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ORIGINAL ARTICLE

Property market liquidity and REIT liquidity

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Abstract

This study examines the asset–stock liquidity relationship for firms with location-specific assets. Using a sample of real estate investment trusts (REITs), we extend the concept of asset liquidity to include information based on local property market turnover. Our findings confirm that holding more cash increases REIT stock liquidity. More importantly, we find a positive relation between property market liquidity and REIT stock liquidity. This relation is stronger for REITs with lower growth opportunities, less information advantage, and greater financial constraints. Our findings also provide evidence that managers can actively influence stock liquidity through asset structure.

KEYWORDS
geographic asset location, liquidity, real estate returns

1 | INTRODUCTION

This article examines the relation between real estate investment trust (REIT) asset liquidity and stock liquidity. The asset–stock liquidity relation is well-documented in the literature across a variety of settings (see, e.g., Charoenwong et al., 2014; Gopalan et al., 2012; Kang et al., 2017; Massa & Xu, 2013; Ortiz-Molina & Phillips, 2014; and others). However, the evidence on fixed asset liquidity and stock liquidity is sparse and generally inconclusive (Charoenwong et al., 2014). Real estate investors, on the other hand, while attentive to the liquidity of individual investments, are also responsive to the liquidity of the markets in which their assets are located.[1] For instance, Ghent (2021) shows that delegated investors concentrate their investments in property markets with higher liquidity. Our study extends prior literature on the asset–stock liquidity relation by considering the effect of property market liquidity on the stock liquidity of REITs.

Gopalan et al. (2012) present a theoretical model to illustrate how managerial investment decisions can affect stock liquidity by converting liquid assets into illiquid investments. In their model, a firm is endowed with cash, an illiquid project, and a growth option. It is important to note that the theoretical model defines "asset liquidity" strictly as the proportion of cash on the firm's balance sheet. Gopalan et al. (2012) then relax this theoretical definition of asset liquidity in their empirical analysis and state that "this measure leaves out a lot of information, as it presumes that all assets other than cash and equivalents are perfectly illiquid" (p. 343).[2] Nevertheless, their model and empirical analysis provide an important contribution to our study. Our theoretical framework is similar in spirit to Gopalan et al. (2012), with the added feature that focuses on the illiquid assets of REITs and information concerning the liquidity of the underlying markets.

A potential shortcoming of Gopalan et al.'s (2012) approach is that it somewhat arbitrarily assigns a uniform liquidity score of 0 or.5 out of 1 to tangible fixed assets. In our view, as well as others' (e.g., Ghent, 2021), there are notable cross-sectional differences in tangible fixed asset or real estate investment liquidity. The information environment of private real estate markets offers a unique opportunity to add insight with respect to differences in the liquidity of fixed assets.[3] For instance, Ghent (2021) finds that delegated investors concentrate their investments in cities with higher turnover, which is more likely associated with liquidity and transparency. Likewise, when market turnover is low, there is inherently less price discovery, and for both buyers and sellers, transactions are realized less quickly. Using REITs as the sample, our study attempts to address this shortcoming using a measure of liquidity based on the individual fixed assets that comprise an REIT's balance sheet.[4]

To capture the heterogeneity in the liquidity of REIT fixed assets, we investigate the market liquidity of the underlying property market, which we refer to as "*property market liquidity*." The market liquidity of underlying assets reflects the ease of buying and selling properties in local

[1] In discussing a large US and UK expansion, the chief investment officer for the Singaporean REIT Ascendas noted that "the US and UK property markets are transparent … They provide attractive investment opportunities, given their depth and liquidity …" (Ong, 2021).

[2] In their empirical analysis, Gopalan et al. (2012) extend their definition of "asset liquidity" to noncash assets. This is accomplished by assigning a uniform liquidity score to each type of asset (e.g., cash and cash equivalent, other current assets, and fixed assets) to derive a weighted asset liquidity (WAL) measure. To distinguish the liquidity concepts used in our study, we refer to Gopalan et al.'s definition of asset liquidity as "*balance sheet liquidity*," while "*stock liquidity*" is based on the classical definition: how rapidly shares of a stock can be bought or sold without substantially impacting the stock price. Furthermore, "*property market liquidity*," which is the focus of our article, is subsequently defined and differentiated from balance sheet liquidity and its various weighted versions.

[3] Investors in the private and public real estate market may differ in many ways; for instance, private market investors appreciate that real estate is lumpy and, typically involves a longer holding period than securities. In contrast, indirect market players may invest in REIT stocks due to the lower transaction costs and divisibility of ownership, among other benefits.

[4] Although our study primarily focuses on property market liquidity, the importance of cash holdings for REITs is well-established in the literature. For instance, Hill et al. (2012) find that the market value of an additional dollar of cash holdings is approximately $1.34 for their sample of REITs. In addition, cash equivalents are an essential instrument for financing REIT investment (Riddiough & Wu, 2009). Cash holdings may also provide a mechanism for smoothing payouts to investors, either to retain an REIT's tax-preferred status or as a buffer against market imperfections (Bond et al., 2019; Case et al., 2012; Hardin & Hill, 2008).

markets and therefore influences the uncertainty in the valuation or utilization of REIT assets. Property market liquidity complements "balance sheet liquidity" by capturing the variations in the liquidity of fixed assets given different markets (i.e., geographical locations). Unfortunately, the markets for real property assets do not have market makers who hold inventory to facilitate transactions, and bid–ask spreads and market depth are not readily available. Shleifer and Vishny (1992) and others argue that a high volume of transactions in an industry—or, in our case, a property market—is evidence of high liquidity; the discounts that sellers must offer to attract buyers are smaller in more active markets. Consequently, we use the volume of transactions in a geographically defined market as a measure of the liquidity of that property market's assets. Our primary results are based on data from the National Council of Real Estate Investment Fiduciaries, which reports turnover in the markets in which their members own property. Our results are remarkably robust to an alternative liquidity metric derived from real capital analytics (RCA) data, which cover a shorter period of time and fewer cities. Just as there is no unanimity in the literature on how to empirically measure stock liquidity, the same can be said about asset liquidity or property market liquidity (see Bian et al., 2021, who measure liquidity by time on market, p. 880).

Our empirical estimation applies an instrumental variable approach to address the potential endogenous relation between an REIT's investment decisions (i.e., asset location) and its stock liquidity, as well as other concerns. Balance sheet liquidity serves as an additional control variable. Admittedly, a caveat to our findings is that we do not capture the idiosyncratic component of individual property liquidity. However, as argued by Liu et al. (2019), when an asset's quality is not easily observable, investors may depend on conditions in the overall real estate market.[5] Consequently, we supplement our baseline analysis, which uses property market liquidity, with an approach that incorporates market-specific asset redeployability as another dimension of asset liquidity.

We find a positive relation between property market liquidity and REIT stock liquidity, which confirms the valuation uncertainty effect documented by Gopalan et al. (2012). Property market liquidity impacts stock liquidity, even when we include the balance sheet liquidity proxies as control variables. This result is particularly interesting, given the dividend distribution requirements and cash retention policies of REITs. Moreover, we conduct several cross-sectional comparisons to provide further insight into the liquidity relation. This portion of our analysis reveals that the property-market-REIT liquidity relation is stronger or more positive for firms with lower growth opportunities, greater financial constraints, and less information advantage.

Our study contributes to the literature on asset–stock liquidity in several ways. First, expanding on Gopalan et al.'s (2012) empirical findings, we provide evidence for REITs that have considerably different cash holdings constraints than non-REITs. Moreover, we examine the asset–stock liquidity relation with the additional dimension of "asset market" (in our case, REIT property market) liquidity. We provide important insight into the role an underlying asset market plays in resolving valuation uncertainty and find that investors rely more on an REIT's property market liquidity in valuing the firm when management has a potential information advantage relative to other REITs. In other words, the property-market-stock relation weakens with the improvement of transparency, turnover, and liquidity, which are all clearly related.

Our study also differs from previous studies on asset–stock liquidity because we are able to account for the heterogeneity of fixed asset liquidity. While prior research weighs balance sheet

[5] Our aggregate metric for asset-specific liquidity can be even more relevant for unlisted real estate firms, private real estate funds, or other nonreal estate firms in which individual assets are unlikely to be observable to the extent that REIT property-specific assets are.

liquidity by the type and proportion of assets, all fixed assets are implicitly assumed to carry the same degree of liquidity or illiquidity. As shown by Gopalan et al. (2012), the theoretical model assumes an illiquid project, and the empirical analysis begins by assuming that cash is the only contribution to "asset liquidity." Our analysis, similar to that of Ghent (2021), provides empirical evidence that property market liquidity matters to real estate investors. The ability to observe the liquidity of the property markets in which an REIT's underlying assets are located makes real estate an ideal laboratory for examining the heterogeneity in liquidity across noncash assets.

The article proceeds as follows. In the next section, we present our hypotheses based on the theoretical framework derived by Gopalan et al. (2012). We then describe the data and our empirical approach; the details of the latter are presented in Appendix A. The empirical results section examines the asset–stock liquidity relation for REITs, with particular emphasis on the contribution of property market liquidity to REIT stock liquidity. In this section, we also examine the effects of growth opportunities, financial constraints, and information on the strength of the property market-REIT stock liquidity relation. The final section summarizes our conclusions.

