

## **Which Factors Determine Liquidity Across US Metropolitan Office Markets?**

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## **Introduction**

Low liquidity is an intrinsic attribute of investment in private real estate markets. Compared to exchange traded assets such as shares and bonds, it tends to have extremely low liquidity. However, it has similar or even higher levels of liquidity compared to other non-exchange traded assets such as infrastructure, private equity and hedge funds. In commercial real estate markets, protracted times-to-transact and relatively high transaction costs stem from the private and dispersed nature of such markets and the fact that commercial real estate assets are heterogeneous, with varying physical, spatial and legal characteristics. This means that there are a range of delays, risks, uncertainties and costs associated with deploying and redeploying capital. ‘Round-trip’ transaction costs can be substantial with significant overflows into performance and the ability to enter and exit real estate markets at specific times is constrained by the time transactions take (to match buyers and sellers, evaluate unique assets, bargain and then execute the transaction), the information and other search costs associated with identifying and evaluating assets and price uncertainty. These characteristics of real estate transactions create liquidity risks.

While acknowledged as imperfect, the level of transaction activity is often used as an approximate proxy for liquidity. This is because there are evident relationships between transaction activity and the numbers of buyers and sellers in the real estate market, which fundamentally affects the ability of investors to enter and exit those markets. It is a stylized fact that the level of transaction activity in commercial real estate markets varies over time and among markets, sectors and assets. It is also well documented that the level of transaction activity is pro-cyclical, being much higher in strong market conditions than during downturns (e.g. see Fisher et al., 2003; 2004). This research paper is concerned with the causes of market-specific transaction activity and liquidity risks across the US metropolitan office markets.

The remainder of this paper is organized as follows. First, we discuss different dimensions to and measures of liquidity in real estate markets. Following this, we outline a theoretical model of what determines commercial real estate transaction activity. The third section of the paper then discusses the data that we gather to test our theoretical model and provides summary statistics for this data. The empirical modelling strategy is then set out prior to discussion of our results to date. A final section then concludes.

## **Real Estate Liquidity**

There is no single, universally accepted definition of liquidity. One fundamental distinction is between trading liquidity and funding liquidity whereby the former relates to the transfer of assets and the latter

relates to obtaining capital (see Brunnermeier and Pedersen, 2009). We focus on trading liquidity, but even this is multifaceted. The finance literature sets out different dimensions to this type of liquidity such as tightness (costs), immediacy, depth, breadth and resilience (response to imbalances in trading). At the core of liquidity risk is the inability to be able to immediately transform assets to cash at current market prices at no cost and *vice versa*. The degree of deviation from these criteria determines the level of relative illiquidity. *In extremis*, ‘liquidity breakdowns’ produce situations where there are no buyers as investors attempt to exit a sector.

The existence of different dimensions to liquidity suggests that several measures might be needed to gauge levels of liquidity in practice. Given the typical length of time-to-transact, immediacy is a largely extraneous concept in research on liquidity in real estate markets. Cheng et al. (2013b) argue that many measures of liquidity from securities markets, where there is centralized and instantaneous trading, are not appropriate for private, opaque and thinly traded assets such as commercial real estate. They state that:

“The notion that all assets are illiquid to different degrees and that private assets, such as real estate, are just less liquid than stocks, fails to recognize the different nature of the two markets. Private assets are not just less liquid than security assets; they are less liquid in a different way.” (Cheng et al., 2013b: 675).

In the real estate literature, IPF (2004) identifies several elements to liquidity including: the rate or volume of turnover/transactions; the time taken to transact; the costs associated with transacting (both formal and information costs); the impact of the decision to transact on the price of an asset and those of similar assets; and uncertainty as to achieved price or returns at the time of the decision to transact. Several common measures are used to gauge liquidity in real estate markets, including the relative liquidity of different property types, locations, countries or time periods. These are transaction volumes, turnover, holding periods, transaction costs and the time taken to transact (incorporating time-on-market). The ease of measurement and availability of each measure varies and several of the measures are interrelated.

Whilst the analysis contained in this paper is at the market level, it is worth acknowledging that there are variations in liquidity between individual assets. There are variations in how likely it is that they will transact, as well as how long it will take to sell them from when they are first marketed. This could reflect attributes that are either positive or negative: for example, a new and well located asset might have a greater number of potential buyers, yet the owners may be less willing to sell because of these features and the difficulty of buying similar quality assets. Even where two buildings are similar, the attributes of the owners in each case also may play a role in how likely it is that they will sell.

The empirical analysis in this study focuses on transaction volumes and turnover as proxies for real estate liquidity. Volumes are a simple and easily available proxy for liquidity in commercial real estate markets while turnover is also a simple proxy, but whose availability is often restricted by the lack of good estimates for the value of the real estate stock in different places. An in-depth discussion of volumes and turnover rates follows in the next section of the paper. Before this, though, we discuss some of the other liquidity measures that prior research on real estate markets has used.

Holding periods are not an obvious proxy for liquidity, but they influence transaction activity. For example, any tendency amongst investors in a particular market to hold properties for a certain length of time affects how often those assets are offered for sale. Shorter holding periods should lead to more transaction activity while longer holding periods will mean fewer assets are sold per period, all else being equal. Several factors might influence investor decisions on how long to hold, with the level of liquidity itself being one of these factors. Early studies in the US and Canada focused on the role of taxation benefits and transaction costs (see Gau and Wang, 1994). Collett et al. (2003) also note the importance of transaction costs and how this motivates longer holding periods for real estate vis-à-vis equities and bonds. They examined how holding periods for UK commercial real estate changed over time and were affected by market conditions. In a strong market, owners might cut short an anticipated holding period to take advantage of rising prices. Conversely, in weaker markets, they might delay disposals until conditions improve. Asset or owner characteristics may be important too, e.g. closed-end funds have specifically defined lifespans which determine their holding periods.

Transaction costs are also a measure of liquidity and affect transaction activity. Higher transaction costs motivate longer holding periods and so can reduce transaction activity in the real estate market. These costs include search, legal, taxation and administration costs. While the components of transaction costs are not difficult to identify, some elements such as search costs are difficult to quantify. Nonetheless, indirect costs connected with obtaining information and searching for assets are potentially substantial. Meanwhile, brokerage services are an important component of the real estate transaction cost structure, influencing both monetary and non-monetary costs, with direct implications for liquidity. The services that an intermediary might provide can be categorised into three types: information provision, matching, bargaining and transaction execution support. Arguably, the most important service is bringing together buyers and sellers. The ability to provide a more effective and efficient marketing platform (compared to 'for-sale-by-owner') is an obvious benefit. Therefore, a key parameter for competition among intermediaries is the quality and quantity of the matching (i.e. listing and marketing) service.

Once a match is found for a potential transaction, a clear understanding of the process and information flow becomes the next crucial factor towards a successful real estate transaction. US research suggests

that intermediaries in the residential sector vary hugely with respect to the quality of negotiation and bargaining services and the extent of information asymmetry plays a crucial role. The residential and commercial sectors do not differ much in terms of the basic roles of an intermediary, but they may differ on the extent and importance of information asymmetry. This is because the commercial sector generally involves (a) fewer buyers and sellers, (b) larger transaction sizes, (c) more complex financing and investment structures and (d) geographically larger markets, particularly for institutional grade assets.

