Capitalization Rates and Transaction Activity in International Office Markets: A Global Perspective

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Abstract

Based on a sample of office markets in 33 cities across 16 countries for the period 2007-2015, this paper explores variations in commercial real estate transaction activity and asset pricing in international office markets. It is argued that there are complex interactions and feedback relationships between asset prices, transaction activity, market conditions and local institutional structures in real estate markets. Commercial real estate pricing is modelled using data on capitalization rates. The relationships found are consistent with previous research in terms of the importance of drivers such as government bond yields, yield spreads and real estate rents. Consistent with information network effects, it is also found that larger and more mature markets tend to have lower cap rates and, thus, higher asset prices. The results for transaction activity are less clear cut. Results from econometric analysis of turnover rates suggest that the same explanatory factors do not determine transaction activity to the same extent as cap rates. When purged of possible joint determinants, there is no evidence to support the view that cap rates affect market turnover rates or that turnover rates affect cap rates.

Introduction

As institutional real estate investment is becoming progressively more globalized, there has been growing interest in understanding the determinants of comparative pricing and risks in international real estate markets. Although there is a substantial literature on international real estate investment, to date, the majority of empirical research in commercial real estate on modelling pricing, transaction activity and their interrelationship has focussed on the US. Based on a sample of 33 cities across 16 nations, this paper explores variations in transaction activity and pricing in international office markets. Owing to potential problems of endogeneity in the relationship between prices and transaction activity, a range of models are used to investigate the determinants of transaction activity, capitalization rates and the dynamic relationship between them across global real estate markets.

Background and context

In real estate and in other major asset classes, measures of transaction activity are often the simplest and most widely available proxies for liquidity. When assessing market conditions, reduced transaction activity is often discussed interchangeably with reduced liquidity. At its core, the liquidity of an asset is the relative ability to be able to immediately exchange it for cash at prevailing prices without cost and *vice versa* in terms of ability to purchase assets. Hence, three core aspects of liquidity are time-to-transact, cost-to-transact and certainty of market price. One consequence of reduced liquidity (through, say, longer transaction times or higher costs) is reduced transaction activity. However, transaction activity is not a perfect proxy for liquidity. For example, when the marginal investors have long-term horizons, it is possible for low transaction activity to co-exist with high asset liquidity.[1]

Fisher et al (2004) identified two stylized facts regarding transaction activity. First, it fluctuates considerably from period to period and from market to market. Second, it is positively correlated with

[1] See Collett, Lizieri and Ward (2003) for examples in regard to real estate markets.

changes in asset prices, i.e. transaction activity is typically higher when prices are relatively high and/or rising, and lower when prices are relatively low and/or falling. Changes in transaction activity are explained as a function of changes in buyers' and sellers' reservation prices and of potential differences in the timing of these changes. Following Fisher et al, Clayton, MacKinnon and Peng (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 this phenomenon. 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. A range of other factors that may affect deviations between buyer and seller valuations such as disposition bias, pro-cyclical credit markets, clientele effects and option values are also identified.

Nevertheless, there is long-standing skepticism as to whether any causal relationship exists between pricing and transaction activity. Positive correlations between transaction activity and price changes may be due to common determinants. Changes in 'fundamentals' such as macro-economic and capital market performance, and debt availability, have been associated with price shifts over time and they may also be significant determinants of transaction activity. As a result, changes in market conditions are reflected by changes in both prices and transaction activity.

A significant factor affecting transaction activity may be market size. Several studies in the US have demonstrated a tendency for institutional real estate investment to concentrate in the largest metro areas. Smith, Hess and Liang (2014) found that the top five markets accounted for 21% of the population, but over 45% of assets in the NCREIF index.[2] For 2001-13, McAllister and Nanda (2015) found that New York, Washington, Boston, Chicago, San Francisco, Los Angeles, Atlanta and Houston accounted for

[2] NCREIF stands for National Council of Real Estate Investment Fiduciaries and this organisation compiles indexes of private commercial real estate performance based on US institutional real estate investments.

nearly 70% of transaction volume by value. This increased to 85% for foreign investors who would be expected to have higher search costs and larger markets typically have higher levels of (foreign) investor recognition. In a sample of 28 major European cities, McAllister and Nanda (2016) found that London alone accounted for more than 50% of transaction volume. Such Merton-type investor recognition effects can stimulate informational cascades and network effects generating geographical concentration of assets, investors, intermediaries and information that can, in turn, reinforce clustering of transaction activity (Merton, 1987).

Studies investigating the short-term dynamic effects of transaction activity on prices and vice versa are relevant in this context. Fisher, Ling and Naranjo (2009) examine whether net capital flows from institutional to non-institutional investors impact upon asset returns for US commercial real estate. They find some evidence that institutional capital flows have a statistically and economically significant association with subsequent returns at the aggregate US level, but the results are not consistent across sectors or CBSAs. Applying a similar methodology to the UK market, Ling, Marcato and McAlllister (2009) did not find any evidence to support a ‘price pressure effect’ of transaction activity on prices. Beyond commercial real estate, similar findings have been reported by both Stein (1995) and Cauley and Pavlov (2002), who focus on US housing markets. Here, volumes tend to fall when house prices are falling and vice versa. These and other studies in the residential sector suggest a contemporaneous and self-reinforcing relationship between prices and transaction activity that is generated by exogenous demand shocks.

It is notable that the body of academic work on the determinants of cap rates does not focus on the potential effect of transaction activity (see Sivitanidou and Sivitanides, 1999; Ambrose and Nourse, 1993; Chen, Hudson-Wilson and Nordby, 2004; Chervachidze, Costello and Wheaton, 2009, Chervachidze and Wheaton, 2013). Only Clayton, Ling and Naranjo (2009) use capital flows as an input into a composite investor sentiment index, but they find no consistent role for sentiment in explaining the time series variation of cap rates during the period 1996-2007.