2 | THEORETICAL FRAMEWORK AND HYPOTHESES

In this study, we are primarily interested in the relation between property market liquidity and REIT stock liquidity. In Gopalan et al.'s (2012) theoretical model, the firm's assets consist of cash, an existing illiquid project, and a growth option (i.e., a new project). The key parameters that affect the overall variance of a firm's value are the proportion of cash holdings, variance of current project cash flows, and variance of the new project's cash flows. The cash holdings and managerial investment decisions affect the volatility of the firm's value and, consequently, stock liquidity.[6] The theoretical model yields two competing effects in describing the relation between asset liquidity and stock liquidity.

Charoenwong et al. (2014) refer to these effects as *valuation uncertainty* and *utilization uncertainty*. The *valuation uncertainty* effect maintains that liquid assets are positively correlated with stock liquidity. Cash and other liquid assets are easier to value than other real assets because of low information asymmetry, as liquid assets are less opaque. Firms with a higher level of asset liquidity are expected to have lower valuation uncertainty and hence higher stock liquidity. The *valuation uncertainty* effect posits a positive relation between asset liquidity and stock liquidity. In contrast, the *utilization uncertainty* effect predicts a negative relation between the asset and stock liquidity. The utilization uncertainty hypothesis focuses on uncertainty pertaining to the usage and redeployment of liquid assets. In Gopalan et al.'s (2012) model, a higher level of asset liquidity (cash holdings) also implies more investments.[7] The firm has greater uncertainty with respect to future assets and therefore will have lower stock liquidity.

An intriguing feature of Gopalan et al.'s (2012) model is that valuation uncertainty and utilization uncertainty are not mutually exclusive. The model predicts a threshold level of asset liquidity (i.e., cash relative to other assets), below which the valuation uncertainty effect dominates and above which the utilization uncertainty effect dominates. Consequently, the asset–stock liquidity relation will be either positive when valuation uncertainty dominates or negative when utilization

[6] See Gopalan et al. (2012) for a detailed derivation.

[7] Gopalan et al. (2012) rely on a strict and narrow definition of asset liquidity definition of asset liquidity in their theoretical model. Asset liquidity is determined by cash holdings. However, this definition is relaxed in their empirical analysis to include the liquidity of noncash assets.

uncertainty dominates. Our first hypothesis tests the two competing effects for property market liquidity:

H1: The property market liquidity of an REIT is positively (negatively) related to its stock liquidity.

On the one hand, firms with higher exposure to more liquid and less opaque asset markets tend to experience less valuation uncertainty. Duffie et al. (2007) and Chen et al. (2021) show that asset values are affected by market liquidity. In particular, illiquidity generally leads to price discounts in equilibrium. On the other hand, firms with assets in more liquid markets may also invest more. As documented in Williamson (1988), Shleifer and Vishny (1992), Benmelech and Bergman (2009), and Ortiz-Molina and Phillips (2014), firms with high real asset liquidity have higher debt capacity and lower costs of debt. As a result, REITs with assets in a more liquid market may invest more and therefore reflect higher valuation uncertainty regarding future assets. Our results empirically test the dominant effect for REITs.

Next, we follow Gopalan et al.'s (2012) theoretical framework and examine the effect of growth opportunities and financial constraints on the property market liquidity and REIT stock liquidity relation. Our hypotheses are as follows:

H2: The relation between property market liquidity and REIT stock liquidity is less positive for REITs with more growth opportunities.

H3: The relation between property market liquidity and REIT stock liquidity is less positive for less financially constrained REITs.

The preceding hypotheses can be interpreted in the context of the competing effects of valuation uncertainty; a strong relation attests to utilization uncertainty. For instance, more growth opportunities and less financial constraint for an REIT would increase the likelihood of future investment. In the case in which the liquidity relation is positive (i.e., the valuation uncertainty effect is dominant relative to the utilization uncertainty effect), the liquidity relation will weaken (be less positive) as utilization uncertainty increases. If the liquidity relation in H1 is negative, the relation will be stronger (less positive or more negative) as, once more, utilization uncertainty increases. Overall, the relation will be less positive for REITs with more growth opportunities and for less financially constrained REITs.

Finally, we appeal to the unique and opaque nature of the private real estate market information environment for our final hypothesis, which is as follows:

H4: The relation between property market liquidity and REIT stock liquidity is less positive for REITs with a property-market information advantage.

Previous studies have shown that property markets are replete with private information, and real estate investors capitalize on the ability to make informed trades (Damodaran & Liu, 1993; Garmaise & Moskowitz, 2004). Again, we rely on the rich context of Gopalan et al.'s (2012) theoretical framework to establish our hypothesis. We posit that when REIT managers possess a relative information advantage, they are (a) more likely to make decisions to invest or divest in the future and (b) more likely to make better—that is, more productive or value-enhancing—investment decisions. Analogously, Gopalan et al. (2012, p. 338) argue that "firms with better investment opportunities invest a higher proportion of their cash."

It follows that an information advantage might either decrease valuation uncertainty due to the future asset value being less volatile or increase utilization uncertainty due to an increased propensity to invest. Both effects would be associated with a less positive or more negative relation between property market liquidity and stock liquidity.

3 | DATA AND LIQUIDITY MEASURES

Location data for REIT property portfolios and individual company characteristics are collected from the S&P Global Market Intelligence (formerly SNL Financial) database, and daily bid and ask prices are from the Center for Research in Security Prices (CRSP) database. We collect data for all available US REITs with asset location information between 1998 and 2015 and obtain a total of 202 real estate firms. Overall, 76% of REIT properties are located within the 144 National Council of Real Estate Investment Fiduciaries (NCREIF)-derived Metropolitan Statistical Areas (MSAs). Of these firms, 145 have more than 70% of their properties located in the 144 MSAs; therefore, we restrict the sample to those 145 firms.

To test our hypotheses, we construct liquidity measures for each REIT in the sample. These include our main variable of interest, property market liquidity, as well as stock liquidity measures and balance sheet liquidity measures. Property market liquidity is calculated for each firm based on the MSA turnover exposure derived from the individual property holdings of the REIT:

$$T_{i,t} = \sum_{m=1}^{M} w_{m.i,t} \tau_{m,t}, \tag{1}$$

where $\tau_{m,t}$ is the relative liquidity 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. Note that $w_{m.i,t}$ is calculated as the number of properties located in MSA m to the total properties.[8] For instance, if REIT A has 80% of its properties located in New York MSA and 20% in Miami, $T_{i,t}$ for REIT A will be calculated as $T_{i,t} = \sum_{m=1}^{2} w_{m.i,t} \tau_{m,t_{m,t}} = 80\% \times \tau_{NY,t} + 20\% \times \tau_{\text{Miami},t}$. We use property turnover within an MSA ($Turnover_{m,t}$) as a proxy for property market liquidity, where $Turnover_{m,t}$ is defined as the number of transactions in MSA m in year t divided by the number of properties at the beginning of period t. $Turnover_{m,t}$ is then standardized to within the range of 0 and 1 ($\tau_{m,t}$).

Our primary results are based on data obtained from NCREIF, which reports the number of transactions (i.e., sales) in the markets in which their members own property. Property turnover in each MSA is defined as the number of sold properties a given year divided by the total number of properties. We collected the number of properties and properties sold in 144 core-based statistical areas (CBSAs) and MSAs since 1978 from the NCREIF database.[9] The average turnover rate across the 144 MSAs from 1996 to 2015 is 2.14%. The turnover rate dropped to 1.2% during the 2000

[8] Alternatively, the weight can be size or adjusted cost. The latter is the maximum of (1) the reported book value, (2) the initial cost of the property, or (3) the historic cost of the property, including capital expenditures and tax depreciation (Ling et al., 2021a). Based on size-weighted or adjusted-cost-weighted real estate market liquidity exposure, the results remain qualitatively robust although somewhat weaker. Due to space limitations, the results are not reported but are available on request.

[9] In the NCREIF data, property markets are divided into Metropolitan Divisions (MD). For instance, for the NCREIF the Detroit–Warren–Dearborn, MI MSA is divided into two MDs: Detroit–Dearborn–Livonia and Warren–Troy–Farmington Hills. However, S&P Global Market Intelligence uses an MSA code for property location that is only at the level of the

TABLE 1 MSAs with highest turnover

CBSA/DIV	Turnover	Mean	SD	No. Prop.
Atlanta–Sandy Springs–Marietta, GA	0.107	2.10%	2.13%	456
Phoenix–Mesa–Scottsdale, AZ	0.107	2.23%	2.87%	165
Washington–Arlington–Alexandria, DC–VA–MD–WV	0.099	2.24%	2.37%	347
Los Angeles–Long Beach–Anaheim, CA	0.097	2.56%	3.09%	441
Chicago–Naperville–Joliet, IL–IN–WI	0.094	2.03%	2.13%	443
Dallas–Fort Worth–Arlington, TX	0.094	1.97%	2.41%	369
San Jose–Sunnyvale–Santa Clara, CA	0.088	2.92%	3.33%	167
Houston–Baytown–Sugar Land, TX	0.086	1.66%	2.86%	242
Anaheim–Santa Ana–Irvine, CA Metropolitan Division	0.079	2.38%	2.89%	178
Cambridge–Newton–Framingham, MA Metropolitan Division	0.074	2.42%	2.57%	109
Denver–Aurora, CO	0.072	2.07%	3.22%	188
San Diego–Carlsbad–San Marcos, CA	0.064	2.38%	2.75%	136
Miami–Fort Lauderdale–Miami Beach, FL	0.063	2.07%	2.40%	145
Seattle–Tacoma–Bellevue, WA	0.062	2.36%	2.37%	295
Miami–Fort Lauderdale–Miami Beach, FL	0.060	1.81%	3.00%	81
New York–Newark–Edison, NY–NJ–PA	0.059	2.66%	5.07%	351
Austin–Round Rock, TX	0.059	1.63%	2.88%	153
Baltimore–Towson, MD	0.057	2.34%	2.27%	100
Minneapolis–St. Paul–Bloomington, MN–WI	0.054	1.86%	1.89%	138
Orlando, FL	0.052	2.21%	2.45%	89

Note: The table shows summary statistics for MSAs with the highest turnover statistics. Mean stands for the average annual returns of NCREIF total returns, and SD stands for the standard deviation of NCREIF total returns. No. Prop. stands for the maximum number of properties in each quarter in the following MSAs in the NCREIF database.

recession and rose to 6% in 2005 during the real estate boom. The market froze in 2008, and the turnover rate declined to less than 0.5%. The market steadily recovered in 2012, and the average turnover rate grew to between 2% and 3%.

