Research Programme
2011–2015

Estimating Liquidity in Real Estate Markets - Literature Review

This research was commissioned by the IPF Research Programme 2011–2015

FEBRUARY 2015

This research was funded and commissioned through the IPF Research Programme 2011–2015.

This Programme supports the IPF's wider goals of enhancing the understanding and efficiency of property as an investment. The initiative provides the UK property investment market with the ability to deliver substantial, objective and high-quality analysis on a structured basis. It encourages the whole industry to engage with other financial markets, the wider business community and government on a range of complementary issues.

The Programme is funded by a cross-section of businesses, representing key market participants. The IPF gratefully acknowledges the support of these contributing organisations:

Literature Review

IPF Research Programme 2011–2015

February 2015

This paper – one of three papers re-visiting the liquidity of real estate – reviews the literature published over the last decade since the IPF original research into liquidity was published in 2004. Two further papers form part of this current study, *Time on Market: Measurement and Drivers* (published September 2014) and *Liquidity Pricing of Illiquid Assets* (published February 2015). A Summary Report is also available (published February 2015).

Estimating Liquidity in Real Estate Markets

Authors

Frank Ametefe, *Henley Business School, University of Reading*
Steven Devaney, *Henley Business School, University of Reading*
Gianluca Marcato, *Henley Business School, University of Reading*

Project Steering Group

Mark Callender (Chairman), *Schroders*
Colin Lizieri, *University of Cambridge*
Joseph Kelly, *formerly Real Capital Analytics*
Pam Craddock, *IPF*

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Estimating Liquidity in Real Estate Markets

1. LIQUIDITY DIMENSIONS AND CAUSES

The role of liquidity in asset pricing is the subject of a vast literature developed over the last 30 years. A recent paper, by Brunnemeier and Pedersen (2009), both theoretically and numerically modelled the relationship between the two main aspects of an asset's liquidity: trading, as defined by "the ease with which it is traded" and funding, represented by "the ease with which [investors/traders] can obtain funding".

The main focus of the present paper is trading (or market) liquidity, following from the first work that was commissioned by the IPF, published in 2004: *Liquidity in Commercial Property Markets* – referred to as IPF (2004). Hence, unless specified otherwise, liquidity in this report refers to the aspect of trading (or market) liquidity.

Goodhart (2008) contends that liquidity has many facets and, hence, it requires a further and closer definition. In this spirit, the main part of the IPF (2004) literature review addressed this definition in the context of real estate markets. IPF (2004) reached two main conclusions in this respect:

- Liquidity not only represents the amount of transaction activity but its impact on cost and price as well;
- No unique definition of liquidity exists and research should consider several dimensions of this risk.

Furthermore, by adding one dimension to the ones highlighted in IPF (2004), five main characteristics of market liquidity can be identified:

i. Tightness: the cost of trading, even in small amounts;

ii. Depth: the capacity to sell/buy without causing price movements;

iii. Resilience: the speed at which the marginal price impact increases as trading quantities increase;

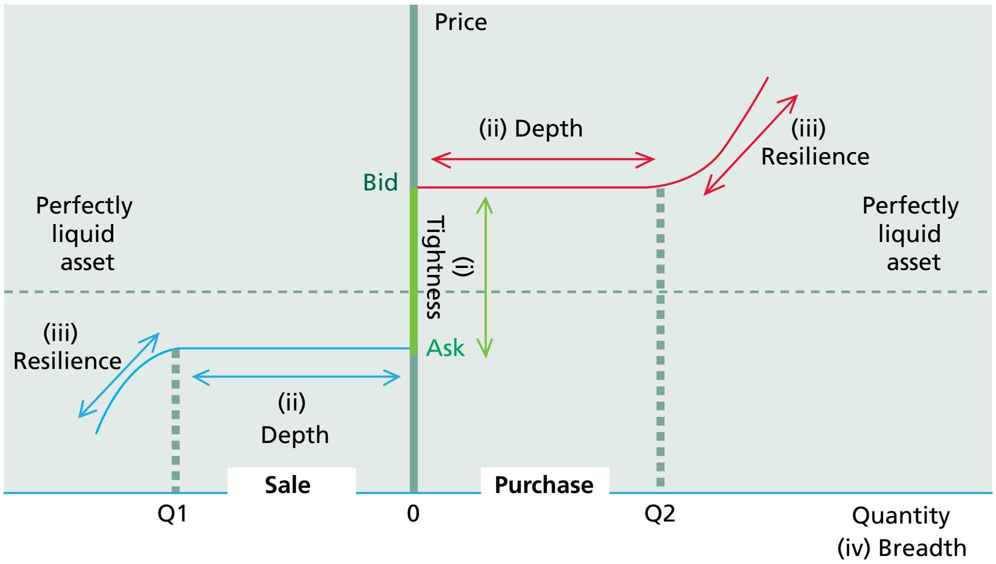
iv. Breadth: the overall size of the volume traded;

v. Immediacy: the cost (discount/premium) to be applied when selling/buying quickly.

Following from Kyle (1985), the first three dimensions of market liquidity are graphically represented in Figure 1.1 – adapted by Hibbert et al. (2009) from Kerry (2008) – where demand and supply curves (respectively represented as red and blue curves) can be compared with the ones of a perfectly liquid asset (horizontal dotted line), whose price would be constant, regardless of the amount of transacted volumes (i.e. no price impact is identified for any volume of trading activity).

1. LIQUIDITY DIMENSIONS AND CAUSES

Figure 1.1: Dimensions of market liquidity (adapted from Hibbert et al. 2009)



On the demand side (red curve), even with a minimum amount of transacted volumes, the buyer needs to pay a price to enter the transaction (Bid on the red line), which is normally above the fundamental price for a perfectly liquid asset. On the opposite side of the trade, the seller needs to accept to receive a price (Ask on the blue line), which is below the one of a perfectly liquid asset, and the discount represents the illiquidity cost to the seller. The difference between Bid and Ask is normally referred to as the bid/ask spread, which corresponds to the green line in Figure 1.1.

Remaining on the demand curve (red), if the buyer decides to increase the order flow, initially the marginal impact of such a change (i.e. first derivative of the demand function) is zero (the line is horizontal) and the length of the initial horizontal section of the curve defines the market depth of an asset (the longer the line, the deeper the market). However, after a certain threshold of transacted volumes/quantities (Q2 in Figure 1.1), the marginal impact of an additional unit of trading volume increases and the speed of this continuous increase defines the resiliency of such a market. In other words, for larger quantities of buy orders introduced in a market, the impact on the price is incrementally increasing.

The same (but with opposite sign) applies to a seller and the supply function (blue curve). Initially, the marginal price change is zero. However, beyond a particular threshold of transacted volumes (Q1 in Figure 1.1), it decreases incrementally as more sell orders come to market.

If markets were fully efficient, assets would be perfectly liquid (transaction prices would stay on the dotted horizontal line). In other words, assets with similar cash flows should reflect similar valuations. However, some asset/market characteristics may lead to different valuations (and expected returns) for investments with similar cash flows and the main reason for such differences is the presence of market imperfections. A recent paper by Vayanos and Wang (2011) – following other work done by Hasbrouck (2007) and O'Hara (1995) in market microstructure and Amihud et al. (2005) in asset pricing – surveyed the liquidity literature both theoretically and empirically. They categorise market imperfections into six main groups that are discussed briefly: transaction and participation costs, imperfect competition, asymmetric information, funding constraints and search costs.

1. LIQUIDITY DIMENSIONS AND CAUSES

Firstly, participation costs arise because there is no immediate and continuous access to the entire population of counterparty agents[1] in a trade (i.e. sellers cannot interact with all buyers and vice versa). Hence, agents have to incur a cost to enter the market and this makes them willing to invest only if compensation for this cost is offered in terms of a liquidity premium – see Huang and Wang (2009) and Amihud and Mendelson (1980). Another consequence is the infrequent arrival of agents into the market, with market makers almost obliged to take losses. A clear example of such expenses in real estate markets is represented by the absence (for some market segments/products) of an active secondary market (e.g. derivative products for small market segments) and the entry of hedge funds and more aggressive players just before and during the most recent economic crisis.

