The determinants of Facebook social engagement for National Tourism Organisations' Facebook pages: a quantitative approach

Which Factors Determine Transaction Activity Across US Metropolitan Office Markets?

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Abstract

Variations in transaction activity between commercial real estate markets and over time are likely to have important implications for investment strategies and pricing. The authors investigate economic and real estate market factors that might drive such variations. Their paper draws upon data on trading volumes and turnover rates for 49 US MSA office markets. Panel models are employed to test which factors lead to higher or lower turnover over the period 2002-2015. The results indicate positive associations between turnover rates and market size, economic growth and occupancy rates. Meanwhile, higher capital market risks and transfer taxes are found to have a negative effect on turnover rates. The findings are economically plausible and are robust to a variety of specifications, including different measures of turnover rates. It is also found that private investor transaction activity is less strongly affected by market fundamentals than institutional investor activity.

Keywords: Commercial real estate. Liquidity. Transaction activity. Turnover rates. Private and institutional investors.

Low liquidity is commonly cited as a key attribute of private real estate as an asset class. For example, it is one of the reasons cited for the supposed risk premium puzzle whereby the risk adjusted performance of private real estate implies that much higher allocations to this asset class should be made within multi-asset portfolios. For many investors, the high direct and indirect transaction costs, protracted search and transaction execution times, and price uncertainty creates substantial risks for real estate investors which are not captured in conventional performance measures. For others, particularly investors with long term investment horizons, potential mispricing of such risks presents perceived opportunities. Although it is an imperfect metric, transaction activity is a widely used indicator of real estate market liquidity. This is because higher levels of transaction activity are thought to correspond with increased numbers of buyers and sellers, and greater overlap in their views regarding prices. The level of transaction activity also determines the flow of price information which is, in turn, central to robust measurement of market performance.

Previous research has examined the behavior of transaction activity in commercial real estate markets over time (e.g. Fisher et al. [2009]; Ling et al. [2009]) as well as differences in the propensity of individual assets to be transacted (e.g. Fisher et al. [2004]). A common observation from such research is that trading activity is strongly pro-cyclical, showing clear connections with the performance of real estate through time. However, there are also major variations in transaction activity between different real estate markets and there has been little research on the patterns and determinants of such variations. For instance, the dollar volume of real estate traded varies over time and between markets, while the relative extent to which markets trade varies as well. The relative level of transaction activity can be captured by the measurement of turnover rates, which divide the volume traded by the value of stock in a location. The research questions for this study are how and why turnover varies between different real estate markets and over time.

Drawing upon a dataset for 49 US MSA office markets, this study investigates patterns and determinants of turnover rates over the period 2002-2015. We measure turnover rates using data on transaction volumes

from Real Capital Analytics (RCA) and data on the office stock in each location from CBRE Econometric Advisors. We then model these turnover rates using panel regression techniques and find that turnover rates are positively related to the size of an office market, the economic growth rate for the MSA and the occupancy rate, while they are negatively related to higher capital market risks and higher transfer taxes. These results are robust to a number of different specifications, including the use of different turnover rate measures. In addition, we model whether institutional investor activity differs from private investor activity in respect of these relationships.

Liquidity and transaction activity in real estate markets

Liquidity is a much broader concept than either volume or turnover. Indeed, Goodhart [2008] argues that liquidity has so many facets that it needs clear definition prior to its use in a particular context. At the core of a market's liquidity is an investor's capacity to be able to *immediately* exchange assets for cash (or cash for assets) *at current market prices at no cost.* Empirical research in finance has focused on measuring liquidity and the economic effects of deviation from perfectly liquid markets (see Hibbert et al. [2009] and Vayanos and Wang [2012]). In the private real estate context, research on liquidity has focused on time-to-transact/time-on-market, direct and indirect transaction costs and certainty of market price. The economic consequences of observed variations in liquidity focus on risk and return performance.[1] While it has been argued by Cheng et al. [2013: 675] that real estate assets "…are not just less liquid than security assets; they are less liquid in a different way", the fundamental differences in liquidity between real estate (and other private assets such as infrastructure and private equity) and securities traded instantaneously on electronic exchanges seem to be quantitative rather than qualitative. It is the scale rather than the nature of differences in liquidity that characterises the huge variations in liquidity between public and private asset markets and the associated costs.

[1] For examples, see Cheng et al. [2010], Cheng et al. [2013] and Lin et al. [2009].

A major source of poor liquidity in real estate markets is the time and costs connected with search and the legal and administration processes of asset transfer. Buyers and sellers need to be matched and individual assets need to be investigated and evaluated before settlement. While some of the components of direct transaction costs are not difficult to identify and measure, e.g. brokerage and legal fees, some indirect costs such as search costs are more difficult to quantify. Nonetheless, the indirect costs connected with obtaining information and searching for assets or counterparties are potentially substantial. Compared to financial transaction taxes for securities, real estate transfer taxes tend to be much higher. In addition, real estate investors have greater *ex ante* uncertainty in the amount of capital receipts (expenditures) from transactions and in the timing of these capital receipts (expenditures). Protracted transaction times also produce opportunity costs that are associated with sub-optimal asset allocation in the wake of costs and delays in switching from undesirable to preferred assets.

Reduced transaction activity is often used interchangeably with reduced liquidity when describing market conditions and there are clear interactions. Trading volume is an absolute measure of activity and turnover rates – the proportion of stock in a sector or location that traded during a period – are a common measure of relative liquidity. Such measures are limited in that they do not capture all of the dimensions of liquidity outlined above. Any tendency amongst investors in a particular market to hold properties for a certain length of time affects how often those properties are offered for sale and, therefore, transact. Fisher et al. [2004] suggested that activity could be low in a market not because assets are difficult to sell, but rather because existing investors prefer to hold at current market price levels. Meanwhile, rapidly growing markets where a lot of new stock is being built are likely to exhibit higher levels of turnover simply because developers will tend to sell stock to investors as they exit projects.