Table 1 lists the MSAs with the highest average turnovers from 1996 to 2015. Atlanta–Sandy Springs–Marietta, GA and Phoenix–Mesa–Scottsdale, AZ are the two most liquid property markets, with an NCREIF turnover rate of more than 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 third to fifth, with an average turnover rate of more than 9%. As reported in Table 2, the average $\tau_{m,t}$ is 10.7%, and the standard deviation is quite small at only 7.2%. The minimum liquidity is 0, which means that no NCREIF properties in this MSA were sold during the year. The maximum is 47.4%.

Two identification challenges need to be addressed. The first is self-selection bias. Some REITs have a bias for less risky and more liquid real estate markets (Ghent, 2021), and thus, $w_{m.i,t}$ may

MSA (Detroit–Warren–Dearborn). Therefore, we convert MD property markets to MSA turnover. The MSA turnover is calculated as the average MD turnovers weighted by the number of properties in each MD of that MSA.

TABLE 2 Descriptive statistics

	Mean	SD	Max	Min
Property market variables				
Turnover	0.021	0.054	0.429	0
RCA Liquidity	−0.013	0.155	0.280	−0.536
GDP Growth Rate	0.019	0.040	0.367	−0.379
House Price Change	0.008	0.028	0.132	−0.166
Firm characteristics				
Stock liquidity				
Amihud Illiquidity Measure	0.197	0.176	1.985	0.032
Roll Illiquidity	0.005	0.009	0.104	0.000
Price Spread	0.025	0.021	0.285	0.003
Property market liquidity				
Property Market Liquidity_NCREIF	0.107	0.071	0.474	0
Property Market Liquidity_RCA	0.413	0.173	0.825	0.187
Property Market Liquidity_Instrumented	0.213	0.081	0.616	0.020
GPK asset liquidity				
Weighted Asset Liquidity (WAL1)	0.027	0.046	0.875	0
Weighted Asset Liquidity (WAL2)	0.040	0.051	0.435	0
Weighted Asset Liquidity (WAL3)	0.581	0.127	1	0.040
Other variables				
Return	0.051	0.231	1.347	−2.395
Volatility	0.373	0.358	5.146	0.055
Debt-to-Equity	1.321	1.525	14.211	0
Market Capitalization (million USD)	2961	3725	28223	4
Price-to-Book Ratio	1.739	1.021	7.305	0.100
MSA Herfindahl Index	0.199	0.22810	1	0.018
Institutional ownership	0.749	0.27690	1.4704	0
Density	112	78	583	15
MSA_GDP_Growth	0.016	0.026	0.277	−0.260

Note: This table shows descriptive statistics. Turnover stands for MSA turnover rate according to NCREIF transaction records. RCA liquidity is based on indices derived from demand and supply reservation prices, similar to the bid–ask spread. House price change is based on the FHFA MSA house price index. The GDP growth rate is the GDP change in each MSA. Stock illiquidity measures, including Amihud, Roll illiquidity, and price spread, are described in Section 3 and Appendix A. Property market liquidity is calculated as the MSA's property market liquidity multiplied by the percentage of properties located in the corresponding MSA (Section 3, Equation 1). We also use instrumented variables to address potential self-selection and/or reversal causality (Section 3, Equations 2–5) and three balance sheet liquidity measures based on Gopalan et al. (2012) (WAL1, WAL2, or WAL3, Section 3, Equations 6–8). Other firm-level variables include REIT cumulative return in the past 6 months, volatility, debt-to-equity ratio, size (in million USD), Herfindahl index for property geographic (MSA) concentration, price-to-book ratio, institutional ownership, average property density (the average number of properties held by other REITs located within a 5 km radius of each property) and asset-weighted average GDP growth rate.

be affected by self-selection. To address this issue, we use the distance from headquarters as the instrument to predict the weights (Equation 3). The second is reversal causality. REIT transactions affect property market liquidity, resulting in a reversal relationship; that is, REIT liquidity influences property market liquidity. To address this issue, we use the change in the home price as an instrument to predict the MSA turnover rate (Equations 4 and 5). Thus, the instrumented property market liquidity is as follows:

$$\hat{w}_{m.i,t} = \hat{p} + \hat{q} \ln D_{m,i,t}, \tag{2}$$

$$\widehat{Turnover}_{m.t} = \hat{l} + \hat{g} \ln HP_{m,t}, \tag{3}$$

$$\hat{\tau}_{m,t} = \frac{\widehat{Turnover}_{m,t} - \min\left(\widehat{Turnover}_{m,t}\right)}{\max\left(\widehat{Turnover}_{m,t}\right) - \min\left(\widehat{Turnover}_{m,t}\right)}, \tag{4}$$

$$\widehat{T}_{i,t}^{HP\ dist} = \sum_{m=1}^{M} \widehat{w}_{m.i,t} \widehat{\tau}_{m,t}, \tag{5}$$

where $D_{m,i,t}$ is the average distance of properties located in MSA m from the headquarters of REIT i in year t. For instance, if two properties are located in MSA m, $D_{m,i,t}$ is the average distance of these two properties from REIT headquarters. $HP_{m,t}$ is the residential house price index provided by the Federal Housing Finance Agency (FHFA) in MSA m. Note that $\hat{p}_i$, $\hat{q}_i$, $\hat{l}$, and $\hat{g}$ are estimated coefficients. Note that $\hat{w}_{m.i,t}$ and $\hat{\tau}_{m,t}$ are the instrumented weights and property market liquidity, respectively. Also, $\widehat{T}_{i,t}^{HP\ dist}$ is the instrumented REIT-weighted average property market liquidity according to its asset allocation. Appendix A details our estimation strategy and the motivation behind our instruments and discusses instrument validity and exclusion restrictions. As reported in Table 2, the average property market liquidity for REITs is 0.2125, with a range between 0.0197 and 0.6155.

Analogous to Gopalan et al. (2012) and Charoenwong et al. (2014), we employ three stock liquidity measures as the dependent variable and three balance sheet liquidity measures, which essentially serve as control variables. Stock liquidity is measured by Amihud illiquidity (Amihud, 2002), implicit bid–ask spread (Roll, 1984), and observed bid–ask spread. Detailed formulas are reported in Appendix A for the stock liquidity variables. The three balance sheet liquidity measures (or, using Gopalan et al.'s terminology, "weighted asset liquidity," hence WAL), are defined as a weighted share of cash and equivalents, other current assets, and tangible fixed assets:

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

$$WAL2_{i,t} = \frac{Cash\ and\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{Other\ Current\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0.5, \tag{7}$$

$$WAL3_{i,t} = \frac{Cash\ and\ Equivalents_{i,t}}{Total\ Assets_{i,t-1}} \times 1 + \frac{Other\ Current\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0.75 + \frac{Tangible\ Fixed\ Assets_{i,t}}{Total\ Assets_{i,t-1}} \times 0.5. \tag{8}$$

As reported in Table 2, the proportion of cash and equivalents of the previous year's total assets is only 3%, which is remarkably less than the 18.48% average reported for the full sample of public firms (Hardin et al., 2009). Not surprisingly, non-REITs have a much higher proportion of cash and equivalents than REITs. When fixed tangible assets are included, WAL3 increases to approximately 60%. Regarding the other control variables, the average monthly return across all REITs is 0.5%, and the monthly return volatility is 37.3%. We also see a large variation across company size in terms of market capitalization, with the highest being \$38 billion and the lowest \$4 million. On average, a company has a market capitalization of \$2961 million. The average price-to-book ratio is 1.74, and the average debt-to-equity ratio is 1.32. We also account for market power or market concentration, which is measured by the Herfindahl–Hirschman Index (HHI) at the MSA level. The HHI measures the geographic concentration of the properties of one firm across different MSAs. It is calculated by squaring the market share of properties located in each MSA with respect to the total number of properties for a given firm i in a given MSA l in a given year t and then summing the resulting shares across MSAs. The HHI ranges from close to 0–1. When the HHI equals 1, it means that all properties of the firm are located in the same MSA and the concentration is highest. The lower the HHI value is, the less concentrated the REIT properties across MSAs. As shown in Table 2, the average HHI for our sample is 0.20, and the standard deviation is 0.23.