Secondly, transaction costs refer to the expenses associated with the execution of a trade and can make the effective buying and selling price of the same transaction diverge. A consequence is that assets with transaction costs trade at a lower price in equilibrium (i.e. offer a premium) but this effect can be mitigated by the lengthening of the investment horizon – see Amihud and Mendelson (1986), Acharya and Pedersen (2005) and Beber et al. (2012) among others. Examples of transaction costs are taxes and brokerage fees, which are notoriously higher for assets such as real estate (in the UK, fees related to a single transaction of direct property for the buyer and seller are approximately 5.5% and 1.5%, respectively). Another clear example is offered by the measure of tightness (in the categorisation above), which indicates different levels of liquidity in the difference between bid-ask spreads of equity and real estate derivatives (i.e. total return swaps) markets.

Thirdly, asymmetric information can exist because some agents have access to private information (not observable by others) or information is obtained from different sources or processed differently. This situation will lead to a liquidity premium when agents want to invest in markets with a high proportion of private information (O'Hara 2003; Easley and O'Hara 2004). It can also cause spillover effects[2] in other assets/markets because of information inefficiencies – see Cespa and Foucault (2014). This market imperfection is especially important for markets with scarce and thin information such as real estate, where a greater difference between offer prices can be observed than in more efficient markets, such as those for publicly-traded equities or bonds.

Fourthly, imperfect competition is linked to the scale of different market players and, hence, their asymmetric impact on prices, either due to their size or information advantage. Seminal works in this area by Kyle (1985, 1989), show the dynamics of risk sharing (DeMarzo and Urosevic, 2006; Brunnermeier and Pedersen, 2005) and the conditions for market failure (Glosten, 1989). They have been further extended to incorporate different speeds of information revelation caused by risk-averse agents (Baruch, 2002), insiders (Chau and Vayanos, 2008) and the presence of regulation (Huddart et al., 2001). The issue of imperfect competition is even more important for heterogeneous and non-divisible goods like real assets. For example, small investors cannot easily obtain information about asset payoffs (only available to large investors) and they do not have access to some investment opportunities because of diversification issues caused by the size of these investments relative to other assets in the portfolio (Fuerst and Marcato, 2009).

[1] Throughout this report, economic agents are meant, rather than estate agents/brokers, when using the word 'agents'.
[2] A secondary effect that follows from the primary source.

1. LIQUIDITY DIMENSIONS AND CAUSES

Fifthly, funding constraints do not allow agents to borrow freely, restricting their capacity to invest in some markets or segments. This phenomenon may be linked to the uncertainty attached to the liquidation value (Hart and Moore, 1994, 1995; Shleifer and Vishny, 1992) and limits to financing applied on intermediaries offering liquidity (Gromb and Vayanos, 2002; Liu and Longstaff, 2004). Furthermore, a possible contagion (or spiral) effect is found for assets that would be otherwise unrelated, as have been seen over the most recent financial crisis (Brunnermeier and Pedersen, 2009), especially for agents with a short investment horizon (e.g. open-ended funds; Shleifer and Vishny, 1997) and even for optimal contracts (Acharya and Viswanathan, 2011). Funding constraints are probably the one market imperfection that interacts most with all other imperfections. Hence Albagli (2011) and Krishnamurthy (2010), among many others, have focused on this interaction to tease out plausible amplifying effects.

Sixthly, search costs arise from a decentralised form of organisation – the normal way OTC (over-the-counter) markets operate – and they are associated with the need of finding a counterparty – see Duffie et al. (2002, 2005, 2007) and Vayanos and Wang (2007) among others. This market imperfection is particularly applicable to direct real estate and other unlisted financial products based on those assets (e.g. property derivatives and unlisted funds). A vast literature on this cause of liquidity has also been developed for the housing sector.

On the empirical front, several studies have tried to estimate the liquidity premia priced in to asset returns. In particular, Amihud et al. (2005) offer a summary of the main asset pricing literature, which theoretically predicts and empirically finds liquidity to be a statistically and economically significant factor, even after controlling for risk measures and asset characteristics. In fact, the introduction of a liquidity factor in asset pricing models improves the explanatory power of cross-sectional differences in returns, indicating the willingness of investors to pay a premium for more liquid assets and it helps to explain some asset pricing puzzles, such as the yield differential between on-the-run and off-the-run Treasuries and between corporate and government bonds (e.g. Longstaff et al., 2005; Bao et al., 2011; Chen et al., 2007), as well as the pricing of alternative assets like hedge funds, closed-end funds, and over-the-counter and hard-to-trade securities (e.g. Sadka, 2010; Franzoni et al., 2012).

Finally, for a concise summary of the liquidity premia estimated for several assets, the reader is referred to Hibbert et al. (2009), who report the findings of seminal papers showing the extent of the premia across and within traditional asset classes. For equities, they consider both developed economies and emerging markets. The latter show a significant impact of liquidity that is augmented by a reduced clientele effect, due to the lack of heterogeneity in ownership and securities structures, which sometimes even prevents global investors from entering such markets. Moreover, the importance of both global and local conditions for its pricing – in line with the concept of commonality in liquidity as in Chordia et al. (2000) – appears to be useful in the modelling exercise, as in Bekaert et al. (2007). For bonds, instead, Hibbert et al. (2009) survey three main categories – government, covered and corporate – and find premia increasing with liquidity risk. In the next section of this literature review, the authors present the liquidity measures used in empirical studies so far.

2. MEASURES OF LIQUIDITY

Liquidity itself is not directly observable and, therefore, proxies need to be created. The literature in market microstructure and finance has identified several trading-based variables that measure different dimensions of liquidity, mirroring the need to capture all these facets, either combined (Korajczyk and Sadka, 2008) or separately. Moreover, some studies have shown that mixed results with respect to liquidity premia may arise from the use of different aspects of overall liquidity risk in the analysis (e.g. Baker, 1996; Bertin et al., 2005). As a consequence, the authors have identified a series of measures that may be helpful to describe liquidity and to compare results across assets and market segments.

In this section, several indicators used in the literature are presented and grouped into five main categories:

i. Transaction cost measures;

ii. Volume-based measures;

iii. Price impact measures;

iv. Time-based measures;

v. Return-based measures.

This classification is analogous to that of Sarr and Lybek (2002), but is extended by isolating return-based measures in a separate category and by adding time-based measures, which are used extensively for real estate assets. The measures can be linked back to the different dimensions of liquidity (tightness, depth, etc.) identified earlier and this is done in the final part of this section, which also summarises the formulae or models required for each measure and the applicability of each one to real estate markets, the focus of this report.

2.1 Transaction Cost Measures

Transaction cost measures capture trading frictions in financial markets. Amihud and Mendelson (1986) state that "illiquidity can be measured by the cost of immediate execution" and "a natural measure of illiquidity is the spread between the bid and ask prices". The difference between ask and bid price and related measures give an approximation of the cost for trading, in addition to taxes and fees, that the investor has to pay to execute the trade.

Demsetz (1968) initiated research on bid-ask spreads empirically and several studies have followed his ground-breaking work. Acker et al. (2002), for example, examine the determinants of bid-ask spreads and their behaviour around corporate earnings announcement dates, while Harris et al. (2002) study the price discovery mechanism by comparing the trading patterns in different stock exchanges. Clearly the higher the spread the more illiquid the market/security is. In the remaining part of this section, a variety of direct and indirect measures of bid-ask spreads are presented.

2.1.1 Absolute (Quoted) Spread

The absolute spread (sabs) is computed as the difference between the lowest ask price p_t^A and the highest bid price p_t^B as follows:

Equation 2.1

$$Sabs_t = p_t^A - p_t^B$$

2. MEASURES OF LIQUIDITY

This illiquidity measure is always positive and its lower boundary is the minimum tick size. While for small orders the quoted spread represents a good proxy for the execution costs of a trade, for larger ones other costs may also need to be added.