Buyers and sellers can have different perspectives on the liquidity of a market. In a market where the marginal investors have long-term horizons and there is high investor demand, institutional grade real estate

assets may be liquid from a seller's perspective and illiquid from a buyer's perspective, leading to 'frustrated capital'. Markets that might be regarded as relatively liquid by investors can have below average turnover rates. In some cases, this might be because such cities are regarded by major investors as core markets, with properties in those markets more likely to be long term holds than 'cycle' or 'rotational' plays. Conversely, in markets with more active funds that have shorter time horizons and where there is low investor demand, similar quality assets may be illiquid from a seller's perspective and liquid from a buyer's point of view.

There are several stylized facts regarding the relationship through time between transaction activity and investment performance in real estate markets. "Hot" phases in the real estate cycle tend to be periods when prices are rising, selling times are relatively short and transaction activity is higher than average. "Cold" phases have the opposite characteristics: prices are falling, selling times are typically longer and transaction activity is lower than average (Krainer [2001]). In equity markets, a positive contemporaneous correlation between price changes and volumes has been noted, but there is longstanding skepticism as to whether a causal relationship exists (see Gallant et al. [1992]). Such a relationship might be due to the fact that transaction flows and returns are jointly dependent on common economic determinants. Results in private real estate markets for the relationship between returns/prices and transaction flows are broadly consistent with a contemporaneous and self-reinforcing relationship generated by exogenous demand shocks (see Fisher et al. [2009]; Ling et al. [2009]). This would suggest that variables such as economic growth, capital market performance, debt availability and supply that have been associated with variations in prices over time will also be significant determinants of transaction activity over time.

Fisher et al. [2003] contend that, in private asset markets such as real estate, changes in market conditions are signaled by changes in both prices and transaction activity. This has led to interest in what influences the number and behavior of buyers and sellers that leads, in turn, to observed transaction volumes and turnover rates. Clayton et al. [2008] present a range of potential determinants of variation in transaction

activity. 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. For trading activity to be pro-cyclical with prices, buyers must respond more rapidly than sellers in updating asset value estimates. 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 consequence, there is a lower propensity in 'cold' markets for trades to occur and transaction activity drops. A range of factors that might affect deviations between buyer and seller valuations are then proposed.

Among other determinants, the role of credit markets has been proposed as reinforcing the pro-cyclical relationship between prices and transaction activity. Stein [1995] and Ortalo-Magné and Rady [2006] show transaction activity to be pro-cyclical when there is a positive relationship between loan-to-value ratios and prices. Meanwhile, drawing on Krainer [2001] and Novy-Marx [2009], Clayton et al. [2008] discuss 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 to sellers and so trading drops. Another explanation for activity decreasing with prices has been behavioral - a disposition effect - as sellers who are averse to realizing losses become unwilling to adjust their valuations (see Anglin et al. [2003]; Case and Shiller [2003]). Finally, drawing upon the 'noise trader' literature, Clayton et al. [2008] debate 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 a decrease in their 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 transaction activity (and liquidity) over time

Another factor affecting transaction activity may be market size. Several studies have demonstrated a tendency for real estate investment to concentrate in the largest US institutional markets. Echoing Shilton

and Stanley [1995], Smith et al. [2004: 1] found 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 21% of the population, but over 45% of assets in the NCREIF index. In the period 2001-13, McAllister and Nanda [2015] found that New York, Washington, Boston, Chicago, San Francisco, Los Angeles, Atlanta and Houston accounted for nearly 70% of transaction volume by value. This increased to 85% for foreign investors, who are likely to have higher information and search costs compared to their domestic counterparts. Large cities, in particular, have higher levels of investor recognition. According to Merton [1987], this familiarity can stimulate initial investment producing path dependency effects and informational cascades. The result is spatial clusters of assets, principals, advisers and information that create increased levels of investment activity relative to the size of the market concerned.

Many of these factors will vary between markets and submarkets at any given point in time. Despite this, there has been little focus on cross-sectional variations in transaction activity between real estate markets. Causal relationships between the determinants of transaction activity (and the determinants of the determinants) tend to be complex with direct and indirect effects, mediated and moderated interactions, and bi-directional and feedback relationships present. The main market level determinants are expected to be a range of interrelated variables such as information availability, market transparency and maturity, quantity of investable stock, demand and supply in occupier markets, local regulation, etc. Inasmuch as these factors influence potential investment returns and the costs of trading in each location, they are expected to be significant determinants of the quantity of potential buyers and sellers and their propensity to transact. Owing to effects on the number of buyers and sellers, the size of the institutional investment market is expected to be positively associated with turnover rates.

In summary, asset market liquidity is concerned with the relative ability to buy and sell assets costlessly, immediately and with price certainty. A positive relationship is expected between the level of transaction activity and liquidity. It is a stylized fact that transaction activity tends to decrease when buyers' and sellers'

asset valuations diverge. Nonetheless, low levels of transaction activity do not necessarily indicate low liquidity. Reinforcing the need to distinguish between liquidity and transaction activity, low relative transaction activity may occur because investors do not wish to sell - rather than any inability to sell - at prevailing market prices. However, such markets are not then liquid from buyers' perspectives. In addition, markets are also expected to vary in the level of transaction activity because of differences in transactions costs, maturity, size and other institutional structures. Empirical evidence is provided next of how transaction activity varies over time and between different US office markets. Econometric analysis then investigates formally whether the empirical evidence is consistent with the expected relationships discussed above.