Furthermore, there has been little previous research investigating the determinants of cap rates at an international scale. One exception is D'Argensio and Laurin (2009). They modelled determinants of office cap rates for a panel of 52 developed and developing countries between 2000 and 2006. Similar to recent US studies (McAllister and Nanda, 2015; Chervachidze and Wheaton, 2013), they found a strong positive relationship between government bond rates and office cap rates, as expected, but they found inconsistent results for relationships with various proxies of expected rental growth. Meanwhile, McAllister and Nanda (2016) investigated the determinants of European office market cap rates, drawing upon data for 28 European cities over 1999-2013. They found that the real risk-free rate coefficient has the expected positive sign and was statistically significant. Consistent with adaptive or myopic expectations, the real rent ratio had a statistically significant negative sign. They also found a statistically significant positive coefficient for country risk (measured as the difference between the yield on US government bonds and local government bonds) on cap rates. In a study of the impact of international investors on cap rates, Oikarinen and Falkenbach (2017) found expected positive relationships between cap rates and bond yields and vacancy rates.

There has been much less empirical work on the determinants of transaction activity in commercial real estate markets. Devaney, McAllister and Nanda (2017a) used data on trading volumes and turnover rates for 49 US MSA office markets and employed panel models to test which factors led to higher or lower turnover over the period 2001-15. They found that turnover rates were positively related to market size and economic growth rates, while a negative relationship with vacancy rates supported the observations of prior research that trading is pro-cyclical with regard to real estate market conditions. A negative coefficient for the spread between corporate and government bond yields suggested that trading activity was sensitive to changes in risk. Finally, turnover rates were lower in office markets where transfer taxes (often the largest direct transaction cost) were higher.

Lieser and Groh (2014) modelled commercial real estate transaction volumes across 47 national real estate markets, with most of this modelling carried out on data spanning the period 2004-09. Building upon earlier work (see Lieser and Groh, 2011), they gathered data on a large number of indicators including measures of economic and market activity, capital markets, legal and regulatory factors, and the wider social and political environment. The dependent variable in this work appears to be total transaction volume per year, including domestic and international real estate investor activity. Lieser and Groh regressed data on transaction volumes on individual variables and composite indicators for the factors listed above. Their results reveal volumes to be driven by the size of real estate markets, the depth of capital markets and the legal and regulatory environment. Although their work draws attention to a wide range of data sources capturing economic activity and the investment environment, there are some issues. Mauck and Price (2017) note that a major concern is the mismatch between 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 conditions in the countries concerned.

Devaney, McAllister and Nanda (2017b) examined the determinants of transaction activity in 38 national markets in Europe and Asia-Pacific over the period 2000-14 at the all property level and for the office sector. They found that the size and wealth of a country, the risk associated with that country and the performance of its commercial real estate market are significant factors that explain the level of transaction activity. In contrast to their earlier findings for US cities, they found that turnover tends to decrease as market size increases.

As discussed above, whilst the relationship between pricing and transaction activity is theoretically uncertain, they tend to be closely related. In line with the analysis above, a real estate market's level of transaction activity is expected to be positively related to real estate investment performance and *vice versa*. Investment performance and transaction activity are then expected to be determined by a range of real estate market, economic and capital market variables. Many of these determining factors will vary between markets and submarkets at any given point in time. There are significant methodological challenges in attempting to investigate the relationships between pricing and transaction activity, and in trying to model the determinants of each variable. Causal relationships between the determinants of transaction activity (and the determinants of the determinants) tend to be complex due to the presence of direct and indirect effects, mediated and moderated interactions, and bi-directional and feedback relationships. Consequently, empirical investigation is hindered by endogeneity issues. Bearing such issues in mind, we present the results of a study on patterns and determinants of pricing and transaction activity in major office markets at a global scale.

Data and Summary Statistics

The sample of 33 cities used in this study is drawn from a selection of 16 developed and emerging countries that were chosen to provide a broad coverage of international real estate markets. A list of the cities, together with basic descriptive statistics, is provided in Appendix A. For comparability, rents and values are displayed in US dollar terms but a local currency basis is used for the econometric analysis to avoid potential exchange rate distortions. Sixteen cities are in Europe, incorporating a range of developed and emerging real estate markets. Six US 'gateway' cities are also included, while three Chinese cities are selected: Hong Kong, Beijing and Shanghai. The Japanese markets of Tokyo and Osaka, along with Seoul and Singapore, complete the sample from Asia, and Sydney and Melbourne represent Australia. Perhaps the most notable omission is the lack of any African or South American cities. This reflects the uneven availability of data across global real estate markets.

The data used in the study were drawn from a range of sources. The real estate market indicators used were provided by CBRE, who are the largest global commercial real estate services firm.[3] The market indicators include the cap rate and rent (in local currency terms) for the office market in each city, and estimates of the size of the office stock. Most of the data was provided at a quarterly frequency from Q1 2007 through to Q2 2015. Cap rates are reported as per local market convention, which means there are some differences in how they are calculated across cities. Any consistent differences, such as one

[3] Tokyo and Osaka are exceptions where rents and stock were sourced from CBRE, but cap rates were sourced from the ARES Japan Property Index and used with permission of ARES (http://index.ares.or.jp/download-ajpi-en.php).

market reporting cap rates on a gross basis and another reporting them as net, should be accounted for through the use of fixed effects in the econometric models.

The transaction activity measures that we use are derived from data supplied to us by Real Capital Analytics (RCA). RCA tracks transactions of commercial real estate above a threshold of $10 million for all major real estate markets around the world. For each city, RCA supplied quarterly data on the number of office transactions, the value of those transactions in local currency terms and the amount of floorspace traded. We then measured turnover rates in two different ways. First, we measured the proportion of floorspace traded relative to the size of the office stock in floorspace terms, using the CBRE figures for the latter. Second, we measured the value of floorspace traded relative to an estimate of the value of the office stock each period in each city.[4] Neither measure is likely to be a perfect indicator of turnover in each market, but deriving two different measures allows us to check our findings in the absence of an established approach.

Finally, we collected economic variables of relevance to commercial real estate pricing. Our proxy for the nominal risk-free rate is the yield on ten-year government bonds. This does not reflect a true risk-free investment in many cases, as bonds issued by some governments might be at risk of default and so incorporate a premium for country sovereign risk (D'Argensio and Laurin, 2009). Therefore, we take the US ten-year government bond yield as a risk-free rate in our modelling and use the spread between local and US government bond yields as a measure of country risk that varies through time and between countries. In line with Chervachidze and Wheaton (2013), we also incorporate a proxy for credit market conditions using the change in the ratio of domestic credit to GDP, sourced from the World Bank.