As well as being more costly, acquiring and disposing of real estate assets takes much longer than for financial assets. A seminal exploration of the implications of time on market for real estate risk is provided by Lin and Vandell (2007). First, a real estate asset is exposed to price risk during the marketing period. Second they identify additional risk associated with the fact that the marketing period is uncertain. Although the final price and transaction date for an asset can be used to estimate the volatility of its returns ex-post, they argue that such a measurement does not capture the additional ex-ante uncertainty experienced by an owner who does not know in advance when the value of their asset might be realized. This work has subsequently been extended by Cheng et al (2010, 2013a, 2013b).

To what extent are liquidity risks priced in direct real estate investment. In principle, investors require higher returns from assets that are illiquid because they present risks in terms of being able to realise capital at a time when it is required. As such, if two assets with similar cash flow characteristics differ in terms of liquidity, then the price for the less liquid asset should be lower. More formally, the requirement for an illiquidity premium arises from the presence of market imperfections. These include participation and search costs, transaction costs, information asymmetries, imperfect competition and funding constraints. Most of these are significant issues in the case of direct real estate markets.

The existence and extent of illiquidity premiums are questions of great importance, but there is little literature that attempts to address these questions for real estate investment. This is in contrast to financial assets, where the impact of variations in liquidity on the required return for different assets has been studied widely. Hibbert et al. (2009) discuss the main studies for equities and bonds, noting that most gauge the pricing of liquidity relative to a reference asset. For example, the liquidity and pricing of small capitalization stocks has been measured relative to that of large capitalization stocks on the same exchange. They also note that clientele effects can arise where types of investors with different requirements for liquidity will price any relative absence of liquidity differently. As a result, the marginal investor for some types of asset will vary.

Cheng et al. (2013a) do not measure illiquidity premiums directly in their study of direct real estate. However, they argue that their estimates of marketing period risk, together with adjustments for the

nature of real estate returns data, explain the risk premium puzzle; i.e. why portfolio allocations to real estate are so low when risk-adjusted performance appears so strong relative to equities and bonds. In other words, once measurement of risk is adjusted for uncertainties around transacting, then the performance of direct real estate is no longer anomalous in risk-return space. Meanwhile, work that estimates liquidation bias (the discount needed to achieve an immediate sale) can be seen as providing more direct quantification. Using UK real estate data, IPF (2015) estimates liquidation bias to be in the range of 1-4% depending on property type and holding period.

IPF (2015) also attempts to estimate illiquidity premiums using a regression-based approach. Real estate returns are regressed on to a variety of control variables and a variable representing liquidity levels over time. A variety of proxies for liquidity are tested, including volumes, turnover and some measures that combine trading activity and performance, such as the Amihud measure. Premiums are then estimated by multiplying the coefficient on the liquidity variable by the average value of that variable over the sample period. The results suggest an illiquidity premium for UK commercial real estate in the order of 3%. This is despite the fact that survey estimates of the total risk premium used by UK investors (including risks such as tenant default and obsolescence) are typically between 2-4%. IPF (2015) also shows that the illiquidity premium is likely to be time varying, with much greater premiums evident during periods of market stress.

### **Determinants of Real Estate Market Transaction Activity: Some Theoretical Considerations**

There are several stylized facts regarding the relationship between transaction activity and investment performance in commercial real estate markets. In terms of variation over time, “hot” phases in the real estate cycle tend to be periods when prices are rising, average selling times are relatively short, and transaction activity is higher than average. “Cold” phases in the real estate cycle have the opposite characteristics: prices are falling, time-to-transact tends to be longer and transaction activity is lower than average.

Fisher et al. (2003) contend that, in private asset markets such as real estate, changes in market conditions are signalled by both changes in prices and changes in transaction activity. More formally, they provide a search-based model that demonstrates how both prices and volumes are influenced by shifts in buyer and seller pricing behaviour (see also Goetzmann and Peng, 2006). Largely focussed on US indices, this has formed the foundation of work on the adjustment of commercial real estate price indices to account for the fact that they are affected by variable levels of market liquidity over time. The creation of a constant-liquidity index based on the concept of the price that would prevail given a constant ease-of-selling through time has been explored by Fisher et al. (2003) and Fisher et al. (2007).

A by-product of this work has been the creation of liquidity metrics to represent how liquidity itself has changed in the US context (see Clayton et al., 2008; Buckles, 2008).

However, outside of the US, similar liquidity metrics are not available and so changes in transaction activity are widely used as a proxy for liquidity in the absence of alternative measures. This has led to interest in what the determinants of such activity are, i.e. what influences the number and behaviour of buyers and sellers that leads, in turn, to the transaction volumes that we observe. The literature on the relationship between returns/prices and transaction flows suggests some determinants of transaction activity (Fisher *et al.*, 2009; Ling *et al.*, 2009). For instance, several possible causal relationships between transaction flows and asset prices/returns have been proposed, which are as follows:

- changes in transaction activity may determine future prices/returns (owing to a so-called ‘price pressure’ effect);
- changes in prices/returns may determine future transaction activity (owing to return chasing behavior by investors);
- prices/returns and transaction activity may be jointly dependent (on common exogenous variables that produce contemporaneous changes in prices/returns and transaction activity);
- and information cascades may produce self-reinforcing feedback relationships between returns/prices and transaction activity.

It is also possible that elements of all of the above may at times be present in observed relationships between asset prices and capital flows (Ling et al., 2009).

Whilst a positive *contemporaneous* correlation between price changes and volume may be a stylized empirical fact in the equities market, there is longstanding scepticism about whether there is a causal relationship (see Gallant *et al.*, 1992). As noted above, a contemporaneous positive relationship might be due to the fact that flows and returns are jointly dependent on common economic determinants. Although results are mixed, research in real estate markets is broadly consistent with a contemporaneous and self-reinforcing relationship between prices and transaction activity generated by exogenous demand shocks.

Fisher *et al.* (2009) examine whether net capital flows from institutional to non-institutional investors’ impact upon asset returns for U.S. commercial real estate. They find some evidence that institutional capital flows have a statistically and economically significant association with subsequent returns at the aggregate U.S. level. However, the results are not consistent across sectors or CBSAs. Applying a similar methodology to UK data, Ling *et al.* (2009) do not find any evidence to support a ‘price pressure’

effect. Beyond commercial real estate, similar findings have been reported by both Stein (1995) and Cauley and Pavlov (2002). They focus on the relationship between price changes and trading volume in US housing markets where trading volumes tend to fall when house prices are falling and vice versa. Both papers suggest a contemporaneous and self-reinforcing relationship between prices and trading volume generated by exogenous demand shocks.

In their review of the drivers of real estate liquidity, Clayton *et al.* (2008) present a range of potential determinants of variation in transaction activity. Rooted in the behaviour of market participants, at the core of their theoretical analysis is variation in buyers' and sellers' valuations. As in Fisher *et al.* (2003), it is expected that transaction frequency will be positively related to the level of overlap in buyers' and sellers' valuations. In 'hot' markets, buyers are expected to be more likely to have higher valuations than sellers. In 'cold' markets, the probability of buyers' valuations being above sellers' is expected to be lower. As a result, in 'cold' markets, there is a lower propensity for trades to occur and transaction activity drops. A range of factors that may result in deviations between buyer and seller valuations are then proposed.