Data and summary statistics

To investigate the determinants of transaction activity further, data on office transaction volumes over 2002-2015 was obtained from RCA for 49 major US MSA office markets. RCA is a private company that collects commercial real estate transaction data for both the US and other major real estate markets around the world. Information about transactions is obtained by RCA from sources such as brokerage and investment firms, listing services, press reports and public records. This information is then used to produce aggregate data on total volume traded and volume by source of capital. In the latter case, this includes reporting whether the acquisitions or sales were performed by investment institutions such as insurance companies or pension funds, publicly listed firms such as REITs or REOCs, private investors, or other organisations such as government entities and non-real estate corporations. This enables us to test whether the activity of subsets of investors is driven by similar factors to total transaction activity.

A weakness of volumes as a measure of investment activity is that they are driven by changes in prices as well as activity. For instance, volumes might be higher in a particular period because prices rose, not because more transactions occurred. In principle, a better measure of activity should be turnover rates.

These can be defined as the total value of buildings traded in a location divided by the total value of all buildings in that location. Alternatively, they could be defined in terms of the number of assets or floor area traded relative to the total number or floor area of assets in a location. In all these cases, a major practical challenge is to secure reliable estimates of the total office stock in different places to act as the denominator for any calculations.

To supplement our data on transaction volumes and pricing, further office market data were sourced from CBRE Econometric Advisors that included real rent series for each MSA and estimates of the stock, vacancy rate, completions and net absorption for each year, all in floor area terms. After checking and addressing differences in how market areas were defined by our sources, the stock series were used to work out turnover rates for different places. This was done in two ways: first, by comparing data on dollar volumes to estimates of the value of the stock in each location and, second, by estimating the floor area traded each year in each location and dividing these estimates by the raw stock series. Thus, two sets of turnover rates were produced for each MSA office market as follows:

$$TRV_t = VLV_t / STKV_{t-1} \quad (1)$$

$$TRF_t = VLF_t / STKF_{t-1} \quad (2)$$

Where TRV_t and TRF_t are the turnover rate in terms of value and floor area, respectively, VLV_t and VLF_t represent total office transactions in either value or floor area terms, and $STKV_{t-1}$ and $STKF_{t-1}$ are the total office stock in terms of value and floor area, respectively, lagged by one period to reflect stock at the start of the year. While VLV_t was obtained directly from RCA, VLF_t was estimated by dividing VLV_t by the average price per square foot reported by RCA for each MSA in each period. However, a price per square foot series was not available for some of the smaller MSAs and this meant that turnover rates based on floor

area were analyzed for a subset of 34 locations only. Meanwhile, $STKV_t$ was estimated in the following manner:

$$STKV_t = RRSF_t / CAP_t \times STKF_t \quad (3)$$

Where $RRSF_t$ is real rent per square foot for each location as reported by CBRE Econometric Advisors, CAP_t is the average capitalization rate estimated by RCA for that MSA,[2] and $STKF_t$ is total floor area for the office stock in each MSA, as noted above.

Two sets of turnover rates were created in order to test how robust the findings would be to the way in which turnover was measured and to see if differences between the measures revealed further insights into the nature of trading activity. Ratios were also measured between the dollar volume traded in each year and the scale of economic activity in each market as captured by MSA level estimates of gross domestic product compiled by the Bureau of Economic Analysis. These estimates are published for total economic activity and for sectors such as Finance, Insurance & Real Estate and Professional & Business Services. GDP in these two specific sectors was summed to produce an estimate of office-related GDP for each MSA and two more transaction activity measures were produced as follows:

$$TTA_t = VLV_t / GDP_{t-1} \quad (4)$$

$$TOA_t = VLV_t / OGDP_{t-1} \quad (5)$$

[2] These are transaction based figures. As the sample of transactions in each MSA changes from year to year, this introduces noise into these series. It is also the case that capitalization rates are not disclosed for all transactions, so the averages are based on a subset of the deals closed in each year.

Where TTA_t and TOA_t are ratios of transaction volume in dollars to total economic activity and office sector economic activity, respectively, while GDP_{t-1} and $OGDP_{t-1}$ are the measures of economic activity for each MSA in the period concerned.

Other data were collected on factors identified as possible influences on transaction decisions. Economic scale and wealth are proxied by real GDP and real GDP per capita data from the Bureau of Economic Analysis. In addition, variables were collected that capture financial market conditions and wider pricing influences such as Treasury Bill yields, ten-year government bond yields, corporate bond yields, the spread between government and corporate bond yields, and the percentage of debt to GDP. The Wharton Residential Land Use Regulation Index was tested as a broad proxy of the local regulatory environment for each MSA while, more directly, data collated by the Lincoln Institute on state and local transfer taxes was used to create a variable related to transaction costs.[3]

Exhibit 1 lists the office markets examined by the study. The list covers a range of markets in terms of size, economic activity and geographical spread. Just four cities, New York, Los Angeles, San Francisco and Chicago, accounted for over one third of the total 2015 GDP of the sample. Similarly, four cities accounted for over one third of the total office stock, with Washington DC replacing San Francisco in that four owing to its large government sector. Volumes in dollar terms are highly concentrated as well. New York alone commanded a 22.9% share of volume over 2002-2015, while Los Angeles (9.7%), San Francisco (9.6%) and Washington DC (9.2%) together with New York accounted for more than half of total volume.

INSERT EXHIBIT 1 HERE

[3] See *Significant Features of the Property Tax*. http://datatoolkits.lincolninst.edu/subcenters/significant-features-property-tax/Report_State_Summaries.aspx. Lincoln Institute of Land Policy and George Washington Institute of Public Policy. (State-by-State Property Tax in Detail; accessed September 2016.)