[4] Value estimates for total floorspace were calculated as follows. For each quarter, we compared prime capital value per square metre based on CBRE rents and cap rates with the average price per square metre from transactions monitored by RCA. The former were too high to produce convincing estimates of stock value while the latter varied too much from period to period. Hence, we computed the ratio of the average and prime figures in each period and used the average value of this ratio as a scaling factor to adjust the prime capital value per square metre figures.

The study period begins in Q1 2007 and ends in Q2 2015. In Figure 1, the value of office transactions over this period for all the cities in the sample is shown in US dollar terms. The start of this period marked the peak of the commercial real estate market in many countries. This peak was followed by a sustained downturn in both values and real estate market activity, driven by the Global Financial Crisis (GFC) in 2008-09. The average of the prime office cap rates for the sample of cities rose from around 5.5% during 2007 to a high of 6.9% by Q1 2009.[5] After this, most markets experienced some recovery in economic conditions, although the extent and speed of recovery varied. From mid-2009 onwards, falling cap rates and rising transaction volumes can be observed. In fact, prime office cap rates fell to their pre-crisis levels by mid-2011 and fell further after this, while transaction volumes recovered to around $65 billion by Q4 2014.[6]

INSERT FIGURE 1 HERE

Whilst Figure 1 indicates a strong correspondence between volumes and cap rates at the aggregate level, this does not demonstrate that one causes the other, as patterns in both could reflect other fundamental factors. Furthermore, patterns for the sample as a whole might not represent the experiences of individual locations. Figure 1 also indicates that there is seasonality in the data at a quarterly frequency. From 2009 onwards, there tends to be spikes in transaction activity at the end of each calendar year. This is not unexpected as institutional investors, in particular, may push to complete transactions within the typical calendar-year performance measurement period. This is accounted for in models of turnover rates through the incorporation of seasonal dummy variables.

Figure 2 shows the average turnover rate for all cities in the sample across the study period. As noted above, the turnover rates are computed in two different ways. The patterns shown by each set of rates are consistent with each other and are broadly similar to the patterns in volumes shown by Figure 1.

[5] The average prime office cap rate in Figure 1 is calculated without the six US cities where cap rates were only available biannually.

[6] Cash volumes themselves will be affected by changing values, but the patterns described here are very similar if the total amount of floorspace traded is graphed in place of the total value of assets traded each quarter.

However, turnover rates do not rise as markedly as transaction volumes in the latter half of the sample period. This is due to the fact that that the increase in volumes during the latter years of the period was partly driven by rising prices and not simply by activity levels.

INSERT FIGURE 2 HERE

Table 1 presents the average turnover rates on a city-by-city basis. Although the underlying calculations are performed at a quarterly frequency, we present annualised numbers for ease of reference. In terms of turnover rate based on value, we estimate that the average is 2.2% per quarter across the sample of cities studied, equating to approximately 9.0% per annum. However, there is a lot of variation around this average. For all cities, apart from Hong Kong, Osaka and St Petersburg, the estimated turnover rates for value of assets transacted are higher than for floorspace transacted. This is consistent with higher value offices experiencing higher turnover levels. Nonetheless, the differences between the measures are usually small, with Chicago and San Francisco being the main exceptions. The rankings of transaction activity that are produced from the two sets of turnover rates are also very similar.

INSERT TABLE 1 HERE

Cities with the lowest turnover rates in Table 1 are a mixed group. Emerging real estate markets such as Istanbul and Moscow have higher turnover rates than several cities in developed economies such as Barcelona, Paris, Tokyo, Munich and Hong Kong. It is hard to discern any notable patterns among the markets with low turnover rates. However, there are clearer patterns for the locations with high turnover rates, which are dominated by cities in the US, Australia, UK and, perhaps surprisingly, China.

Many markets that might be regarded as relatively liquid by investors have below average turnover rates. In some cases, this may be because such cities are regarded by major investors as core markets and so are more likely to be long-term holds in portfolios. In turn, second or third tier cities may be regarded as ‘cycle’ or ‘rotational’ plays. In the US, it has been found that Sun Belt cities such as Phoenix and Las Vegas have had higher turnover rates than so-called Gateway cities such as New York, Washington and Los Angeles (see Devaney, McAllister and Nanda, 2017a). This reinforces the need to distinguish between liquidity and transaction activity. Markets like Hong Kong, Tokyo, Munich and New York might have low turnover rates because owners do not wish to sell rather than because they are unable to sell. Indeed, in such markets the liquidity problem is often for buyers who find it difficult to source suitable stock.

A simple scatter graph illustrating the relationship between cap rates and transaction activity is displayed in Figure 3. At this stage, this comparison does not control for differences between cities in factors such as risk or rental growth prospects. Nonetheless, from this graph, there appears to be no correspondence between turnover rates and cap rates. This is so regardless of whether value-based or floorspace-based turnover rates are graphed. Some markets with low turnover rates have high cap rates (such as St Petersburg and Sofia), while others with low turnover rates have low cap rates (for example, Tokyo and Hong Kong).

Econometric Estimation Strategy

Our empirical starting point is the well-established literature on modelling cap rates (see Sivitanides et al, 2001; Hendershott and MacGregor, 2005a, 2005b; Chichernea *et al*, 2008; Archer and Ling 1997; Chervachidze, Costello and Wheaton, 2009; Chervachidze and Wheaton, 2013; Nanda and Tiwari, 2013; McAllister and Nanda 2015). Standard models of cap rates are founded upon the Gordon Growth Model as follows:

Cap rate = Required return – Income growth

Where the required return is a function of the risk-free rate plus a risk premium. The nominal risk-free rate is composed of the real rate of return plus a rate reflecting inflation expectations. It is typically proxied by government bond yields. Income growth is the expected increase in cash flows through time associated with the investment. In previous research, a range of variables have been used to proxy risk premiums and income growth expectations - the term structure of interest rates, the spread between corporate and government bond yields, the reported risk premium demanded by investors, availability of credit and market-specific real estate fundamentals such as rental growth rates and real rent levels. Following the basic model outlined in the literature, the empirical model used here takes the following form:

$$k_{ijt} = \alpha_0 + \beta_1 RFR_{jt} + \beta_2 Riskpr_{jt} + \beta_3 Debt_{jt} + \beta_4 RentDev_{ijt} + \mu_{ij} + \epsilon_{ijt} \tag{1}$$

where k_{ijt} is the cap rate in city *i* in country *j* at time *t*, RFR_{jt} is the US risk-free rate and $Riskpr_{jt}$ is country *j*'s risk premium at time *t*, defined as the difference between the country's government bond yield and US government bond yield. As noted earlier, we include the change in domestic credit as a proportion of GDP (*Debt flow*) as an explanatory variable. Chervachidze and Wheaton (2013) note that the expected sign of the *Debt Flow* variable is ambiguous. A positive sign may indicate potential financial instability and a negative sign may indicate less severe lending constraints.

