# REITs, Underlying Property Markets and Liquidity: A Firm Level Analysis

**David H. Downs**[1] and **Bing Zhu**[2]

***Abstract***

*This paper examines the impact of underlying property market liquidity on the liquidity of publicly traded REIT shares. Our analysis measures firm-level exposure to local, direct real estate market liquidity using the property allocation of each REIT. The findings show that property market liquidity can causally influence the liquidity of real estate securities. This is especially true during the crisis period, which confirms with the notion that illiquidity is transmitted from direct to indirect property markets. The results also reveal that the liquidity of a firm's assets can affect the liquidity of financial claims on the assets. The corporate investment decision, including the selection of a geographic market, can affect stock liquidity. Furthermore, we find that the sensitivity to underlying asset liquidity changes with the firm's credit constraint and investment opportunities. Small REITs, REITs with a lower cash interest coverage ratio, and REITs with a higher book-to-market ratio might choose to invest in more liquid property markets to improve their stock liquidity. Finally, we find that underlying asset liquidity is associated with REIT values.*

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[1] The Kornblau Institute & FIRE Department, Virginia Commonwealth University. 301 W. Main Street Richmond, VA 23284. Email: dhdowns@vcu.edu

[2] Real Estate and Planning, Henley Business School, University of Reading Whiteknights, Reading RG6 6UD. Email: B.Zhu@henley.reading.ac.uk

# REITs, Underlying Property Markets and Liquidity: A Firm Level Analysis

## 1 Introduction

A characteristic of REITs is that through securitization, illiquid assets are transformed into more liquid assets. The real estate property market is well known for its friction and illiquidity, while capital markets are generally viewed as near perfectly competitive and homogeneous. During the recent global financial crisis, there was a decline in the liquidity in both markets. An interesting question that arises is whether these two trends are related. Bond and Chang (2012) find significant directional causality for most liquidity proxies from the public to private real estate markets, based on a Vector Autoregressive (VAR) Model. Their finding implies a spill over effect of liquidity drying up from the public to the private market. Using a time-series regime-switching model with non-linear least square estimator, Hoesli et al. (2017) explore the pricing of the commonality with the underlying property market for REITs. Over the period from 2001 to 2012, the average commonality in liquidity with the private market is not strong (6% on average), but exhibits an obvious time variation. The correlation sharply increases during the crisis period, then declines during the 2008-2009 period, and increases again afterwards.

Although the commonality in liquidity has been widely used in the analyses on the pricing of the liquidity factor, we argue that time series analysis may not be suitable for the study of causal relationships in cross-market liquidity transmission. Firstly, as the private real estate market is segmented, the degree of liquidity can vary across markets. Some markets, such as New York, or Los Angeles exhibit a high transaction volume while the other markets can be much more illiquid. Therefore, REITs with different allocations to property markets can be exposed to different levels of liquidity risk from the underlying real estate markets. Using an aggregated national index may ignore the heterogeneity in the local real estate markets. Secondly, REITs are also active investors of commercial real estates. As a result, there can be an endogeneity relationship between REIT liquidity and private real estate market liquidity. Self-selection can be one reason for the endogeneity, as some REIT may have a bias for liquid markets and their transactions affect the private real estate market liquidity. Ghent (2019) documents the nexus between the liquidity preference of investors and the market liquidity: Delegated investors are concentrated in cities with higher turnover. By calibrating a search model, Ghent shows that heterogeneity in liquidity preferences makes some markets more liquid even when assets have identical cash flows. Consequently, contemporaneous correlation or the granger causality in the liquidity across private and securitized markets may not be enough to identify a directional impact from one market to another.

In this paper, we use REIT firm level data and the geographic allocation of properties to study the sensitivity of REIT liquidity to the liquidity of local private real estate markets. The different level of liquidity in local markets is measured by property turnover at the MSA level. REITs with higher property allocation in markets with higher turnover should have a lower exposure to the liquidity risk from the underlying real estate markets. Secondly, we use instruments to deal with the endogeneity issue. We first use the distance of underlying assets to the headquarter to instrument for the selection of geographic markets for REITs to deal with the self-selection issue. We also use house price growth, which is unlikely to be affected by REIT transactions, to instrument the turnover of private real estate market, because commercial property market liquidity can be affected by REIT transactions (reversal causality). Based on these instruments, our empirical results confirm a significant impact of local real estate market turnover on REIT equity liquidity. The impact increases significantly during the crisis period, implying the transmission of a liquidity shock (i.e., drying up), from the direct to the indirect markets.

This paper also contributes to the literature on asset liquidity and stock liquidity. Recent years have seen a secular increase in both stock liquidity and asset liquidity as measured by the level of cash on the firm's balance sheet (Foley et al., 2007, Gopalan et al., 2012). A significant relationship can shed light on the question of whether corporate finance decisions can affect stock liquidity. However, only using the level of cash holdings to measure the asset liquidity may not be enough for REITs, as REITs hold significantly less cash than other public firms. REIT carry cash and equivalents equal to 3% of total assets, which is considerably less than the 18.48% average reported for the full sample of public firms (Hardin et al., 2009). This may be the case at least partially due to the legal limitations on these firms' ability to retain capital internally via a dividend requirement. In order to qualified as a REIT, a REIT must pay a minimum of 90% percent of its taxable income in the form of shareholder dividends. As shown in our empirical results, different from the finding by Gopalan et al. (2012), we find that REIT stock liquidity is not significantly affected by the level of cash holding, but there is a significant relationship between REIT liquidity and the level of fixed assets, implying the critical role of properties on the stock liquidity of REITs. As it is well accepted that local real estate markets are heterogeneous with different level of liquidity, we further refine the measure of asset liquidity for REITs by adding the exposure to real estate market liquidity. The significant influence of the exposure to real estate market liquidity on REIT liquidity confirms that the liquidity of fixed assets, which are traditionally viewed as illiquid, can affect stock liquidity. Incorporating the liquidity of underlying properties can add additional information to the relationship between asset liquidity and stock liquidity.

Furthermore, we show that the sensitivity of REIT liquidity to real estate liquidity varies across firms. Financially constrained firms, including smaller firms and firms with lower cash interest rate coverage ratio, are more sensitive to the illiquidity in their underlying direct property markets. During the financial crisis, when most firms faced credit constraints, REITs were more sensitive to the real estate market liquidity, confirming that the relation between asset liquidity and stock liquidity is more positive for financially constrained firms. Besides, using the Book to Market ratio and Tobin's Q as the proxy for the growth opportunity, we find that the sensitivity decreases with a higher growth opportunity. This result sheds light on the value of holding properties in more liquid markets, especially for financial constrained REITs and REITs with a lower growth opportunity.

The remainder of the paper proceeds as follows. Section 2 discussed the related literature, ands Section 3 describes our data and the methodology. Section 4 presents our findings and, Section 5 concludes.

