$\Delta\Upsilon_t^{cds}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta CapRateSP_t$
$\Delta\Upsilon_{t-1}^{cds}$	**-0.827*****	0.00000458	0.0143	-0.000218
	(-6.92)	(0.44)	(0.60)	(-0.36)
$\Delta\Upsilon_{t-2}^{cds}$	**-0.536*****	0.00000154	0.0122	-0.000897
	(-4.57)	(0.15)	(0.53)	(-1.49)
ΔLIQ_{t-1}^{REIT}	1137.1	**-0.702*****	**620.7***	8.382
	(0.71)	(-5.10)	(1.97)	(1.03)
ΔLIQ_{t-2}^{REIT}	-118.9	**-0.331****	**682.9****	3.917
	(-0.08)	(-2.54)	(2.29)	(0.51)
$\Delta\Upsilon_{t-1}^{BOND}$	-0.0584	0.0000944	0.106	**0.0127*****
	(-0.09)	(1.63)	(0.80)	(3.70)
$\Delta\Upsilon_{t-2}^{BOND}$	**-1.739****	0.0000185	-0.125	0.00513
	(-2.24)	(0.28)	(-0.81)	(1.29)
$\Delta CapRateSP_{t-1}$	0.353	0.000734	-7.147	0.207
	(0.01)	(0.29)	(-1.25)	(1.39)
$\Delta CapRateSP_{t-2}$	-17.78	-0.00207	-3.086	0.0161
	(-0.69)	(-0.93)	(-0.60)	(0.12)
cons	11.07	-0.00214	-0.968	-0.00637
	(0.54)	(-1.20)	(-0.24)	(-0.06)
MonthlyDummy	Yes	Yes	Yes	Yes
N	71			
R^2	0.61	0.52	0.37	0.44

Table 8: VAR using the BidAskSP with a 2-month lag

This table shows the results from estimating four unrestricted VAR models for the underlying-asset, CDS, bond, and stock markets. An unrestricted p^{th}order Gaussian VAR model can be represented as

$$Y_t = \mu + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \ldots + \varphi_p Y_{t-p} + e_t$$

The lag-length of the VAR is chosen by looking at the FPE, AIC, HQIC, SBIC, and the likelihood ratio for various choices of p. Our measure of liquidity, Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *CapRateSP* is the monthly difference between the average cap rate and a 10-year Treasury bill. *BidAskSP* is the monthly aggregate stock-market liquidity measure based on the difference between the bid and ask price of an individual REIT. *MonthlyDummy* constitutes a system of dummy variables defined by the months of the year. *CrisisDum* is a dummy variable with the value 1 for a sub-period before 2008 and otherwise, 0.

(t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01)

	$\Delta\Upsilon^{cds}_t$	$\Delta BidAskSP_t$	$\Delta\Upsilon^{BOND}_t$	$\Delta CapRateSP_t$
$\Delta\Upsilon^{cds}_{t-1}$	**-0.820*****	0.00151	0.0108	0.000104
	(-6.98)	(1.10)	(0.55)	(0.18)
$\Delta\Upsilon^{cds}_{t-2}$	**-0.544*****	0.000618	0.00242	-0.000526
	(-4.63)	(0.45)	(0.12)	(-0.92)
$\Delta BidAskSP_{t-1}$	8.623	**-0.269****	**7.985*****	**-0.133****
	(0.78)	(-2.09)	(4.36)	(-2.48)
$\Delta BidAskSP_{t-2}$	5.975	**-0.480*****	**8.430*****	-0.00806
	(0.47)	(-3.23)	(4.00)	(-0.13)
$\Delta\Upsilon^{BOND}_{t-1}$	-0.142	0.00726	0.00265	**0.0121*****
	(-0.19)	(0.83)	(0.02)	(3.33)
$\Delta\Upsilon^{BOND}_{t-2}$	**-1.538****	0.00233	-0.0527	**0.00659***
	(-2.11)	(0.27)	(-0.43)	(1.84)
$\Delta CapRateSP_{t-1}$	-2.832	**-0.755****	-1.496	0.146
	(-0.10)	(-2.22)	(-0.31)	(1.03)
$\Delta CapRateSP_{t-2}$	-11.83	0.0709	-2.232	-0.000797
	(-0.46)	(0.23)	(-0.52)	(-0.01)
Constant	12.23	-0.200	2.597	-0.0650
	(0.59)	(-0.81)	(0.75)	(-0.64)
MonthlyDummy	Yes	Yes	Yes	Yes
N	71			
R^2	0.60	0.32	0.56	0.49

Table 9. VAR using the 5YR Treasury-Bill with a 2-month lag

This table represents results from estimating four unrestricted VAR models for the underlying-asset, CDS, bond, and stock markets. An unrestricted p^{th} order Gaussian VAR model can be represented as:

$$Y_t = \mu + \varphi_1 Y_{t-1} + \varphi_2 Y_{t-2} + \ldots + \varphi_p Y_{t-p} + e_t$$

