Does Foreign Investment Affect US Office Real Estate Prices?*

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ABSTRACT

This study examines the impact of foreign real estate investment on the US office market capitalization rates. The geographic unit of analysis is MSA and the time period is 2001-2013. Drawing upon a database of commercial real estate transactions provided by Real Capital Analytics, we model the determinants of market capitalization rates with a particular focus on the significance of the proportion of market transactions involving foreign investors. We have employed several econometric techniques to explore the data, potential estimation biases, and test robustness of the results. The results suggest statistically significant effects of foreign investment across 38 US metro areas. It is estimated that, all else equal, a 100 basis points increase in foreign share of total investment in a US metropolitan office market causes about an 8 basis points decrease in the market cap rate.

Keywords: Foreign investment, Capitalization Rate, Real Estate, Panel data.
JEL Classifications: F21, G15, R11, C33

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INTRODUCTION

The growth of cross-border real estate investment in recent decades has generated increasing interest about its characteristics and impacts. Although there is little empirical evidence, foreign investors are frequently perceived to be affecting prices. This paper reports on research investigating the relationship between the activity of foreign investors in different US office markets and capitalization rates. An important market shift in this period has been the global transformation in the range and scope of real estate investment organizations and their third party service providers. In addition to relatively long established institutional investors such as pension funds, insurance companies and listed real estate companies/trusts, other types of real estate investment organizations have become increasingly prominent. Sovereign wealth funds, specialist open and closed end real estate funds, investment banks, specialist real estate investment managers, private equity groups and endowment funds have emerged as significant market participants. A number of these investment organizations have created global operational platforms to execute international real estate investment strategies.

Compared to international equity flows, the patterns and effects of cross-border *direct* real estate investment have been the subject of limited research. Given relative data availability, the majority of published work has focussed on international real estate securities and their return determinants, diversification potential and currency risk (for examples see Eichholtz *et al.*, 2011; Ling and Naranjo, 2002; Worzala and Sirmans, 2003b; Bond *et al.*, 2003). Following sporadic surges of cross-border investment from particular countries since 1970s (Japanese in 80s), there emerged a body of survey research on the costs and benefits of international real estate investment (see Falkenback, 2009; Lizieri, 2009 and Worzala and Sirmans, 2003a for reviews). However, recent evidence indicates that cross-border capital flows between real estate markets have become increasingly important – albeit the Global Financial Crisis caused a fall in both intra- and inter-national real estate investment activity (see Lizieri *et al.*, 2011; Newell *et al.*, 2010; Lizieri and Pain, 2013 and Lieser and Groh, 2013). The networks of third party support services (accountancy, legal and real estate services providers) that support cross-border real estate investment have also globalized in this period. Ball (2002) emphasized the importance of real estate investors and developers being able to rely on networks of professional firms that operate at a spatial scale equivalent to their own (see also D'Arcy, 2009).

The focus of this paper is on the effects of increasing integration of real estate markets on real estate capitalization rates. Focusing at the city level, drawing upon RCA's transaction database this research investigates the extent of variation in the level of foreign investment in the commercial offices markets of 38 US MSAs. Given that differences in levels of capitalization rates due to differences in liquidity, income growth expectations, market transparency, local economic conditions etc. are expected, we attempt to isolate the effect of foreign capital flows on office capitalization rates. Information is most readily available for office markets. It is highly likely that there will be a positive association between trading, information and prices. Essentially information availability stimulates initial investment and this initial investment generates more information, resulting in path dependency effects and informational cascades. New York is a classic example of such effects. The quantity of transactions produces self-perpetuating advantages in terms of information, transparency, professional support services and liquidity that, in turn, attracts more investors and generates more information, transparency, etc.