## 2 Liquidity, Commercial Real Estate and REITs - Related Literature

Stock liquidity has received great attention by researchers and practitioners, as theoretical and empirical research has shown that liquidity risk is a priced factor for assets (Acharya and Pedersen, 2005, Pastor and Stambaugh, 2003, Lee, 2011, Amihud, 2002, Brennan and Subrahmanyam, 1996). In general, most literature documents a positive relationship between liquidity and expected returns, in addition to other traditional factors such as size, book-to-market. For instance, Acharya and Pedersen (2005) develop an asset pricing model including a liquidity risk which has three dimensions: commonality in liquidity, the covariance of asset returns with market liquidity, and the covariance of asset liquidity with market returns. Their empirical results confirm a positive relationship between liquidity and stock returns. The pricing of liquidity risk has also been documented in the REIT literature. Hoesli et al. (2017) explore the pricing of the commonality with stock market liquidity and with the underlying property market. They find that expected REIT returns increase following a rise in commonality in liquidity only during bad market conditions, implying the existence of time-varying liquidity risk. They show that REIT prices are sensitive to shocks in REIT and stock market liquidity. The liquidity correlation between REITs and the underlying property market represent significant risk factors but, again, only during market downturns. Therefore, it is important to understand the dynamics of REIT liquidity.

Using U.S. trade-by-trade data, Clayton and MacKinnon (2000) find strong evidence on the increase of REIT liquidity during the period from 1993 to 1996. Using similar method but at an international setting, Marcato and Ward (2007) also find a time variation liquidity for REITs. They also find that larger REITs are more liquid, but once a REIT is listed on the NYSE, this size effect becomes less important. Brounen et al. (2009) further explore the determinants of REIT liquidity. They find that the liquidity of real estate firms varies importantly across countries and documented two factors for the stock liquidity: firm size and shareholder base. REIT liquidity is positively related to the firm's market capitalization and negatively to the percentage of shares held by institutional investors.

Given the hybrid nature of REITs, another strand of literature attempts to understand the dynamics of REIT liquidity by linking it to the liquidity in the underlying real estate market. Benveniste et al. (2001) examine the relationship between the liquidity of equity and its market value. The authors document a premium of 12-22% increase in firm value by creating liquid equity claims on relatively illiquid property assets. Bond and Chang (2012) investigate cross-market liquidity between public and private real estate markets using several proxies for the liquidity. The authors find both markets share a generally similar trend in their liquidity. They also find liquidity in the public market can predict the liquidity in the private market, but not vice versa. This result implies a directional granger causality from the public markets to the private markets. Also using a VAR model and Granger Causality test, Agarwal and Hu (2014) show that property market liquidity leads that of the REIT market. They also find that returns in the property market have a causal effect on the liquidity and returns of the REIT market. Both papers use aggregate national indices to measure the liquidity in both markets. Hoesli et al. (2017) also confirm a positive correlation between the REIT liquidity commonality and real estate market liquidity commonality. The correlation varies over time and exploded in during the subprime crisis and after the global financial crisis.

The relationship between stock liquidity and the liquidity of underlying assets can also supported by the finance literature. Using the level of cash holdings as the proxy of asset liquidity, Gopalan et al. (2012) find a positive relationship between asset liquidity and stock liquidity. More importantly, they find the sensitivity varies across firm. The relation is more positive for firms that are less likely to reinvest their liquid assets (i.e., firms with less growth opportunities and financially constrained firms). In addition to cross-firm variation in the sensitivity to underlying asset liquidity, literature also shows that the stock liquidity stock liquidity also varies with economic conditions and across geographic locations. For instance, Loughran and Schultz (2005) find evidence that the headquarter location matters for a firm's stock liquidity. The shares of rural firms trade much less often than urban firms (i.e., firms located in the 10 largest MSAs in terms of total population). Bernile et al. (2015) examine whether state- and MSA-level economic conditions affect the liquidity of stocks issued by local firms. They find that liquidity of local stocks is positively associated with performance of the local economy. The finding of the variation in the stock liquidity across geographic locations highlight the importance of distinguishing the different level of liquidity of underlying real estate markets when studying the relationship between asset liquidity and stock liquidity for REITs.

Indeed, it is well known that real estate markets are heterogenous with various level of liquidity. According to Fisher et al. (2004), the transaction frequency of properties varies dramatically from period to period and market to market. Based on property level data from NCREIF database, they show that the probability of being sold is positively related to market cycle (property returns) and macro-economic conditions (employment). Besides, owners' characteristics and property characteristics can also affect the transaction frequency. Focusing on office market, Devaney et al. (2017) show that in addition to macro-economic conditions, the transaction volume at U.S. cities is also significantly affected by the credit availability, the size of institutional investment market and the percentage of foreign investors in the market. Moreover, the type of traders also received attention from the researcher. Wiley (2017) studies the interlinkages between commercial real estate prices, property market fundamentals, credit policy, transactions volume and the participation of highly active investors. Wiley does not find a significantly impact of transaction volume on property price but, instead, finds that markets with a higher share of active buyers tend to exhibit higher property returns. As highly active investors may be able to better predict the market (i.e., “informed traders”), they may increase their participation in advance of price appreciation and they may contemporaneously influence higher prices if they outbid other investor types (i.e., a “clientele effects”), or the group may expand market share following periods of higher observed price appreciation (i.e., a “herding effect”). Ghent (2019) also documents differences in the liquidity across U.S. cities and finds that the liquidity of commercial real estate market is linked to the investor composition. Ghent finds that delegated investors have shorter holding periods, and delegated investors are concentrated in cities with higher turnover. The heterogeneity in liquidity preferences of different type of investors makes some markets more liquid even when assets have identical cash flows. Given the heterogeneity in the liquidity of commercial property markets, using a nation-wide liquidity indicator to measure the exposure to underlying real estate market of REITs may not be enough. Our paper seeks to address this shortcoming in the literature.

## 3 Data

### 3.1 Property Market Liquidity

Private real estate markets are characterized by a relative lack of liquidity, and the degree of liquidity can vary considerably over time and across markets. Strong (or ‘‘hot’’) markets are characterized by both an increase in sales activity and a decrease in the average time-on-the-market required to sell a property. Conversely, weak (or ‘‘cold’’) markets typically exhibit a decrease in sales and a concomitant increase in average time-on-the-market. In this paper, local real estate market liquidity is measured by the turnover in the market ($\tau_{i,t}$), which is defined as the number of sold properties divided by the total number of properties. We collect the number of properties and sold properties in 144 core based statistical areas (CBSAs) and metropolitan statistics areas (MSAs) since 1978 from the NCREIF database. Turnover rate is calculated as the total number of NCREIF properties sold in each year divided by the total number of NCREIF properties by year in that market. SNL records the MSA location of properties. In contrast, NCREIF divides property markets into Metropolitan Divisions (MD). For instance, in NCREIF the Detroit-Warren-Dearborn, Michigan MSA is divided into the Detroit-Dearborn-Livonia MD and the Warren-Troy-Farmington Hills MD. However, SNL provides property location codes at the MSA level (e.g., Detroit-Warren-Dearborn MSA). To address this issue, we convert MD property market turnover into MSA turnover. The MSA turnover is calculated as the average of MD turnovers weighted by the number of properties in each MD as reported by NCREIF.