4 | EMPIRICAL RESULTS

4.1 | Property market liquidity and REIT liquidity

We begin our empirical analysis by testing whether, on average, there is a significant relation between property market liquidity and REIT stock liquidity. To do this, we estimate panel models with fixed effects:

$$y_{i,t} = \alpha \widehat{T}^{HP\ dist}_{i,t-1} + \beta X_{i,t-1} + \varphi_i + \varrho_p + \delta_t + e_{i,t}, \tag{10}$$

where $y_{i,t}$ stands for REIT stock liquidity, which is measured by Amihud illiquidity ($ILLIQ_{it}$), Roll illiquidity (s_{it}), or bid–ask spread ($Qspread_{it}$). Note that $\widehat{T}^{HP\ dist}_{i,t-1}$ measures the proxy for underlying property market liquidity, as described previously. The parameter α indicates whether the property market liquidity and REIT stock liquidity relation is positive or negative, which is our H1. Note that $X_{i,t}$ is a matrix of firm characteristics: Gopalan et al.'s (2012) three balance sheet liquidity metrics; the debt-to-equity ratio; previous return volatility, which is measured as the standard deviation of returns in the last month; a momentum effect, which is measured by returns over the past 6 months; log of market value; the book-to-market ratio; the MSA focus of properties measured by the Herfindahl index based on the number of MSAs in which the firm's properties are located; institutional ownership; nearby property density; and the GDP growth rate for the MSA in which the firm allocates its assets. Nearby property density is defined as the average number of properties held by other REITs located within a 5 km radius of each property. Note that β is a vector of corresponding coefficients. Also, Φ_{I}, ϱ_p and δ_t represent firm fixed effects, property type fixed effects, and time fixed effects, respectively.

Table 3 reports the average relation between property market liquidity and stock liquidity in our sample. We employed nine combinations of Gopalan et al.'s (2012) three balance sheet liquidity (WAL1, WAL2, and WAL3) and three stock liquidity measures (Amihud, Roll, and spread), reported in Panels A, B, and C, respectively. It should be noted that as all three measures of stock

TABLE 3 REIT stock liquidity and property market liquidity

	Panel A:Amihud ILLIQ			Panel B:Roll ILLIQ			Panel C:Price Spread		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
PptyMktLiq	−0.293***	−0.291***	−0.287***	−0.009***	−0.009***	−0.009***	−0.032***	−0.032***	−0.032***
	(−15.75)	(−12.82)	(−14.57)	(−5.62)	(−7.50)	(−6.00)	(−13.33)	(−14.55)	(−13.91)
WAL1	−0.055***			0.000			−0.000		
	(−2.67)			(0.22)			(−0.13)		
WAL2		−0.060**			0.001			−0.001	
		(−2.44)			(0.90)			(−0.59)	
WAL3			−0.007			−0.000			−0.002**
			(−1.49)			(−0.60)			(−2.40)
Volatility	0.133***	0.135***	0.133***	0.007***	0.007***	0.007***	0.020***	0.020***	0.020***
	(9.37)	(8.54)	(9.38)	(8.81)	(7.54)	(8.81)	(12.10)	(10.63)	(12.12)
MOM	−0.087***	−0.087***	−0.086***	−0.003***	−0.003***	−0.003***	−0.014***	−0.014***	−0.013***
	(−7.49)	(−6.91)	(−7.41)	(−4.09)	(−3.14)	(−4.07)	(−10.39)	(−8.71)	(−10.03)
Debt-to-Equity	−0.001	−0.001	−0.001	0.000	0.000	0.000	0.000**	0.000**	0.000**
	(−0.68)	(−0.55)	(−0.58)	(0.39)	(0.45)	(0.38)	(2.35)	(2.38)	(2.34)
Size	−0.018***	−0.018***	−0.018***	−0.000*	−0.000**	−0.000*	−0.001***	−0.001***	−0.001***
	(−8.34)	(−11.17)	(−8.27)	(−1.77)	(−2.00)	(−1.83)	(−3.93)	(−3.75)	(−4.70)
Price to Book	−0.002	−0.002	−0.002	−0.000	−0.000	−0.000	−0.001***	−0.001***	−0.001***
	(−1.15)	(−1.27)	(−1.13)	(−0.34)	(−0.29)	(−0.33)	(−4.45)	(−4.18)	(−4.32)
HHI_MSA	0.008	0.009	−0.001	−0.002*	−0.002*	−0.002*	−0.005**	−0.004**	−0.004**
	(0.58)	(0.69)	(−0.10)	(−1.82)	(−1.93)	(−1.92)	(−2.55)	(−2.51)	(−2.52)
Institutional ownership	−0.043***	−0.042***	−0.044***	0.000	0.000	0.000	−0.002	−0.002	−0.002
	(−5.14)	(−4.81)	(−5.22)	(1.18)	(1.00)	(1.17)	(−1.53)	(−1.54)	(−1.55)

(Continues)

TABLE 3 (Continued)

	Panel A:Amihud ILLIQ			Panel B:Roll ILLIQ			Panel C:Price Spread		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
PropDensity	−0.024***	−0.022***	−0.025***	0.001***	0.001***	0.001***	−0.000	−0.000	−0.001
	(−3.75)	(−3.38)	(−3.89)	(3.15)	(3.05)	(3.15)	(−0.73)	(−0.48)	(−0.81)
MSA GDP	−0.186***	−0.180***	−0.183***	−0.005**	−0.005**	−0.005**	−0.015**	−0.015**	−0.015**
	(−4.36)	(−4.32)	(−4.31)	(−1.99)	(−2.18)	(−1.98)	(−2.17)	(−2.21)	(−2.12)
FE	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	8352	8363	8352	8643	8654	8643	8641	8652	8641
Adjusted R^2	0.828	0.829	0.828	0.687	0.686	0.687	0.830	0.829	0.830

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as the Amihud ILLIQ, the Roll ILLIQ, and price spread. PptyMktLiq stands for the average liquidity of the underlying property market to which each REIT is exposed, instrumented by distance from headquarters and MSA-level house price change. Control variables include Gopalan et al. (2012) cash-based asset liquidity (WAL1, WAL2, or WAL3); return volatility in the last month; cumulative return in the past 6 months (MOM); market value (size); book-to-market ratio; debt-to-equity ratio; MSA focus; institutional ownership; property density; and MSA-level GDP growth rate. Firm fixed effects, property type fixed effects and time fixed effects are also included. Firm-level clustered standard errors are used. The standard error for PptyMktLiq is measured using bootstrapping. The *t*-statistics are reported in parentheses.***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

liquidity are actually measures of stock illiquidity, the sign of the relation between property market liquidity and stock liquidity is opposite to the sign of the coefficient. The coefficients for the property market liquidity variable (PptyMktLiq) in all three specifications are significantly negative. This confirms that the valuation uncertainty effect dominates utilization uncertainty: REITs with more assets in more liquid markets have lower valuation uncertainty and therefore have higher stock liquidity. This also indicates that the sample REITs' assets fall in the spectrum of firms with low asset liquidity, which is in line with our expectations because REITs generally do not hold much cash (due to the 90% distribution requirement; Hardin et al., 2009). We discuss these in our empirical results section. A one-standard-deviation increase in PptyMktLiq reduces stock liquidity by 0.134, 0.077, and 0.124 standard deviations, respectively, as measured by Amihud illiquidity, Roll illiquidity, and price spread.[10] Although the impact is statistically significant, it is economically moderate. However, this finding is consistent with previous literature. For instance, Hoesli et al. (2017) document a moderate relation between the commonality in property market liquidity and REIT liquidity; they find a 6% correlation coefficient for the across-asset commonality in liquidity.

We also note, in Panel A, that REIT share liquidity is positively related to balance sheet liquidity (WAL1 and WAL2) because the coefficient is significantly negative. This is consistent with the findings of Gopalan et al. (2012). Holding more liquid assets, especially more cash, lowers valuation uncertainty and increases an REIT's stock liquidity.[11] Table 3, Panel A, shows that a one-standard deviation increase in WAL1 and WAL2 is associated with an approximately 0.013-standard-deviation decrease in Amihud ILLIQ. Other control variables have the expected sign. REIT stock liquidity decreases with previous return volatility, and winners with higher previous returns tend to have more liquid shares. In addition, smaller REITs or REITs with lower institutional ownership tend to have lower share liquidity. REITs with assets concentrated in MSAs with better economic conditions show significantly higher stock liquidity. The coefficient for density is significant and negative in Panel A, which confirms that stock liquidity improves by investing in denser locations (e.g., CBD areas). In Panel C, we also see that a higher price spread is associated with a lower price-to-book ratio and more geographically diversified assets. However, this relation becomes insignificant when we use Amihud and Roll ILLIQ as the dependent variable.

4.2 | Robustness tests

We take a number of steps to examine the validity of our results. First, we consider whether our empirical analysis is robust to alternative measures of specific property market liquidity. For instance, our principal liquidity metrics are based on NCREIF data; however, our results are remarkably robust to an alternative liquidity metric derived from RCA data, the latter of which covers a shorter time period and few cities. Appendix B discusses this approach and presents the results.

[10] The economic impact is calculated as the coefficient multiplied by the standard deviation of the property market liquidity measure, then divided by the standard deviation of the REIT share liquidity measure.

[11] An interesting issue concerning REIT balance sheet liquidity, particularly with regard to cash holdings, is the role of cash in providing a cushion to maintain a stable dividend flow (i.e., a smooth payout to investors). This is especially important given the significant penalties REITs face in violating payout mandates and jeopardizing their REIT status. The extent to which REIT cash holdings, due to dividend payout requirements, impact the threshold level of asset liquidity and the competing effects on stock liquidity seems to be an empirical question. We provide some evidence, as shown in Table 3; however, property market liquidity, as opposed to balance sheet liquidity, is the principal focus of our study.