$RentDev_{ijt}$ is the deviation from the long-run trend in real rent in city *i* in country *j* at time *t*. The real rent deviation represents the difference between the log of real rent in that city and the predicted log of real rent based on a simple linear trend. Therefore, it is derived from a regression of (logged) real rent on time. This follows the approach taken by Hendershott and MacGregor (2005a) and acts as a portmanteau variable assumed to capture several attributes of local office market dynamics. For example, the real rent level may deviate from its long-run trend in a positive direction during the expansionary phase of the business cycle. If investors exhibit forward-looking expectations, higher levels of real rent than suggested by historical trends could signal a forthcoming downward correction in the market. However, it is conceivable that investors may form adaptive expectations and interpret a deviation from long-run trend as a signal of continued positive future performance (Chervachidze and Wheaton, 2013), although arguably this might not be rational. μ_{ij} denotes city fixed effects. Finally, ε_{ijt}

is a time-variant unobservable that is assumed to be randomly distributed and uncorrelated with the observed controls.

The turnover models take a similar form with common determinants as in Equation (1):

$$T_{ijt} = \delta_0 + \theta_1 RFR_{jt} + \theta_2 Riskpr_{jt} + \theta_3 Debt_{jt} + \theta_4 RentDev_{ijt} + \mu_{ij} + \epsilon_{ijt} \qquad (2)$$

where T_{ijt} is the turnover rate in city i in country j at time t. We also test models without explicitly specifying fixed effects, but including institutional indicators such as market transparency scores (as measured by JLL's Global Real Estate Transparency Index) and size of the local office market instead. Seasonal dummies (quarterly or half yearly) are included in all turnover models to address potential seasonality issues. We have also performed unit root tests for all time-varying determinants to check for stationarity. These indicate that all variables are stationary. All models are estimated using robust standard errors to address potential biases due to heteroscedasticity.

Given the well-known endogeneity issues associated with investigating the relationship between prices and transaction activity, we apply a two-stage orthogonalization procedure to first identify the element of transaction activity or cap rate not explained by market fundamentals. The unexplained (by market fundamentals) variance or residual error from these models then represents the component of transaction activity or cap rate that is not jointly determined. We then re-estimate the cap rate (turnover rate) model above, adding the residual errors from the initial turnover rate (cap rate) model as a further explanatory variable. This is to test whether the residual element of turnover rate (cap rate) is also a significant explanatory variable for cap rate (turnover rate). We lag the residuals by one period to try to control for simultaneity bias.

Results

The results of the econometric estimations are presented in Tables 2 and 3. In Table 2, four model specifications are presented that estimate the determinants of cap rates. Models 1 and 3 incorporate city fixed effects whilst Models 2 and 4 introduce explanatory variables in place of fixed effects that may explicitly identify the drivers of cross-sectional differences in cap rates embedded in the city fixed effects. With an adjusted R-squared of 87%-88%, the explanatory power of the fixed effects models is high. The omission of city fixed effects reduces the explanatory power of the models to 64%-66%.

INSERT TABLE 2 AROUND HERE

In all models, the coefficient for US risk-free rate has the expected positive sign and is statistically significant. The country risk premium is positive and statistically significant. As the required return on government bonds relative to US government bonds increases, the cap rate is higher. The change in debt outstanding as a proportion of GDP has a negative effect on cap rates. This is in line with Chervachidze and Wheaton (2013) who found a negative impact on US cap rates from the change in total debt outstanding as a proportion of GDP. Previous analysis has acknowledged potentially contrasting expectations regarding the sign of this variable, with macroeconomic theory proposing that high debt availability signalled possible financial instability and microeconomic theory suggesting that easy credit conditions raise asset prices. At the international level, our finding is that, all else equal, increases in debt levels are associated with higher asset prices and lower cap rates.

The real rent deviation variable has a statistically significant negative sign. This indicates that cap rates are lower where real rents are above their long-term trend. This finding is also in line with most previous research and is consistent with adaptive expectations by investors (see Chervachidze et al, 2009, Chervachidze and Wheaton, 2013, McAllister and Nanda, 2016, Hendershott and MacGregor, 2005b). When the lagged transaction activity variable is added to the model specification, there are negligible changes to the coefficients and to the explanatory power of the models. The coefficient for this variable is not statistically significant. This suggests that, when purged of possible joint determinants, transaction activity does not affect cap rates.

Models 2 and 4 omit city fixed effects and include city and national market-attributes in the estimation. In terms of these variables, the coefficient for market size is significant and negative. This is consistent with larger cities having lower cap rates. It is in line with the degree of concentration of investment, investors and intermediaries in 'core' markets having an influence on pricing. Further, given that the least transparent markets tend to have the highest scores, the JLL Transparency Score has the expected positive effect on cap rates. To be clear, the coefficient on the JLL Transparency variable suggests that more transparent or mature markets tend to have the lower cap rates.

The semi-annual models in Panel B of Table 2 are run as a robustness check on the quarterly models. This is because, at a quarterly frequency, cap rates can display high levels of persistence. Results for these models are strongly supportive of the patterns observed at a quarterly frequency, with all variables having the same signs and similar levels of significance.

A similar modelling strategy is employed for turnover rates, the results of which are shown in Table 3. Models were estimated for the percentage turnover rate by value (models 1 to 4) and for the percentage turnover rate by floorspace (models 5 to 8). The results for turnover rates are much less consistent and comprehensible when compared with the cap rate models. This is reflected in the lower explanatory power of the turnover rate models. Indeed, in line with the pattern observed in Figure 3, it is notable that the turnover rate models have extremely low explanatory power when fixed effects are omitted.