There are many examples of research studies that utilise this measure. For example, Chordia et al. (2001) and Corwin (1999) study stocks traded in the New York Stock Exchange, Christie and Schultz (1994) in the NASDAQ and Grammig et al. (2001) in the German market. Barclay et al. (1999) analyse the impact of the NASDAQ market reforms of 1997 ending the collusion among market makers, while futures markets are studied by Karagozoglu (2000).

Finally, some works use a logarithmic version of the absolute spread to improve the distributional properties (e.g. Hamao and Hasbrouck 1995). Its value is computed as follows:

Equation 2.2

$$LogSabs_t = \ln(p_t^A - p_t^B)$$

2.1.2 Relative Spread

The relative spread (also known as inside spread, e.g. Levin and Wright, 1999) represents the most extensively used measure of illiquidity because it allows a comparison between stocks with different stock prices. As it can be computed as a percentage of the last traded price (p_t) or of the middle price (p_t^M, average of bid and ask prices), an advantage of the latter is the possibility to compute it even if even if no trade takes place:

Equation 2.3

$$Srel\_last_t = \frac{p_t^A - p_t^B}{p_t}$$

$$Srel\_mid_t = \frac{p_t^A - p_t^B}{p_t^M}$$

2.1.3 Effective Spread

Even if bid-ask spreads reflect the cost of trading, these measures have also been criticised in the literature: for example, Grossman and Miller (1988) and Lee et al. (1993) document that a large number of transactions take place at prices outside the bid-ask range, hence the quoted spread seems to be too noisy. As a result, the effective spread better represents the round-trip cost of an order. It includes price movement (as dealers execute orders at a price better than previously quoted) and market impact (where the spread is widening due to the order size) and it is computed as follows:

Equation 2.4

$$Seff_t = |p_t - p_t^M|$$

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If the effective spread is smaller than half the absolute spread, trading is happening within quotes. For this reason, the effective spread is normally multiplied by two to make it comparable to other spread measures (Lin et al., 1995; Bacidore, 1997; Breedon and Holland, 1997; Jones and Lipson, 1999; Bacidore et al., 2002) and sometimes weighted with trade size (or number of trades) to obtain an average effective spread over a period of time (Lee et al., 1993). A liquidity premium can also be estimated, as in Battalio et al. (1998), who calculate it as $LP_t = I(p_t - p_m^t)$, where I is the direction of trade indicator (equal to 1 and -1 for trades initiated respectively by buyers and sellers) and the premium is positive if the buyer (seller) pays (receives) more (less) than the spread midpoint.

2.1.4 Relative Effective Spread

The relative effective spread can be computed with last trade or mid-price. The relative measure (often multiplied by two) facilitates comparability across securities:

Equation 2.5

$$Sreleff\_mid_t = \frac{|p_t - p_t^M|}{p_t^M}$$

$$Sreleff\_last_t = \frac{|p_t - p_t^M|}{p_t}$$

2.2 Volume-Based Measures

Volume-based measures distinguish liquid markets either by the absolute or relative amount of transactions to understand the breadth and depth of a market/asset. Barclay et al. (1998) argue that volume measures are indicators to be preferred to price discounts. Trading volumes can be measured in several ways, which include number of transactions and number or dollar volume of shares traded. Volume-based measures are most useful in measuring the breadth of the market and include: (i) transaction volume, (ii) turnover ratio, (iii) quote size, (iv) number of bids and (v) market depth.

2.2.1 Transaction Volume

Trading volume is an indirect liquidity measure widely used in the literature. Its popularity derives from empirical evidence that more active markets – e.g. Treasury bonds – tend to be more liquid and from theoretical studies linking increased trading activity with improved liquidity through ease of access and decrease in transaction costs. The popularity of such a measure (sometimes represented by 'order flows' in equity markets) reflects its simplicity and availability as volume figures are regularly reported for most assets. A drawback, however, is its association with market volatility, which may reduce market liquidity (Karpoff 1987).

Transaction volumes for a given period t (i.e. the dollar volume traded Vol_t) are computed as the sum of individual i trades within the period (computed as prices P_{it} times quantities Q_{it}).

Equation 2.6

$$Vol_t = \sum_{i=1}^{n} P_{it} Q_{it}$$

2. MEASURES OF LIQUIDITY

Initially, empirical studies on intraday patterns of share prices mainly focused on trading volume. Admati and Pfleiderer (1988) present the first comprehensive model, with informed and discretionary liquidity traders trading at the market opening and closing when many active traders reduce the price impact. Building on this finding, Brock and Kleidon (1992) model the pattern of intraday bid-ask spreads and find it best explained by a U-shaped function, when there is a corresponding pattern in transaction volumes. Jain and Joh (1988) study volumes for the S&P 500 Index constituents and Foster and Viswanathan (1993) examine shares with relatively low volumes.

2.2.2 Turnover Ratio

Turnover represents a proxy for the number of times the outstanding volume of an asset is transacted within a specified time period:

Equation 2.7

$$Turn_n = \frac{Vol_t}{(S_t * P_t)}$$

where Vol_t is the transaction volume, S_t is the number of outstanding securities of a certain asset and P_t is the average price of the *i* trades in the equation for transaction volumes. While its computation is easy for exchange-traded securities, an adequate coverage of transaction volumes and estimation of existing stocks represent critical issues for assets traded over the counter (i.e. OTC products) and for real estate. Amihud and Mendelson (1986) show that this measure is negatively correlated with illiquidity costs. In fact, when the turnover ratio is low, market makers tend to charge a higher transaction cost to cover the risk of holding their position (i.e. the higher the turnover ratio, the more liquid is the asset/market).

Turnover has been a popular liquidity measure in the literature (Rouwenhorst, 1999; Chordia and Swaminathan, 2000 and Dennis and Strickland, 2003). The theoretical motivation for using turnover as a liquidity proxy goes back to Demsetz (1968), who shows that the price of immediacy would be smaller for stocks with high trading frequency since frequent trading reduces the cost of inventory control. Glosten and Milgrom (1985) also show that shares with high trading volumes have lower levels of information asymmetry to the extent that information is revealed by prices. Finally, Constantinides (1986) finds that investors would increase their holding periods (thus, reducing turnover) when a stock is highly illiquid.

2.2.3 Quote Size

To be studied along with bid-ask spreads, quote size (QS) proxies for market depth and refers to the quantity of securities tradable at the bid and ask prices (Mann and Ramanlal 1996). As market makers do not necessarily reveal the full amounts they are willing to trade at the stated prices, the measured depth may underestimate the true depth:

Equation 2.8

$$QS = \frac{Average\ No.\ of\ Transacted\ Assets}{Average\ Size\ of\ the\ Market}$$

2. MEASURES OF LIQUIDITY

A related measure is represented by the quantity of securities actually traded at the bid and ask prices. A drawback of this measure is the limited availability of such information because market makers may decide not to reveal this amount. It can also underestimate market depth because the quantity actually traded does not necessarily reflect the amount that could have been traded at a given price.

2.2.4 Number of Bids

The number of investors who bid for a particular asset can be used as a measure of liquidity. The larger the number of bids, the easier trading should be because it should be easier for the seller to find a counterparty for the transaction. A more liquid asset is likely to generate greater buyer interest, which should translate into a greater number of bids.

Kleymenova et al. (2012) use the number of bids to gauge the liquidity of private equity markets. They compute the natural logarithm of the number of individual spot or portfolio bids received for a particular asset in the first round of bidding and find this measure to be highly correlated with the number of bidders. This measure has also been used in the corporate bond market – see Gehr and Martell (1992) and Jankowitsch et al. (2002). Potentially, it could also be used for real estate markets if adequate data on bidding activity were to be compiled.