THEORETICAL CONTEXT AND PREVIOUS RESEARCH

There are a number of theoretical and empirical grounds to expect foreign investment to have significant price effects. From an International Capital Asset Pricing Model perspective, the key determinant is the expectation that globally diversified investors have a lower risk premium. It is worth noting that global diversification requires prohibitive amounts of capital for vast majority of institutional investors, who are therefore exposed to specific risks such as liquidity, transparency, exchange rate in volatility. In this vein, Kang *et al.* (2010) argue that foreigners who invest in multiple countries and whose performances are likely to be assessed in a global context will evaluate domestic stocks via a global benchmark whilst domestic investors will use a local benchmark to evaluate domestic stocks. One consequence of the diversification benefits from cross-border investment is a change in the set of investors. In integrated markets, firms' share prices may benefit from increased capital flows from investors in previously segmented markets as integration allows the firms' risks to be shared by a larger pool of investors with different risk exposures and risk appetites. It is expected that a global shareholder base results in a lower cost of capital and hence a greater equity value (see Stulz, 1999).

An increase in the size of the investor base produced by financial globalization is central to Merton's investor recognition hypothesis (Merton, 1987). Drawings upon both information and diversification rationales, a central behavioral assumption in Merton's model is that investors

tend to invest in securities with which they are familiar. For securities that are unfamiliar to foreign investors, the smaller pool of domestic investors may have to take undiversified positions and, consequently, may require higher returns to compensate them for the higher specific risk associated. Hence the main proposition of this model is that the value of a security is increasing in the number of investors who know about the security.

Whilst the focus above is on investor heterogeneity, informational heterogeneity and asymmetries between local and foreign investors have been the topics of much research in the equity literature. There are contrasting hypotheses and evidence on whether local investors possess superior information and, therefore, superior valuation skills (see Kalev *et al.*, 2008). On the one hand, it is argued that local investors are faced with fewer investment barriers compared foreign investors and, as a result, have easier access to firm-specific information (see for example: Hau, 2001; Dvorak, 2005; Brennan and Cao, 1997; Parwada *et al.*, 2007). On the other, it has been argued that foreign investors tend to be more sophisticated investors with superior investment skills making better investment decisions (see Froot and Ramadorai, 2001; Grinblatt and Keloharju, 2000; Karolyi, 2002; Seasholes, 2004 among others). Chen *et al.* (2009) identify a range of contrasting and inconsistent empirical findings on the relative performance of local and foreign investors. This inconsistency suggests that the relative performance and pricing ability of local and foreign investors is contingent upon timescale of investment, locations of stock listing, maturity of the local market *inter alia.*

Although there are inconsistent findings on the relative performance of foreign and local investors, a stylized fact from the body of empirical work in equity markets is that foreign investors tend to have different patterns of investment compared to local investors and that the effect is to lower firms' cost of capital. Much of the research tends to be consistent with Merton's investor recognition hypothesis. The level of foreign ownership seems to be positively related to the market capitalization of firms and the amount of cash on their balance sheets, and negatively related to dividend yields. Covrig *et al.* (2007) find that foreign fund managers tend to invest only in those stocks that they know about with large market capitalization, large foreign sales, extensive analyst coverage, and whose stocks have foreign listings and index memberships. For instance, Kang and Stulz (1997) found that foreigners investing in Japan tend to be underweight in smaller and highly leveraged firms. Looking at pricing effects, Dahlquist and Robertsson (2004) found a strong link between the magnitude of a price impact and the fraction of foreign ownership of a firm; the higher the fraction, the larger is the price impact. Large,

financially solid, and well-known firms show the largest reductions of cost of equity capital due to foreign investors.

Implicit in the conventional wisdom about foreign investment is that weight of money produces 'price pressure' effects. However, as has been restated many times, under the efficient markets hypothesis, investor demand should not matter since prices are supposed to encapsulate the present value of the cash flow generated by the asset. Given this horizontal demand curve assumption, investors should be able to buy or sell any amount of a security without affecting its price. The common empirical observation of a downward sloping demand curve for securities is typically explained by deviations from a perfect market. In market segmentation literature, there is a longstanding body of work suggesting that the size and nature of the investor base does affect security prices. When perfect market assumptions are relaxed, there are strong *a priori* grounds to predict that the size of a security's investor base will affect its prices and returns.

In commercial real estate markets, compared to the equity and bond markets deviations from perfect market assumptions are substantially larger. Thin trading, high search costs, information asymmetries, heterogeneous assets and expectations all increase the potential size and significance of clientele effects. Segmentation is also often highlighted between investor types. Short-hand clientele investor categories such as institution/non-institutional and core/value/opportunistic reflect variations in risk preferences amongst investor groups. Indeed, assets are also classified in the same way. There tends to be cross-sectional and time-varying variations in marginal investors for real estate assets with different investment qualities.