For each market, Exhibit 1 reports the average figure over the period for each of the turnover measures. There are substantial variations in turnover rates over the course of the cycle, but as transactions tend to be large and lumpy, it is important not to over-interpret a single year's figure and to focus on long-term patterns. Taking value-based turnover rates first, the average across all the cities was 5.9%. The highest turnover rates were recorded for San Francisco, Austin, Phoenix and San Diego. Despite its significance in terms of dollar volume, the turnover rate for New York was below average at 4.1%. In contrast, other 'Gateway' cities such as Los Angeles, Houston, Chicago, Boston and Washington DC had above average turnover rates. 'Rustbelt' cities such as Albany, Pittsburgh, Cleveland and Cincinnati had well below average turnover in this period. At first sight, there seems some evidence to support the argument that large markets are more liquid as measured by the proportion of office stock transacted.

The broad patterns for other turnover indicators are similar. However, it is notable that the turnover rates based on floor area, where available, are larger than those based on the value of stock traded. This suggests that lower value space tends to transact more commonly than high value space. When looking at the ratios of volume to total GDP or office related GDP, both Washington DC and New York are now above average in terms of transaction activity. This suggests that their high levels of government and other socio-cultural activities are associated with higher levels of office space per unit of GDP. Finally, the last two columns in Exhibit 1 report the share of volume accounted for by institutions and publicly listed investors. The average across all the cities was 49% for acquisitions and 52% for disposals in terms of value. Many of the locations with high turnover rates have an above average share of institutional / publicly listed investors. Meanwhile, the share of institutions in buying and selling is broadly consistent within each location apart from a number of low turnover Rustbelt cities where the share of institutions / publicly listed investors as sellers is notably higher than the corresponding share among buyers.

Exhibit 2 illustrates the relationship through time between capitalization rates and value-based turnover rates, taking the annual averages for the cities in the sample. The study period begins at the time of the

stock market correction associated with the 'dot.com bust'. Capitalization rates then fall between 2002 and 2007. This period leading up to the Global Financial Crisis (GFC) shows the positive association between prices and transaction activity. The GFC was then associated with large falls in volumes and substantial increases in capitalization rates. In 2009, the mean turnover rate fell to 1%. Not surprisingly, the recovery from the GFC was associated then with rising transaction activity and falling capitalization rates.

INSERT EXHIBIT 2 HERE

The temporal connection between capitalization rates and transaction activity appears to be strong, but the cross-sectional correspondence is weaker. Exhibit 3 shows that there is a broad relationship whereby more intensively traded markets tend to have lower capitalization rates. This would be expected if turnover rates for different markets are a proxy for their liquidity. The correlation between average turnover rates on a value basis and average capitalization rates is -0.43. However, the relationship is messy and includes a number of outliers. Taken together, Exhibits 2 and 3 suggest that pricing and turnover rates are correlated and so might share a number of common determinants. However, Exhibit 3 also suggests that transaction activity has further determinants that are not reflected in capitalization rates or other performance indicators.

INSERT EXHIBIT 3 HERE

Econometric Model

We test the influence of a range of possible determinants of transaction activity at MSA level, regressing both economic and real estate indicators on to each of our turnover measures. The standard OLS model in a panel setting (pooled OLS) is:

$$y_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \varepsilon_{it} \quad (6)$$

Where y_{it} is one of the measures of turnover discussed above, X_{it} is a vector of economic attributes and Z_{it} is a vector of real estate market attributes for market i in year t. Capitalization rates might seem a natural candidate for inclusion among the real estate variables in Z_{it}. However, the inclusion of capitalization rates raises the possibility of simultaneity bias. This is because pricing and transaction activity are likely to be jointly determined by a number of other variables such as economic and capital market conditions, as well as occupier market fundamentals (see Fisher et al., 2009; Ling et al., 2009). For this reason, we choose to model turnover rates using these other variables directly.

OLS estimation of Equation (6) can be affected by two major econometric biases. First, there could be significant levels of unobserved heterogeneity. The unobserved heterogeneity can be modelled as fixed effects, after conducting the Heckman specification test.[4] Therefore, the disturbance term is specified as a two-way error component that captures either area-specific or time-specific fixed effects such that:

$$y_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \delta_i + \omega_{it} \quad (7)$$

$$y_{it} = \alpha + \beta_1 X_{it} + \beta_2 Z_{it} + \lambda_t + \omega_{it} \quad (8)$$

Where δ_i are market-specific dummies, λ_t are time-specific dummies and ω_{it} is the idiosyncratic error. This estimation strategy is consistent with theoretical expectations that market-specific and time-specific unobserved characteristics can lead to shifts in key real estate indicators such as turnover rates across markets and between individual years.

[4] The advantage of this approach is that it allows use of both time series and cross sectional variations in the data, which increases the efficiency of the OLS estimates. We perceive that fixed effect modelling might be more appropriate than random effect modelling because there are only a small number of cross-sections and time periods to work with. Furthermore, all models have been estimated using Feasible Generalized Least Square method in order to address heteroscedasticity issues in the data. Moreover, we also allow for panel-specific heteroscedasticity and first-order auto-correlation for each cross-section.