INSERT TABLE 3 AROUND HERE

As before, two model specifications are presented for estimating the determinants of turnover rates, whether measured by value or by floorspace. Models 1, 3, 5 and 7 incorporate city fixed effects. Models 2, 4, 6 and 8 introduce cross-sectional explanatory variables in place of the city fixed effects. In all of the quarterly models, the coefficient on the US risk-free rate is positive and statistically significant. This is surprising since it would be expected that higher risk-free rates would be associated with lower turnover. However, this period may not be typical in that it was dominated by a recovery in transaction activity following the Global Financial Crisis and also characterised by falling US bond yields. There is a fairly stable result for the country risk premium in the turnover rate models. The coefficient for this variable is negative in all the models, albeit it is not significant in models 6 and 8. As expected, the more risky a country's government bonds are perceived to be relative to US bonds, the lower is the level of transaction activity, which is in line with the findings of Devaney et al (2017b) for a sample of European and Asia-Pacific real estate markets. There is no consistent statistically significant result for the debt flow variable. This takes a negative sign in the turnover rate models, which does not correspond with expectations that increases in credit stimulate transaction activity.

The coefficient for the real rent trend deviation variable is not statistically significant when value-based turnover rates are examined. However, in six out of eight models of floorspace-based turnover rate, it is statistically significant. This may reflect increased trading of secondary space when rents are above long-term trend. Meanwhile, the size variable is not in line with expectations as there is a significant negative coefficient for this variable. This result is also in line with the findings of Devaney et al (2017b). It is supportive of the argument that large, core cities have less transaction activity relative to their size which, whilst empirically unproven, has been explained as due to the increased propensity of core assets in core locations to be held longer within investment portfolios. Perhaps surprisingly it is notable that the JLL Transparency score was found to have no significant impact on the turnover level.

When the lagged residual cap rate variable is added to the specification, there are negligible changes to the coefficients and to the explanatory power of the models. The coefficient for the cap rate variable is not statistically significant. This suggests that, when purged of joint determinants, cap rates do not affect turnover rates. Once again, for robustness, we present the results of estimations on semi-annual data in Panel B. In this case, it is owing to concerns about 'noise' in quarterly turnover rates. The results here are consistent with those for the quarterly estimations, albeit there is a higher level of explanatory power for the models with fixed effects at c. 50%.

A notable feature of the results is the stark differences between the explanatory power of the cap rate models and that of the turnover models when city fixed effects are omitted. Market fundamentals such as bond yields, risk premiums, rental market conditions and amount of credit explain approximately 65% of the variation in the cap rate variable. In contrast, the comparable figure for turnover rates is 1%-5%. This suggests that any presumption that the same variables determine both prices and transaction activity may be incorrect.

Conclusion

An association between changes in asset prices and transaction activity is a stylized fact in real estate research. Complex causality relationships involving the interaction of market conditions, behavioral phenomena, debt availability, clientele effects and feedback effects between all these variables are considered to be jointly determining variations in transaction activity and asset price levels over time. A notable finding of the research is that, when purged of their joint determinants, there was no evidence to support the view that prices affect turnover rates or that turnover rates affect prices. Cross-sectional variations in transaction activity and asset prices may also reflect differences in local institutional structures as well as market fundamentals. Local institutional structures are expected to have impacts upon the propensity of market participants to transact due to differences in transaction costs and risks, which also have effects on asset prices. As local institutional constructs, commercial real estate markets vary in terms of transfer taxes, time to transact, protection of property rights, and brokerage costs and arrangements. The negligible explanatory power for the models of turnover rates with no city fixed effects suggests that it is local institutional factors that determine transaction activity.

The empirical findings on cap rate determination are much stronger than the results for turnover rates. They are mostly in line with the results of previous research in terms of relationships with market fundamentals such as government bond yields, risk premiums and rental market conditions. The finding of a negative relationship between market size and cap rate is consistent with a degree of spatial concentration of investment, investors, information and intermediaries in ‘core’ global real estate markets. All else equal, large markets are likely to be more transparent, and the expectation of a significant effect of market transparency on cap rates is confirmed.

The strong association between transaction activity, prices and market conditions is particularly apparent from the spike in transaction activity during the commercial real estate price bubble of 2007 and the subsequent plunge in values and volumes in 2008-09 as the global financial crisis took hold. Yet, in contrast to cap rates, the results for and patterns in turnover rates are inconsistent. Whilst cities with high turnover rates tend to be in the US, Australia and UK, it is difficult to discern any notable patterns in markets with low transaction activity. Perhaps surprisingly, many markets that might be regarded as relatively liquid by investors have below average turnover rates. In some cases, this may be because assets in such cities are regarded as long-term holds by investors, with assets in second or third tier cities regarded as 'cyclical' or 'rotational' plays. The results of formal econometric analysis support these insights. In contrast to the cap rate variable, turnover rates tend to decrease with market size, while market transparency does not seem to have any impact.

So, whilst the models for cap rates work fairly well at an international scale, it is clear that market fundamentals do not shed much light on the determinants of turnover rates. It is possible that the macro-differences in transaction activity reflect broader variations in forms of market economy and the different investment cultures that have evolved in different locations. Whilst a binary classification may be too simplistic, the bottom half of the city rankings for turnover rates are dominated by economies that would be classified as following a Rhenish or coordinated market economy model. The business culture in such markets, e.g. Munich, Paris, Tokyo, Rotterdam, is commonly characterized as "patient capitalism". The contrast here is with the Anglo-American liberal market economies that have more fragmented share ownership patterns, shorter performance horizons and deregulated markets. It is the Anglo-American markets that dominate the upper half of the city ranking by turnover rate. Studies drawing upon 'Varieties of Capitalism Theory' rather than market fundamentals may be more fruitful areas of research in terms of transaction activity.