Figure 1 plots the average turnover rate across the 144 MSAs from 1996 to 2015. On average, the It drops to 1.2% during the 2000 recession and rose to 6% in 2005 during the real estate boom. In 2008, the market froze, and the turnover rate reduced to less than 0.5%. The market steadily recovered in 2012. The average turnover rate grew to between 2% and 3%.

<< Figure 1 about here >>

Table 1 lists the MSAs with the highest turnovers. Atlanta-Sandy Springs-Marietta, GA and Phoenix-Mesa-Scottsdale, AZ are the two most liquid property markets with a NCREIF turnover rate over 10% from 1996 to 2015. Washington-Arlington-Alexandria, DC-VA-MD-WV, Los Angeles-Long Beach-Anaheim, CA and Chicago-Naperville-Joliet, IL-IN-WI are ranked as the third to the fifth. The average turnover rate is over 9%. MSAs with a more liquid property market tend to have a larger economic size (as measured by GDP) and a higher house price growth rate. The correlation coefficient between MSA NCREIF turnover rate and the average GDP from 2000 to 2015[1] is 54%, and the correlation coefficient with the average house price change from 1996 to 2015 is 57%. However, we do not see significant correlation with MSA level unemployment rates. We also find a moderate positive relationship between the turnover and NCREIF property return, with a correlation coefficient of 13%.

<< Table 1 about here >>

The liquidity risk from the underlying property market for each REIT is the key explanatory variable in this paper. Based on the property portfolio of each firm, we calculate the average turnover of all local markets where the firms' properties are located:

[1] The MSA level GDP in Bureau of Economic Analysis only dates back to 2001.

$$\mathrm{T}_{i,t} = \sum_{m=1}^{M} w_{m.i,t} \tau_{m,t}, \qquad (1)$$

where $\tau_{m,t}$ is the illiquidity measure in MSA *m* at period *t*, and $w_{m.i,t}$ represents the share of properties of firm *i* in each market at period *t*. $w_{m.i,t}$ is calculated as the number of properties located in MSA *m* to total properties[2] and the location data of REIT property portfolios are derived from the SNL database. For instance, if REIT A has 80% of properties located in New York MSA and 20% of properties located in Miami, $\mathrm{T}_{i,t}$ for REIT A will be calculated as $\mathrm{T}_{i,t} = \sum_{m=1}^{2} w_{m.i,t} \tau_{m,t_{m,t}} = 80\% * \tau_{NY,t} + 20\% * \tau_{Miami,t}$. To be consistent with the stock illiquidity measure, we convert the property market turnover ($Turnover_{m,t}$) to the illiquidity measure ($\tau_{m,t}$ ):

$$\tau_{m,t} = \frac{\max(Turnover_{m,t}) - Turnover_{m,t}}{\max(Turnover_{m,t}) - \min(Turnover_{m,t})}, \qquad (2)$$

The estimated property market illiquidity for each REIT is summarized in Table 2. The average $\tau_{m,t}$ is 0.893 and the standard deviation is quite small, only 0.07. The maximum illiquidity is 1, which means, no NCREIF properties in this MSA has been sold in the year. The minimum is 0.45. Obviously, the firm level property market turnover or illiquidity a has a much smaller standard deviation than the MSA turnovers. The reason is that most REITs have well diversified property portfolios. On average, properties in each REIT are distributed in 33 MSAs, with a minimum of 1 MSA and a maximum of 370. Therefore, the standard deviation of the firm level property market turnover is much smaller than the real estate market turnover.

<< Table 2 about here>>

### 3.2 REIT Share Liquidity

The data for individual company characteristics are collected from SNL Financial. The returns and the market capitalization data are from Thomson Reuters DataStream. We collect data for all available US listed real estate companies with asset locational information between 1998 and 2015, a total of 202 real estate firms. Overall, 76% of properties in each firm are located in the 144 MSAs in the NCREIF NPI data. 145 firms have over 70% of properties located in the 144 MSAs. Therefore, the results are based on the 145 firms. Due to missing values in other explanatory

[2] Alternatively, the weight can also be size weighted. Size weighted share generates very robust results.

variables, the sample consists of 119 distinct REITs.

Figure 2 shows the number of firms with complete observations in our sample over the study period as well as the market capitalization in each year. Up until 2015, the number of listed real estate companies has steadily increased from 23 to 100 and the average firm size has increased by nearly 10 times. The total market capitalization grew from $10 billion to over $538 billion. During the GFC, real estate companies experienced a large drop in size and shrunk to $110 billion as of 2009. Starting in 2010, real estate stocks recovered to their pre-crisis values. Between 2010 and 2015, real estate companies showed the highest increase in market capitalization across the entire sample period.

<< Figure 2 about here>>

We construct three measures of stock liquidity. The first is the illiquidity measure proposed by Amihud (2002). Amihud proposes a measure based on the absolute percentage price change per dollar of daily trading volume. This measure follows Kyle's concept of illiquidity – the response of price to order flow. In Amihud (2002), the illiquidity of stock *i* is calculated as the average ratio of the daily absolute return to the (dollar) trading volume on that day, which can be denoted as $\frac{|R_{itd}|}{VOLD_{itd}}$. $R_{itd}$ is return on stock *i* on that day $d$ of month $t$ and $VOLD_{itd}$ is the respective daily volume in dollars, which is calculated as the product of daily trading volume in shares and closing price of the previous day ($VOL_{itd}P_{itd-1}$).

For each stock, the monthly illiquidity ratio is defined as:

$$ILLIQ_{it} = 1/D_{it} \sum_{d=1}^{D_{it}} |R_{itd}|/VOLD_{itd} \quad (3)$$

Where $D_{it}$ is the number of days for which data are available for stock i in month t. The stock illiquidity is compounded in a given month only if there are more than 15 days' data available for that month ($D_{it} > 15$).

The second measure of stock liquidity is the implicit bid-ask spreads, which was first proposed in Roll (1984). It measures the illiquidity of stock i as the square root of the negative daily autocorrelation of its returns:

$$s_{it} = \sqrt{-cov(R_{itd}, R_{itd-1})}, \tag{4}$$

where $s_{it}$ is the illiquidity of stock i in month m. Roll motivates $s_{it}$ as one-half the posted bid-ask spread. It also measures the effective cost of transaction. If the autocorrelation of stock returns is positive, it is set to be 0.