The lag-length of the VAR is chosen by looking at the FPE, AIC, HQIC, SBIC, and the likelihood ratio for various choices of p. Our measure of liquidity, Υ^{cds} is the monthly aggregate CDS-market liquidity measure based on a negative covariance between consecutive changes of CDS spread of an individual REIT. LIQ^{REIT} is the monthly aggregate stock-market liquidity measure based on the modified Amihud illiquidity measure. Υ^{BOND} is the monthly aggregate bond-market liquidity measure based on a negative covariance between consecutive daily price changes of each bond. *OfferClosedSP* is the monthly average difference between the offered and closed cap rate of each property type.*MonthlyDummy* constitutes a system of dummy variables defined by the months of the year. *CrisisDum* is a dummy variable with the value 1 for a sub-period before 2008 and otherwise, $0.5YRTBILL$ is the 5-year Treasury bill yield. (t statistics in parentheses, * p<0.1, ** p<0.05, *** p<0.01)

	$\Delta\Upsilon_t^{cds}$	ΔLIQ_t^{REIT}	$\Delta\Upsilon_t^{BOND}$	$\Delta OfferClosedSP_t$
$\Delta\Upsilon_{t-1}^{cds}$	**-0.814*****	0.00000990	0.00934	-0.00000191
	(-6.75)	(0.98)	(0.43)	(-0.73)
$\Delta\Upsilon_{t-2}^{cds}$	**-0.511*****	0.00000552	-0.000487	-0.00000183
	(-4.24)	(0.54)	(-0.02)	(-0.69)
ΔLIQ_{t-1}^{REIT}	558.8	**-0.755*****	**686.9****	-0.0160
	(0.35)	(-5.55)	(2.37)	(-0.45)
ΔLIQ_{t-2}^{REIT}	-530.1	**-0.359****	**722.3****	-0.0162
	(-0.33)	(-2.65)	(2.50)	(-0.46)
$\Delta\Upsilon_{t-1}^{BOND}$	0.371	**0.000117***	0.0569	0.0000169
	(0.52)	(1.97)	(0.45)	(1.10)
$\Delta\Upsilon_{t-2}^{BOND}$	**-1.644****	0.0000222	-0.164	**0.0000295***
	(-2.39)	(0.38)	(-1.33)	(1.97)
$\Delta OfferClosedSP_{t-1}$	-1383.6	0.305	**-2862.6****	0.0922
	(-0.21)	(0.56)	(-2.44)	(0.65)
$\Delta OfferClosedSP_{t-2}$	8640.6	0.0902	-1179.3	0.0723
	(1.26)	(0.16)	(-0.96)	(0.48)
CRISISDUM	1.854	-0.00154	**-12.20****	-0.000752
	(0.06)	(-0.61)	(-2.26)	(-1.14)
5YRTBILL	0.612	0.000715	**5.324****	0.000262
	(0.05)	(0.67)	(2.33)	(0.94)
Constant	4.919	-0.00353	-10.69*	-0.000424
	(0.15)	(-1.26)	(-1.79)	(-0.58)
MonthlyDummy	Yes	Yes	Yes	Yes
Observations	69			
R^2	0.62	0.54	0.50	0.27

Appendix A. REITs with CDS contracts

	company name
1	AMB Property LP
2	Archstone-Smith
3	AvalonBay Communities
4	Boston Properties
5	Brandywine Realty Trust
6	BRE Properties Inc
7	Brookfield Asset Management Inc
8	Camden Property Trust
9	CarrAmerica Realty Corp
10	Developers Diversified Realty
11	Duke Realty
12	Equity Office Properties
13	Federal Realty Invs Trust
14	Felcor Lodging LP
15	First Industrial LP
16	General Growth Properties In
17	HCP
18	Health Care REIT
19	Healthcare Realty Trust Inc
20	Highwoods Properties Inc
21	Hospitality Properties Trust
22	iStar Financial
23	Kimco Realty
24	Mack-Cali Realty
25	Nationwide Health Properties Inc
26	Prologis
27	Regency Centers LP
28	Rouse Co
29	Simon Property Group
30	UDR Inc
31	Vornado Realty
32	Washington Real Estate Investment Trust
33	Weingarten Realty Investors

Appendix B. REITs with traded bonds

	company name
1	Camden Property Trust
2	Developers Diversified Realty
3	Duke Realty
4	Federal Realty Invs Trust
5	Healthcare Realty Trust Inc
6	Nationwide Health Properties Inc
7	Prologis
8	Simon Property Group
9	Vornado Realty
10	Washington Real Estate Investment Trust
11	Archstone-Smith
12	BRE Properties Inc
13	CarrAmerica Realty Corp
14	HCP
15	Health Care REIT
16	Hospitality Properties Trust
17	iStar Financial
18	Kimco Realty
19	Rouse Co
20	Weingarten Realty Investors