We also generate results in which we include general stock market turnover as another REIT liquidity measure and obtain somewhat weaker results than using the other three liquidity measures. However, they are qualitatively robust, especially in the baseline model.[12] We also consider other factors that can influence REIT asset liquidity, such as lines of credit (An et al., 2012; Hardin & Hill, 2011; Hill et al., 2012). An unused line of credit improves the perceived financial health of a company and therefore may influence the REIT asset and stock liquidity relation. Consequently, we add the unused line of credit as an additional control variable. The results regarding the relation between property market liquidity and REIT stock liquidity remain robust. The unused line of credit has a significant negative coefficient on Amihud ILLIQ and the price spread, which indicates that the unused line of credit improves REIT stock liquidity. Due to space limitations, the results are not reported but are available on request.

In addition, concerns may arise if the property market liquidity and stock liquidity relation is influenced by investor sentiment (Freybote & Seagraves, 2018), but time fixed effects should be able to capture this comovement. Nevertheless, we include the consumer sentiment index as an additional control variable and, consequently, exclude time fixed effects. The sentiment variable has a significant negative coefficient, which indicates that higher sentiment is associated with higher REIT stock liquidity. We also consider economic situations across the MSAs in which REITs allocate their properties by including the average NCREIF total returns in which REITs invest. The coefficient on property market return has a negative coefficient, which indicates that REIT stock liquidity is significantly and positively related to property market performance. In both cases, baseline results regarding the relation between property market liquidity and REIT stock liquidity remain robust. However, we do not attempt to isolate the liquidity spillover from local business cycles, as the liquidity of a real estate market may reflect local economic conditions. Therefore, in the baseline model, we do not include these two variables. Due to space limitations, the results are not reported but are available on request.

Finally, we address the fact that there are many other relevant factors that may impact property market liquidity and stock liquidity relations for REITs. Perhaps most prominent are asset redeployability (e.g., zoning regulations and physical flexibility; Benmelech, 2009; Benmelech et al., 2005; Giambona et al., 2008) and asset quality (e.g., lease maturity and recovery rate; Giambona et al., 2008; Liu et al., 2019). We therefore control for tenant credit rating, share of the long-term lease, recovery rate, and the property county weighted average land-use restrictions index based on the Wharton Residential Land Use Regulation Index (Gyourko et al., 2008). Appendix C provides the details of this robustness exercise; nonetheless, the results show that our findings are also robust when factors such as asset quality and redeployability are incorporated in our analysis.

4.3 | Cross-sectional evidence

Our main result—whereby the relation between property market liquidity and REIT liquidity is positive—suggests that the competing effects of valuation uncertainty and utilization uncertainty favor the former. In this section, we provide additional insights into this dynamic by providing cross-sectional evidence. To do so, we turn to H2–H4 and partition our sample according to firm characteristics intended to reflect varying degrees of growth opportunity, financial constraint, and information advantage. To conserve space, we only report the results for Amihud's (2002) stock

[12] We thank Jean-Christophe Delfim, Martin Hoesli, and other discussants for this suggestion.

illiquidity measure and suppress the coefficients on control variables. All unreported results are available from the authors.

Table 4, Panel A, shows the effect of high and low growth opportunities on the liquidity relation. Recall that H2 states that REIT stock liquidity will be more positive to property market liquidity for REITs with lower growth opportunities. We compare the half of REITs with higher growth opportunity (i.e., higher price-to-book ratio or higher Tobin's Q in the gray columns of Table 4, Panel A) with the half with lower growth opportunity (i.e., lower price-to-book ratio or lower Tobin's Q in the white columns of Table 4, Panel A). As shown in Table 4, Panel A, for REITs with a lower price-to-book ratio or Tobin's Q, the coefficient for real estate market liquidity is more negative. The difference in the coefficient between the two groups of REITs is statistically significant. This result supports H2. For the 50th percentile of REITs with a lower price-to-book ratio and Tobin's Q, a one-standard-deviation increase in property market liquidity is accompanied by an up to 0.255-standard-deviation increase in Amihud ILLIQ.

A REIT's financial constraints can also increase the sensitivity to real estate market liquidity. H3 states that the relation between property market liquidity and REIT liquidity should be more positive for firms that face financial constraints. We use four proxies to identify financially constrained firms: firm-level debt-to-assets ratio, the Kaplan–Zingales (KZ) Index for financial constraints,[13] firm size, and debt rating. As shown in Table 4, Panels B1 and B2, the relation between property market liquidity and stock liquidity is significantly stronger for firms with higher leverage or potentially binding financial constraints (higher KZ index value). For the half of REITs with a higher debt-to-assets ratio or higher KZ index value, a one-standard-deviation increase in property market liquidity is accompanied by a maximum of a 0.156-standard-deviation increase in Amihud ILLIQ.

Firm size is the third proxy for financial constraint. Smaller firms may be subject to greater scrutiny in raising external capital than larger firms. Table 4, Panel B3, compares the half sample with a higher market capitalization and the other half with a lower market capitalization; however, in this case, the difference is insignificant. If we classify REITs as rated or unrated, the empirical evidence is strong: Firms with an investment rating have better credit quality and therefore are less constrained in raising external finance. As shown in Table 4, Panel B4, the coefficient on property market liquidity for unrated firms is nearly twice that for rated firms. The difference in the coefficient is also significant. For unrated firms, a one-standard-deviation increase in property market liquidity is related to a 0.212-standard-deviation increase in Amihud ILLIQ.

Finally, we test H4 by considering varying information advantages across REIT firms using two measures of information advantage for REITs: property size per property sector and the average share of assets in the home market. The information advantages of local investment are well-documented in the literature; this is especially the case in real estate markets, in which the information environment is more obscure due to the low transaction volume (Garmaise & Moskowitz, 2004). We compare the half of REITs with a higher concentration of properties in their headquarters' MSA and the half with a lower proportion. As shown in Table 4, Panel C1, the coefficient for REITs with fewer properties in their home MSA has a significantly larger magnitude than that of REITs that invest mainly in their local market. We also categorize REITs according to the size of the managed properties. Firms holding more properties tend to be more experienced,

[13] The KZ index developed by Kaplan and Zingales (1997) measures the degree of firm-level financial constraint. The KZ index score is a five-factor model, as described by Lamont et al. (2001). Factors include cash flow to PP&E in the previous period, Q, debt-to-capital ratio, dividends to PP&E in the previous period, and cash and equivalents to PP&E in the previous period.

TABLE 4 REIT stock liquidity and property market liquidity: Cross-firm analysis

Panel A: Growth opportunities				
	A1: Price-to-Book Ratio		**A2: Tobin's *Q***	
	High	**Low**	**High**	**Low**
PptyMktLiq	−0.242***	−0.370***	−0.297***	−0.552***
	(−7.31)	(−13.67)	(−12.36)	(−17.11)
Controls	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4210	4094	4070	4072
Adjusted R^2	0.8620	0.8064	0.8683	0.8300
Diff. Coef.		−0.129***		−0.256***
Panel B: Financial constraint				
	B1: Debt-to-Asset Ratio		**B2: KZ Index**	
	Low	**High**	**Low**	**High**
PptyMktLiq	−0.271***	−0.456***	−0.236***	−0.390***
	(−9.02)	(−32.10)	(−7.14)	(−13.03)
Controls	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4273	4031	3486	3553
Adjusted R^2	0.8637	0.8074	0.8538	0.8703
Diff. Coef.		−0.185***		−0.154***
	B3: Size		**B4: Rating**	
	Large	**Small**	**Rated**	**Unrated**
PptyMktLiq	−0.242***	−0.379***	−0.197***	−0.459***
	(−8.99)	(−12.68)	(−8.14)	(−11.43)
Controls	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4251	4050	5985	2367
Adjusted R^2	0.9162	0.7701	0.8865	0.7629
Diff. Coef.		−0.137***		−0.262***
Panel C: Information advantage				
	C1: Proportion of assets in home MSAs		**C2: Properties size per property sector**	
	High	**Low**	**High**	**Low**
PptyMktLiq	−0.192***	−0.313***	−0.252***	−0.468***
	(−6.11)	(−8.49)	(−9.93)	(−14.62)
Controls	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	3394	3468	3999	4065
Adjusted R^2	0.8306	0.8672	0.8482	0.8297
Diff. Coef.		−0.121***		−0.216***

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as the Amihud illiquidity measure. Panel A groups REITs according to the median price-to-book ratio and Tobin's *Q* ratio. Panel B groups REITs according to Debt-to-Asset Ratio, KZ index, Market Capitalization, and Credit Rating. Panel C groups REITs according to the number of properties per property sector and the proportion of properties located in the same MSA as the headquarters of the firm. Model specifications are the same as those in Model (3), Table 3. The standard error for PptyMktLiq is measured using bootstrapping. The *t*-statistics are reported in parentheses. Diff. Coef. is the difference in the coefficient for PptyMktLiq between the gray column and the white column. Significance of Diff. Coef. is based on one-tailed *t*-statistics. *** denotes significance at the 1% level.