2.2.5 Market Depth

The market depth at time *t*, (D_t) – also known as quantity or volume depth, e.g. Huberman and Halka (2001), Brockman and Chung (2002) – is computed as the sum of bid and ask volumes at time *t*:

Equation 2.9

$$Depth = q_t^A + q_t^B$$

Several studies employ this measure to assess the premium of specific assets (Corwin, 1999) or to link it to abnormal trading (Corwin and Lipson, 2000; Greene and Smart, 1999). To improve the distributional properties of this measure, a logarithmic transformation is used (Butler et al. 2005) and computed as follows:

Equation 2.10

$$Log\ Depth = In(q_t^A + q_t^B)$$

As the market depth for bid and ask can be computed separately, the overall depth may also be obtained as an average between the two (Chordia et al. 2001; Goldstein and Kavajecz, 2000; Sarin et al., 1996). As the depth measures of the bid and the ask sides of the limit order book are not symmetric and do not necessarily move in common, the computation of separate measures may be helpful to the study of both dimensions of liquidity (Kavajecz 1999; Kavajecz and Odders-White, 2001).

2. MEASURES OF LIQUIDITY

2.3 Price Impact Measures

Price impact measures intend to separate liquidity from other factors, such as general market conditions or the arrival of new information driving price movements. Bernstein (1987) argues that liquidity should be more relevant for securities when there is no information revelation than when new information processing leads to a new equilibrium. Price impact measures include the following: (i) Amihud measure; (ii) Regressed lambda; (iii) Pastor-Stambaugh liquidity factor; (iv) Percentage of 0% return and (v) Market efficiency coefficient. Each proxy has a slightly different interpretation and measures one of the facets of liquidity.

2.3.1 Amihud Measure

The Amihud (2002) measure identifies the price impact of transaction volumes and has been widely used in the finance literature – see Avramov et al (2006), Watanabe and Watanabe (2008) and Karolyi et al. (2012). The higher the value found for this measure, the lower the liquidity of an asset/market. In equity markets, it has been computed at a monthly frequency using daily data in the following way:

Equation 2.11

$$Amihud_t = \frac{1}{n}\sum_{i=1}^{n}\frac{|TR_i|}{Vol_i}$$

where t and n respectively refer to the month and number of trading days in the month, while TR_i and Vol_i represent the total return and transaction volume of an asset/market on day i of month t.

This liquidity measure is particularly useful because it addresses the issue of finding an adequate functional form for the relationship between transaction costs and trading volumes. In fact, institutional traders and investors with large trading volumes and fee discounts could, potentially, obtain economies of scales, normally leading to a nonlinear relationship.

2.3.2 Regressed Lambda

An alternative illiquidity measure to the Amihud (2002) metric is the regression coefficient of returns on the volume of transaction activities, as represented by the following equation:

Equation 2.12

$$TR_t = \alpha + \lambda Vol_t + \sum_{j}^{m} \delta_t * Z_{jt}$$

where λ is the illiquidity measure which represents the price impact per unit of trade due to the existence of market imperfections, while Z_{jt} and δ_j represent respectively j control variables and their estimated coefficients.

2.3.3 Pastor-Stambaugh Liquidity Factor

This liquidity dimension refers to temporary price changes associated with order flows. Pastor and Stambaugh (2003) propose a monthly liquidity measure, obtained using daily data within each month. It is computed for a market as the equally weighted average of liquidity measures for single assets/securities.

2. MEASURES OF LIQUIDITY

In particular, the liquidity factor for asset *i* at time *t* is computed as the γ_{it} coefficient of the following estimated equation:

Equation 2.13

$$r^{e}_{i,d+1,t} = \theta_{i,t} + \omega_{i,t} r_{i,d,t} + \gamma_{i,t}\, sign(r^{e}_{i,d,t}) * Vol_{i,d,t} + \epsilon_{i,d+1,t}$$

where $r_{i,d,t}$ is the return of asset *i* in day *d* of the month *t*, while $r^{e}_{i,d,t}$ is the same return but in excess of the market return and $sign(.)*Vol_{i,d,t}$ represents the signed transaction volumes (positive if the excess return is positive and negative if vice versa).

The liquidity factor γ_{it} is linked to the idea that the signed transaction volume should lead to an expectation of reversal in future returns. Hence, the estimated value should be negative and increasing in absolute value for assets/periods with higher illiquidity.

2.3.4 Percentage of 0% Return

Lesmond et al. (1999) develop a model to estimate transaction costs from time series of daily stock returns, assuming that days of zero return should be observed when the expected return does not exceed the transaction cost, which is set as a threshold. Hence, the likely relationship between days of high transactions costs and days of zero return should be coupled with a relatively small incentive for investors to gain private information for shares with high transaction costs. As a result, most trades are noisy and, therefore, they should lead to zero-return days with volumes still likely to be positive. The measure is computed as follows:

Equation 2.14

$$ZR_{i,t} = \frac{NR_{i,t}}{T_t}$$

where:

T_t= number of trading days in a month *t*

$NR_{i,t}$ = number of zero-return days of stock *i* in month *t*

In emerging markets, Lesmond (2005) and Bekaert et al. (2007) find that this measure is highly correlated with other traditional measures of transaction costs – see also Lee (2011) for the pricing of liquidity risk in global financial markets. Moreover, using Trade and Quote (TAQ) data, Goyenko et al. (2005) find a similar pattern between transaction costs obtained with high-frequency data and the measure of zero-return days in the US market. Finally, Goyenko et al. (2009) suggest an alternative and restricted version of the original measure, arguing that zero returns in periods with no transaction volumes do not contain any new information and, hence, they do not represent an adequate proxy for illiquidity. Therefore, they compute the proportion of days with positive trading volume but zero return (i.e. eliminating the days with zero returns and zero volumes). Since highly illiquid assets are transacted less frequently and, hence, are more likely to report days with a zero trading volume, another proxy (*ZV*) is suggested, which is computed as the proportion of days with zero trading volumes within month *t* ($NV_{i,t}$):

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Equation 2.15

$$ZV_{i,t} = \frac{NV_{i,t}}{T_t}$$

2.3.5 Market Efficiency Coefficient

The Market-Efficiency Coefficient, or variance ratio, was developed by Hasbrouck and Schwartz (1988) and has been used extensively in the finance literature. For a given permanent price movement, the transitory shifts to that price tend to be minor in resilient markets. This measure is computed as follows:

Equation 2.16

$$MEC = \frac{Var(R_t)}{(\,p * Var(r_t)\,)}$$

where $Var(R_t)$ and $Var(r_t)$ represent the variance of, respectively, long-period and short-period returns and p is the number of short periods within each long period.

The ratio tends to be close to but slightly below one in more resilient markets, since a minimum threshold of short-term volatility should be expected in such an environment. The intuition is the following: in markets with low resiliency, a higher short-term volatility should be expected due to overshooting and, hence, a greater amount of transitory changes between periods with different equilibrium prices. Spreads, price rounding and inaccurate pricing mechanisms, including partial adjustment to new information, represent some of the factors reducing the MEC measure significantly below one (Sarr and Lybek, 2002).

2.4 Time-Based Measures

Time-based liquidity measures capture either the time that has elapsed between transactions or the amount of time required to trade an asset once a decision to buy or sell has been made. It might be assumed that, where a particular asset or type of asset is traded more often, then that asset or group of assets is more liquid. If so, then this would be captured by two of the measures examined in this section: (i) holding period and (ii) trading frequency. However, there could be instances where assets are held for a long period because they have particularly desirable characteristics and not because they are difficult or costly to trade. If so, then it may be possible to transact such assets very quickly once marketed and this would be captured by the third measure explored here: time on market.

Time on market can be split in two, with the search for a counterparty forming one stage and the time to process a trade forming the other. In mainstream financial markets, both of these stages may seem trivial in length owing to the existence of centralised, public exchanges. In contrast, the decentralised and private nature of direct real estate markets means that time on market has been studied extensively for residential real estate, with more limited attention from the commercial real estate literature. Nonetheless, the time to execute trades is still of importance in financial markets. For instance, certain arbitrage strategies may need to be executed within minutes or even seconds and, so, the possibility of being able to trade within such intervals becomes important.