The third measure of stock liquidity is the bid-ask spread, which is calculates as the quoted percentage spread is measured for each trade as the ratio of the quoted bid-ask spread and the bid-ask midpoint $((Ask_{itd} + Bid_{itd})/2)$. Monthly estimates are a simple average through the month t:

$$Qspread_{it} = \frac{1}{D_{t,i}} \sum_{d=1}^{D_t} \frac{Ask_{itd} - Bid_{itd}}{(Ask_{itd} + Bid_{itd})/2} \tag{5}$$

$Ask_{itd}$ and $Bid_{itd}$ are the ask and bid quotes prevailing at the time of the $d^{th}$ trade of asset *i* in month *t*.

### 3.3 Asset Liquidity

In this paper, we also use three measures of classical asset liquidity defined by the corporate finance literature. The first measure is proportion of cash and equivalents to total assets. In order to be consist with the stock illiquidity measure, instead of using the percentage of cash and equivalents holding, we use percentage of non-cash and equivalents holding, which is calculated as 1 – cash and equivalents holding. As reported in Table 2, on average, only 3 percent of total assets of REITs are cash and equivalents. So the proportion of none cash and equivalents is 97%, which is much higher than none property firms. We also use two weighted asset liquidity measures (WAL) by Gopalan et al. (2012):

$$WAL1_{i,t} = \frac{Cash\ \&\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{Other\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0, \tag{6}$$

$$WAL2_{i,t} = \frac{Cash\ \&\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{Tangible\ Fixed\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0.5, \tag{7}$$

Thus, effectively, WAL1 is the proportion of cash and equivalents to the firm's lagged total assets.

$WAL2_{i,t}$ assumes a liquidity score of 1 for cash and 1/2 for tangible fixed assets, and 0 for the rest.

In the paper, we use the illiquidity score, so that we have $WAIL1_{i,t}$ and $WAIL2_{i,t}$ as

$$WAIL1_{i,t} = 1 - WAL1_{i,t}, \quad (8)$$

$$WAIL2_{i,t} = 1 - WAL2_{i,t}. \quad (9)$$

### 3.4. Firm Characteristics

Table 2 summarizes the firm characteristics of the REITs, averaged across time, from 1996 to 2015, and across the 121 companies. The average annual return across all companies is 6.7%, with a standard deviation of 48.7%. The annual volatility is 0.31%. We also see a large variation across the size of the companies in terms of market capitalization with the highest being $57 billion and the lowest, $0.35 million. On average a company has a market capitalization of $2,927 million. The average book to market ratio is 0.82, similar to the average ratio of 0.8 across all types of industries. The average debt to equity ratio is 1.49. The average real estate investment growth rate is 0.18%, and a maximum of 3.66% and a minimum of -0.98%. On average, 49% of the properties in each firm locate in the 25 Gateway cities, defined as Atlanta, Boston, Chicago, Dallas, Denver, Detroit, Houston, Indianapolis, Kansas City, Los Angeles, Miami, Minneapolis, New York, Orlando, Philadelphia, Phoenix, Portland, Sacramento, Saint Louis, San Antonio, San Diego, San Francisco, Seattle, Tampa, and Washington, D.C. In our sample, on average REITs allocate 20% of properties in the MSAs where the headquarter of the REIT locates.

<< Table 2 about here >>

## 4 Empirical Results

### 4.1 Property market illiquidity and REIT illiquidity

Table 3 reports the relationship between property market liquidity measured by the inverse of turnover and REIT stock liquidity quantified by the Amihud illiquidity measure. We see a significantly positive relation across asset liquidity commonality. A one standard deviation increase in the property market illiquidity is associated with around 0.43% increase in the Amihud illiquidity measure.

Model 1 uses non-cash holding as the control of asset liquidity and model 2 and 3 uses the weighted asset illiquidity measures. In contrast to the results by Gopalan et al. (2017), for REITs, cash holdings do not increase stock liquidity. The reason could be that REITs in general are constrained in cash due to their dividend pay-out policy. When fixed assets are considered (WAIL2), the weighted asset illiquidity measure becomes significant (Model 6). So in the following models, we use the WAIL2 as the control of asset liquidity.

<< Table 3 about here>>

The first concern is that $w_{m.i,t}$ may be affected by the potential self-selection in some REIT having a bias for less risky and more liquid real estate markets. As shown by Ghent (2019), delegated investors are concentrated in cities with higher turnover. In order to solve this problem, we use the distance to headquarter as the instrument for $w_{m.i,t}$. Based on home bias theory, the distance of assets to the headquarters can be a good predictor for the firm's asset allocation. Market participants often choose local investment to reduce information asymmetry in opaque information environments (Garmaise and Moskowitz, 2004). Also, Ling et al. (2018) shows that managers overweight asset allocations to their local market and concentrated REITs receive higher equity returns than dispersed REITs. Therefore, the distance of properties to a headquarters can be a valid instrument as it is both exogenous and relevant. For each firm, we regress the proportion of properties in MSA $m$ on the distance to the headquarter:

$$w_{m.i,t} = a_i + b_i \ln D_{m,i,t} + e_t, \tag{10}$$

where $D_{m,i,t}$ is the average distance of properties located in the MSA $m$ to the headquarter of REIT $i$. For instance, if two properties located in MSA $m$, $D_{m,i,t}$ is the average distance of these two properties to the headquarter of the firm. For the estimation of Equation 5, it is required that the firm has investments in at least three different MSAs. For firms with properties located in only one or two MSAs, we use the observed weights. The estimated $b_i$ is illustrated in Figure 3. Most of the coefficient is negative. The average coefficient is -0.056 and the average T statistics is -1.96. So the instrumented weight is calculated as $\widehat{w}_{m.i,t} = \hat{a}_i + \hat{b}_i \ln D_{m,i,t}$ and the local beta is calculated as $\mathrm{T}_{i,t} = \sum_{m=1}^{M} \widehat{w}_{m.i,t} \tau_{m,t}$. The estimated results based on instrumented weights are reported in Table 4, Model 4. The results are robust.