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Figure 1: Transaction volumes and cap rates, Q1 2007 – Q1 2015

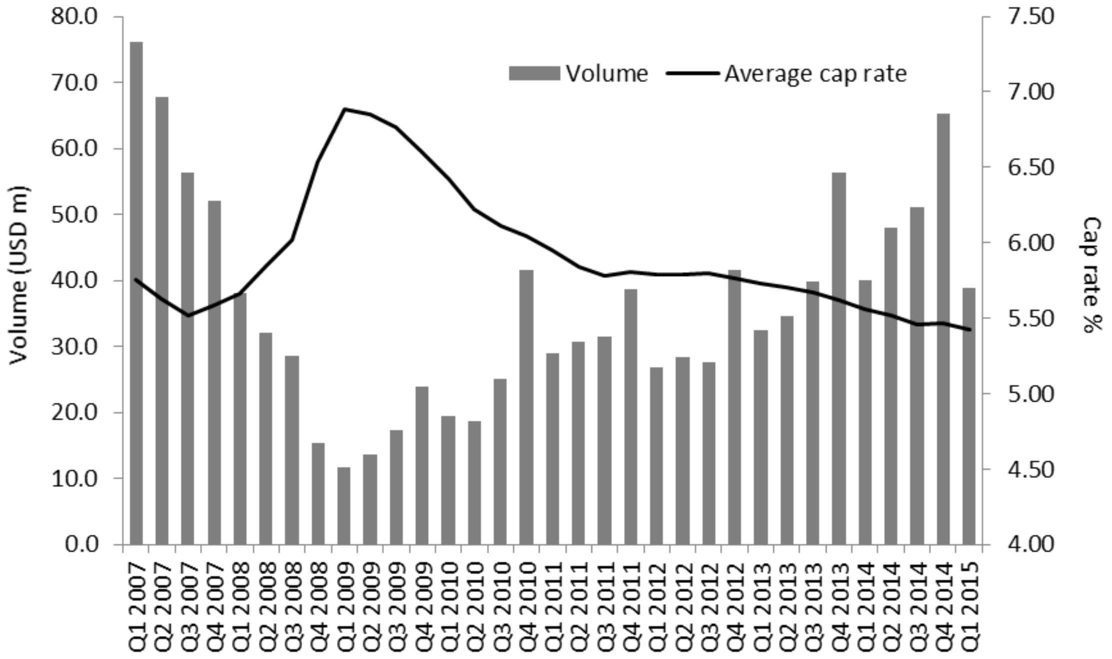

Figure 2: Average turnover rate, Q1 2007 – Q1 2015

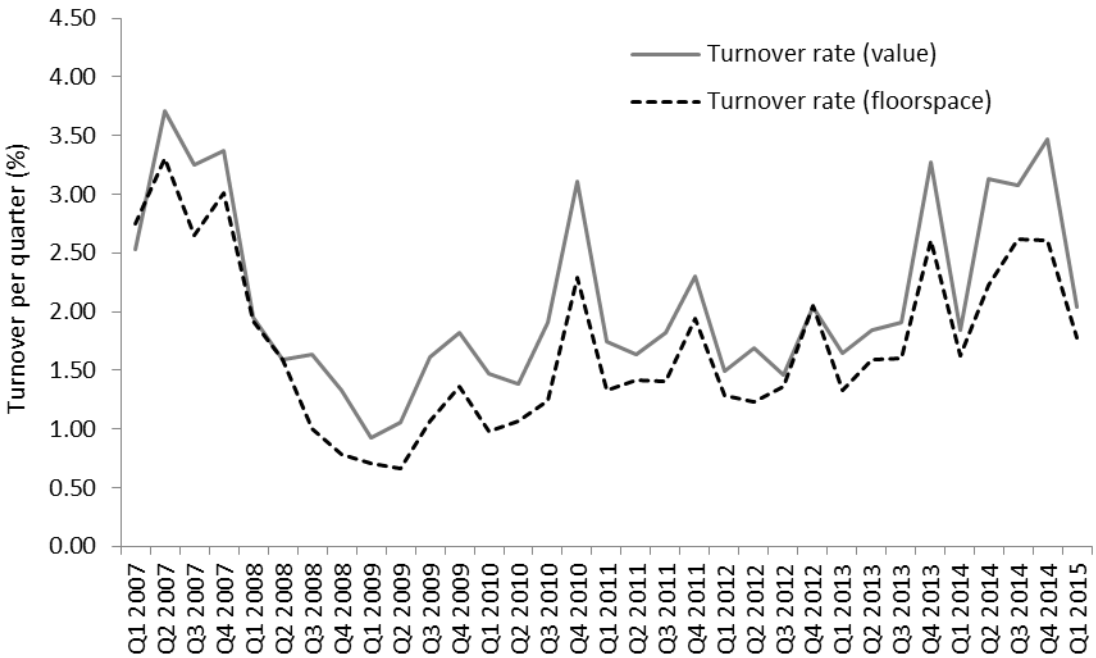

Figure 3: Average cap rate (%) and average turnover rate (% per quarter) by city

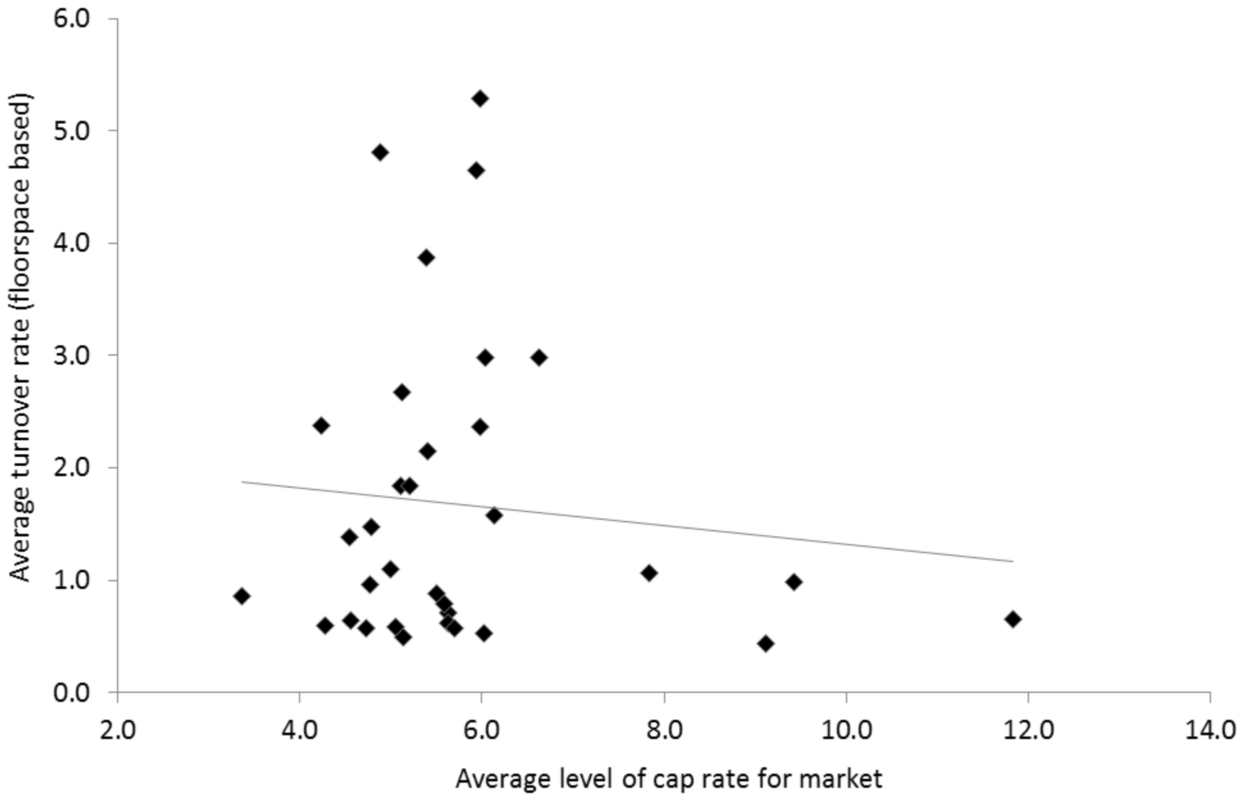

Table 1: Ranking of cities according to turnover and volume – Q1 2007 to Q1 2015

Average volume traded in USD billion p.a.		**Average turnover p.a. based on stock value (%)**		**Average turnover p.a. based on sq. m. traded (%)**	
London	23.9	Chicago	28.6	Seoul	21.1
New York City	17.4	San Francisco	27.6	San Francisco	19.2
Tokyo	15.7	Seoul	21.8	Chicago	18.6
Paris	13.8	Beijing	17.1	Beijing	15.5
Los Angeles	5.2	Sydney	14.7	Sydney	11.9
Seoul	5.2	Melbourne	14.6	Melbourne	11.9
San Francisco	5.0	Boston	14.3	Boston	10.7
Sydney	4.4	Los Angeles	12.9	London	9.5
Boston	4.4	Manchester	11.6	Manchester	9.4
Chicago	4.3	London	10.1	Los Angeles	8.6
Singapore	4.0	Washington DC	8.8	Shanghai	7.4
Shanghai	3.9	Shanghai	8.6	Washington DC	7.4
Frankfurt	3.9	New York City	7.7	Warsaw	6.3
Beijing	3.6	Warsaw	7.5	New York City	5.9
Stockholm	3.5	Frankfurt	6.8	Singapore	5.6
Washington DC	3.3	Singapore	6.6	Frankfurt	4.4
Moscow	3.1	Stockholm	6.3	Istanbul	4.3
Hong Kong	3.0	Gothenburg	5.4	Moscow	3.9
Munich	2.7	Moscow	5.2	Stockholm	3.9
Melbourne	2.5	Amsterdam	4.3	Amsterdam	3.5
Berlin	2.4	Rotterdam	4.0	Hong Kong	3.4
Madrid	2.1	Tokyo	3.9	Osaka	3.2
Osaka	1.6	Berlin	3.6	Barcelona	2.8
Amsterdam	1.4	Barcelona	3.6	St Petersburg	2.6
Warsaw	1.2	Munich	3.2	Paris	2.6
Barcelona	0.8	Osaka	3.2	Madrid	2.5
Manchester	0.8	Paris	3.2	Tokyo	2.4