There has been limited work on clientele effects in commercial real estate markets. It has been argued that the existence of a seller for every buyer means that flow of funds analysis is simply a means of identifying which group or sector moves market prices i.e. the marginal investor(s) (Zheng, 1998). Benjamin *et al.* (2008) define a clientele effect a short-term occurrence where separate, independent investor groups face different expected returns for a range of reasons such as cost of capital, taxation, leverage, operating efficiency *inter alia*. However, it is a short-term event that is ultimately self-correcting. Further developing work by Hardin and Wolverton (1999) and Lambson *et al.* (2004) and drawing upon a much larger sample of transactions, Ling and Petrova (2010) find evidence that tax-motivated, out-of-state and REITs buyers pay significantly more than in-state buyers. In a recent paper, Akin *et al.* (2013) looked at similar issues. However, in order to control for unobserved explanatory variables (the premium property

explanation) associated with, what they suggest are, implausible price premiums, they also analyze a subsample of repeat sales transactions. Using this type of approach, they estimate REIT premiums of 6% compared to the 20%-50% premiums estimated in their hedonic regression models. This premium is attributed to the incentives for REITs to deploy capital quickly and their capital access advantages. However, broad location controls in their hedonic estimation are likely to account for the potential mis-estimation of the premium in the hedonic estimation. Further, Chinloy *et al.* (2013) identify selection bias issues with repeatedly sold properties. It is the effects on prices of the presence of a specific type of investor – foreign, international or non-domestic investors that is the focus of this research.

In the capital markets, there is a large body of empirical testing the Wall Street maxim that it takes trading volume to make prices move. Whilst a positive *contemporaneous* correlation between price changes and volume may be a stylized empirical fact, it is debateable whether there is a causal relationship (see Gallant *et al.*, 1992). This contemporaneous positive relationship may be due to the fact that flows and returns are jointly dependent on common economic variables. As stated below, this is also key issue in analysing the relationship between capitalization rate and foreign investment.

In the real estate literature, the results of empirical work on the investment flow ↔ return relationships are mixed. Fisher *et al.* (2007) examine whether net capital flows from institutional to non-institutional investors' impact upon asset prices and returns in a cross-section of U.S. real estate sectors and geographic markets. At the aggregate U.S. level, they find evidence that institutional capital flows have a statistically and economically significant association with subsequent returns. However, the results are not consistent amongst sector or CBSAs. Applying a similar methodology to UK data, Ling *et al.* (2009) do not find any evidence to support a 'price pressure' effect. Beyond commercial real estate, similar findings have been reported by both Stein (1995) and Cauley and Pavlov (2005) who focus on the relationship between price changes and trading volume in US housing markets. They investigate the stylized fact that trading volumes tend to fall when house prices are falling and that rising prices tend to be associated with increases in transaction activity. Both papers suggest a contemporaneous and self-reinforcing relationship between prices and trading volume generated by exogenous demand shocks.

It is also notable that the body of academic work on the determinants of capitalization rates is largely silent on the effect of capital flows (see Sivitanidou and Sivitanides, 1999; Ambrose and Nourse, 1993; Chen *et al.*, 2004; Chervachidze *et al.*, 2009; Chichernea *et al.*, 2008). Two papers on capitalization rate determination include trading volume or fund flows as explanatory variables in their model specification with different results. Hendershott and MacGregor (2005) find that the share of real estate in institutional portfolios is negatively associated with capitalization rates. Clayton *et al.* (2008) use capital flows as an input into a composite investor sentiment index. Using a VECM approach, they find no consistent role for sentiment in explaining the time series variation of capitalization rates during the period 1996-2007. Chervachidze and Wheaton (2013) focus on availability of debt (debt flow) as a driver of capitalization finding that changes in debt availability at the national level have significant effects on capitalization rates.