- Following Fisher *et al.* (2003), Clayton *et al.* (2008) propose that changes in sellers' estimates of asset values lag changes in buyers' estimates. For transaction activity to be pro-cyclical with prices, buyers must respond more rapidly than sellers in updating asset value estimates. Clayton *et al.* propose a 'sticky' valuation model to explain variations in valuations between buyers and sellers. They argue that in a low transaction (low liquidity) environment, sellers are faced with a lack of new information with which to update prior valuations and hence place considerable weight on old and potentially stale information, causing reservation prices to be high relative to bids.
- An alternative explanation is that when there is a noisy price signal suggesting a shift in values, buyers and sellers may have different propensities to adjust their valuations to incorporate that signal owing to differences in prior beliefs and incentives. Assuming information arrives to suggest that prices have fallen, buyers who believe that there is a high probability that the signal is correct or have incentives (e.g. paying a higher price) to accept its accuracy are more likely to incorporate it into their valuations. In contrast, sellers who believe that there is a low probability that the signal is correct or have incentives (e.g. receiving a lower price) to doubt or reject its reliability are more likely *not* to incorporate it into their valuations. If the signal is proven to be reliable with the arrival of further information that confirms price falls, it is expected that sellers will *eventually* accept that prices have changed, producing a Bayesian-style convergence to agreement. However, in dynamic, thinly traded, 'noisy' markets, 'agreement' on value may be difficult to achieve until prices stabilize.

- In the residential sector, the conventional explanation for transaction activity decreasing with prices has been behavioural - a disposition effect - as sellers who are averse to realizing losses become unwilling to adjust their valuations (see Anglin et al., 2003; and Case and Shiller, 2003). While Clayton *et al.* (2008) suggest that professional, institutional investors may be more objective in their decisions compared to amateur individuals in commercial real estate markets, evidence of such a behavioural bias has been found in the UK by McAllister *et al.* (2003), who report that some institutional investors can find it difficult to justify sales at prices below previous appraised value.
- The role of credit markets is also identified as reinforcing the pro-cyclical relationship between prices and transaction activity, Stein (1995) and Ortalo-Magné and Rady (2006) develop models in which transaction activity is pro-cyclical owing to a positive relationship between loan-to-value ratios and prices.
- Drawing on Krainer (2001) and Novy-Marx (2004), Clayton *et al.* (2008) focus on differences in optimal pricing and bargaining strategies in ‘hot’ and ‘cold’ markets. In falling markets, it is proposed that the option to wait becomes more valuable for sellers and transaction activity falls.
- Finally, drawing upon the ‘noise trader’ literature, Clayton *et al.* (2008) focus on clientele effects. Transaction activity is presented as a sentiment indicator that indicates the relative presence of irrational investors in the market. As market corrections occur, an interlinked decrease in the number of potential buyers and decrease in valuations results in lower turnover.

Hence, this literature stresses the interaction of market conditions, a disposition effect, the availability of credit and the numbers of buyers and sellers as key determinants of liquidity over time. However, many of these factors will also vary between markets and asset segments at any given point in time.

In addition to the factors above, cross-sectional variation in the level of transaction activity may be due to differences in real estate market institutions and broader economic conditions. A range of interrelated variables such as information availability, market transparency and maturity, quantity of investable stock, quality of brokerage and other support services, direct and indirect transaction costs and other institutional factors may be significant determinants of the quantity of potential buyers and sellers and of their propensity to transact.

Drawing on the literature above and *a priori* inferences, Exhibit 1 presents a simplified and parsimonious causal model that hypothesises the main determinants of real estate market transaction activity. The thickness of the lines illustrates the expected relative strength of the transmission processes. While the relationship between investment performance and transaction activity is theoretically uncertain, nevertheless they are closely interlinked. Similar potential feedback relationships can be noted among many of the other variables. While macro-economic and capital market drivers are expected to affect each other and the real estate market, the performance of the real estate market is also expected to influence, albeit more indirectly and less extensively, the macro-economy and capital markets. Given that the focus of this study is on variations within a single, national market, the interaction of national-level and urban-level variables needs to be acknowledged. Clearly different cities will have different economic structures and trajectories. Even market maturity will vary between cities as market depth, information availability etc. varies. Whilst market maturity is expected to be an important determinant of transaction activity, it is perhaps less obvious that transaction activity will also be a factor that determines market maturity.

[INSERT EXHIBIT 1 HERE]

In line with the analysis above, the level of transaction activity in a market is assumed to be positively related to real estate investment performance – and *vice versa*. The latter is then expected to be determined by a range of real estate market, economic and capital market variables. A number of causal relationships can be identified. As a determinant of performance, it is presumed that there will be a positive relationship between economic growth and real estate market transaction activity. Mainly owing to its effects on the number of buyers and sellers, the size of the institutional investment market is expected to be positively associated with transaction activity as well. All else equal, primarily through the increased presence of cross-border investors, a positive relationship between a market's global economic integration and the level of transaction activity is expected.

Capital market indicators are commonly used as a proxy for investor risk perceptions. It is expected that there will be a negative relationship between risk perceptions and transaction activity. Debt availability may increase the number of potential buyers and has been identified as a significant determinant of capitalization rates in other work (see Chervachidze and Wheaton, 2013). A positive relationship between debt availability and transaction activity is expected. Given the potential broad scope of market regulation, it is more difficult to propose strong *a priori* expectations. For instance, restrictive regulations or supply constraints may be attractive for investors if it helps to support price growth. However, unpredictable and arbitrary imposition of regulation may act as a deterrent to investment. Meanwhile, transaction costs are expected to be negatively related to transaction activity. Direct transaction costs (taxes, brokerage fees, settlement costs, etc.) are relatively

straightforward to measure. However, indirect costs are less tangible. At the city level, it is expected that indirect or implicit transaction costs (search costs, price impact effects, regulation etc.) will mainly be driven by local factors.

Indirect costs are also related to theoretical expectations regarding market size. In sectors that are characterized by scale economies and opaqueness, it is expected that investment will be more concentrated because of information networks. Information availability stimulates initial investment and initial investment generates more information, which generates path dependency effects and results in informational cascades. Owing to such information network effects, a positive relationship is expected between market size and transaction activity. Several studies demonstrate a tendency for real estate investment to concentrate in the largest US institutional markets. Echoing earlier similar findings by Shilton and Stanley (1995), Smith et al. (2004: 1) find that “most of the value and the overwhelming proportion of investor-owned, institutional quality real estate lies in a small subset of the US”. The top five markets accounted for by 21% of population and over 45% of assets in the NCREIF index. McAllister and Nanda (forthcoming) found that New York, Washington, Boston, Chicago, San Francisco, Los Angeles, Atlanta and Houston accounted for nearly 70% of transaction volume by value. It was notable that this proportion increased to 85% for foreign investors who are expected to have higher information and search costs compared to domestic investors.

Recent modelling of commercial real estate transaction volumes across a wide range of national real estate markets has been carried out by Lieser and Groh (2014). They set their work in the context of the attractiveness of markets to international real estate investors. In this and an earlier article (Lieser and Groh, 2011), they assemble data on a range of indicators that potentially might affect international investor decisions on where to invest. These include measures of economic activity, the scale and potential for real estate market growth, capital markets, legal and regulatory factors, and the wider social and political environment. Their dependent variable in this work appears to be total transaction volume per year, including domestic and international real estate investor activity, for 47 different countries. This is despite the focus of their conceptual framework on international investment patterns.

Lieser and Groh (2014) regress data on volumes on to composite indicators for the factors listed above. This reveals volumes to be driven by the scale of real estate markets, the depth of capital markets and the legal and regulatory environment. Taking each factor in turn, volumes are also regressed on to raw data for the indicators that make up the composite indices. The bulk of this modelling is carried out on data spanning the period 2004-2009. Although their work is useful in drawing attention to a wide range of data sources capturing economic activity and the investment environment, there are some problematic issues. A major issue is the mismatch between the focus of the conceptual framework (on cross-border activity) and the nature of the variable being modelled (total transaction activity). Another

issue is the omission of any variables relating to real estate market performance in the countries concerned.