The second concern is the endogeneity in REIT transactions affecting property market liquidity, resulting in a reversal relationship: i.e., REIT liquidity influences property market liquidity. We use the change in a residential house price index provided by Federal Housing Finance Agency as the instrument to predict MSA turnover rate, as it is unlikely that house price change causes REIT transactions:

$$Turover_{m.t} = c + d\Delta \ln HP_{m,t} + e_{m,t}, \quad (11)$$

Considering Turnover rate is always between 0 and 1, instead of using a linear regression, we use a probit panel regression. The estimated *d* is 9.85 with a T statistic of 2.88. The increase in house prices is positively related to the increase in commercial property turnover. The R squared of question 11 is 24%. With this approach, the illiquidity of the underlying property markets for each REIT is calculated using the estimated turnover ($\widehat{Turnover}_{m,t}$), rather than the observed one.

$$\hat{\tau}_{m,t} = \frac{\max(\widehat{Turnover}_{m,t}) - \widehat{Turnover}_{m,t}}{\max(\widehat{Turnover}_{m,t}) - \min(\widehat{Turnover}_{m,t})}, \quad (12)$$

$$\widehat{\mathrm{T}}_{i,t} = \sum_{m=1}^{M} w_{m.i,t} \hat{\tau}_{m,t} \quad (13)$$

The estimated results based on the instrumented turnover rate are reported in Table 4, Model 5. The results are robust. We even use the instrumented weights and instrumented turnover rate to construct the illiquidity of underlying property markets to address both the self-selection issues and reversal causality issue:

$$\widehat{\mathrm{T}}_{i,t} = \sum_{m=1}^{M} \widehat{w}_{m.i,t} \hat{\tau}_{m,t} \quad (13)$$

As shown in Table 4, Model 6, the results are robust.

<< Table 4 about here>>

The above analyses use the Amihud illiquidity measure for REIT stock liquidity. We also use the Roll measure and price spread as additional measurements. The results are reported in Table 5. The results remain robust.

<< Table 5 about here>>

**4.2 Time variation in the transmission of liquidity**

We further divide our sample into three time periods: before crisis (1996-2006); crisis period (2007-2009) and post crisis period (2010 – 2015). The property market illiquidity measure is based on Equation (13), controlling for the self-selection issue and reversal causality issue. The results in Table 6 confirm a significant increase during the crisis period, when the market is drying out of liquidity. The increase in the impact of property market liquidity on the stock liquidity during the crisis period is significant and remarkable in all three stock illiquidity measures.

<< Table 6 about here >>

**4.3 Cross firm variation in the transmission of liquidity**

We further study the sensitivity of REIT stock liquidity to the liquidity of underlying property market by dividing firms according to their financial constraints and growth opportunities. We use firm size and cash interest coverage rate to measure the firm's financial constraints. We compare the 10 percentile smallest REITs and the 10 percentile biggest REITs. Smaller REITs are more likely to be subject to financial constraints. Table 7 Panel A reports the results. Based on the Roll illiquidity measure, we see that biggest firms are less sensitive to the illiquidity of underlying property markets. Based on cash interest coverage ratio (Table 7, Panel B), we run the regression with 10 percentile of REITs with lowest interest coverage ratio and the 10 percentile of REITs with the highest interest coverage ratio. The difference is stronger. Based on the Amihud and Roll measurements, the impact of illiquidity of underlying property markets is significantly larger for REITs with lower coverage rate.

<< Table 7 about here>>

We also investigate how growth opportunity affects the relationship. Growth opportunity is measured by Book to market ratio and Tobin’s Q ratio. We again compare the 10th percentile REITs with the lowest growth opportunity (highest BM or lowest Tobin’s Q, in the grey columns of Table 8) with the results by the 10 percentile REITs with the highest growth opportunity (lowest BM or highest Tobin’s Q, in the white columns of Table 8). In all cases, we see a significant difference in the sensitivity to the underlying property markets for the two groups of REITs. Firms with lower growth opportunity are more vulnerable to the illiquidity shock of underlying property markets.

<< Table 8 about here>>

## 5 Conclusion

This paper studies the cross-asset liquidity between REITs and private real estate. Prior studies typically focus on the time variation in aggregated market liquidity using nation-wide indices. In this paper, we examine the impact on REITs of local, underlying property market liquidity as measured by the property allocation of each REIT. We show that the property market liquidity causally influences the liquidity of real estate securities, especially during the crisis period. This results shows the effect of drying-up liquidity and the transmission from the direct to indirect markets. The results also support that the liquidity of the firm’s assets can affect the liquidity of financial claims on the assets. The corporate investment decision, including the selection of the geographic market, can affect stock liquidity. Furthermore, we find that the sensitivity to the liquidity of underlying assets changes with a firm’s credit constraint and investment opportunities. Small REITs, REITs with a low cash interest coverage ratio, and REITs with a high book-to-market ratio could choose to invest in more liquid markets to improve their stock liquidity. Overall, REIT valuations depend on their underlying property market liquidity.

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**Figure 1: Average Turnover Rate in Property Markets from 1996 to 2015**

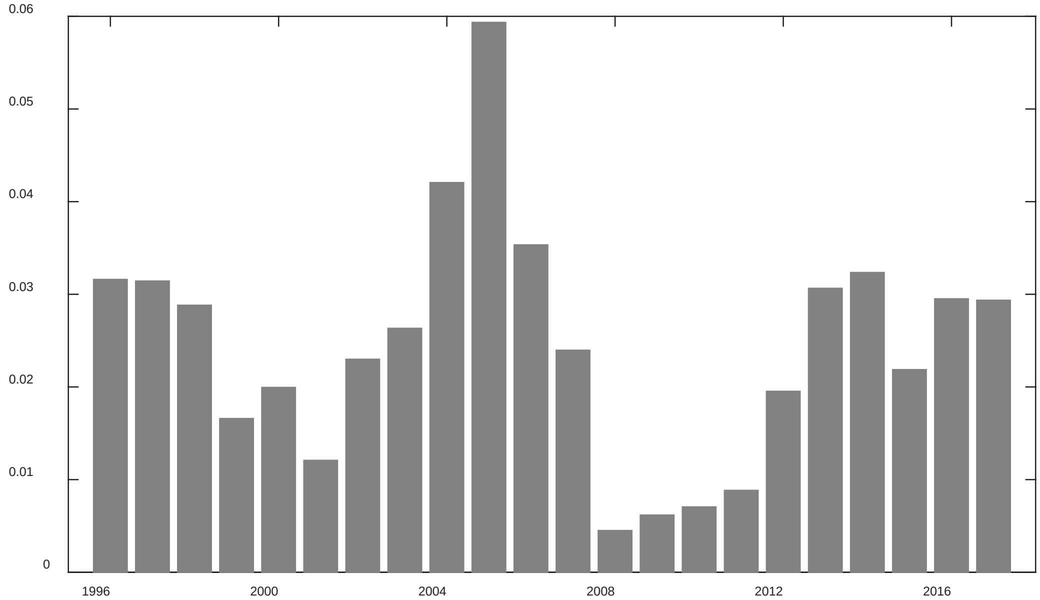


**Figure 2: Number of US real estate firms with complete observations and their market capitalization between 1996 and 2015**