In summary, there are some theoretical and empirical grounds to expect the level of foreign investment to affect prices. Whilst generalization can be problematic, all else equal better diversified foreign investors are likely to have lower risk premiums and be able to outbid local investors. However, it is likely that the additional demand from foreign investors will be concentrated in specific sectors, asset segments and locations and that, consequently, initial price effects will be concentrated. Shiller (1998) recognised that there was an inherent problem with flow-return studies in that capital 'surges' do not add capital to the overall market since other investors are taking the other side of the transaction. It is also important to acknowledge the potential indirect effect of foreign investment. Foreign investment may produce additional investment flows but also may simply replace local capital that is, in turn, now being allocated to foreign markets. Foreign capital may also be 'crowding out' local capital redirecting it towards smaller or lower quality locations and/or assets creating secondary price pressure effects. This study specifically focuses on the impact of proportion of foreign purchases on cap rates, rather than the effect of changes in net capital flows. We hypothesise that an increase in market share of foreign buyers will lead to decrease in market cap rates (there, an increase in asset prices).

DATA

Transaction data on commercial real estate markets tends to be partial, particular (to the collector's circumstances and requirements), proprietary and/or private. To investigate cross-border real estate investment flows empirically, we have been provided with access to Real

Capital Analytics' (RCA) transactions database. RCA started tracking commercial property transactions in the United States 2000. In 2007, coverage was expanded to include all markets globally. RCA focuses primarily on the main income-producing property types: office, industrial, retail, apartment and hotel, plus sales of commercially developable land sites.

Given the increasing globalization of investment markets allied with growing complexity of investment vehicles, in particular, the growth of unlisted, pooled funds, joint ventures and Special Purpose Vehicles, it is also important to acknowledge that it has become more and more simplistic to classify ownership by nationality. RCA define a transaction as "cross-border" if the buyer or major investor is not headquartered in the same country where the acquired asset is located. They state that the buyer's identity or country of origin is known for well over 90% of total volume. If the country of origin is not known, the buyer is assumed to be domestic. An increasing number of firms have subsidiaries accessing capital in multiple countries so a firm may have two headquarter locations. For example, RCA assume that Deutsche Bank (DB Real Estate) is assumed to be based in Germany for deals outside of the US while their acquisitions in the US are assumed to be made via its US headquartered subsidiary, RREEF. RREEF, now re-named Deutsche Asset and Wealth Management, have six offices in Europe, six in Asia and nine in North America. Further, many of the real estate investing institutions located in global financial centres will not be the ultimate investors in the sense that they are not the source of the capital. Capital may be drawn from a range of international markets and simply 'pass through' the major financial centres which effectively act as capital transhipment hubs. Particularly when capital is pooled, there are major difficulties in establishing the ultimate source of the real estate investment routed through these centres. For instance, sovereign wealth funds such as the Abu Dhabi Investment Authority or Government of Singapore Investment Corporation (now GIC Private Limited) invest directly in real estate assets but also invest in pooled funds that may be located in one international market but invest in real estate assets in other markets. The complexities involved in some real estate transactions illustrate some of the difficulties of categorization. One of the largest transactions in the database involved the General Motors Building - a 50-story office tower located in Manhattan, New York City. In May 2013, a joint venture consisting of Zhang Xin (a Chinese real estate magnate) and Moise Safra (a Brazilian banking magnate) bought a 40% stake in the building through an entity entitled Sungate Trust. They acquired it from a joint venture between Boston Properties (a US Real Estate Investment Trust), Goldman Sachs Real Estate Opportunities Fund (backed by funds from Kuwait and Qatar), and Meraas Capital (Dubai-based real estate private equity firm). Boston Properties

retained a 60% stake in the asset whilst the Goldman Sachs fund and Meraas Captital sold their interests.