In summary, asset market liquidity is concerned with the timing and costs of entering and exiting asset markets and the effects of trades on asset prices. Whilst transaction activity is an imperfect proxy for liquidity, it seems evident that there should be a close relationship between the direct and indirect costs to transact and the level of transaction activity. Within national markets, determinants of liquidity such as direct transaction costs and transaction execution (post-matching) times are relatively uniform. However, other determinants of liquidity such as numbers of potential buyers and sellers, market transparency and size will vary. Over time, changes in macro-economic and capital market conditions will have disparate effects on local commercial real estate investment markets and, consequently, on transaction activity. Below we provide empirical evidence of how transaction activity varies between markets and over time and investigate more formally whether the empirical evidence is consistent with the relationships hypothesized above.

### **Data and summary statistics**

To explore determinants of transaction activity further, data on individual office transactions over the period 2001-2014 was obtained from Real Capital Analytics (RCA) for 49 major office markets across the United States. This was used to compute annual frequency measures for the number, value and square footage of offices transacted in each year. RCA is a private company that collects commercial real estate transaction data for both the US and, more recently, all other real estate markets around the world. In the US, the data collection focuses on transactions of \$2.5 million or greater. Information on transactions is obtained from multiple sources including brokerage firms, investment firms, listing services, press reports and public records.

Data on office market performance and economic conditions were gathered from several sources. Given the relationships between transaction activity and performance identified by earlier research, we obtained capitalization rates and return rates for different locations from NCREIF. However, this data was not available for 20 cities in our sample and so we sought alternative variables capturing Grade A office market conditions in each location, namely rents, vacancy rates, completions and absorption, which we obtained from CBRE. Capitalization rate series were also obtained from RCA. Unlike the NCREIF data, these rates are transaction based, but the sample of transactions in each city changes from year to year and this introduces noise into the capitalization rate series.

Transaction volumes are not a perfect measure of transaction activity since they are driven by both changes in activity and changes in prices. For instance, volumes might be higher in a particular year because prices have risen, not because more transactions occurred. In principle, a superior measure of

activity should be turnover rates. These can be defined as the total value of buildings traded in a period divided by the total value of all buildings in that location.<sup>1</sup> However, a major practical challenge is that turnover rates are not routinely published for different areas. This reflects the absence of regular and reliable estimates of the commercial office stock for different places. To address this, we use data on capitalization rates and rents to create proxy capital values for each location. The rental series in our dataset track the average gross and average net asking rent per square foot per annum in each market. Meanwhile, the capitalization rates from RCA are average rates based on all transactions in that year and place. Dividing the rental figure by the capitalization rate produces a capital value per square foot that can be multiplied with each year's floorspace estimate.

Finally, we also collect economic data to reflect the additional factors that could influence investment transaction decisions. For example, if certain locations are more popular because of their scale or wealth, this might lead to higher levels of transaction activity. Economic scale and wealth are proxied by annual frequency data published at MSA level on real GDP and real GDP per capita by the Bureau of Economic Analysis. The US all-items consumer price index represents inflation and, as such, is used to create real rental series from the nominal terms data supplied by CBRE. Our other economic variables then capture financial and wider pricing influences on transaction activity, these being the yield on Treasury Bills, the spread between lending and deposit rates, and the percentage of debt to GDP.

Exhibit 2 lists the 49 markets covered by the study as well as reporting average turnover ratios, market size indicators and cap rates for each market. The sample covers a wide range of markets in terms of estimated size and geographical spread. In terms of relative economic importance, the largest ten markets account for nearly 56% of the total (2014) GDP for the markets in our sample. Just three markets - New York (14.3%), Los Angeles (8.0%) and Chicago (5.6%) - account for c28% of total GDP for the 49 cities. In terms of estimated stock size in 2014, the largest ten markets account for nearly 68% of Net Rentable Area. The five largest markets alone - New York (19.5%), Washington (9%), Los Angeles (8.2%), Chicago (6%) and Boston (4.75%) - account for nearly half of the total Net Rentable Area. Washington is a clear anomaly. With its large government sector, it accounts for 9% of office stock compared to 4.4% of GDP in our sample cities.

[INSERT EXHIBIT 2 HERE]

Turning to transaction activity, again with reference to 2014 only, the largest ten markets account for around three quarters of transaction activity. New York alone is very prominent accounting for nearly

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<sup>1</sup> Alternatively, they could be defined in terms of number of assets or floorspace traded relative to total number or total floorspace in a location. It is unusual to use the latter basis in an investment setting, but more common in analysis of rental markets where data on gross and net absorption are often studied.

24% of transaction volume. The five largest markets - New York (23.6%), San Francisco (13%) Los Angeles (8.7%), Boston (7.9%) and Washington (6.3%) account for nearly 60% of the total. In terms of numbers of transactions, this level of concentration tends to be less marked. For instance, in 2014 New York accounted for approximately 11% of the total number of transactions compared to 19% of the total office stock and nearly 24% of transaction volume by value. However, the data also indicates that transaction activity varies substantially during the cycle. As a result of the propensity for transactions to be large and lumpy, it is important not to over-interpret a single year's data and to focus on long-term patterns.

As noted, since absolute measures provide little indication of relative levels of market activity, we focus on turnover rates. With substantial variation over time and between markets, for the period 2001-2014 the average turnover rate across all markets was 9%. The highest average turnover rates were recorded for Las Vegas (26.7%), San Diego (18.5%), Phoenix (18.1%), San Francisco (16%) and Austin (15.8%). Despite its large significance in terms of value of transactions, the average turnover ratio in New York is below average at approximately 5.4%. However, in contrast to New York, other 'Gateway' cities such as Boston, Los Angeles Washington had near average turnover rates. 'Rustbelt' cities such as Pittsburgh, Baltimore, Cleveland, Columbus and Detroit have below average levels of turnover as well as a number smaller office markets. On the face of it, there seems weak evidence to support the argument that large markets are more liquid as measured by the proportion of office stock transacted and this is illustrated by Exhibit 3.

[INSERT EXHIBIT 3 HERE]

Exhibit 4 illustrates the relationship between office cap rates as reported by RCA and office market turnover ratios at an aggregate level, taking the unweighted average of each variable in each year across the 49 cities. Broadly, the study timeframe is comprised of four periods. It begins at the time of the stock market correction associated with the 'dot.com bust'. Capitalization rates then fall between 2000 and 2007 and the period leading up to the Global Financial Crisis (GFC) illustrates dramatically the positive association between pricing and transaction activity. In 2007, the mean turnover ratio peaked at slightly over 20%. The GFC was associated with large falls in transaction volumes and substantial increases in cap rates. During the GFC, average capitalization rates rose from a low of 7.2% in 2007 to 8.3% in 2010. In 2009, the mean turnover rate fell to 1.5%. Not surprisingly, the recovery from the GFC was associated with rising transaction activity and falling cap rates. Yet, in terms of the cross-sectional spread of mean capitalization rates, there is little evidence of a significant relationship between cap rates and market turnover, as illustrated by Exhibit 5.

[INSERT EXHIBIT 4 HERE]

[INSERT EXHIBIT 5 HERE]

### **Econometric Model**

Drawing upon well-established econometric procedures, we test the influence of a range of determinants on market liquidity/turnover by regressing MSA-level economic and real estate indicators on liquidity ratios. The standard OLS model in a panel setting (pooled OLS) is:

$$p_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \varepsilon_{it} \quad (1)$$

Where  $p_{it}$  is the market liquidity as proxied by volume and turnover rate in market  $i$  in year  $t$  and  $X_{it}$  is a vector of MSA economy attributes, and  $Z_{it}$  is a vector of property market attributes (e.g. market size, transaction costs, etc.) of market  $i$  in year  $t$ .