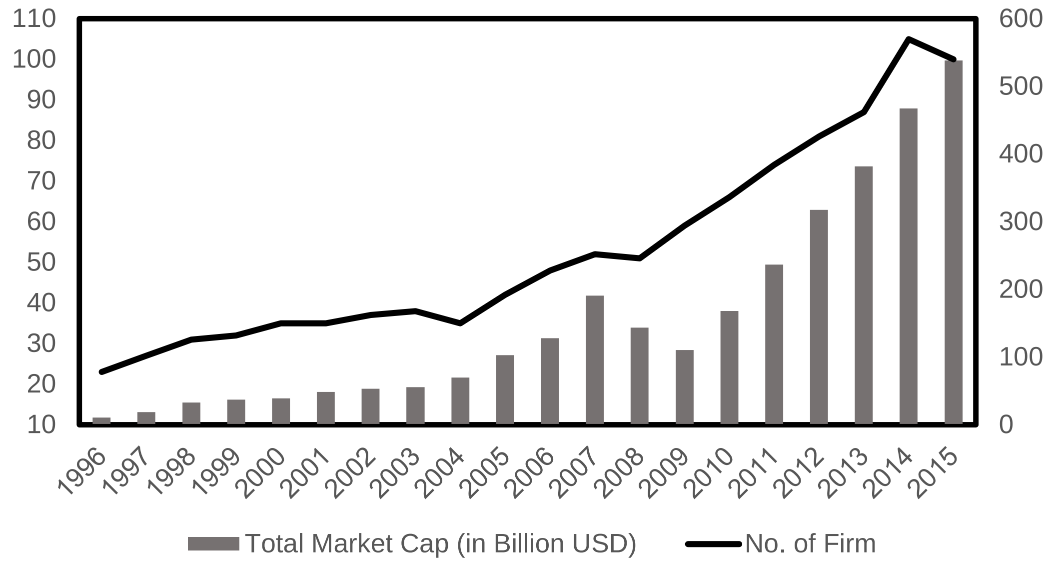
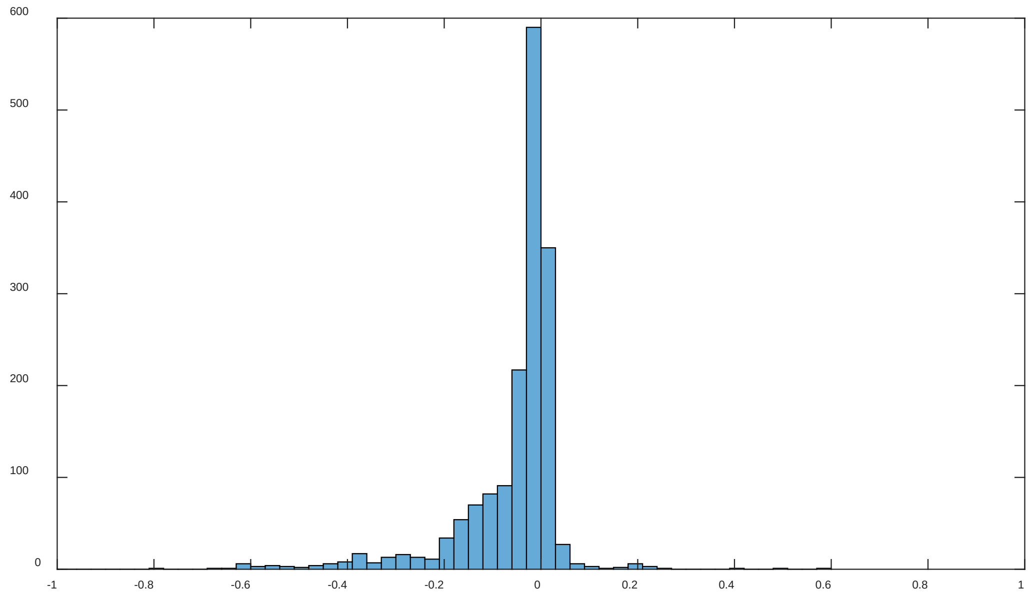


**Figure 3: Coefficient for Distance**




Note: The figure plots the distribution of the coefficient for the distance in the auxiliary regression for the instrumented proportion of properties in each MSAs. The proportion of properties for a certain MSA is regressed on the average distance of all properties held this firm located in a certain MSA to the headquarter of the firm. The regression is run separately for each firm.

## Table 1: MSAs with Highest Turnover

*The table shows summary statistics for the MSAs with the highest (Panel A) and lowest (Panel B) betas and the return statistics in these MSAs. Mean stands for the average annual returns of NCREIF total returns, and std stands for the standard deviation of NCREIF total returns. GDP stands for Gross Domestic Product for all industries for each MSA in 2015 (millions of current dollar). Ump. rate stands for the unemployment rate for each MSA in 2015.*

| CBSA/ DIV | | Turn over | Mean | Std | No. Prop. | GDP | Ump | HP |
|---|---|---|---|---|---|---|---|---|
| 12060 | Atlanta-Sandy Springs-Marietta, GA | 0.107 | 2.10% | 2.13% | 181 | 276695 | 5.78 | 0.7% |
| 38060 | Phoenix-Mesa-Scottsdale, AZ | 0.107 | 2.23% | 2.87% | 88 | 181825 | 5.25 | 1.0% |
| 47894 | Washington-Arlington-Alexandria, DC-VA-MD-WV | 0.099 | 2.24% | 2.37% | 159 | 400773 | 4.17 | 1.3% |
| 31084 | Los Angeles-Long Beach-Anaheim, CA | 0.097 | 2.56% | 3.09% | 197 | 750884 | 7.10 | 1.5% |
| 16974 | Chicago-Naperville-Joliet, IL-IN-WI | 0.094 | 2.03% | 2.13% | 201 | 532513 | 6.65 | 0.6% |
| 19124 | Dallas-Fort Worth-Arlington, TX | 0.094 | 1.97% | 2.41% | 168 | 360164 | 5.32 | 0.9% |
| 41940 | San Jose-Sunnyvale-Santa Clara, CA | 0.088 | 2.92% | 3.33% | 74 | 158279 | 6.12 | 1.5% |
| 26420 | Houston-Baytown-Sugar Land, TX | 0.086 | 1.66% | 2.86% | 103 | 362057 | 5.68 | 1.2% |
| 11244 | Anaheim-Santa Ana-Irvine, CA Metropolitan Division | 0.079 | 2.38% | 2.89% | 91 | 750884 | 7.10 | 1.4% |
| 15764 | Cambridge-Newton-Framingham, MA Metropolitan Division | 0.074 | 2.42% | 2.57% | 49 | 317974 | 4.58 | 1.1% |
| 19740 | Denver-Aurora, CO | 0.072 | 2.07% | 3.22% | 85 | 149277 | 5.17 | 1.2% |
| 41740 | San Diego-Carlsbad-San Marcos, CA | 0.064 | 2.38% | 2.75% | 72 | 175391 | 5.89 | 1.4% |
| 22744 | Miami-Fort Lauderdale-Miami Beach, FL | 0.063 | 2.07% | 2.40% | 60 | 256776 | 6.03 | 1.2% |
| 42644 | Seattle-Tacoma-Bellevue, WA | 0.062 | 2.36% | 2.37% | 116 | 236810 | 5.61 | 1.2% |
| 48424 | Miami-Fort Lauderdale-Miami Beach, FL | 0.060 | 1.81% | 3.00% | 37 | 256776 | 6.03 | 1.2% |
| 35614 | New York-Newark-Edison, NY-NJ-PA | 0.059 | 2.66% | 5.07% | 117 | 1287693 | 6.29 | 0.9% |
| 12420 | Austin-Round Rock, TX | 0.059 | 1.63% | 2.88% | 70 | 85079 | 4.58 | 1.2% |
| 12580 | Baltimore-Towson, MD | 0.057 | 2.34% | 2.27% | 54 | 146022 | 5.37 | 1.0% |
| 33460 | Minneapolis-St. Paul-Bloomington, MN-WI | 0.054 | 1.86% | 1.89% | 75 | 197426 | 4.33 | 0.9% |
| 36740 | Orlando, FL | 0.052 | 2.21% | 2.45% | 43 | 98633 | 5.59 | 0.9% |