Second, the theoretical discussion indicated that many variables might drive spatial and temporal variation in transaction activity and a key concern in incorporating these variables is that there might be strong inter-relationships between them, leading to multicollinearity. After testing different possibilities, results from the following empirical specification are presented below:

$$y_{it} = \alpha_0 + \beta_1 \log(\text{stock}_{it}) + \beta_2 \text{ real GDP growth}_{it} + \beta_3 \text{ vacancy rate}_{it} + \beta_4 \text{ stock growth}_i + \beta_5 \text{ transfer tax}_i + \beta_6 \text{ spread}_t + \varepsilon_{it} \quad (9)$$

Where y_{it} is one of the four measures of turnover, $stock_{it}$ is size of the office stock in terms of floor area for market i in year t, *real GDP growth*$_{it}$ is the percentage change in real GDP in each MSA each year, *vacancy rate*$_{it}$ captures conditions in the space market in each year and location, *stock growth*$_i$ measures the average rate of growth in the size of the stock in each market during the study window and, as such, is time-invariant, *transfer tax*$_i$ is the average rate of tax levied on transfers of commercial property in each location during the study window, which is time-invariant, and *spread*$_t$ is the difference in yields between corporate and government bonds in year t and captures risk perceptions in capital markets. For estimations that contain location fixed effects, both *stock growth*$_i$ and *transfer tax*$_i$ are omitted, while in models that contain time fixed effects, *spread*$_t$ is omitted owing to its collinearity with the time dummies being used.[5]

Results

Exhibit 4 contains the results for regressions run on the full sample of markets with either turnover rate in terms of value (models 1-3) or rate in terms of floor area (models 4-6) as the dependent variable. In each case, a model with no fixed effects and a full set of explanatory variables is reported first, followed by

[5] Stock growth is quite noisy from year to year and it was found to perform better in models when specified as an average annual rate. Transfer tax did not vary over the time frame of the study for the vast majority of MSAs and so use of the average resulted in little loss of information.

models with either time or MSA fixed effects, with variables that are time or place invariant then omitted as appropriate. Sample sizes are affected by gaps in the data for the dependent variable in some years or, in the case of the floor area based rates, for some markets during the study time frame. Despite this, the results are relatively robust and consistent across the different specifications.

INSERT EXHIBIT 4 HERE

Looking first at results for turnover rate in terms of value, model 1 suggests that the variables for real estate market size and supply, economic conditions, real estate market conditions, trading costs and capital market conditions all have the expected relationships with market transaction activity. There is an expected and statistically significant positive effect of market size on turnover rates. This is consistent with information network effects and economies of scale in large office markets which, in turn, produces larger and relatively concentrated pools of assets, principals, advisers and information. A positive and statistically significant coefficient is estimated for real GDP growth, which indicates that stronger economic conditions stimulate transaction activity. Meanwhile, a negative coefficient is found for vacancy rates that is also statistically significant. With vacancy rate acting as a portmanteau variable to capture conditions in the space market, we find that, all else equal, the higher the vacancy rate, the lower the turnover rate. This is consistent with the stylized fact of a positive relationship between real estate market conditions and transaction activity.

The average rate of change in the quantity of stock is estimated to have a statistically significant positive effect on transaction activity. As suggested above, this relationship is somewhat mechanistic given that the developers of new buildings would be expected to be more likely to transact as they sell completed buildings and move on to new projects. A statistically significant and negative effect of transfer taxes on turnover rates is apparent. All else equal, the higher the level of transfer taxes, the lower the level of turnover with a 1% increase in transfer tax producing a fall in the turnover rate of approximately 1%. As a time-varying explanatory variable that is the same for all cities, the spread between corporate and government bonds is

a portmanteau variable to capture conditions and risk perceptions in the national capital market. The expected negative effect of this variable on transaction activity is, indeed, estimated. All else equal, an increase in the spread produces a fall in transaction activity during this period.

When time or MSA fixed effects are used in the model, the findings reported above are confirmed. Most of the coefficients keep their expected signs and remain statistically significant. The stock size variable loses its statistical significance when MSA fixed effects are used, but it still has a positive coefficient. In similar vein, when models of transaction activity are estimated using the floor area based turnover rate, nearly all of the core findings are repeated.

Exhibit 5 contains the results for regressions run on the full sample of markets with volume as a percentage of all GDP (models 1-3) or office-related GDP (models 4-6) as the dependent variable. The rates are smaller for these measures than where turnover is scaled to the size or value of the stock. As a consequence, the coefficients for the various explanatory variables are smaller. Despite this, the main relationships remain notably stable. In all cases, there are positive and statistically significant coefficients for size of stock, real GDP growth rate and average change in stock. Likewise, there are negative and statistically significant coefficients throughout for vacancy rate, transfer tax rate and the spread between corporate and government bonds. This suggests that our results are robust to the way that turnover rates are measured and so capture real influences on transaction activity in different office markets over the study period.

INSERT EXHIBIT 5 HERE

In addition to examining turnover rates based on total transaction activity, the activity of different investor groups is studied.[6] As noted earlier, RCA subdivides volumes according to source of capital when they

[6] We thank an anonymous referee for making this suggestion.

report statistics for different MSAs. From this information, the percentage share of different investor groups, either as buyers or as sellers, within total activity for that period can be computed. This percentage share is then multiplied by turnover rate to determine the element of total turnover attributable to each group. Having established that determinants of turnover are relatively consistent across the different turnover measures, this additional analysis is performed using the value-based turnover rates only. Of interest are institutional investors that are likely to be larger and more national in scope compared to private investors who are likely to be smaller and more locally focused. It is hypothesised that the former will show stronger relationships to our chosen determinants than the latter.[7]

Exhibit 6 and 7 report estimations for the different investor groups identified above, both in terms of their activity as buyers and their activity as sellers. In models 1-6 of Exhibit 6, similar relationships are evident for the institutional sample relative to the whole sample, while there is little difference in the results for buying activity versus selling activity. This suggests that both buying and selling activity by institutional investors tends to be affected in the same way by market fundamentals. For instance, growth in stock has a highly significant positive effect on both institutional buying and selling activity. This is consistent with institutions investing in new stock and selling older stock to private investors or selling in anticipation of excess supply. In the same way, institutional buying and selling activity is negatively affected by changes in market sentiment as indicated by the significant negative coefficient for the government-corporate bond spread.