TABLE 5 REIT valuation and property market liquidity

	(1)	(2)	(3)
PptyMktLiq	0.605**	0.618**	0.637**
	(2.38)	(2.50)	(2.36)
WAL1	0.804**		
	(2.14)		
WAL2		0.974**	
		(2.34)	
WAL3			0.314***
			(2.75)
Volatility	−0.322**	−0.319**	−0.334**
	(−1.98)	(−1.96)	(−1.99)
MOM	0.490***	0.485***	0.448***
	(2.94)	(2.99)	(2.68)
Debt-to-Equity	−0.003	−0.001	−0.004
	(−0.36)	(−0.12)	(−0.48)
Size	0.065***	0.064***	0.099***
	(2.63)	(2.63)	(4.70)
MSA Focus	−0.310	−0.340	−0.172
	(−0.87)	(−0.91)	(−0.65)
Institutional ownership	−0.181**	−0.171**	−0.205**
	(−2.29)	(−2.22)	(−2.29)
Density	−0.311***	−0.300***	−0.315***
	(−3.17)	(−3.23)	(−3.14)
MSA GDP	−0.467	−0.514	−0.470
	(−1.06)	(−1.20)	(−1.06)
FE	T,P,F	T,P,F	T,P,F
No. of observations	791	791	791
Adjusted R^2	0.834	0.836	0.836

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is the REIT's annual Tobin's *Q*. Model specifications are the same as in Table 3. The standard error for PptyMktLiq is measured using bootstrapping. The *t*-statistics are reported in parentheses. ***, and ** denote significance at the 1%, and 5% levels, respectively.

which, in turn, may provide them with an information advantage. Given that management experience with one type of property (such as offices) may not be applicable to other types of properties (such as industrial properties), we calculate the average number of properties per property sector. For instance, if an REIT manages 100 properties across two sectors, office and retail, the number of properties per sector for this REIT is 50. We compare the half of our sample that consists of REITs with more properties within each sector and the half with fewer properties. As shown in Table 4, Panel C2, firms with fewer properties exhibit a significantly stronger or more positive property market liquidity and stock market liquidity relation. For the 50% of REITs with information disadvantage (fewer properties per property sector or more properties located outside their home MSA), a one-standard-deviation increase in real estate market liquidity results in a maximum of 0.216-standard-deviation increase in Amihud ILLIQ.

Overall, the baseline results confirm that high asset liquidity, including property market liquidity, leads to higher stock liquidity, which can be explained by lower valuation uncertainty. However, when REITs have higher growth opportunities and strong information advantage and are less financially constrained, the relation between property market liquidity and stock liquidity becomes less positive due to the potential for current liquidity to be invested in future investments with uncertain terminal values.

To see if and how the relation between property market liquidity and REIT stock liquidity changes with time, we split our sample into three subperiods corresponding to the global financial crisis (1996–2006, 2007–2009, and 2010–2015) and repeat our estimation. Consistent with Huang and Mazouz (2018), we find that the property market-stock liquidity relation is stronger during the 2007–2009 crisis period, which constitutes a market-wide liquidity shock. During this crisis period, the impact rises to 0.403, 0.389, and 0.310 standard deviations by Amihud measurement, Roll measurement, and price spread, respectively. This relationship is economically notable: The impact is nearly three times stronger relative to the whole period. These results can also be interpreted in the context of our Table 4 analysis. For instance, we can generally characterize the global financial crisis as a period of limited growth opportunity, diminished information advantage (arguably due to an information void and little or no price discovery), and universally higher financial constraints. In this regard, even REITs with relatively high asset liquidity may be less likely to invest in projects that create valuation uncertainty; consequently, the property market liquidity and stock liquidity relation is (considerably) stronger. To conserve space, we do not report these results; however, they are available from the authors.

4.4 | The value of property market liquidity

As an added facet of our analysis, we examine the value implications of the property market liquidity and stock liquidity relation for REITs. If improvements in REIT share liquidity caused by the increase in underlying property market liquidity lead to higher firm value, then the strategy of allocating assets to more liquid real estate markets will likely be more valuable, all else being equal. To test this prediction, we regress an REIT's value proxy on the instrumented PptyMktLiq ($\hat{T}^{HP\ dist}_{i,y-1}$):

$$Q_{i,y} = \alpha \, \hat{T}^{HP\ dist}_{i,y-1} + \beta X_{i,y-1} + \varphi_i + \delta_y + e_{i,y}, \tag{11}$$

where $Q_{i,y}$ stands for the REIT's annual Tobin's Q in year y for firm i, which has been widely used as a measure of firm valuation (Capozza & Seguin, 1999; Capozza & Seguin, 2003; Ling et al., 2021b; Riddiough & Steiner, 2020). Note that $Q_{i,y}$ is defined as the ratio of market equity (stock price times the number of shares) to replacement costs. We follow Ling et al. (2021b) and calculate replacement costs as the book value of property, adding back depreciation minus book liabilities. The control variables are the same as in the previous sections. The results of this regression are reported in Table 5. The coefficient for $\hat{T}^{HP\ dist}_{i,y-1}$ is significant and positive, which indicates a significant positive relation between property market liquidity and REIT relative valuation. A one-standard-deviation increase in property market liquidity is associated with a 5.17% increase in value, as measured by Tobin's Q. Moreover, consistent with previous literature, Gopalan et al.'s (2012) balance sheet liquidity measure, WML2, also exhibits a significant positive coefficient. This result confirms the value of cash holdings for REITs. However, and more to the point of our study, property market liquidity further increases Tobin's *Q* for REITs above and beyond the effects of balance sheet liquidity.

5 CONCLUSION

We propose a novel approach to investigate the asset–stock liquidity relation for REITs by extending the concept of asset liquidity to include information based on local property market turnover. Gopalan et al. (2012) examine the relation between the level of cash on a firm's balance sheet and the liquidity of financial claims on the firm's assets. Likewise, much of the prior literature takes a cash-centric perspective on balance-sheet liquidity (Charoenwong et al., 2014; Giambona et al., 2008; Hill et al., 2012). Our study aims to shift this paradigm by focusing on the liquidity of fixed assets. Specifically, we examine the relation between a firm's tangible fixed asset liquidity and its stock liquidity. A potential shortcoming with a cash-centric perspective on balance-sheet liquidity is that it ignores the cross-sectional differences in tangible fixed assets. Real estate firms (i.e., REITs) provide an important laboratory for this study, as the liquidity of fixed assets can be quantified by the liquidity of underlying property markets. Our study attempts to address this shortcoming using a measure of liquidity based on the individual fixed assets on an REIT's balance sheet.

Based on REITs' firm-level data over the period from 1996 to 2015, we find a significant impact on individual REIT liquidity due to the liquidity of the local, underlying property market in which the assets are located. Our analysis controls for self-selection bias and reversal causality. A one-standard-deviation increase in property market liquidity reduces Amihud, Roll, and spread ILLIQ by 0.134, 0.077, and 0.124 standard deviations, respectively. The sensitivity of REIT share liquidity to the underlying property market also depends on the firm's information environment, growth opportunity, and financial constraints. We further show that stock liquidity caused by the liquidity of the markets in which the underlying assets are located can explain stock valuation in a statistically significant way: A one-standard-deviation increase in an REIT's property market liquidity results in a 5.17% increase in its Tobin's *Q*. The positive relationship between the liquidity of underlying local real estate markets and REIT share liquidity, as well as the valuation effect, implies that corporate investment decisions, including the selection of geographic markets, can affect stock liquidity and firm value.

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APPENDIX A

DETAILS OF IV ESTIMATION AND STOCK LIQUIDITY METHODOLOGY

An instrumented variable estimation is used to address two identification challenges. The first is that $w_{m.i,t}$ may be affected by self-selection; some REITs have a bias for less risky and more liquid real estate markets. As Ghent (2021) demonstrates, delegated investors are concentrated in cities with higher turnover. To address this issue, we use the relative distance between a REIT's property market holdings and the REIT's headquarters as an instrument for $w_{m.i,t}$. Based on home bias

theory (Coval & Moskowitz, 1999), the distance of assets from headquarters can be a good predictor of a firm's asset allocation. Market participants often choose local investments to reduce information asymmetry in opaque information environments (Garmaise & Moskowitz, 2004; Ling, Naranjo, et al., 2021). Hence, for each firm, we regress the proportion of properties in MSA m on the distance from the headquarters:

$$w_{m.i,t} = p + q \ln D_{m,i,t} + e_{i,t}, \tag{A1}$$

where $D_{m,i,t}$ is the average distance of properties located in MSA m from the headquarters of REIT i. For instance, if two properties are located in MSA m, $D_{m,i,t}$ is the average distance of these two properties from the REIT's headquarters; q, is −0.052; and the t-statistic is −189.77. The F-statistic is also significant at the 1% level. Hence, distance from the headquarters is a valid instrument. The instrumented weight is calculated as $\hat{w}_{m.i,t} = \hat{p} + \hat{q} \ln D_{m,i,t}$.

A potential criticism of using distance from the headquarters as an exogenous instrument is that the liquidity of a firm's shares can also be affected by the investment diversification strategy. For instance, Garcia and Norli (2012) find that local firms have lower investor recognition, which implies lower stock liquidity for local firms. We note and emphasize that we are using the relative distance of each property from the headquarters as the instrument; we are not using the absolute distance. Therefore, this instrument is not affected by whether the firm is a local firm or dispersed firm and is independent of the average distance of the assets from the headquarters. For example, if firm A has all its assets in one distant MSA and if firm B has all its assets in its headquarters' MSA, the weights for both firms are 1, although firm A is a dispersed firm and firm B is a local firm.