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2.4.1 Holding Periods

Asset pricing models normally include market frictions, assuming the presence of exogenous transaction costs, and their price impact increases proportionally to the trading frequency of investors. The magnitude of these costs may influence investors' expected holding periods with markets/assets associated with higher trading costs, showing longer investment holding periods (e.g. real estate). For example, Amihud and Mendelson (1986) develop a model that incorporates the expected holding period. As data on holding periods are not readily available, empirical work using this proxy normally uses an indirect measure computed as the inverse of the turnover rate:

Equation 2.17

$$HP = \frac{(S_t * P_t)}{Vol_t} = \frac{1}{Turn_n}$$

where $Turn_n$ is turnover rate, Vol_t is the dollar volume traded in month t, S_t is the outstanding stock of the asset and P_t is the average price of i trades in month t. In contrast, the actual holding period for an asset held by an investor would simply be the time between the purchase date and the sale date for that asset.

In financial markets, even though shares with high turnover are likely to have many actively trading investors, all shareholders do not necessarily have short holding periods because the high turnover may be caused by a few very actively engaged traders – see Collett et al. (2003), who correct the measurement of holding periods for the presence of untraded assets.

2.4.2 Trading Frequency

Trading frequency is also closely related to trading volume. It represents the number of trades executed within a specified interval disregarding the trade size. Even if a high value of trading frequency is associated to a liquid market, it can also be linked to an asset/market of high volatility and, hence, to low liquidity. Jones et al. (1994) confirm this finding, as the positive volume-volatility relationship is found to mirror the positive relationship between volatility and the number of trades, with trade size containing little information.

To obtain trading frequency, a count of the number of trades between time (*t-1*) and *t* is required. Information on the timing of transactions may also be used to compute waiting time between trades, as studied by Peng (2001):

Equation 2.18

$$WT_t = \frac{1}{N-1} \sum_{i=2}^{N} tr_i - tr_{i-1}$$

where tr_i denotes the time of the trade and tr_{i-1} the time of the trade before. Therefore, waiting time for a specific time space has to be calculated as an average time between two trades.

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2.4.3 Volumes Volatility

As real estate is not divisible and is traded infrequently, a proxy one may use to represent the above dimension of liquidity is the volatility of transaction volumes. This measure should be inversely proportional to the trading frequency because the implication of this measure can be twofold: the average trading volume is lower (and, hence, similar swings show higher impact) and/or the swings in transaction volumes from one period to the next are higher. The volumes volatility measure is computed as follows:

Equation 2.19

$$\sigma Vol_t = \frac{\sum Vol_t - \overline{Vol_t}}{N - 1}$$

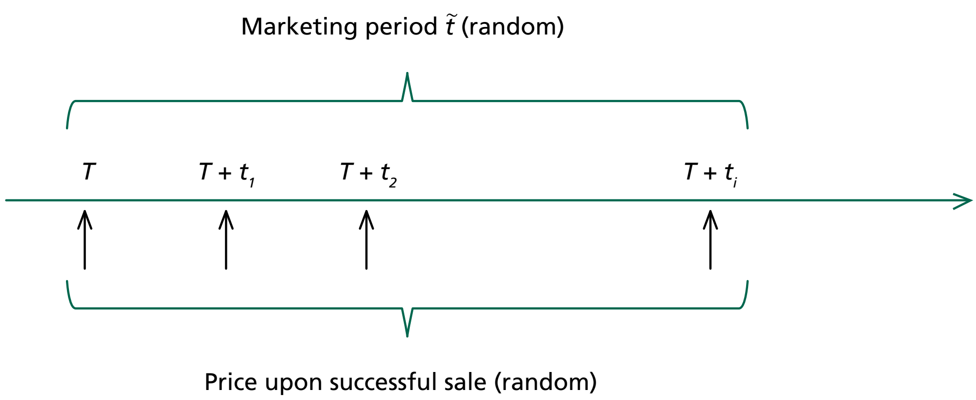
where Vol_t is the dollar volume traded and N is the number of observations within the period.

2.4.4 Time on Market

A fundamental characteristic differentiating real estate investments from mainstream financial assets is the time involved in buying or selling once a decision to transact has been made. Furthermore, the timescale is not only long, but it is also uncertain. This is because the private and decentralised nature of real estate markets requires searches by participants for appropriate assets and/or willing counterparties, while the physical, legal and spatial heterogeneity of assets necessitates extensive due diligence by purchasing parties.

The uncertainty surrounding the time needed to transact is discussed from a seller perspective by Lin and Vandell (2007). They provide a description of the real estate sale process that is represented pictorially in Figure 2.1. Here, an investor purchases a real estate asset at time 0 and holds it until time T, at which point it is placed on the market for sale. $\tilde{t}$ is the potential marketing period, the actual length of which is a random variable, while t_1, t_2 and t_i represent points when buyers are encountered and a price might be agreed. This price is also unknown at the outset of the marketing period and can be characterised as a random variable.

Figure 2.1: Transaction Process for Real Estate (adapted from Lin and Vandell, 2007)



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A defining feature of this process is the sequential but random arrival of offers that characterises the outcome of searches by both buyers (for assets) and sellers (for counterparties). During the marketing period, buyers make offers based on information acquired during their search and, each time a buyer makes an offer, the seller evaluates the benefits of waiting for a potentially better offer, and the costs associated with waiting, before deciding whether to sell the asset or not. If a price is agreed, the marketing period ends but, if agreement is not reached, the search by each party continues.

The uncertainty surrounding both price and the length of the marketing period (and, thus, when the price will be received) affects both the risk and returns from real estate investment. This is explored further by Lin and Vandell (2007) and in several subsequent studies,[3] as well as in the chapter of this report on liquidity pricing.

Another issue surrounds how time to transact is defined and measured. It is commonly equated with time on market, but the definition of the latter is actually much narrower. Firstly, time on market is viewed specifically from the perspective of a seller, whereas it is also relevant to consider time to transact from the perspective of buyers. Secondly, time on market is typically defined as starting from the date when a property is advertised for sale, but this then excludes the time needed to prepare an asset for sale, while the end point for this period is also ambiguous: should it be the date of price agreement, the date when contracts are exchanged or the date of formal completion?

Benefield and Hardin (2013) highlight a lack of attention to the definition of time on market in the otherwise extensive literature on this topic in residential real estate. In contrast, several studies of commercial real estate have debated the different stages involved with buying and selling assets. For instance, McNamara (1998) breaks the sales process into three periods: (i) the period up to when heads of terms are agreed; (ii) a subsequent period up to exchange of contracts and (iii) the last period up to when money is finally transferred. Arguably, all three periods affect the liquidity risk, though the achieved price should not change during the third of these periods.

The times and stages in the sales process for commercial real estate are analysed further by Crosby and McAllister (2004), while Scofield (2013) focuses on the buyer perspective. The results of these studies are considered more fully in the chapter on time to transact, which provides updated figures and seeks to establish key drivers of differences in observed transaction times.

2.5 Return-Based Measures

Some liquidity indicators have been drawn theoretically from the impact that a lack of transaction activity may have on price movements and, hence, the properties of return time series. These measures have become popular because price indices exist for several assets and markets and no additional information is required.

2.5.1 Roll Measure

Roll (1984) develops an implicit measure of the effective bid-ask spread using the serial covariance of share prices, whereby an illiquid asset should show a stronger auto-correlation pattern. With the probability distribution of returns assumed to be stationary and the market to be informationally efficient, the price of an asset/security (P_t) is modelled as the sum of its unobserved fundamental value on day t (V_t) and half of the effective spread (S, to be estimated) and a buy/sell indicator for the last trade on day t (Q_t) – equal to 1 and -1 respectively for a buy and a sell trade:

[3] See Cheng et al. (2010, 2013), Lin and Liu (2008) and Lin et al. (2009).

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Equation 2.20

$$P_t = V_t + \frac{1}{2} SQ_t$$

If it is assumed that Q_t is serially uncorrelated, equally likely to be 1 or -1, and dependent on public information shocks on day *t*, Roll demonstrates that the effective spread could also be estimated as:

Equation 2.21

$$S = 2 \text{ x} \sqrt{-cov(\Delta P_t, \Delta P_{t-1})}$$

where Δ is the change operator and ΔP_t indicates the return (i.e. change in prices) at time *t*.