Further, in the US there are tax incentives for foreign investors to pool capital with other investors and acquire minority interests in real estate assets. It is relatively common for foreign investors to acquire a 49% interest in a (vehicle owing) a real estate asset. The remaining 51% could be owned by another foreign investor (49%) and a global investment manager (2%) with local presence who acquired the asset, structured the vehicle etc. We expect this issue to have greater significance in markets with high-value lot sizes with a result that the level of foreign investment is likely to be under-estimated in major gateway cities such as New York, LA, San Francisco. Put simply, many trophy assets may be too large in value for a single investor and therefore, more likely to be acquired by investor consortia. Further, the notion of foreignness is increasingly becoming conceptually problematic in this context. The local offices of global service providers are typically the product of mergers with local practices employing local professionals who are embedded in local business and political networks. In essence, in most developed markets, foreign real estate investing organizations who set up local operating platforms, by employing experienced local professionals in local offices who are effectively enculturated insiders, are likely to have access to similar informational sets about local markets as local investors. These definitional and data difficulties notwithstanding, the RCA database provides a valuable source of data in real estate investment transactions that warrants a detailed analysis.

Summary statistics are displayed in Exhibit 1. Broadly the sample period consists of a period of falling office capitalization rates between 2000 and 2007. As expected, the mean capitalization rate is at its lowest in 2007 at the peak of the market boom preceding the Global Financial Crisis (GFC) which began in the period 2007/8. During the GFC, mean capitalization rates rose significantly from a low of 6.8% in 2007 to 8.2% in 2009. Post-GFC, the recovery period of 2010 onwards, average market cap rate started to recover. A broadly similar cross-sectional spread of mean capitalization rates was found. New York's mean capitalization rate in the sample period was 6.9% and Oklahoma City's was highest at 8.6%. Indicating a relatively highly integrated national office investment markets, cities within the US have had similar trajectories in the sample period with broadly similar levels of volatility in capitalization rates. Not surprisingly, major 'gateway' cities such as New York, Boston, Washington, Los Angeles and San Francisco have had the lowest mean capitalization rates.

Exhibit 1: Summary Data: Office Market Transactions across 38 US Cities

	Cap Rate		Transaction Volume ($bn p.a.)		% Foreign	
City	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Un-weighted National Figures	7.9% (average)		34.9 (total)		8.6% (average)	
Atlanta	7.9%	0.72%	1.44	1.22	7.0%	11%
Austin	7.8%	1.06%	0.75	0.77	7.9%	13%
Baltimore	8.0%	0.92%	0.15	0.15	3.6%	7%
Boston	7.4%	1.02%	1.52	1.37	28.6%	27%
Charlotte	7.8%	0.86%	0.41	0.35	3.3%	8%
Chicago	7.8%	0.75%	2.22	1.29	17.6%	17%
Cincinnati	8.3%	1.18%	0.12	0.12	5.9%	19%
Cleveland	8.5%	0.84%	0.12	0.14	2.8%	10%
Columbus	8.1%	1.22%	0.10	0.07	5.6%	15%
Dallas	8.1%	0.84%	1.10	0.93	5.2%	8%
Denver	7.9%	0.92%	0.76	0.58	7.4%	10%
Detroit	8.5%	0.69%	0.05	0.07	5.6%	14%
Houston	8.1%	0.96%	2.08	1.75	10.3%	13%
Indianapolis	8.5%	1.04%	0.20	0.15	9.4%	27%
Kansas City	7.8%	0.71%	0.09	0.07	6.8%	10%
Las Vegas	7.8%	0.91%	0.32	0.25	2.9%	5%
Los Angeles	7.2%	0.91%	1.93	1.46	5.4%	8%
Memphis	8.3%	1.13%	0.07	0.04	3.9%	11%
Miami	7.6%	0.87%	0.61	0.38	16.1%	18%
Minneapolis	8.2%	1.10%	0.42	0.32	10.1%	13%
New York	6.9%	0.96%	10.28	8.38	20.6%	12%
Norfolk	8.1%	0.78%	0.03	0.04	0.5%	2%
Oklahoma City	8.6%	0.83%	0.06	0.04	0.0%	0%
Orlando	8.1%	0.95%	0.23	0.19	15.8%	20%
Philadelphia	7.8%	0.94%	0.46	0.29	15.0%	19%
Phoenix	7.8%	0.92%	0.71	0.57	7.5%	5%
Pittsburgh	7.9%	0.74%	0.13	0.12	16.1%	29%
Portland	7.5%	0.63%	0.30	0.21	8.5%	15%
Raleigh/Durham	7.8%	0.72%	0.11	0.12	7.1%	16%
Sacramento	8.0%	1.01%	0.31	0.30	2.1%	5%
San Antonio	8.4%	1.20%	0.21	0.11	1.9%	4%
San Diego	7.5%	0.94%	1.24	1.00	7.6%	13%
San Francisco	7.2%	0.96%	1.93	2.41	24.0%	23%
Seattle	7.5%	1.15%	0.99	1.17	7.4%	9%
St Louis	8.5%	1.02%	0.25	0.22	5.0%	11%
Tampa	8.3%	0.99%	0.29	0.25	9.0%	9%
Tucson	8.0%	0.98%	0.06	0.05	1.9%	7%
Washington	7.1%	1.00%	2.79	1.50	21.5%	11%