The second identification challenge is the reversal relationship. REIT transactions affect property market liquidity, which results in a reversal relationship—that is, REIT liquidity influences property market liquidity. In particular, our property market liquidity is measured by NCREIF turnover, which is based on the transactions of NCREIF members; these include some REITs. As a result, REIT investment activities may influence NCREIF turnover. Given that REITs are not the major investors in residential markets,[14] we use house price change as the instrument for NCREIF turnover. In other words, an REIT's investments should not influence the local residential market directly, with the exception of apartment REITs. However, in our sample, less than 10% of the observations are from apartment REITs, so the results may not be seriously affected. If we exclude apartment REITs from the sample, the results are quite robust.[15] Thus, we regress the MSA turnover rate on the change in a residential house price index:

$$Turnover_{m.t} = l + g\Delta \ln HP_{m,t} + e_{m,t}. \tag{A2}$$

[14] The National Association of Real Estate Investment Trusts (NAREIT) identifies 21 residential REITs for 2021, and the total assets of these residential REITs was 124 billion USD (S&P Market Intelligence Database). In contrast, US housing stock reached 33 trillion in 2020 (Zillow Data), with approximately 1.9 trillion USD homes being sold in 2020 (REALTOR Data)

[15] We thank several conference participants, most particularly Roland Füss, for motivating this analysis. The results are reported in Table A1.

Considering that the turnover rate is always between 0 and 1, we use a probit panel regression. The estimated g 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^2 is 24%. The F-statistic is 8.29, which is significant at the 1% level; this confirms the relevance of the instrument.

Luo et al. (2017) find that changes in house prices have an impact on local stock liquidity. For our analysis, house price change is calculated for the MSAs in which the REIT's properties are located and not necessarily for the REIT's headquarters MSA. Most REITs have assets outside their home MSA. However, Lou et al.'s finding does not necessarily imply that REIT stock liquidity is affected by house prices in the underlying property MSAs. Consequently, and as a robustness test, we exclude those REITs with all investments in their home MSA. As shown in Table A1, the results remain robust. In our cross-firm analysis, we also find that firms with a larger share of assets in their home MSA exhibit a less positive relationship between property market liquidity and REIT stock liquidity. This further confirms that Luo et al.'s (2017) findings do not seriously influence our findings based on REITs.

Another consideration is that the exclusion restriction may be violated when both stock liquidity and home prices are driven by local macroeconomic conditions. However, national macroeconomic conditions have been captured by our time fixed effects. National-level sentiment has also been included as a robustness test. As shown in Appendix A and Table A1, the results are robust. Local economic conditions have been controlled for by the GDP growth rate of the MSA in which the REITs allocate their assets. Thus, we argue that the independence restriction is satisfied conditional on the fact that national and local macroeconomic conditions have been controlled for. In the robustness test, we included the MSA-level NCREIF property return weighted by property locations as an additional control variable. As shown in Table A1, the results are also robust.

One issue with the two-stage least squares regression is that the standard error of the instrumented variable can be biased. Therefore, we use bootstrapping to generate the standard error of $\hat{T}_{i,t}^{HP\ dist}$. We first bootstrap Equation (A1) and then bootstrap Equation (A2) using the bootstrapped $\hat{w}_{m.i,t}$ and $\hat{\tau}_{m,t}$ to generate the standard error of α.

In this article, we use three REIT stock liquidity measures. The first is the illiquidity measure proposed by Amihud (2002). For each stock, the monthly illiquidity ratio is defined as:

$$ILLIQ_{it} = 1/D_{it} \sum_{d=1}^{D_{it}} |R_{itd}| / VOLD_{itd}, \tag{A3}$$

where D_{it} is the number of days for which data are available for stock i in month t. Note that R_{itd} is the return on stock i on 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 the closing price of the previous day ($VOL_{itd}P_{itd-1}$). Stock illiquidity is compounded in a given month only if more than 15 days of data are available for that month ($D_{it} > 15$).

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

$$s_{it} = \sqrt{-\mathrm{cov}\left(R_{itd}, R_{itd-1}\right)}, \tag{A4}$$

TABLE A1 Robustness tests for instrumented property market liquidity

	(1) Instrumented (excluding Home MSA)	(2) Instrumented (excluding Residential)	(3) MSA-RE Return	(4) National Sentiment
Panel A: Amihud ILLIQ				
PptyMktLiq	−0.336***	−0.283***	−0.218***	−0.260***
	(−15.86)	(−12.53)	(−9.53)	(−8.13)
MSA CRE Return			−1.821***	
			(−6.72)	
Sentiment				−0.277***
				(−17.88)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	P,F
No. of observations	7847	7775	8094	8170
Adjusted R^2	0.829	0.828	0.833	0.568
Panel B: Roll ILLIQ				
PptyMktLiq	−0.013***	−0.009***	−0.006***	−0.006**
	(−9.29)	(−6.33)	(−4.27)	(−2.07)
MSA CRE Return			−0.090***	
			(−6.00)	
Sentiment				−0.014***
				(−9.60)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	P,F
No. of observations	8137	8039	8389	8468
Adjusted R^2	0.702	0.712	0.705	0.459
Panel C: Price Spread				
PptyMktLiq	−0.038***	−0.030***	−0.026***	−0.034***
	(−15.40)	(−12.71)	(−8.60)	(−3.80)
MSA CRE Return			−0.196***	
			(−7.76)	
Sentiment				−0.031***
				(−22.00)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	P,F
No. of observations	8135	8037	8381	8460
Adjusted R^2	0.835	0.826	0.839	0.568

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as the Amihud illiquidity measure (Panel A), Roll illiquidity measure (Panel B), and price spread (Panel C). In Model (1), REITs with over 90% of assets in the home MSA are excluded from our sample. In Model (2), residential REITs are excluded from the sample. In Model (3), MSA-level NCREIF property return weighted by property locations is added as an additional control variable. In Model (4), the Michigan sentiment index is added as an additional control variable. As the sentiment index is nationwide, time fixed effects have been removed. Other specifications are the same as in Table 3. The standard error for PptyMktLiq is measured using bootstrapping. The *t*-statistics are reported in parentheses. *** denote significance at the 1%.

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 the transaction: If the autocorrelation of stock returns is positive, it is set to be 0.

The third liquidity measure is the observed bid–ask spread, which is calculated as the quoted percentage spread. It 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 month t:

$$Qspread_{it} = \frac{1}{D_{t,i}} \sum_{d=1}^{D_t} \frac{Ask_{itd} - Bid_{itd}}{(Ask_{itd} + Bid_{itd})/2} \tag{A5}$$

Ask_{itd} and Bid_{itd} are the ask and bid quotes prevailing at the time of the dth trade of asset i in month t.

APPENDIX B
ROBUSTNESS BASED ON AN ALTERNATIVE PROPERTY MARKET LIQUIDITY PROXY

Using property transaction data provided by real capital analytics (RCA) from 2005 to 2018, (van Dijk & Francke, 2021) estimate liquidity indices based on the demand and supply reservation price for 31 US regions. The RCA liquidity indices provide an alternative metric for NCREIF turnover. As shown in Figure B1, the national average of van Dijk and Francke's RCA liquidity index shares a quite similar trend with our NCREIF turnover metric; the overall pattern of results reported in Table B1 using RCA-derived data as an alternative property market liquidity proxy is remarkably similar to those reported in Table 3, our main results. Based on the RCA liquidity index, a one-standard-deviation decrease in property market liquidity is associated with a 0.1162-standard-deviation decrease in Amihud stock liquidity, which confirms a positive relationship between REIT shock liquidity and property market liquidity.

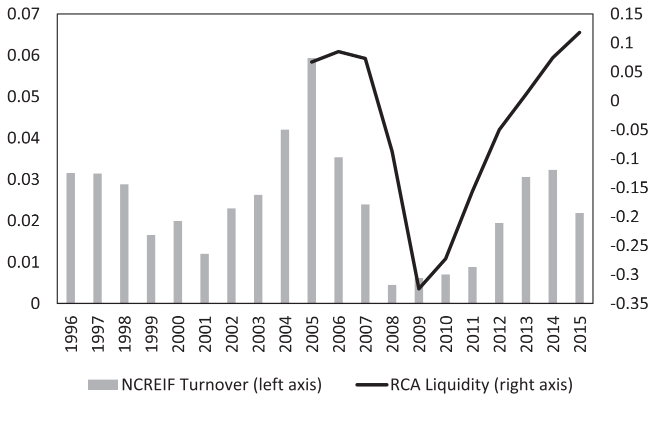

FIGURE B1 Average liquidity measures across property markets
Note: This graph shows the average turnover rate based on NCREIF data across 144 MSAs from 1996 to 2005. For comparison and robustness testing, we include the average of an alternative liquidity measure, developed by van Dijk and Francke (2021), based on RCA data. The latter indices cover 31 US regions; however, van Dijk and Francke's liquidity measurement is only available since 2015.