The Roll measure is useful because daily prices are enough to estimate it, but it does not seem to have a meaningful interpretation when the sample serial covariance is positive, normal stylised fact in markets with low market efficiency, e.g. emerging markets and real estate. As a result, Goyenko et al. (2009) present a modified Roll measure as follows:

Equation 2.22

$$\begin{Bmatrix} 2 \text{ x } \sqrt{-cov(\Delta P_t, \Delta P_{t-1})} & \text{when } cov(\Delta P_t, \Delta P_{t-1}) < 0 \\ 0 & \text{when } cov(\Delta P_t, \Delta P_{t-1}) \geq 0 \end{Bmatrix}$$

2.5.2 Run Length

Das and Hanouna (2010) develop an illiquidity proxy based on the run length of returns, defined as the consecutive series of positive or negative returns without reversion. Empirically, they show that run lengths are positively related to the price impact of trading and can explain cross-sectional variation of stock returns. Using daily stock returns, the monthly measure of run lengths is computed as follows:

Equation 2.23

$$RL_{i,m} = \frac{N^{run}}{N_m}$$

where N^{run} is the sum of the length of each run in a month *m* and N_m is the number of runs in a month *m*.

If the consecutive occurrence of positive or negative returns is not reversed right after the presence of zero return, the zero-return day does not terminate the run. If any run is reversed after the presence of zero returns, then the run terminates with the last zero. The minimum possible run length of a stock in any month is one.

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2.6 Linking Liquidity Measures and Dimensions

After presenting the main liquidity measures used in the literature so far, the measures are summarised and linked to the five liquidity dimensions identified earlier: (i) tightness; (ii) depth; (iii) resilience; (iv) breadth and (v) immediacy. Table 2.1 reports the liquidity category and measures in the first two columns an indication of whether the measure is a proxy for liquidity (L) or illiquidity (I) in the third column and the formula or model to compute it, together with a reference for its empirical estimation, in columns 4 and 5. The liquidity dimension(s) captured by each measure and the applicability of each measure to real estate markets are then shown in the last two columns.

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Table 2.1: Summary of Main Liquidity Measures

Liq. Cat.	Liquidity Measure	Proxy	Formula/Model	Reference	Liquidity Dimension	Real Estate
Transaction Cost Measures	Absolute Quoted Spread	I	$Sabs_t = p_t^A - p_t^B$	Chordia et al. (2001)	(i)	No
		I	$LogSabs_t = \ln(p_t^A - p_t^B)$	Hamao and Hasbrouck (1995)	(i)	No
	Relative Quoted Spread (or "inside spread")	I	$Srel\_mid_t = \frac{p_t^A - p_t^B}{p_t^M}$	Levin and Wright (1999)	(i)	~Yes (US)
		I	$Srel\_last_t = \frac{p_t^A - p_t^B}{p_t}$		(i)	No
	Effective Spread	I	$Seff_t = \lvert p_t - p_t^M \rvert$	Grossman and Miller (1988), Lee et al. (1993)	(i)	No
	Relative Effective Spread	I	$Sreleff\_mid_t = \frac{\lvert p_t - p_t^M \rvert}{p_t^M}$		(i)	No
		I	$Sreleff\_last_t = \frac{\lvert p_t - p_t^M \rvert}{p_t}$		(i)	No
Volume-Based Measures	Transaction Volume	L	$Vol_t = \sum_{i=1}^{n} P_{it} Q_{it}$	Admati and Pfleiderer (1988), Jain and Joh (1988), Karpoff (1987)	(iv)	Yes
	Turnover Ratio	L	$Turn_n = \frac{Vol_t}{(S_t * P_t)}$	Amihud and Mendelson (1986), Constantinides (1986)	(iv)	Yes
	Quote Size	L	$QS = \frac{\text{Ave No. of Transactions}}{\text{Ave Size of the Market}}$	Mann and Ramanlal (1996)	(ii)	~Yes
	Number of Bids	L	*No. (or log) of individual bids*	Gehr and Martell (1992), Kleymenova et al. (2012)	(iv)	~Yes
	Market Depth	L	$Depth = q_t^A + q_t^B$	Chordia et al. (2001)	(ii)	No
			$Log\ Depth = \ln(q_t^A + q_t^B)$		(ii)	No
Price-Impact Measures	Amihud Measure	I	$Amihud_t = \frac{1}{n} \sum_{i=1}^{n} \frac{\lvert TR_t \rvert}{Vol_i}$	Amihud (2002)	(ii, iii)	~Yes

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Table 2.1: Summary of Main Liquidity Measures (Continued)

Liq. Cat.	Liquidity Measure	Proxy	Formula/Model	Reference	Liquidity Dimension	Real Estate
Price-Impact Measures (continued)	Regressed Lambda	I	$TR_t = \alpha + \lambda Vol_t + \sum_j^m \delta_j * Z_{jt}$	Ling et al. (2009)	(ii, iii)	Yes
	Pastor-Stambaugh Liquidity Factor	I	$r^e_{i,d+1,t} = \theta_{i,t} + \omega_{i,t} r_{i,d,t} + \gamma_{i,t}\, sign(r^e_{i,d,t}) * Vol_{i,d,t} + \epsilon_{i,d+1,t}$	Pastor and Stambaugh (2003)	(ii, iii)	Yes
	Percentage of Zero Returns	I	$ZR_{i,t} = \frac{NR_{i,t}}{T_t}$	Lesmond et al. (1999), Goyenko et al. (2009)	(ii)	Yes
	Percentage of Zero Volumes	I	$ZV_{i,t} = \frac{NV_{i,t}}{T_t}$		(ii)	~Yes
	Market Efficiency Coefficient	I	$MEC = \frac{Var(R_t)}{(p * Var(r_t))}$	Hasbrouck and Schwartz (1988)	(iii)	Yes
Time-Based Measures	Holding Periods	I	$HP = \frac{(S_t * P_t)}{Vol_t} = \frac{1}{Turn_n}$	Collett et al. (2003)	(iv)	Yes
	Trading Frequency	L	$WT_t = \frac{1}{N-1}\sum_{i=2}^{N} tr_i - tr_{i-1}$	Peng (2001)	(ii)	~Yes
	Volumes Volatility	I	$\sigma Vol_t = \frac{\sum Vol_t - \overline{Vol_t}}{N-1}$		(ii, iv)	Yes
	Time on Market	I	Time required to transact	Lin and Vandell (2007)	(v)	Yes
Return-Based	Roll Measure	I	$\begin{cases} 2 \times \sqrt{-cov(\Delta P_t, \Delta P_{t-1})} & \text{if } cov < 0 \\ 0 & \text{if } cov \geq 0 \end{cases}$	Roll (1984), Goyenko et al. (2009)	(iii)	~Yes
	Run-Length	I	$RL_{i,m} = \frac{N^{run}}{N_m}$	Das and Hanouna (2010)	(ii, iii)	Yes

Legend: Proxy L = liquidity measure; Proxy I = illiquidity measure; p_t^A = lowest ask price; p_t^B = highest bid price; p_t = last traded price before time t; p_t^M = mid-quote price, obtained as $p_t^M = \frac{p_t^A + p_t^B}{2}$; P_{it} = Trading Prices; Q_{it} = Traded Quantities; S_t = number of outstanding stocks; P_t = average price of the i trades included in transaction volumes; q_t^A = bid volumes at time t; $q_t^A + q_t^B$ = ask volumes at time t; TR_i = total return of an asset/market on day i of month t; Vol_i = transaction volume of an asset/market on day i of month t; Z_{jt} and δ_j = j control variables and their estimated coefficients; $r_{i,d,t}$ = return of asset i in day d of month t; $r^e_{i,d,t}$ = same return but in excess of the market return; sign(.)$*Vol_{i,d,t}$ = signed transaction volumes; T_t = number of trading days in month t; $NR_{i,t}$ = number of zero-return days in month t; $NV_{i,t}$ = number of zero-volume days in month t; $Var(R_t)$ = variance of long-period returns; $Var(r_t)$ = variance of short-period returns; p = number of short periods within each long period; where tr_i denotes the time of the trade and tr_{i-1} the time of the trade before.