A plain OLS estimation of Equation (1) may suffer from two main econometric biases. First, the specification assumes strict exogeneity between the regressors and the error term whereas, in reality, there may be significant levels of unobserved heterogeneity. The unobserved heterogeneity may be modelled as fixed effects, after conducting the Heckman specification test. We envisage that fixed effect modelling may be more appropriate than random effect modelling due to presence of a small number of cross-sections. The advantage of this method is that it allows us to use both time series and cross sectional variations in the data, which increases the efficiency of the OLS estimates. A potential bias in estimating equation (1) is the possibility of correlation between unobserved heterogeneity at the metro level and the observables, which would violate standard assumptions of OLS estimation. Therefore, the disturbance term in equation (2) is specified as a two-way error component capturing area-specific fixed effects and time-specific effects:

$$\varepsilon_{it} = \delta_i + \lambda_t + \omega_{it} \quad (2)$$

i.e.

$$p_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \delta_i + \lambda_t + \omega_{it} \quad (3)$$

Where  $\delta_i$  are market-specific dummies,  $\lambda_t$  are the time-specific dummies and  $\omega_{it}$  is the idiosyncratic error. In this specification, heterogeneity is assumed to be constant over time and correlated with observables. The constant effect is removed by mean-differencing the data. This estimation strategy is

consistent with theoretical expectations that market-specific unobserved characteristics can bring in a permanent shift in key real estate indicators such as turnover ratios across markets.

Second, our theoretical discussion indicates several variables that can capture the variation in liquidity ratios across markets. A key concern in incorporating these variables is that there may be strong inter-relationships among them, which gives rise to the perennial econometric problem of multi-collinearity. In the presence of multi-collinearity, interpretation of individual coefficients becomes problematic owing to difficulties in separating the individual contributions. Therefore, it is advisable to have a parsimonious specification of the model without loss of information on several dimensions of the research hypothesis. With this goal, we specify a model that is parsimonious, yet it captures the main areas of confounding factors as indicated below.

$$\begin{aligned}
 liq_{it} = & \alpha_0 + \beta_1 \log(real\ GDP_{it}) + \beta_2 govt\ bond_t + \beta_3 debt_t + \beta_4 spread_t + \beta_5 \log\ rent\ ratio_{it} \\
 & + \beta_6 \log\ absorption_{it} + \beta_7 foreignshare_{it} + \beta_8 regulatoryindex_i + \delta_i + \lambda_t + \omega_{it}
 \end{aligned}
 \tag{4}$$

Where,  $liq_{it}$  is the liquidity as proxied by volume and turnover rate;  $\log(real\ GDP_{it})$  is the log of MSA real GDP as a proxy for size;  $govt\ bond_t$  is the risk free rate as a proxy for cost of funding;  $debt_t$  is the debt availability as a percentage of GDP which works as a proxy for funding liquidity;  $spread_t$  is difference between lending and deposit rates as a proxy for risk premium;  $\log\ rent\ ratio_{it}$  is the log of real rent ratio;  $\log\ absorption_{it}$  is the log of total absorption in the market;  $foreignshare_{it}$  is the % of foreign transactions in the market and  $regulatoryindex_i$  is the time-invariant Wharton index of regulatory control.

However, a further correlation check (see Exhibit 6) reveals significant relationship within these set of variables which calls for orthogonalization procedures. Therefore we conduct the following set of orthogonalization processes.

[INSERT EXHIBIT 6 HERE]

$$\log(absorption)_{it} = \alpha_0 + \beta_1 \log(realgdp_{it}) + \chi_{it}
 \tag{5}$$

$$govt\ bond_t = \alpha_0 + \beta_1 \log\ rent\ ratio_{it} + \beta_2 spread_t + \beta_3 debt_t + \theta_{it}
 \tag{6}$$

$$\log\ rent\ ratio_{it} = \alpha_0 + \beta_1 govt\ bond_t + \beta_2 debt_t + \phi_{it}
 \tag{7}$$

$$debt_t = \alpha_0 + \beta_1 govt\ bond_t + \beta_2 \log\ rent\ ratio_{it} + \beta_3 spread_t + \zeta_{it} \quad (8)$$

We can then incorporate the orthogonalized variables as follows:

$$liq_{it} = \alpha_0 + \beta_1 \log(real\ GDP_{it}) + \beta_2 \hat{\theta}_{it} + \beta_3 \hat{\zeta}_{it} + \beta_4 spread_t + \beta_5 \hat{\phi}_{it} + \beta_6 \hat{\chi}_{it} + \beta_7 foreignshare_{it} + \beta_8 regulatoryindex_t + \delta_t + \lambda_t + \omega_{it} \quad (9)$$

Specifically,  $\hat{\chi}_{it}$  is the orthogonalized  $\log(absorption_{it})$ .  $\hat{\theta}_{it}$  is the orthogonalized government bond.  $\hat{\phi}_{it}$  is the orthogonalized  $\log(rent\ ratio)$  and  $\hat{\zeta}_{it}$  is the orthogonalized debt availability. Equation (9) provides an econometric specification that is parsimonious and devoid of confounding correlations with adequate controls for unobserved time and MSA heterogeneity.

## Results

We present the results of the econometric models for transaction volumes and turnover ratios in Exhibit 7. Model 2, which incorporates city effects and a wider range of potential determinants, is our preferred model as represented by Equation 4. Looking first at the determinants of transaction volumes, a positive relationship was expected between market size and volume. In our preferred model (column 2), we find an expected and statistically significant positive effect of the size of the economy as measured by real GDP on transaction volumes. Controlling for the fact that large cities will have higher transaction volumes than small cities, we examine how the other potential determinants of transaction volume perform. For government bond yields, the expected negative coefficient is identified. As government bond yields increase, transaction volumes fall. For debt availability, the expected positive coefficient is found and it is statistically significant. An increase in the amount of bank lending relative to GDP is associated with an increase in transaction volumes. With the spread between lending and deposit rates used as an indicator of risk perceptions, we also estimate a significant negative coefficient for the lending-deposit rate spread. An increase in the lending-deposit rate spread is associated with a fall in transaction volumes. Bearing in mind that a positive real rent ratio is associated with rental levels above long-run real levels, a statistically significant positive coefficient is found for this variable. This is consistent with myopic expectations by investors with investment being higher in periods of relatively high rents (see also Chervachidze and Wheaton, 2013). This is reinforced by the fact that there is a significant positive effect of absorption rate on transaction volume. The results for the effect of foreign investment are less clearcut. It has a statistically significant positive coefficient in the first and third models but not in our preferred model.

## INSERT EXHIBIT 7 HERE

In contrast to transaction volumes, the results for turnover rates are more ambiguous. In our preferred model (column 5), we find a statistically significant positive effect of market size on turnover rate. Although there are grounds to expect larger markets to have higher turnover ratios due to information and network effects, given the patterns in the descriptive statistics such a strong finding is unexpected. Similar to the finding on transaction volume, we also estimate a significant negative coefficient for the lending-deposit rate spread. However, we do not identify the expected coefficients for the other potential determinants. The coefficients for government bond yields, debt availability, real rent ratio, absorption rate and foreign investment are not statistically significant.