Source: RCA database.

Turning to capital flows, a similar pattern emerges. In the sample period, office transactions worth approximately $635 billion were recorded (of which the 38 cities in the sample accounted for approximately $550 billion). Whilst this averaged at nearly $50 billion per annum, there were notable variations in transaction volume over the real estate cycle. Peaking in 2007 at c$112.5 billion, there was a dramatic fall to under $7 billion in 2009 – the lowest year by transaction volume. New York had the highest level of transaction volume averaging $12.3 billion per annum comprising over 27% of the total. The next largest was Washington which accounted for 7.5% of the total. Overall, New York, Washington, Boston, Chicago, San Francisco, Los Angeles, Atlanta and Houston accounted for nearly 70% of transaction volume by value.

Whilst New York was the largest destination for foreign real estate investment in absolute terms, it was not the largest in relative terms. At an aggregate level, transactions involving foreign purchasers account for approximately 15% of all transaction volume by value in the period 2001-2013. It is notable that at the aggregate level there has been no consistent upward or downward trend. However, the level of foreign investment has tended to drift upwards. It was the 'gateway' cities that experienced the highest relative levels of foreign investment. They received nearly 85% of all foreign investment in the sample cities and just under 70% of all domestic investment. Boston (25.21%), New York (19.47%), San Francisco (19.4%) Washington (20.13%) had the largest proportion of foreign investment overall. However, whilst foreign investment accounted for just over 17% of total transaction volume in Chicago, other large 'gateway' cities such as Los Angeles (8.96%), Atlanta (8.72%) and Houston (10.43%) did not fir this pattern. At the other end of the scale, Norfolk (1.08%), Oklahoma City (0%) and Colorado Springs (0.99%) had zero or negligible levels of foreign investment. Broadly, the data display the expected negative relationship between capitalization rate and foreign investment i.e. the higher the level of foreign investment, the lower the capitalization rate. However, it is also clear that there is a simultaneity issue in that a common factor may be jointly determining foreign investment and capitalization rate. It tends to be the largest cities that have the lowest capitalization rate. In order to investigate this issue more formally, we now attempt to disentangle the various drivers of office capitalization rates and to estimate the 'pure' effect of foreign investment.

EMPIRICAL ESTIMATION STRATEGY

The testable hypothesis generated by the research objectives is: *All else equal, there is a negative relationship between the proportion of purchases involving foreign real estate investors and market capitalization*

rates. In order to address this hypothesis, we draw and build upon a well-established literature on modelling capitalization rates. The models basically draw upon the standard equation of capitalization rates as a function of required return and rental growth. Building upon their previous work, in the recent Chervachidze and Wheaton (2013) (CW) paper, a relatively simple empirical model including the lagged dependent variable is used to explain US cap rates.

$$\log(k_{it}) = \alpha_0 + \beta_1 \log(k_{it-1}) + \beta_2 RRFR_{t-1} + \beta_3 \log(RRR)_{it-1} + \varepsilon_{it} \quad (1)$$

where k_{it} is a real estate capitalization rate in city *i* at time *t*. $RRFR_t$ is the real risk free rate (long-term rate at time *t*. $log(RRR)_{it}$ is the real rent ratio in city *i* at time *t*. Real rent ratio is computed as ratio of real rent in a year and the sample period average of real rent. Normally it would simply be a matter of adding more explanatory variables to the basic CW model and then to find out whether the additional variables improve the explanatory power of the model and are statistically significant. However, potential interdependency of variables violates the assumption of independence required for consistent regression estimation with the additional possibility that the results may not be robust.