INSERT EXHIBITS 6 AND 7 HERE

[7] To overcome issues around low representation in smaller MSAs, institutions and publicly listed real estate firms are grouped together as one category while private investors are grouped with other as a second category. The categories are labelled as 'institutions' and 'private' since these are the dominant investor type in terms of volume within their respective categories.

However, there is evidence of some notable differences in the results for the non-institutional component of market turnover. While the pattern of results is similar to that for the total activity estimations and the institutional estimations, the coefficients are generally smaller. This is in line with the trading activity of private investors being less affected by market fundamentals. It is notable that the effect of market size is much reduced for the private investor group. This is consistent with the argument that locally based private investors do not face the same search costs and information barriers in smaller markets compared to institutional investors.

Conclusion

Transaction activity is an indirect indicator of market liquidity. Previous research on changes in prices and transaction activity in real estate markets has demonstrated that these are strongly interlinked. It has also proposed complex patterns of causality that involve the interaction of market conditions, feedback effects, behavioral biases, clientele effects and credit cycles as co-determining variations in transaction activity and price levels over time. Yet there has been little empirical work to examine how such fundamental factors drive transaction activity in commercial real estate markets. It is anticipated that market conditions and many other determinants of liquidity will vary over time, but it is also expected that they will vary between different places, depending on the market and institutional attributes of those locations. In this study, variations in transaction activity were investigated for a set of 49 US MSA office markets over the period 2002-2015, and the determinants of transaction activity were tested using a panel regression framework.

Cross-sectional variations in transaction activity could reflect differences in both market conditions and institutional conditions between locations. It is expected that the propensity of market participants to transact will be affected by direct and indirect transaction costs and risks. Real estate markets can have different sizes, growth rates, economic structures, regulations and transfer taxes, all of which affect the returns, costs and risks of investing in those places. Given scale economies and opacity in real estate markets, investment

can have a tendency for spatial concentration owing to information network effects. Merton-type investor recognition effects can stimulate initial investment generating more information that, in turn, produces path dependency effects and informational cascades. This then leads to larger and relatively spatially concentrated pools of assets, principals, advisers and information, which are likely to drive increased levels of investment activity relative to the size of the market concerned.

In this study, turnover rates were measured to capture the intensity of trading in different locations. This was done by combining data from different sources on transaction volumes, stock, yields and values for the sample of MSAs. Different measures of turnover were created to check the robustness of the results obtained. High turnover rates were found in Sunbelt cities such as Phoenix, Austin, San Diego, Orlando and Tampa. With the exception of New York, the large 'Gateway' cities, especially San Francisco, had above average turnover rates. In contrast, cities in the Rustbelt such as Pittsburgh, Cincinnati, Cleveland and Columbus tended to have turnover rates that were in the bottom quartile of the sample. Expectations of a positive relationship between local economic performance, local real estate market conditions and market transaction activity was confirmed. Cities with higher levels of new office completions were also expected to have high turnover rates as developers sell to investors when the development phase is completed.

The econometric analysis confirmed many of the hypotheses about the determinants of variations in turnover rates. Turnover rates were found to be positively related to market size and economic growth rates. However, the results also indicate that there are variations in the size of these effects between different types of investor. Consistent with information network effects, institutional investment tends to be more concentrated in large metro areas and market size has a stronger positive effect on trading levels compared to investment by private buyers. Assuming that private investors are more local, this finding is consistent with them having superior information to institutional investors in smaller markets. A negative relationship with vacancy rates supported the observations of previous research that trading is pro-cyclical with regard to real estate market conditions. Meanwhile, a negative coefficient for the spread between corporate and

government bond yields suggests that trading activity is also sensitive to changes in risk. Often the largest direct transaction cost, turnover rates were lower in office markets where transfer taxes were higher. In summary, the findings confirmed a number of plausible economic relationships for commercial real estate trading activity that have hitherto lacked empirical support, particularly in regard to cross-sectional variation between different locations.

While there has been a body of work investigating the dynamic relationship between transaction activity and investment returns in commercial real estate markets, the implications of variations in liquidity for cross-sectional differences in market pricing have been largely neglected. Given the simultaneity issues, untangling the effects of capitalization rates on transaction activity (market liquidity) – and vice versa – remains a significant challenge. Further, while expected, the negative relationship between transfer taxes and transaction activity found here has potential public policy implications. The variation between markets in terms of real estate transfer taxes raises questions around the appropriate taxation rate that maximizes overall tax receipts at given levels of transaction activity.

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Exhibit 1: Measures of average turnover by MSA office market: 2002-15