### **Conclusion**

Although it is widely used as a proxy for liquidity, transaction activity is not a 'pure' measure of liquidity. Whilst high levels of transaction activity require the ability to transact, it is not axiomatic that low levels of transaction activity reflect an inability to sell at the prevailing market price within a reasonable timeframe. A positive relationship between transaction activity and market conditions is a stylized fact. Transaction activity can collapse in falling markets and increase rapidly in rising markets. At the macro-level, this can be observed in the study period. It is particularly apparent from the spike of transaction activity in the real estate price bubble of 2006-7 and the subsequent plunge in values and volume in 2008-9 as the crisis took hold. The results of the formal econometric analysis are consistent with this pattern in that a negative relationship between market risk (as proxied by lending-deposit rate spreads) and the turnover rate is confirmed. There are also positive associations between market size and the turnover rate.

The summary data indicate some findings that merit more in-depth investigation. There appears to be a sharp Sunbelt-Rustbelt disparity. The highest turnover cities are the Sunbelt cities of Las Vegas, Phoenix, Houston, Austin, San Diego and San Antonio. In contrast, cities in the Rustbelt such as Pittsburgh, Cincinnati, Cleveland, and Columbus tend to have the turnover rates that are in the bottom quartile. Hence there is scope for further investigation in a number of areas. The differences in the models results for the volumes and turnover rates are notable. Given the control for market size, it is difficult to identify a rationale for the difference in the significances of the explanatory variables. The wide spread in the turnover ratios suggests that the models are omitting important variables. It is possible that cities with high supply of new buildings may experience higher turnover ratios as such buildings are more likely to transact as developers sell to long term investors. Further modelling is required to explore these initial findings.

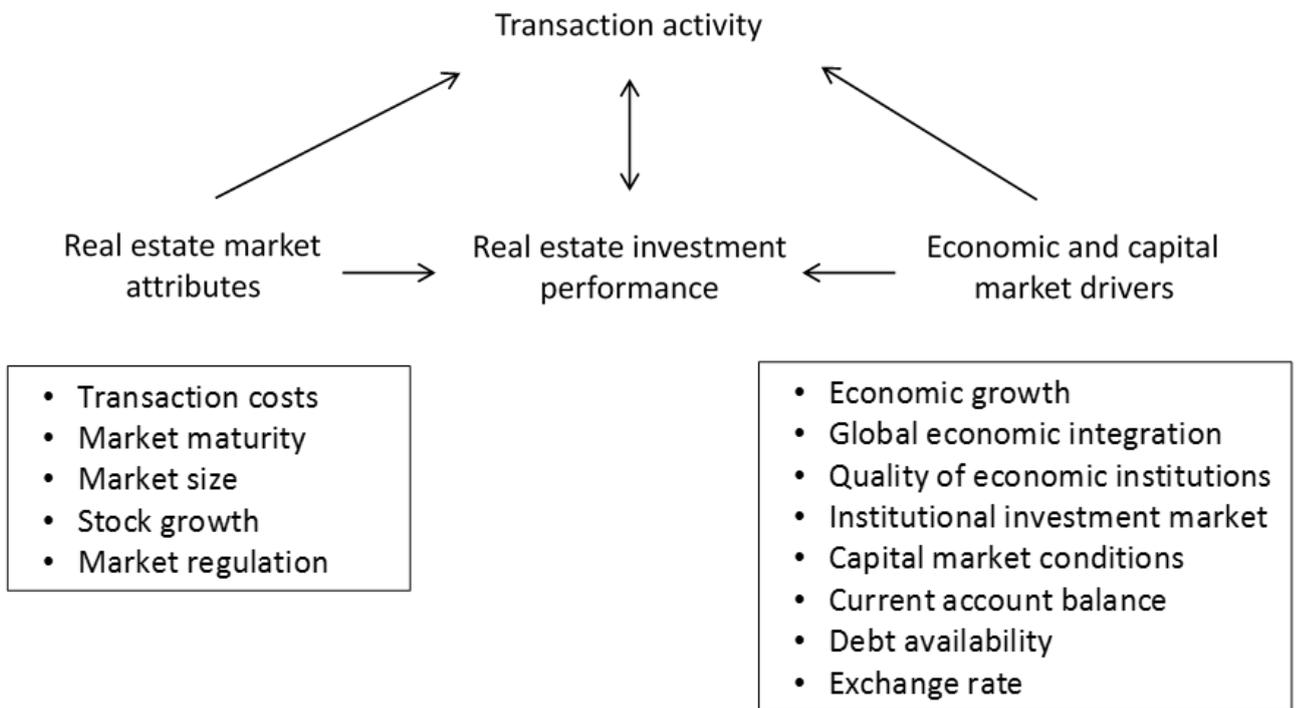
## References

- Anglin, P., Rutherford, R. and Springer, T. (2003). The trade-off between the selling price of residential properties and time-on-the-market: The impact of price setting. *The Journal of Real Estate Finance and Economics*, 26(1), 95-111.
- Brunnermeier, M. K. and Pedersen, L. H. (2009), Market liquidity and funding liquidity. *The Review of Financial Studies*, 22 (6): 2201-2238.
- Buckles, B. W. (2008), Liquidity dynamics in commercial real estate. *Journal of Real Estate Portfolio Management*, 14 (4), 307-324.
- Case, K. and Shiller, R. (2003). Is there a bubble in the housing market?. *Brookings Papers on Economic Activity*, 2003(2), 299-362.
- Cauley, S. and Pavlov, A. (2002). Rational delays: the case of real estate. *The Journal of Real Estate Finance and Economics*, 24(1-2), 143-165.
- Cheng, P., Lin, Z. and Liu, Y. (2010). Illiquidity and Portfolio Risk of Thinly Traded Assets. *Journal of Portfolio Management*, 36 (2): 126-138.
- Cheng, P., Lin, Z. and Liu, Y. (2013a). Performance of Thinly Traded Assets: A Case in Real Estate. *The Financial Review*, 48 (3): 511-536.
- Cheng, P., Lin, Z. and Liu, Y. (2013b). Liquidity Risk of Private Assets: Evidence from Real Estate Markets. *The Financial Review*, 48 (4): 671-696.
- Chervachidze, S., and Wheaton, W. (2013). What determined the Great Cap Rate Compression of 2000–2007, and the dramatic reversal during the 2008–2009 Financial Crisis?. *The Journal of Real Estate Finance and Economics*, 46(2), 208-231.
- Clayton, J., MacKinnon, G. and Peng L. (2008), Time variation of liquidity in the private real estate market: An empirical investigation. *Journal of Real Estate Research*, 30 (2), 125-160.
- Collett, D., Lizieri, C. and Ward, C. (2003). Timing and the Holding Periods of Institutional Real Estate. *Real Estate Economics*, 31 (2): 205-222.
- Fisher, J., Gatzlaff, D., Geltner, D. and Haurin, D. (2003), Controlling for the Impact of Variable Liquidity in Commercial Real Estate Price Indices. *Real Estate Economics*, 31 (2), 269-303.
- Fisher, J., Gatzlaff, D., Geltner, D. and Haurin, D. (2004), An Analysis of the Determinants of Transaction Frequency of Institutional Commercial Real Estate Investment Property. *Real Estate Economics*, 32 (2): 239-264.