Rotterdam	0.6	Hong Kong	3.2	Berlin	2.3
Gothenburg	0.6	Madrid	2.8	Rotterdam	2.3
Lyon	0.6	Lyon	2.7	Munich	2.3
Istanbul	0.2	St Petersburg	2.0	Lyon	2.1
St Petersburg	0.2	Istanbul	n/a	Gothenburg	2.0
Sofia	0.1	Sofia	n/a	Sofia	1.7

Table 2: Panel models of office market cap rates – Q1 2007 to Q1 2015

Panel A: quarterly data	Prime capitalisation rate							
	(1)		(2)		(3)		(4)	
Constant	3.557	***	8.097	***	3.460	***	7.686	***
US govt bond yield	0.212	***	0.331	***	0.253	***	0.341	***
Country risk premium	0.255	***	0.545	***	0.244	***	0.666	***
Debt flow as % of GDP	-0.009	***	-0.019	***	-0.006	***	-0.016	***
Real rent trend deviation	-2.215	***	-2.141	***	-2.126	***	-2.214	***
Log(average floorspace)	-		-0.505	***	-		-0.416	***
JLL transparency score	-		0.463	***	-		0.187	**
Lag residual - turnover	-		-		-0.003		0.000	
City fixed effects	YES		NO		YES		NO	
Adjusted r-squared	87.6%		64.1%		87.1%		66.3%	
No of cities	33		33		31		31	
Observations	946		946		840		840	

Panel B: Semi-annual data	Prime capitalisation rate							
	(1)		(2)		(3)		(4)	
Constant	3.526	***	8.030	***	3.344	***	7.560	***
US govt bond yield	0.233	***	0.335	***	0.316	***	0.375	***
Country risk premium	0.264	***	0.566	***	0.249	***	0.700	***
Debt flow as % of GDP	-0.010	***	-0.020	***	-0.006	**	-0.017	***
Real rent trend deviation	-2.352	***	-2.213	***	-2.144	***	-2.212	***
Log(average floorspace)	-		-0.484	***	-		-0.392	***
JLL transparency score	-		0.408	***	-		0.092	
Lag residual - turnover	-		-		0.001		-0.001	
City fixed effects	YES		NO		YES		NO	
Adjusted r-squared	87.5%		63.6%		87.6%		66.9%	
Cities	33		33		31		31	
Observations	505		505		442		442	

Note: Robust standard errors are computed. ***p<0.01; **p<0.05; *p<0.1.