**Table 2: Descriptive Statistics for Liquidity Data and Firm Characteristics**

| | Mean | Std. Dev. | Max | Min |
|---|---|---|---|---|
| **NCREIF data** | | | | |
| Turnover | 0.0214 | 0.0536 | 0.429 | 0 |
| | | | | |
| **Illiquidity Measure** | | | | |
| Amihud Illiquidity Measure | 0.209 | 0.260 | 9.918 | 0.000 |
| Roll Illiquidity Measure | 0.005 | 0.011 | 0.283 | 0 |
| Price Spread | 0.025 | 0.020 | 0.285 | 0.001 |
| Property Market Illiquidity | 0.893 | 0.071 | 1.000 | 0.474 |
| Property Market Illiquidity_self-selection | 0.893 | 0.071 | 1.000 | 0.474 |
| Property Market Illiquidity_reversal causality | 0.781 | 0.085 | 0.980 | 0.285 |
| Property Market Illiquidity_self-selection and reversal causality | 0.781 | 0.085 | 0.980 | 0.285 |
| | | | | |
| **Firm Characteristics** | | | | |
| Debt to Equity | 2.037 | 2.355 | 14.211 | 0 |
| Asset illiquidity (non-cash assets) | 0.972 | 0.052 | 1.000 | 0.332 |
| Weighted Asset illiquidity (WAIL1) | 0.971 | 0.053 | 1.000 | 0.125 |
| Weighted Asset illiquidity (WAIL2) | 0.628 | 0.277 | 0.988 | 0.000 |
| Return | 0.067 | 0.487 | 2.787 | -9.231 |
| Volatility | 0.310 | 0.391 | 7.709 | 0 |
| Market Capitalization (Billion USD) | 2927 | 4488 | 57337 | 0.35 |
| Book to Market Ratio | 0.827 | 1.321 | 50.000 | 0.000 |
| RE Investment Growth (%) | 0.180 | 0.385 | 3.661 | -0.984 |
| Proportion of properties in 25 Gateway MSAs | 0.492 | 0.192 | 1 | 0 |
| Proportion of properties in the same MSA as the headquarter | 0.202 | 0.267 | 1 | 0 |

## Table 3: REIT stock illiquidity and underlying property market illiquidity

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Amihud Illiquidity Measure. RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| | Model 1: | Model 2: | Model 3: |
|---|---|---|---|
| RE Makt. Illiquidity | 0.4342*** | 0.4387*** | 0.3686*** |
| | (0.0449) | (0.0385) | (0.0541) |
| Debt to Equity | 0.0166*** | 0.0165*** | 0.0195*** |
| | (0.0041) | (0.0040) | (0.0070) |
| Non-cash | 0.1671 | | |
| | (0.1289) | | |
| WAIL1 | | 0.1521 | |
| | | (0.1166) | |
| WAIL2 | | | 0.2124*** |
| | | | (0.0724) |
| Volatility | 0.6119*** | 0.6114*** | 0.6074*** |
| | (0.1041) | (0.0963) | (0.1078) |
| MOM | -0.1394*** | -0.1395*** | -0.1476*** |
| | (0.0295) | (0.0265) | (0.0352) |
| Size | -0.0143*** | -0.0142*** | -0.0321*** |
| | (0.0045) | (0.0048) | (0.0083) |
| Book to Market | 0.0004 | 0.0004 | -0.0018 |
| | (0.0054) | (0.0051) | (0.0057) |
| RE Investment Growth | -0.0070 | -0.0064 | -0.0101 |
| | (0.0068) | (0.0070) | (0.0075) |
| 25 MSA | -0.0663 | -0.0619 | 0.1056 |
| | (0.0835) | (0.0933) | (0.0882) |
| Home Assets | 0.1123* | 0.1074* | 0.1210 |
| | (0.0581) | (0.0587) | (0.0743) |
| Time FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| No. of obs | 10748 | 10703 | 7323 |
| Adj. R2 | 0.3604 | 0.3597 | 0.3716 |

## Table 4: Instrumented Regression

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Amihud Illiquidity Measure. RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| | Model 4: Instrumented Weights | Model 5: Instrumented NCREIF Turnover | Model 6: Instrumented Weights and NCREIF Turnover |
|---|---|---|---|
| RE Makt. Illiquidity | 0.3684*** | 0.4586*** | 0.4559*** |
| | (0.0489) | (0.0427) | (0.0446) |
| Debt to Equity | 0.0198*** | 0.0068 | 0.0074 |
| | (0.0075) | (0.0052) | (0.0055) |
| WAIL2 | 0.2121*** | 0.2613*** | 0.2605*** |
| | (0.0684) | (0.0666) | (0.0651) |
| Volatility | 0.6077*** | 0.5923*** | 0.5964*** |
| | (0.1092) | (0.1231) | (0.1117) |
| MOM | -0.1479*** | -0.1240*** | -0.1201*** |
| | (0.0351) | (0.0379) | (0.0354) |
| Size | -0.0324*** | -0.0365*** | -0.0374*** |
| | (0.0085) | (0.0076) | (0.0073) |
| Book to Market | -0.0018 | -0.0131 | -0.0147 |
| | (0.0057) | (0.0129) | (0.0118) |
| RE Investment Growth | -0.0105 | -0.0204*** | -0.0199*** |
| | (0.0079) | (0.0078) | (0.0078) |
| 25 MSA | 0.1082 | 0.1167* | 0.1389* |
| | (0.0804) | (0.0686) | (0.0828) |
| Home Assets | 0.1213 | 0.0785 | 0.0769 |
| | (0.0766) | (0.0610) | (0.0661) |
| Time FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| No. of obs | 7287 | 6856 | 6820 |
| Adj. R2 | 0.3715 | 0.3828 | 0.3810 |