3. STUDIES OF REAL ESTATE LIQUIDITY

After identifying the dimensions and causes of liquidity and introducing measures to proxy for this risk and compute a premium, this section presents the main empirical findings related to real estate markets/products. The section begins by reviewing studies that explore listed real estate before turning to the direct market and, then, to a smaller amount of work produced on non-listed real estate vehicles.

3.1 Empirical Evidence in Listed Real Estate

Corgel et al. (1995), Zietz et al. (2003) and Feng et al. (2011) provide a descriptive overview of exchange-listed REITs. The liquidity of REITs relative to alternative investments linked to real estate has great appeal and this has allowed the market to develop with a high institutional component in the ownership structure. Nelling et al. (1995) are among the first ones to find that the liquidity of REITs – daily closing bid-ask spread for securities listed in the NASDAQ – decreased during the 1980s, making these products relatively expensive over that period.

Following this work, but using market microstructure data, Bhasin et al. (1997) show that during the mid-1990s the trend inverted and these products became more liquid, also thanks to a significant growth in their number and market capitalisation driven by the "new REITs era" (Cole 1998). Bhasin et al. (1997) use an empirical model of spreads, following Stoll (1978), and shed light upon their determinants: price and dollar volume (positive relationship) and return volatility (negative) – see also Cannon and Cole (2011), who find significant improvements in overall liquidity around 2000-2006. Clayton and MacKinnon (2000) confirm these results for the early 1990s by decomposing the percentage spread into three components (depth, tightness and resiliency), following Kyle (1985), and find that most gains are driven by improvements in depth rather than tightness.

Marcato and Ward (2007) develop the model in Clayton and MacKinnon (2000) to allow an estimation with daily rather than intraday data. Similar results are found for the US, with improving liquidity measured for both estimated spreads and market depth. The choice of stock exchange is found to be significant, with even smaller REITs benefiting from listing in the NYSE, as opposed to NASDAQ and AMEX – similar to Danielson and Harrison (2002), who found NYSE and AMEX to be preferable to NASDAQ. Weaker results are also found for other markets (UK and Australia).

Characterising the intraday-trading behaviour, Below et al. (1995) find that (i) REIT structures present a smaller amount of volumes and trades than non-REIT ones, (ii) equity REITs present higher spreads than mortgage REITs and (iii) REITs with high institutional ownership trade at spread levels similar to those observed for non-REITs. However, Bertin et al. (2005) argue that using raw spreads fails to include transactions taking place inside the quoted spread. Therefore, they compute several liquidity proxies and show that REIT liquidity follows an intraday U-shaped pattern similar to the one of common stocks, even if the former is generally lower than the latter.

Brounen et al. (2009) support the idea of studying several dimensions of liquidity in international markets and use three proxies for liquidity – dollar trading volume, turnover and a version of the Amihud measure – to avoid misleading conclusions. They show that dividend yield, market capitalisation and non-retail share ownership are the main drivers of liquidity. Furthermore, Subrahmanyam (2007) finds liquidity risk to be priced in REITs and is the first to explore order flow spillovers across NYSE stocks, finding that this phenomenon occurs from REITs to non-REITs and that liquidity measures of the latter are a good predictor of the former.

3. STUDIES OF REAL ESTATE LIQUIDITY

Benveniste et al. (2001) compare the asset replacement value with the company value and show that the securitisation process of assets obtained through the REIT structure enhances the underlying assets value by 10%-20%. Yet, they do not find the market value of equity to explain liquidity (i.e. dollar volume) when they include control variables, such as sector and institutional ownership. Following from the evidence that REITs reflect partly equities and partly private real estate performances, Bond and Chang (2012) also study the cross-asset liquidity between these three markets/assets. In line with theoretical expectations, they find liquidity risk and commonality in liquidity to be generally lower for REITs than for other equities and causality going from public to private markets.

Finally, a recent study by Glascock and Lu-Andrews (2013) sheds light upon the macroeconomic factors driving REIT funding liquidity and its linkages with market liquidity across the business cycle. The authors use the Amihud measure and turnover ratio for market liquidity and LTV ratio, debt service coverage ratio and number of loans for funding liquidity. This study shows that both contemporaneous and lagged macroeconomic factors have a significant impact on REIT funding liquidity – negative for inflation, default spreads and term spreads, and positive for the banks' willingness to lend.

3.2 Empirical Evidence in Direct Real Estate

There are fewer studies of liquidity for direct real estate than for either financial assets or REITs. In part, this stems from the decentralised and private nature of real estate markets that has, in the past, created difficulties in obtaining data and creating liquidity measures. Yet, in recent years, liquidity issues have been subject to more extensive study. For example, the debate summarised in IPF (2004) on the effects of liquidity on real estate investment risk has been taken further in Lin and Vandell (2007), Bond et al. (2007) and Lin and Liu (2008), among others. Meanwhile, work that considers the impact of liquidity on real estate price series has also developed substantially since IPF (2004). This has resulted in the creation of liquidity indices in the US, though the assumptions and models required to produce such indices are methodologically complex. Further research has occurred using more traditional liquidity indicators, such as volumes as well as time on market.

Two recent studies have explored the relationship between volumes and returns in private real estate investment markets. Fisher et al. (2009) and Ling et al. (2009) examine relationships between capital flows and investment returns in the US and the UK, respectively, to see whether they affect each other. Both studies use a vector autoregressive (VAR) approach, where institutional capital flows and returns are specified as endogenous variables in a two-equation system. Fisher et al. (2009) find that lagged capital flows have a statistically and economically significant relationship with returns, which suggests weight-of-money effects in pricing. They do not find evidence for return chasing. Ling et al. (2009) then find positive contemporaneous correlations between returns, absolute and percentage capital flows, and turnover, but their results did not support the idea that capital flows have a 'price pressure' effect in the UK.

These studies were facilitated by the fact that measures of absolute, if not relative, trading volumes are now available for most major real estate investment markets. In contrast, tightness, as captured by bid-ask spreads, is much more difficult to measure for direct real estate than for many financial assets as there is not an observable bid-ask spread for different assets in the real estate investment market. However, there is a distinction between the reservation price of a seller (the price at which they would be prepared to sell a real estate investment) and that of a buyer. The distance between these determines the likelihood of a sale taking place: where reservation prices meet or overlap, a buyer and seller can conclude a trade but, where they do not, the asset concerned will stay unsold.

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More generally, a distribution of reservation prices that reflects the views of potential buyers of real estate assets can be inferred, as can a similar distribution of reservation prices that reflects views of potential sellers. Such distributions are proposed by Fisher et al. (2003); they describe how the shape and extent of overlap between these distributions influence the number of assets likely to trade. They also argue that variations in liquidity of the real estate market over time make the interpretation of real estate price series more difficult. This is because prices tend to adjust slowly to changes in real estate market conditions. In fact, the nature of real estate markets causes adjustments to occur in prices, volumes and time to transact when market conditions change, as well as in the mix of assets being traded. As such, Fisher et al. (2003) argue that real estate indices need to be adjusted to reflect the differential ability to enter and exit the market at different points of the real estate cycle.

Adjustments to create constant liquidity real estate price series are proposed and tested by Fisher et al. (2003), Goetzmann and Peng (2006) and Fisher et al. (2007). Subsequently, the relationship between constant liquidity and uncorrected price series for the US has been used by Clayton et al. (2008) to derive a measure of market-wide liquidity, while Buckles (2008) proposes a liquidity index, based on a more complicated procedure but building from the same body of work. This area of research has resulted in the periodic publication of a liquidity series by the MIT Centre for Real Estate alongside the transaction-based price series resulting from the work of Fisher et al. (2007). However, similar, constant-liquidity transaction price indices do not exist in other countries and are a prerequisite for creating a liquidity index of this nature.