Therefore, in attempting to isolate the effect of foreign investment on capitalization rates, since it is likely that foreign investment and capitalization rate are determined by a common variable e.g. a city's global economic importance, a key problem in the modelling process is simultaneity bias. For instance, New York's office capitalization rate may be low **and** the level of foreign investment may be high because New York is the leading global financial center and a gateway city. Since New York's global economic importance may also be linked to its level of foreign investment, we need to be able to separate the effect of the level of foreign investment from the effect of the city's global economic importance on capitalization rate. This type of joint determination problem tends to be easy to identify since the explanatory variables will typically be strongly correlated. A common econometric approach for dealing with this issue is to use a regression procedure to identify the element of foreign investment that is not explained by global economic importance. Given that this procedure effectively identifies the effect of global economic importance on foreign investment, it is the unexplained (by global economic importance) variance or residual error that is then used as a 'pure' foreign investment variable. This is termed as an orthogonalization procedure.

In order to counteract the problems outlined above, we use a two stage regression procedure. In the basic model above, ε_{it} is the residual error and is capturing the component of a city's capitalization rate that is not explained by the determinants (e.g. risk free rate and real rent ratio) included in the basic CW model. This residual error may be explained by other variables such as urban economic structure. In our modelling procedure, having identified the element of a city's capitalization rate that is unexplained by the CW model (the residual error), we then try to see whether we are able to identify what is determining the residual error (the unexplained component).

We estimate whether the component of a city's capitalization rate that is not explained by the basic model can be explained by other factors – that have themselves been purged of the effects of common determinants. So then our modelling process involves a number of steps:

Step 1: Identify the component of a city's capitalization rate that is (un)explained by the standard model of capitalization rate determination.

Step 2: Identify other potential explanatory variables and estimate the extent to which other potential explanatory variables are themselves correlated.

Step 3: If there is evidence of correlation, apply orthogonalization procedures to estimate the 'pure' component of the potential explanatory variables.

Step 4: Finally, estimate whether the variables identified in Steps 2 and 3 are significant determinants of the unexplained variance in capitalization rates estimated in Step 1.

We discuss these procedures in more detail below.

The literature has proposed inclusion of other macro-economic controls as well such as capital market risk premium (or, a risk factor) or debt availability (or, a measure of domestic bank lending as a share of GDP) as in equation (2).

$$\log(k_{it}) = \alpha_0 + \beta_1 \log(k_{it-1}) + \beta_2 RRFR_{t-1} + \beta_3 \log(RRR)_{it-1} + \beta_4 Risk_{t-1} + \beta_5 Debt_{t-1} + \varepsilon_{it} \qquad (2)$$

Equation (2) is our baseline cap rate model, in line with the literature. While the parsimonious specifications in equations (1) and (2) are quite attractive, those are fraught with some severe econometric biases. First, although real rent ratio by definition is able to capture much of the local real estate market characteristics, city level data is notorious in terms of having a significant amount of unobserved heterogeneity. Unobserved heterogeneity may be modelled as fixed

effects, after conducting the Heckman's specification test. However, we envisage that fixed effect modelling may be more appropriate than random effect modelling due to presence of small number of cross-sections. The advantage of this method is that it allows us to use both time series and cross-sectional variations in the data, which increases the efficiency of the OLS estimates. A potential bias in estimating equation (2) is the possibility of correlation between unobserved heterogeneity at the local area level and the observables, which would violate standard assumptions of OLS estimation. Therefore, the disturbance term in equation (2) is specified as a two-way error component capturing city fixed effects and time-specific effects.

$$\varepsilon_{it} = \mu_i + \lambda_t + \nu_{it} \tag{3}$$

i.e.

$$\log(k_{it}) = \alpha_0 + \beta_1 \log(k_{it-1}) + \beta_2 RRFR_{t-1} + \beta_3 \log(RRR)_{it-1} + \beta_4 Risk_{t-1} + \beta_5 Debt_{t-1} + \mu_i + \lambda_t + \upsilon_{it} \tag{4}$$

where μ_i denotes city fixed effects and λ_t time-specific effects. In this fixed effect specification, heterogeneity is assumed to be constant over time and correlated with observables. The constant effect is removed by mean-differencing (or first differencing) the data. This estimation strategy is consistent with theoretical expectations that market-specific unobserved characteristics can bring in permanent shift in key real estate indicators such as rental growth, capital value growth, vacancy rate, net absorption and capitalization rate across markets. The fundamental demand and supply shifters can also reflect the unobserved heterogeneity. A two-way error component model would allow us to control for these unobservables.