## Table 5: Alternative Stock Illiquidity Measure

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Roll Illiquidity Measure (Panel A) and interday price spread (Panel B). RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| | Model 3: No Instrument | Model 4: Instrumented Weights | Model 5: Instrumented NCREIF Turnover | Model 6: Instrumented Weights and NCREIF Turnover |
|---|---|---|---|---|
| | | Panel A: Roll | | |
| RE Makt. Illiquidity | 0.0183*** | 0.0183*** | 0.0202*** | 0.0201*** |
| | (0.0019) | (0.0020) | (0.0015) | (0.0016) |
| Control Variables | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| No. of obs | 8100 | 8064 | 7487 | 7451 |
| Adj. R2 | 0.2933 | 0.2928 | 0.3237 | 0.3194 |
| | | Panel B Spread | | |
| RE Makt. Illiquidity | 0.0591*** | 0.0591*** | 0.0678*** | 0.0677*** |
| | (0.0034) | (0.0032) | (0.0028) | (0.0034) |
| Control Variables | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes |
| No. of obs | 7152 | 7116 | 6647 | 6611 |
| Adj. R2 | 0.3373 | 0.3363 | 0.4085 | 0.4013 |

## Table 6: Time Difference in the Impact

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Amihud Illiquidity Measure (Panel A), Roll Illiquidity Measure (Panel B) and interday price spread (Panel C). RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| | Model 7: 1996-2006 | Model 8: 2007-2010 | Model 9: 2011-2015 |
|---|---|---|---|
| Panel A: Amihud | | | |
| RE Makt. Illiquidity | -0.0193 | 2.2870*** | 0.2058*** |
| | (0.0212) | (0.1844) | (0.0655) |
| Control Variables | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| No. of obs | 3229 | 1230 | 2290 |
| Adj. R2 | 0.0367 | 0.3927 | 0.2114 |
| Panel B: Roll | | | |
| RE Makt. Illiquidity | 0.0004 | 0.1314*** | 0.0140*** |
| | (0.0007) | (0.0097) | (0.0033) |
| Control Variables | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| No. of obs | 3611 | 1386 | 2376 |
| Adj. R2 | 0.0190 | 0.3918 | 0.0812 |
| Panel C: Spread | | | |
| RE Makt. Illiquidity | 0.0023*** | 0.2616*** | 0.0297*** |
| | (0.0008) | (0.0273) | (0.0024) |
| Control Variables | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes |
| No. of obs | 3143 | 1242 | 2156 |
| Adj. R2 | 0.0240 | 0.4075 | 0.2732 |

## Table 7: Liquidity and Financial Constraints

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Amihud Illiquidity Measure (Panel A), Roll Illiquidity Measure (Panel B) and interday price spread (Panel C). RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| Panel A: Size | | | | | | |
|---|---|---|---|---|---|---|
| | Amihud | | Roll | | Spread | |
| | Size >5048 | Size <= 109 | Size >5048 | Size <= 109 | Size >5048 | Size <= 109 |
| RE Makt. Illiquidity | 0.6600*** | 1.3273** | 0.0262*** | 0.0691*** | 0.0773*** | 0.0774*** |
| | (0.0827) | (0.5979) | (0.0047) | (0.0140) | (0.0123) | (0.0172) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of obs | 828 | 479 | 878 | 594 | 878 | 413 |
| Adj. R2 | 0.5695 | 0.5218 | 0.5314 | 0.3306 | 0.5288 | 0.1141 |
| Panel B: Cash Interest Coverage Ratio | | | | | | |
| | Amihud | | Roll | | Spread | |
| | Cash IR Ratio >8.8 | Cash ÍR Ratio <= 2.1 | Cash IR Ratio >8.8 | Cash ÍR Ratio <= 2.1 | Cash IR Ratio >8.8 | Cash ÍR Ratio <= 2.1 |
| RE Makt. Illiquidity | 0.5608*** | 3.2681*** | 0.0189* | 0.0860** | 0.0702*** | 0.5212 |
| | (0.0974) | (1.3289) | (0.0099) | (0.0396) | (0.0087) | (0.3758) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of obs | 447 | 279 | 447 | 348 | 425 | 203 |
| Adj. R2 | 0.3678 | 0.3079 | 0.2705 | 0.1609 | 0.4205 | 0.3340 |

## Table 8: Liquidity and Growth Opportunities

Note: This table reports the results of unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as Amihud Illiquidity Measure (Panel A), Roll Illiquidity Measure (Panel B) and interday price spread (Panel C). RE Makt. Illiquidity stands for the average illiquidity of the underlying property market each REIT exposes. Control variables include debt to equity ratio, three asset illiquidity measures (the percentage of non-cash assets (non-cash), the percentage of non-cash assets to past total assets (WAIL1) and the percentage of non-cash and non-fixed asset to previous total asset (WAIL2)), return volatility, return in past 6 months (MOM), market value (Size), book to market ratio, real estate investment growth rate, proportion of properties located in 25 Gateway cities (25 MSA), and proportion of properties located in the same MSA as the headquarter (Home Assets). Firm fixed effect and time fixed effect are also included. Standard error is reported in parenthesis. ***, ** and * denote significant at 1%, 5% and 10% level, respectively.

| Panel A: Book to Market Ratio | | | | | | |
|---|---|---|---|---|---|---|
| | Amihud | | Roll | | Spread | |
| | BM< 0.35 | BM>1.4 | BM< 0.35 | BM>1.4 | BM< 0.35 | BM>1.4 |
| RE Makt. Illiquidity | 0.2531*** | 0.7812*** | 0.0016 | 0.0296*** | 0.0262*** | 0.0382* |
| | (0.0240) | (0.1635) | (0.0015) | (0.0077) | (0.0021) | (0.0206) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of obs | 514 | 487 | 773 | 555 | 535 | 410 |
| Adj. R2 | 0.3158 | 0.2717 | 0.1438 | 0.2176 | 0.4813 | 0.2601 |
| Panel B: Tobin's Q | | | | | | |
| | Amihud | | Roll | | Spread | |
| | Tobin Q > 0.71 | Tobin Q < 0.4 | Tobin Q > 0.75 | Tobin Q < 0.4 | Tobin Q > 0.75 | Tobin Q < 0.4 |
| RE Makt. Illiquidity | 0.2303*** | 0.5206*** | 0.0040 | 0.0208*** | 0.0306*** | 0.0555*** |
| | (0.0626) | (0.0328) | (0.0025) | (0.0029) | (0.0051) | (0.0060) |
| Control Variables | Yes | Yes | Yes | Yes | Yes | Yes |
| Time FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Firm FE | Yes | Yes | Yes | Yes | Yes | Yes |
| No. of obs | 596 | 683 | 854 | 764 | 640 | 742 |
| Adj. R2 | 0.2349 | 0.3350 | 0.1024 | 0.2428 | 0.3704 | 0.2857 |