	Turnover rate		Value traded as %		Institutions and public firms	
	Value-based	Floorspace	Total GDP	Office GDP	% buyers	% sellers
San Francisco	14.1	16.0	1.7	4.7	70	70
Austin	11.9	18.4	1.4	6.7	69	69
San Diego	10.8	15.4	1.2	3.3	60	63
Phoenix	10.8	17.1	1.0	2.8	54	50
Seattle	10.7	13.3	1.3	4.1	75	62
Los Angeles	9.4	13.5	1.0	2.8	64	64
Atlanta	8.8	13.7	1.0	2.6	62	64
Denver	8.4	12.1	1.1	2.8	65	62
Orlando	8.2	12.5	0.6	1.5	60	58
Tampa	8.1	13.9	0.6	1.7	57	58
Houston	7.8	12.5	0.7	3.1	60	65
Charlotte	7.6	10.6	0.6	1.4	58	56
Chicago	7.5	12.9	1.0	2.6	64	72
Dallas	7.5	13.5	0.8	3.0	55	57
Miami/So Fla	7.3	14.3	0.9	2.5	52	48
Jacksonville	7.2	-	0.5	1.4	60	65
Boston	7.1	10.8	1.6	3.7	79	72
Sacramento	6.7	10.1	0.8	2.4	47	45
Washington DC	6.6	9.4	2.2	5.5	74	67
Indianapolis	6.5	-	0.3	0.9	50	46
Minneapolis	6.1	12.9	0.5	1.3	53	42
St Louis	6.0	13.6	0.4	1.3	37	45
San Antonio	6.0	10.3	0.4	1.6	36	39
Las Vegas	5.7	9.3	0.5	1.7	37	36
Portland	5.7	8.3	0.6	1.7	67	58
Richmond	5.6	-	0.5	1.3	54	58
Nashville	5.5	9.3	0.4	1.5	38	47
Salt Lake City	5.2	7.8	0.5	1.3	38	29
Raleigh	4.8	-	0.9	2.5	57	51
Philadelphia	4.8	9.0	0.4	1.0	52	67
Baltimore	4.4	8.9	0.4	1.3	60	56
Toledo	4.1	-	0.1	0.4	24	48
Kansas City	4.1	-	0.3	0.8	54	41
New York	4.1	8.9	1.5	3.3	65	62
Oklahoma City	4.0	-	0.2	1.0	33	34
Columbus	4.0	9.5	0.3	0.7	37	56
Louisville	3.9	-	0.2	0.8	22	38
Tucson	3.7	-	0.3	1.0	25	24
Milwaukee	3.6	6.0	0.3	0.8	41	42
Detroit	3.4	7.5	0.2	0.6	20	34
Albuquerque	3.3	-	0.2	0.6	20	32
Memphis	2.8	-	0.2	0.8	40	49
Norfolk	2.8	-	0.2	0.9	50	45
Tulsa	2.7	-	0.2	0.9	24	57
Hartford	2.5	7.0	0.2	0.5	31	52
Cincinnati	2.5	-	0.2	0.6	41	53
Cleveland	2.1	5.3	0.2	0.6	28	54
Pittsburgh	1.8	4.0	0.2	0.9	38	40
Albany	1.3	-	0.1	0.5	30	35

Exhibit 2: Transaction Activity and Capitalization Rates through Time – All Markets

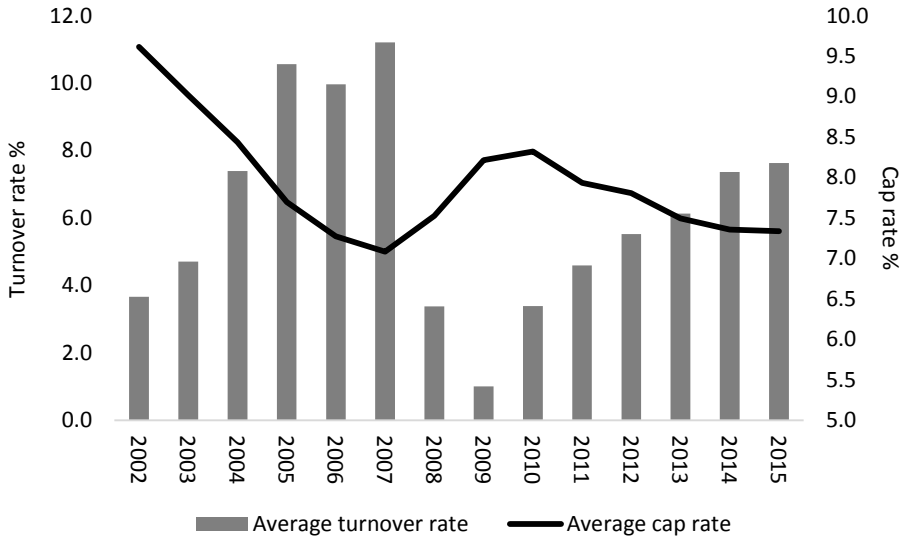

Exhibit 3: Transaction Activity and Capitalization Rates by Market

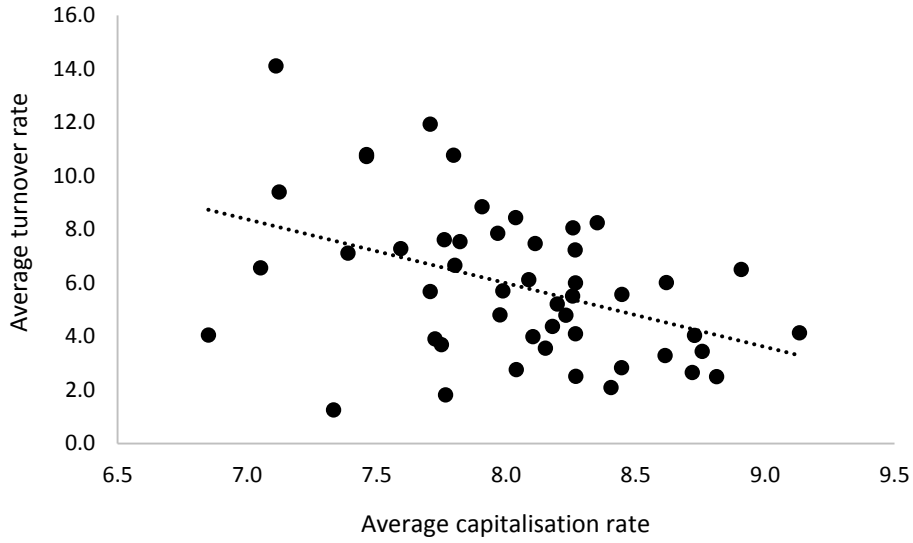

Exhibit 4: Panel models explaining real estate transaction activity across US cities: 2002-15