The other major area of examination has been in regard to the time it takes to transact assets in the direct property market. A substantial body of research has explored time-on-market for residential property and key findings from this literature are considered in the chapter on time to transact. For real estate investment markets, there are fewer studies and they tend to focus on measurement rather than explanation. For example, McNamara (1998) conducted survey work to establish perceived average times to transact for different real estate investments in the UK. For the sell side, he reported a marketing period of four to eight weeks and a due diligence period of four to twelve weeks depending on property type. However, subsequent work by Crosby and McAllister, contained within IPF (2004), finds actual times to be longer, with a median time of 190 days (c.27 weeks) in their sample of transactions. This study also found considerable dispersion in transaction times. Finally, Scofield (2013), who considers time to transact from the buy side, finds that time to transact is time varying and that transactions were conducted more rapidly during the boom phase of the UK real estate cycle.

The nature of real estate markets (heterogeneous assets with limited numbers of buyers and sellers operating under various economic constraints) means that the length of the time-on-market is likely to be affected by many factors. Thus, when real estate investors come to sell a property, they face uncertainty not only in regard to transaction price (price risk), but also around the time it will take to sell (marketing period risk). In contrast, many financial assets can be sold instantaneously through public exchanges and so investors do not bear marketing period risk.

The nature and behaviour of marketing period risk is investigated in the work of Lin (2004) and Lin and Vandell (2007), who highlight the importance to real estate investors of the hidden risk exposure that occurs during the extended marketing period of a commercial real estate asset. Their models estimate the extent to which ex-post data on real estate performance understates the ex-ante risk exposure taken by real estate investors, because it does not take into account the asset risk exposure during the marketing period or the uncertainty of the marketing period itself. This work is extended by Bond et al. (2007), who calibrate such models using the transaction time results found by Crosby and McAllister (2004). Their study suggests that the ex-ante level of risk exposure for a commercial real estate investor is around one and a half times that

3. STUDIES OF REAL ESTATE LIQUIDITY

obtained from historical statistics, although this may decrease for investors who construct portfolios of real estate assets. Meanwhile, Lin and Liu (2008) consider how the level of risk may vary with the financial circumstances and investment horizons of different types of seller.

In summary, this work provides evidence of the importance of liquidity in direct real estate markets and, to some extent, the degree of liquidity for different types of property or in different periods. However, it is only recently that liquidity has attracted more extensive research. It is also the case that the range of measures produced and tested in a direct real estate context is much narrower than for either REITs or financial assets, and is less developed for real estate investment assets than for residential property markets, where data have traditionally been much richer.

3.3 Empirical Evidence in Other Real Estate Vehicles

A descriptive overview of the public non-listed REIT sector is provided by Corgel and Gibson (2008) for US funds and by Brounen et al. (2009) for European funds. New empirical work on the estimation of liquidity premia for investment vehicles different from REITs has started to be developed in recent times and this area is likely to be further analysed in the future. So far, however, few papers have focused on European unlisted funds, debt products and US real estate mutual funds.

Schweizer et al. (2013) discuss open-ended property funds, which offer apparently perfect daily liquidity, but fail to do so in market conditions when liquidity is most required (redemptions are suspended if a threshold of requests is passed). They find that these vehicles offer a liquidity premium (measured as discount to net asset value) of about 6% in the short run, but are not affected by liquidity risk in the long-run and represent an attractive investment tool for long-term investors (e.g. pension funds and other institutional players).

A recent working paper by Marcato and Tira (2013) builds upon the issue of suspended redemptions and tries to estimate the impact of traded volumes on the price of such vehicles. Interestingly, if no effect is seen for aggregate transaction volumes – in line with previous findings in the finance literature – an opposite effect is found for money flows entering and exiting such funds. In fact, a smart money effect is estimated for outflows (i.e. capability of disinvesting timely), suggesting that current investors have access to a better set of information. In contrast, a return chasing behaviour seems to drive inflows, i.e. investors enter funds that performed well in the past,[4] also thanks to the persistence of fund returns over time.

As a further step in the analysis of indirect causes of liquidity for unlisted funds, Wiley (2013) links the problem of suspended redemptions to managerial incentives and finds that an increase in compensation increases illiquidity risk indirectly because it reduces the ability to generate revenues and to raise equity capital to be used to fulfil redemption requests.

Finally, as far as debt products are concerned, a shift in the pricing of liquidity risk for such products may be seen. If, before the last economic crisis, Northaft et al. (2002) estimate a very small liquidity premium for agency (e.g. Freddie Mac, Fannie Mae) products, Kim (2009) later finds that a liquidity shock is more likely for mortgage-backed securities than for government bonds if there is a sudden and significant drop of trading activities (as observed in 2008). Work from the Federal Reserve Bank of New York and Atlanta also reinforces these results, linking the premium to vintage and a common factor (along with credit rating and idiosyncratic factor) – Dungey et al. (2013) – and showing the positive effect (around 10 to 25 b.p.) of the trading method on a "to-be-announced" basis and no effect of the presence of a government credit guarantee.

[4] See also Chou and Hardin III (2014) for US real estate mutual funds.

4. CONCLUSION

This review has examined the literature on liquidity published since the release of the first IPF-funded study on *Liquidity in Commercial Property Markets*. Particular interest in the issue of asset pricing has been stimulated, not least, by the experiences of financial and other asset markets during the global financial crisis and economic downturn from 2007 onwards. This is discussed both in the opening and the third sections of this review, the latter focusing on real estate specific literature, which has grown substantially in recent years. The review also sets out a wide variety of individual measures that are used to proxy liquidity either in financial or real estate markets, these being discussed in Section 2.

At the outset, two types of liquidity are distinguished. These are trading (or market) liquidity and funding liquidity. The first is related to the nature of different assets and the markets in which they are traded, while the second is related to investors and their ability to gain funding to execute trades of those assets. It is the first of these concepts – trading/market liquidity – that is the focus of this review and several dimensions are presented and related to the time and costs of trading and their potential impact on prices: (i) tightness; (ii) depth; (iii) resilience; (iv) breadth and (v) immediacy. Different measures attempt to gauge these dimensions of liquidity and, in so doing, help investors to understand liquidity and market activity. For each individual measure considered by the review, both the formula for calculation and notes on its use in financial or real asset markets are presented.

The applicability of different measures to real estate markets and their occurrence in the real estate literature are examined subsequently. While this shows that some measures may be impractical for direct real estate markets, these may have relevance for alternative means of investing in real estate, such as REIT shares or real estate debt. Other measures, instead, have potential for use with real estate data but are yet to be widely exploited. A clear example is represented by the Amihud measure that is used in the associated research on liquidity pricing. Meanwhile, time-based measures and, in particular, time on market, is an area where discussion in the (residential) real estate literature has been more substantial and this topic is taken further in the report on time to transact for commercial real estate[1] (focusing on an empirical analysis of the UK market).

Finally, the literature suggests that liquidity measures do not reflect, per se, the premium to be used by investors. In fact, the use of these measures implies the estimation of models that determine the impact of such measures on the pricing of assets. For this reason, two other reports are presented to determine a risk premium. The second IPF paper – *Time to Transact: Measurement and Drivers* by Devaney and Scofield (2014) – studies the time on market, measuring and presenting how long it takes to buy and sell commercial real estate assets over different periods and across sectors and locations. In the third IPF paper – *Liquidity Pricing of Illiquid Assets* by Marcato (2014) – an empirical analysis of asset pricing is presented, where the time on market evidence is used, along with several other liquidity measures, to find a related risk premium for use in real estate markets.

[1] Time to Transact: Measurement and Drivers, IPF 2014

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IPF Research Programme 2011–2015

Investment Property Forum
New Broad Street House
35 New Broad Street
London EC2M 1NH

Telephone: 020 7194 7920
Fax: 020 7194 7921
Email: ipfoffice@ipf.org.uk
Web: www.ipf.org.uk

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