TABLE B1 Robustness tests for RCA-based property market liquidity

	Panel A:Amihud ILLIQ			Panel B:Roll ILLIQ			Panel C:Price Spread		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
PptyMktLiq (RCA)	−0.193***	−0.193***	−0.192***	−0.008***	−0.008***	−0.008***	−0.028***	−0.028***	−0.028***
	(−4.93)	(−4.62)	(−4.89)	(−3.04)	(−2.79)	(−3.04)	(−5.75)	(−6.02)	(−5.75)
WAL1	−0.038			0.001			−0.002		
	(−1.57)			(0.47)			(−0.67)		
WAL2		−0.049**			0.001			−0.005**	
		(−2.01)			(0.69)			(−2.17)	
WAL3			−0.018*			0.001			−0.001
			(−1.82)			(1.50)			(−1.30)
Volatility	0.163***	0.163***	0.163***	0.010***	0.010***	0.010***	0.025***	0.025***	0.025***
	(8.20)	(7.79)	(8.24)	(7.07)	(7.62)	(7.62)	(12.65)	(13.26)	(12.60)
MOM	−0.073***	−0.073***	−0.073***	−0.003***	−0.003***	−0.003***	−0.010***	−0.010***	−0.010***
	(−4.50)	(−4.19)	(−4.43)	(−2.78)	(−2.78)	(−3.13)	(−6.00)	(−6.40)	(−6.40)
Debt-to-Equity	0.004***	0.004***	0.004***	0.000**	0.000**	0.000**	0.001***	0.001***	0.001***
	(3.15)	(3.08)	(3.15)	(2.00)	(2.00)	(2.00)	(5.00)	(5.00)	(5.00)

(Continues)

TABLE B1 (Continued)

	Panel A:Amihud ILLIQ			Panel B:Roll ILLIQ			Panel C:Price Spread		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
Size	−0.031***	−0.031***	−0.031***	−0.001*	−0.001*	−0.001*	−0.004***	−0.004***	−0.004***
	(−9.15)	(−9.78)	(−9.12)	(−1.67)	(−1.67)	(−1.67)	(−9.00)	(−9.00)	(−9.00)
Price to Book	−0.005***	−0.005***	−0.005***	0.000	0.000	0.000	−0.001***	−0.001***	−0.001***
	(−3.57)	(−3.57)	(−3.79)	(0.00)	(0.00)	(0.00)	(−4.50)	(−4.50)	(−4.50)
HHI_MSA	−0.019	−0.016	−0.020	−0.002*	−0.002*	−0.002**	−0.002	−0.001	−0.002
	(−1.09)	(−0.93)	(−1.18)	(−1.67)	(−1.75)	(−2.00)	(−1.11)	(−0.72)	(−1.06)
Institutional ownership	−0.111***	−0.111***	−0.112***	−0.001	−0.001	−0.001	−0.010***	−0.010***	−0.010***
	(−11.71)	(−11.73)	(−11.74)	(−1.00)	(−1.00)	(−1.00)	(−7.92)	(−7.92)	(−7.92)
PropDensity	−0.003	−0.003	−0.005	0.000	0.000	0.000	−0.000	0.000	−0.000
	(−0.62)	(−0.58)	(−1.08)	(0.25)	(0.00)	(0.33)	(−0.20)	(0.20)	(−0.40)
MSA GDP	−0.392***	−0.391***	−0.377***	−0.013	−0.013	−0.013	−0.026*	−0.026	−0.025
	(−2.90)	(−2.82)	(−2.74)	(−1.02)	(−0.96)	(−1.08)	(−1.66)	(−1.63)	(−1.58)
FE	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	5218	5218	5218	5413	5413	5413	5412	5412	5412
Adjusted R^2	0.868	0.868	0.868	0.737	0.737	0.737	0.895	0.895	0.895

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as the Amihud illiquidity measure, Roll illiquidity measure, and interday price spread. PptyMktLiq (RCA) stands for the liquidity of the underlying property market, and each REIT is exposed based on the RCA MSA-level liquidity index. Model specifications are the same as in Model (3), Table 3. The *t*-statistics are reported in parentheses.***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX C
ROBUSTNESS BASED ON ASSET CHARACTERISTICS, LIQUIDATION VALUE, AND REDEPLOYABILITY

In the baseline model, we argue that the liquidity of underlying property markets in which firms allocate their assets influences the liquidity of that asset. Previous literature documents other factors that can influence the liquidation value of assets. For instance, Liu et al. (2019) and Giambona et al. (2008) use the lease maturity and loss severity rate to measure the asset liquidation value. Liu et al. (2019) and Lu-Andrews (2017) investigate tenant quality. Benmelech et al. (2005) and Giambona et al. (2008) study the impact of asset redeployability, which reflects the flexibility of converting the current asset to suit an alternative owner/user. As a robustness test, we further test whether our property market liquidity measurement can add information to the other factors, such as asset quality and redeployability. In Model (1), Table C1, we include tenant credit rating and the share of long-term leases. Tenant credit rating is the average S&P rating of the top 30 tenants of the REITs, weighted by the share of each tenant's rental revenue. Long-term leases is the share of long-term leases (leases with a rental term more than 5 years) to total leases. In Model (2), Table C2, we explore the impact of the recovery rate. We follow Giambona et al. (2008) and define the recovery index as the weighted average recovery rate based on Standard and Poor's study of CMBS recoveries by property type and the REIT's property type portfolio. Regarding the recovery rate, we follow the Standard and Poor's (2005) report and obtain 70.2% for residential apartments, 61.1% for offices, 60.5% for industrial properties, 59.8% for retail properties, and 51.5% for hotels and motels. In Model (3), Table C3, we create an index for land-use restrictions. Ideally, we should follow Benmelech et al. (2005) and create a zoning flexibility index. However, we do not have microlevel zoning information. Therefore, we extract county-level indicators from the Wharton Residential Land Use Regulation Index (Gyourko et al., 2008) as a proxy. The Land Use Flexibility Index is calculated as the average of the standardized State Political Involvement Index, State Court Involvement Index, Local Zoning Approval Index, Local Project Approval Index, Local Assembly Index, Exactions Index, Approval Delay Index, and Density Restriction Index for each county. Model (4), Table C1, includes all asset liquidation value factors and the property market liquidity measurement.

As shown in Table C1, from Model (1) to Model (4), the coefficient for property market liquidity remains significantly negative, which confirms that the property market liquidity in the MSA in which the properties are located can add additional information to other liquidation value factors. Additionally, in Model (1), Panels A and C, tenant quality has a significant negative coefficient, indicating that better tenant quality can reduce uncertainty and improve stock liquidity. In Model (3), Panels B and C, land-use flexibility indicators have a significant positive coefficient, which confirms that the ease of adapting the properties to new tenants/users improves stock liquidity. In Model (4), Panels A and C, the recovery rate shows a significant negative coefficient, which indicates that a higher recovery rate improves REIT stock liquidity. In Model (4), Panel C, we also see a significant negative coefficient of tenant quality and a significant positive coefficient of land-use restrictions, consistent with the results in Panel C, Models (1) and (3).

TABLE C1 Robustness tests for asset liquidation value

	(1) Asset quality	(2) Recovery rate	(3) Land-use flexibility	(4) All
Panel A: Amihud ILLIQ				
PptyMktLiq	−0.201***	−0.295***	−0.339***	−0.271***
	(−9.44)	(−14.00)	(−15.77)	(−10.77)
Tenant credit	−0.001*			0.000
	(−1.71)			(0.00)
Long-term lease	−0.021			0.001
	(−0.88)			(0.06)
Recovery rate index		0.038		−0.100***
		(1.31)		(−3.21)
Land-use flexibility			−0.058	0.063
			(−1.11)	(0.87)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4422	8352	6610	3497
Adjusted R^2	0.904	0.828	0.868	0.901
Panel B: Roll ILLIQ				
PptyMktLiq	−0.008***	−0.009***	−0.010***	−0.009***
	(−4.28)	(−6.07)	(−5.11)	(−4.14)
Tenant credit	0.000			0.000
	(0.00)			(0.00)
Long-term lease	−0.003			−0.002
	(−1.63)			(−0.92)
Recovery rate index		−0.003		0.000
		(−1.25)		(0.13)
Land-use flexibility			0.005	0.004
			(1.46)	(0.87)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4605	8643	6841	3680
Adjusted R^2	0.785	0.687	0.722	0.783
Panel C: Price Spread				
PptyMktLiq	−0.031***	−0.033***	−0.045***	−0.041***
	(−13.08)	(−13.08)	(−17.88)	(−13.67)
Tenant credit	−0.000***			−0.000***
	(−3.00)			(−3.00)
Long-term lease	−0.003			−0.001
	(−0.97)			(−0.19)

(Continues)

TABLE C1 (Continued)

Panel C: Price Spread				
Recovery rate index		0.005**		−0.010***
		(2.04)		(−2.86)
Land-use flexibility			0.022***	0.014*
			(3.79)	(1.68)
Control variables	Yes	Yes	Yes	Yes
FE	T,P,F	T,P,F	T,P,F	T,P,F
No. of observations	4605	8641	6839	3680
Adjusted R^2	0.918	0.830	0.873	0.912

Note: This table reports the results of the unbalanced panel with fixed effects. The dependent variable is REIT stock liquidity, which is measured as the Amihud ILLIQ (Panel A), Roll ILLIQ (Panel B), and interday price spread (Panel C). Tenant credit rating is the average S&P rating of the top 30 tenants of the REITs, weighted by the share of each tenant's rental revenue. Long-term lease is the share of long-term leases (leases with rental term of more than 5 years) to total leases. Recovery index is the weighted average recovery rate based on the S&P study of CMBS recoveries by property type and the REIT's property type portfolio. The Land Use Flexibility Index is calculated as the average of the standardized State Political Involvement Index, State Court Involvement Index, Local Zoning Approval Index, Local Project Approval Index, Local Assembly Index, Exactions Index, Approval Delay Index, and Density Restriction Index for each county, weighted by the county-level property portfolio. Other specifications are the same as in Model (3), Table 3. The standard error for PptyMktLiq is measured using bootstrapping. The *t*-statistics are reported in parentheses.***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.