Table 3: Panel models of office market turnover rates – Q1 2007 to Q1 2015

Panel A: quarterly data					Value-based turnover rate								Floorspace turnover rate			
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Constant	1.149	***	5.681	***	1.208	***	4.804	***	1.688	***	3.806	***	1.460	***	2.842	***
US govt bond yield	0.383	***	0.288	**	0.354	***	0.333	**	0.180	*	0.251	**	0.252	**	0.239	**
Country risk premium	-0.222	***	-0.073	*	-0.214	***	-0.074	*	-0.185	***	-0.031		-0.163	***	-0.028	
Debt flow as % of GDP	-0.011		-0.018	**	-0.011		-0.016	*	-0.011	*	-0.016	**	-0.014	**	-0.016	**
Real rent trend deviation	0.318		-0.470		0.499		0.173		1.757	***	1.735	**	1.424	**	1.260	
Log(average floorspace)	-		-0.446	***	-		-0.428	***	-		-0.259	***	-		-0.198	***
JLL transparency score	-		-0.381		-		-0.071		-		-0.397	*	-		-0.153	
Lag residual - cap rate	-		-		0.030		0.020		-		-		-0.026		-0.029	
City fixed effects	YES		NO		YES		NO		YES		NO		YES		NO	
Quarter dummies	YES		YES		YES		YES		YES		YES		YES		YES	
Adjusted r-squared	38.6%		3.8%		32.5%		2.7%		34.5%		3.4%		35.9%		1.5%	
No of cities	31		31		31		31		33		33		33		33	
Observations	901		901		824		824		1031		1031		875		875	

Panel B: Semi-annual data					Value-based turnover rate								Floorspace turnover rate			
	(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
Constant	2.881	***	10.49	***	3.164	***	11.30	***	3.465	***	6.870	***	3.305	***	7.421	***
US govt bond yield	0.590	**	0.480	*	0.475	*	0.209		0.391	**	0.585	**	0.374	*	0.183	
Country risk premium	-0.547	***	-0.175		-0.488	***	-0.152		-0.447	***	-0.075		-0.435	***	-0.060	
Debt flow as % of GDP	-0.019		-0.038	*	-0.017		-0.034		-0.022	*	-0.036	**	-0.021		-0.031	*
Real rent trend deviation	1.588		-0.386		1.348		-0.466		4.573	***	4.377	**	3.127	**	2.079	
Log(average floorspace)	-		-0.809	***	-		-0.794	***	-		-0.459	***	-		-0.410	***
JLL transparency score	-		-0.474		-		-0.677		-		0.728		-		0.749	
Lag residual - cap rate	-		-		-0.069		0.030		-		-		-0.200		-0.076	
City fixed effects	YES		NO		YES		NO		YES		NO		YES		NO	
Half year dummy	YES		YES		YES		YES		YES		YES		YES		YES	
Adjusted r-squared	48.7%		3.6%		51.2%		3.7%		48.4%		4.4%		56.7%		2.4%	
No of cities	31		31		31		31		33		33		33		33	
Observations	445		445		415		415		507		507		439		439	

Note: Robust standard errors are computed. ***$p<0.01$; **$p<0.05$; *$p<0.1$.

Appendix A: Averages for cap rates and other selected indicators by city – Q1 2007 to Q2 2015

	Prime office cap rate (%)	Quarterly real rent growth (%)	Prime office rent psm USD	Prime office CV psm USD	Total office floorspace 000 m^2	Volume traded in USD m
Amsterdam	5.5	-0.2	453	8,282	6,977	348
Barcelona	5.6	-1.3	340	6,195	5,356	208
Beijing	5.4	2.1	986	19,435	7,217	900
Berlin	5.1	-0.1	352	6,998	17,686	590
Boston[2]	5.1	0.0	388	7,416	9,418	1,092
Chicago[2]	5.9	0.6	346	5,936	8,525	1,071
Frankfurt	5.0	0.0	615	12,307	11,589	963
Gothenburg	5.1	0.9	348	6,837	3,106	145
Hong Kong	3.4	-0.3	2,462	75,906	5,971	745
Istanbul	7.8	2.7	481	6,188	2,196	60
London	4.2	-0.1	1,805	43,599	20,285	5,982
Los Angeles[2]	5.4	-0.2	359	6,624	13,538	1,299
Lyon	6.0	0.7	352	5,873	5,151	145
Madrid	5.6	-1.5	484	8,850	11,940	531
Manchester	6.0	-0.3	527	8,973	1,571	204
Melbourne	6.6	0.3	440	6,652	4,141	627
Moscow	9.4	0.4	1,149	12,652	11,681	763
Munich	4.7	-0.1	506	10,698	20,675	678
New York City[2]	4.8	0.1	639	13,449	35,045	4,356
Osaka[3]	5.6	0.1	794	14,075	8,532	405
Paris	4.6	-0.2	1,086	24,300	53,894	3,455
Rotterdam	5.7	0.1	279	4,911	4,014	151
San Francisco[2]	4.9	1.0	516	12,317	4,346	1,254
Seoul	6.0	0.2	390	6,590	6,166	1,292
Shanghai	5.1	-0.2	743	15,205	8,898	972
Singapore	4.5	-0.3	1,215	27,264	4,636	995
Sofia	9.1	-1.7	241	2,677	1,267	24
St Petersburg	11.8	-2.3	872	7,773	2,072	42
Stockholm	4.8	0.4	630	13,404	10,923	882
Sydney	6.0	0.2	862	14,314	4,864	1,095
Tokyo	4.3	-1.5	1,834	42,232	29,807	3,923
Warsaw	6.1	0.0	438	7,195	3,524	294
Washington DC[2]	5.2	-0.1	581	11,399	7,381	837
Overall average[1]	6.1	-0.1	714	14,550	10,655	1,016

[1] Measured as the mean of all underlying observations, which does not equal the mean of figures in the table owing to some locations not having a complete set of observations for all variables. [2] Six-monthly observations for cap rate.