- Fisher, J., Geltner, D. and Pollakowski, H. (2007), A quarterly transactions-based index of institutional real estate investment performance and movements in supply and demand. *Journal of Real Estate Finance and Economics*, 34 (1), 5-33.
- Fisher, J., Ling, D. C., & Naranjo, A. (2009), Institutional Capital Flows and Return Dynamics in Private Commercial Real Estate Markets. *Real Estate Economics*, 37 (1), 85–116.
- Gallant, R., Rossi, P. and Tauchen, G. (1992) Stock prices and volume, *Review of Financial Studies*, 5, 199–242.
- Gau, G. W. and Wang, K. (1994). The Tax-Induced Holding Periods of Real Estate Investors: Theory and Empirical Evidence. *Journal of Real Estate Finance and Economics*, 8 (1): 71-85.
- Goetzmann, W. and Peng, L. (2006), Estimating house price indexes in the presence of seller reservation prices. *The Review of Economics and Statistics*, 88 (1): 100-112.
- IPF (2015). *Liquidity Pricing of Illiquid Assets*. London: Investment Property Forum.
- Keogh, G. & D'Arcy, E. (1994). Market maturity and property market behaviour: A European comparison of mature and emergent markets. *Journal of Property Research*, 11 (3): 215-235.
- Krainer, J. (2001) A Theory of Liquidity in Residential Real Estate Markets. *Journal of Urban Economics*, 49, 32–53.
- Lieser, K. & Groh, A. P. (2011). The Attractiveness of 66 Countries for Institutional Real Estate Investments. *Journal of Real Estate Portfolio Management*, 17 (3): 191-211.
- Lieser, K. & Groh, A. P. (2014). The Determinants of International Commercial Real Estate Investment. *Journal of Real Estate Finance and Economics*, 48 (4): 611–659.
- Lin Z. and Vandell K. (2007). Illiquidity and Pricing Biases in the Real Estate Market. *Real Estate Economics*, 35 (3): 291–330.
- Ling, D., Marcato G. and McAllister P. (2009), The dynamics of asset prices, capital flows, and transaction activity in illiquid, informational inefficient, commercial real estate markets. *Journal of Real Estate Finance and Economics*, 39 (3), 359-383.
- McAllister, P., Baum, A., Crosby, N., Gallimore, P., and Gray, A. (2003). Appraiser behaviour and appraisal smoothing: some qualitative and quantitative evidence. *Journal of Property Research*, 20(3), 261-280.
- McAllister, P. and Nanda, A, Does Foreign Investment Affect US Office Real Estate Prices? *Journal of Portfolio Management*, forthcoming
- Novy-Marx, R. (2004) The Microfoundations of Hot and Cold Markets. Working Paper, University of Chicago Graduate School of Business.

- Ortalo-Magné, F. and Rady. S. (2006) Housing Market Dynamics: On the Contribution of Income Shocks and Credit Constraints. *Review of Economic Studies*, 2006, 73, 459–85.
- Shilton, L. and Stanley, C. (1995). Spatial Filtering: Concentration or Dispersion of NCREIF Institutional Investment. *Journal of Real Estate Research*, 10(5), 569-582.
- Smith, A. Hess, R. and Liang, Y. (2004). Size-Tiered Economic Geography: A New View of the US Real Estate Markets. Pramerica Real Estate Investors.
- Stein, J. (1995). Prices and Trading Volume in the Housing Market: A Model with Down-Payment Effects. *Quarterly Journal of Economics*, 110, 379–406.

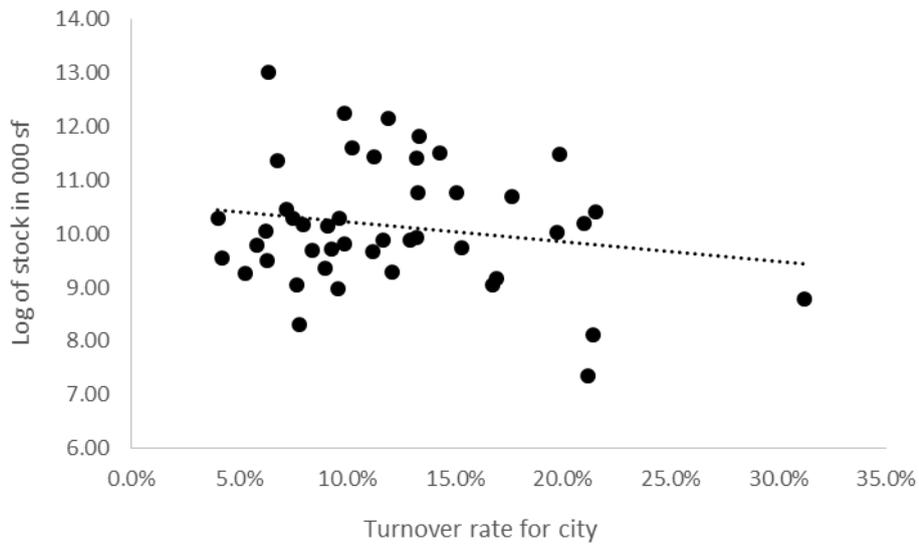
**Exhibit 1: Determinants of Real Estate Market Transaction Activity: An Explanatory Model**



## Exhibit 2: Summary Statistics

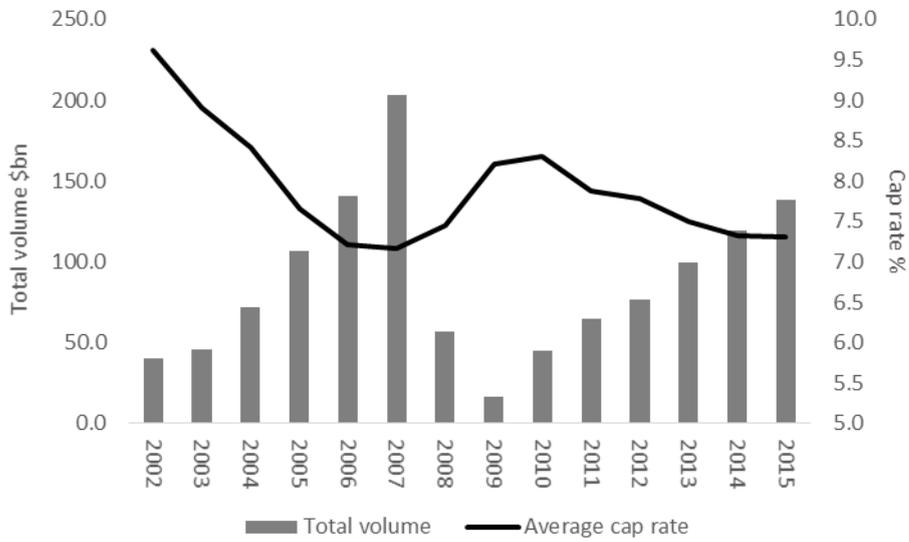
	<b>% Real GDP in 2014</b>	<b>% Office stock in 2014</b>	<b>Mean cap rate 2002-15</b>	<b>Mean turnover rate 2002-15</b>
Albany	0.45%	0.16%	7.3%	-
Albuquerque	0.39%	0.07%	8.6%	21.2%
Atlanta	3.00%	4.04%	7.8%	11.2%
Austin	1.07%	0.98%	7.5%	19.7%
Baltimore	1.61%	1.51%	8.0%	7.2%
Boston	3.56%	4.75%	7.2%	10.2%
Charlotte	1.32%	1.29%	7.6%	9.6%
Chicago	5.61%	5.96%	7.7%	13.3%
Cincinnati	1.12%	1.00%	8.8%	6.2%
Cleveland	1.14%	0.78%	8.4%	5.8%
Columbus	1.09%	0.71%	8.1%	8.4%
Dallas	4.63%	4.37%	8.0%	14.3%
Denver	1.72%	2.07%	7.9%	15.1%
Detroit	2.21%	1.27%	8.6%	7.5%
Hartford	0.79%	0.61%	8.2%	4.2%
Honolulu	0.54%	0.34%	7.1%	9.5%
Houston	4.58%	3.89%	7.8%	13.2%
Indianapolis	1.15%	0.78%	8.7%	9.9%
Jacksonville	0.60%	0.47%	8.0%	12.1%
Kansas City	1.13%	0.72%	8.2%	9.3%
Las Vegas	0.87%	0.29%	7.9%	31.2%
Los Angeles	8.03%	8.18%	7.0%	11.9%
Louisville	0.62%	0.39%	7.7%	-
Memphis	0.64%	0.37%	8.3%	7.7%
Milwaukee	0.91%	0.51%	8.0%	9.0%
Minneapolis	2.18%	1.53%	8.1%	-
Nashville	0.99%	0.69%	8.1%	11.2%
New York	14.32%	19.54%	6.7%	6.3%
Norfolk	0.84%	0.46%	7.9%	5.3%
Oklahoma City	0.65%	0.14%	8.7%	21.4%
Orlando	1.07%	0.86%	8.3%	12.9%
Philadelphia	3.61%	3.77%	8.2%	6.7%
Phoenix	1.99%	1.43%	7.7%	21.5%
Pittsburgh	1.26%	1.27%	7.8%	4.0%
Portland	1.54%	0.85%	7.6%	11.6%
Raleigh	0.66%	1.15%	7.8%	7.9%
Richmond	0.65%	0.59%	8.4%	6.3%
Sacramento	1.04%	0.75%	7.6%	15.3%
Salt Lake City	0.69%	0.41%	8.1%	16.9%
San Antonio	0.96%	0.37%	8.1%	16.7%
San Diego	1.92%	1.16%	7.4%	21.0%
San Francisco	3.73%	4.18%	7.0%	19.8%
Seattle	2.80%	1.93%	7.3%	17.6%
South Florida	2.75%	2.08%	7.4%	13.3%
St Louis	1.38%	1.10%	8.4%	9.1%
Tampa	1.19%	0.90%	8.1%	13.2%
Toledo	0.30%	0.09%	9.1%	-
Tucson	0.33%	0.18%	7.8%	7.7%
Washington	4.38%	9.08%	6.9%	9.9%