	Turnover rate ($)			Turnover rate -floor area		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(stock)	1.983***	1.928***	2.805	2.001***	1.947***	7.590***
	(9.79)	(10.54)	(1.64)	(5.23)	(5.93)	(2.78)
Real GDP growth	0.233***	0.212***	0.232***	0.280***	0.278***	0.332***
	(5.01)	(3.58)	(5.36)	(3.49)	(3.09)	(4.77)
Vacancy rate	-0.262***	-0.147***	-0.422***	-0.430***	-0.144*	-0.676***
	(-5.67)	(-2.94)	(-9.72)	(-5.18)	(-1.74)	(-9.56)
Stock growth	1.077***	1.094***		1.014***	1.060***	
	(4.93)	(5.28)		(2.66)	(3.08)	
Transfer tax	-1.099***	-1.034***		-1.825***	-1.492***	
	(-7.00)	(-6.37)		(-7.31)	(-6.15)	
Spread	-4.478***		-4.284***	-8.595***		-7.952***
	(-14.17)		(-16.27)	(-14.58)		(-16.78)
Intercept	-6.067***	-15.75***	-12.29	8.341*	-12.58***	-51.61*
	(-2.69)	(-7.23)	(-0.67)	(1.74)	(-2.89)	(-1.77)
Fixed effects	No FE	Year FE	City FE	No FE	Year FE	City FE
N	579	579	579	476	476	476

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

Exhibit 5: Panel models of transaction activity relative to economic activity in US cities: 2002-15

	Volume traded as a percentage of GDP			Volume traded as a percentage of office		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(stock)	0.355***	0.351***	0.457**	0.955***	0.928***	1.160**
	(12.76)	(13.87)	(2.39)	(12.69)	(13.76)	(2.26)
Real GDP growth	0.008**	0.011**	0.011***	0.034***	0.045***	0.032***
	(2.00)	(2.09)	(2.72)	(2.69)	(2.99)	(2.81)
Vacancy rate	-0.036***	-0.025***	-0.045***	-0.105***	-0.072***	-0.130***
	(-7.55)	(-4.68)	(-9.59)	(-7.56)	(-4.70)	(-9.82)
Stock growth	0.147***	0.152***		0.416***	0.425***	
	(6.09)	(6.95)		(6.15)	(6.63)	
Transfer tax	-0.088***	-0.072***		-0.299***	-0.277***	
	(-3.81)	(-2.95)		(-4.29)	(-3.71)	
Spread	-0.425***		-0.401***	-1.206***		-1.159***
	(-13.10)		(-14.44)	(-12.63)		(-14.63)
Intercept	-2.229***	-3.175***	-3.065	-5.682***	-8.196***	-7.117
	(-7.62)	(-11.92)	(-1.50)	(-7.12)	(-11.45)	(-1.30)
Fixed effects	No FE	Year FE	City FE	No FE	Year FE	City FE
N	682	682	682	623	623	623

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

Exhibit 6: Panel models of Institutional Purchases and Sales: 2002-15

	Institutional share in purchases x Turnover rate			Institutional share in sales x Turnover rate		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(stock)	1.639***	1.707***	1.635	1.400***	1.499***	1.229
	(10.67)	(11.09)	(1.12)	(8.80)	(9.87)	(0.86)
Real GDP growth	0.119***	0.106**	0.110***	0.125***	0.140***	0.131***
	(3.27)	(2.20)	(3.14)	(3.42)	(2.98)	(3.79)
Vacancy rate	-0.184***	-0.137***	-0.265***	-0.107***	-0.063	-0.184***
	(-5.27)	(-3.52)	(-7.24)	(-3.07)	(-1.64)	(-5.34)
Stock growth	0.822***	0.887***		0.537***	0.601***	
	(5.05)	(5.60)		(3.47)	(3.99)	
Transfer tax	-0.678***	-0.695***		-0.501***	-0.528***	
	(-5.47)	(-5.19)		(-4.11)	(-3.98)	
Spread	-2.537***		-2.351***	-2.403***		-2.246***
	(-10.16)		(-10.72)	(-10.01)		(-11.04)
Intercept	-9.024***	-15.130***	-6.611	-7.543***	-13.810***	-4.215
	(-5.53)	(-8.55)	(-0.42)	(-4.43)	(-7.92)	(-0.28)
Fixed effects	No FE	Year FE	City FE	No FE	Year FE	City FE
N	579	579	579	579	579	579

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

Exhibit 7: Panel models of Private Investor Purchases and Sales: 2002-15

	Private share in purchases x Turnover rate			Private share in sales x Turnover rate		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log(stock)	0.239***	0.244***	1.216*	0.387***	0.391***	0.898
	(3.08)	(3.24)	(1.84)	(4.29)	(4.72)	(1.12)
Real GDP growth	0.156***	0.134***	0.166***	0.120***	0.096***	0.110***
	(7.01)	(4.97)	(8.83)	(5.24)	(3.58)	(5.43)
Vacancy rate	-0.061***	-0.018	-0.137***	-0.132***	-0.075***	-0.209***
	(-3.18)	(-0.88)	(-8.23)	(-6.31)	(-3.53)	(-10.74)
Stock growth	0.347***	0.342***		0.577***	0.558***	
	(4.35)	(4.37)		(5.63)	(5.75)	
Transfer tax	-0.441***	-0.386***		-0.461***	-0.418***	
	(-7.36)	(-6.43)		(-8.35)	(-8.96)	
Spread	-1.819***		-1.678***	-1.817***		-1.810***
	(-12.90)		(-16.06)	(-12.22)		(-15.80)
Intercept	3.412***	-1.077	-7.049	2.520**	-1.991*	-1.668
	(3.65)	(-1.12)	(-1.00)	(2.30)	(-1.89)	(-0.19)
Fixed effects	No FE	Year FE	City FE	No FE	Year FE	City FE
N	579	579	579	579	579	579

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