**Exhibit 3      Turnover Rates and Market Size**

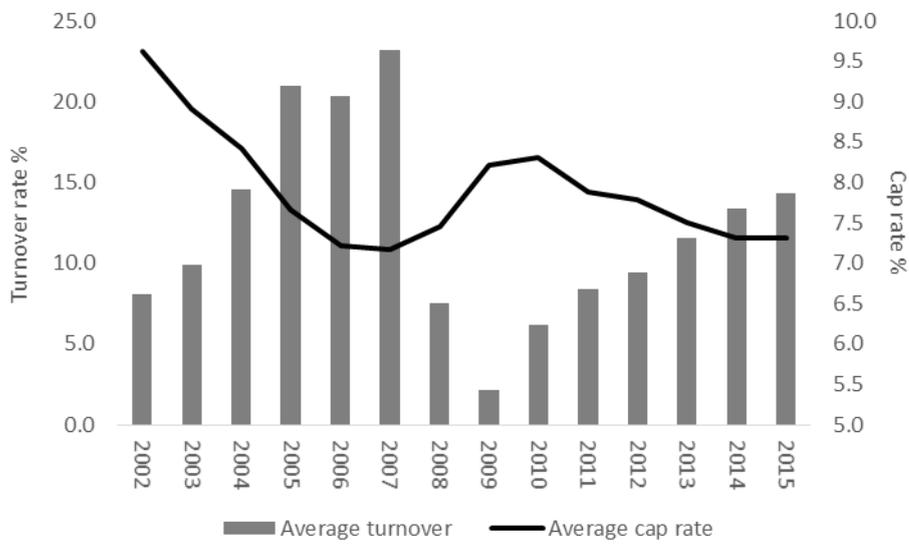


**Exhibit 4 Transaction Activity and Cap Rates: All Markets in Sample**

(a) Volumes and cap rates



(b) Turnover rates and cap rates





**Exhibit 6: Correlation Matrix**

	log(volume)	log(real GDP)	Government Bond	Debt availability	Lending-Deposit rate	log(real rent ratio)	log(absorption)	%Foreign investors	Wharton Regulatory Index
<b>log(volume)</b>	100.0%								
<b>log(real GDP)</b>	84.5%	100.0%							
<b>Government Bond</b>	6.8%	-1.8%	100.0%						
<b>Debt availability</b>	-3.3%	3.4%	<b>-94.4%</b>	100.0%					
<b>Lending-Deposit rate</b>	-29.7%	-7.1%	<b>-64.9%</b>	<b>55.3%</b>	100.0%				
<b>log(real rent ratio)</b>	-10.2%	-13.1%	<b>48.4%</b>	<b>-48.3%</b>	-15.4%	100.0%			
<b>log(absorption)</b>	66.3%	<b>64.4%</b>	8.5%	-7.2%	-20.6%	-8.3%	100.0%		
<b>%Foreign investors</b>	36.6%	34.7%	-2.1%	3.1%	-7.7%	2.9%	23.6%	100.0%	
<b>Wharton Regulatory Index</b>	21.1%	10.6%	-2.7%	3.7%	-2.9%	-6.3%	7.9%	11.7%	100.0%

Note: Variables with correlations **shown in bold above** are specified in regression after the orthogonalization process.

**Exhibit 7: Panel Data Models Explaining Real Estate Liquidity across US Cities**

	(dependent variable: volume)			(dependent variable: Turnover ratio)		
	(1)	(2)	(3)	(4)	(5)	(6)
Log(real GDP)	1.514*** (42.06)	3.591*** (12.63)	1.973*** (5.37)	0.641* (1.83)	15.93*** (5.21)	22.67*** (5.35)
Government bond yield ( <i>orthogonalized</i> )	0.011 (0.12)	-0.130* (-1.89)		0.152 (0.17)	-0.786 (-1.15)	
Debt Availability ( <i>orthogonalized, lagged</i> )	0.009* (1.80)	0.008** (2.29)		0.035 (0.80)	0.007 (0.21)	
Lending rate – Deposit rate	-0.831*** (-12.90)	-0.898*** (-18.96)		-8.992*** (-15.10)	-8.483*** (-18.28)	
Log(real rent ratio) ( <i>orthogonalized</i> )	0.591* (1.81)	0.911*** (3.26)	0.596** (2.64)	-6.835*** (-2.95)	-1.411 (-0.43)	-4.726 (-1.62)
Log(absorption) ( <i>orthogonalized</i> )	0.062** (2.32)	0.057** (2.49)	0.027 (1.37)	-0.502** (-2.17)	0.149 (0.63)	0.331 (1.52)
% foreign investors	0.005* (1.85)	0.002 (1.28)	0.004** (2.18)	-0.0003 (-0.02)	0.0225 (1.06)	0.0224 (1.16)
Wharton Regulatory Index	0.193*** (6.74)			0.961*** (3.93)		
Intercept	3.544*** (8.18)	-18.70*** (-6.14)	-3.622 (-0.94)	16.83*** (3.99)	-135.9*** (-3.88)	-227.7*** (-4.78)
Sample (markets and time period); Model	All markets 2001-2014 No FE	All markets 2001-2014 City FE	All markets 2001-2014 City and Year FE	All markets 2001-2014 No FE	All markets 2001-2014 City FE	All markets 2001-2014 City and Year FE
N	454	454	470	414	414	425

Note: \*\*\* $p < 0.01$ ; \*\* $p < 0.05$ ; \* $p < 0.1$ . All models are estimated with Feasible Generalised Least Square method.