Second, the fixed effect approach in equation (4) indicates another potential bias i.e. dynamic panel bias. Each cross-section or city may follow its own error process. It is quite conceivable that a city would have panel-specific heteroscedasticity and auto-correlation process. This calls for incorporating the panel-specific variations into the parameter estimates. To address this issue, we follow a Feasible Generalized Least Squares (FGLS) procedure that allows panel specific AR(1) process using first-differenced data.

Third, a key variable in our study is proportion of foreign or non-domestic transactions (I_{it}), which can now be incorporated as follows:

$$\log(k_{it}) = \alpha_0 + \beta_1 \log(k_{it-1}) + \beta_2 RRFR_{t-1} + \beta_3 \log(RRR)_{it-1} + \beta_4 Risk_{t-1} + \beta_5 Debt_{t-1} + \beta_6 \log(APS)_i + \beta_7 I_{it} + \beta_8 I_{it-1} + \mu_i + \lambda_t + \upsilon_{it} \quad (5)$$

An important concern with above estimation procedure is the potential simultaneity of relationships. The key issue is that an omitted variable(s) may be jointly determining capitalization rates (k_{it}) and foreign investment flows (I_{it}) in equation (5). A range of factors may affect both capitalization rate and foreign investment e.g. market transparency, growth prospects, liquidity etc. exacerbating the econometric problem of endogenous determination. Such joint dependency issues undermine the reliability of the empirical estimations. In order to counter the potential misspecification introduced, we attempt to purge the independent variables of the effects of interdependent determinants and estimate 'pure' effects. In the first stage, we estimate the determinants of cap rates using the Chervachidze and Wheaton (CW) model as in equation (4). The residual variation from this model then provides an estimate of the unexplained variance in capitalization rates that may be caused by other factors e.g. market transparency, size, foreign investment etc.

In the second stage, given that these additional variables also suffer from similar problems of joint dependency, we also purge these variables of common dependency by orthogonalization procedures. This orthogonalization process is guided by the correlation matrix in Appendix 1. Correlation between two variables greater than 25% is put through the orthogonalization process.[1] See Appendix 1 for details of correlation coefficients.

We orthogonalize several variables as follows:

$$\log(RRR)_{it} = \alpha_0 + \beta_1 RRFR_t + \chi_{it} \quad (6)$$

$$Debt_t = \alpha_0 + \beta_1 RRR_{it} + \beta_2 RRFR_t + \beta_3 Risk_t + \varphi_t \quad (7)$$

Therefore, equation (5) can now be specified as follows incorporating residuals from equations (6) and (7):

$$\log(k_{it}) = \alpha_0 + \beta_1 \log(k_{it-1}) + \beta_2 RRFR_{t-1} + \beta_3 \hat{\chi}_{it-1} + \beta_4 Risk_{t-1} + \beta_5 \hat{\varphi}_{t-1} + \mu_i + \lambda_t + \upsilon_{it} \quad (8)$$

[1] The 25% threshold is ad hoc but it can capture statistically significant correlations.

Finally, we model the unexplained variance in cap rates in equation (8) as a function of world city indicator such as number of offices of Advanced Producer Services (APS) firms sourced from the Globalization and World Cities Research Network (GaWC). We also orthogonalize the number of APS firms and percent foreign investment variables against each other.

$$\hat{\upsilon}_{it} = \alpha_0 + \beta_1 \hat{\upsilon}_{it-1} + \beta_2 I_{it} + \beta_3 I_{it-1} + \beta_4 \log(APS)_i + \mu_i + \lambda_t + \gamma_{it} \quad (9)$$

The two-stage procedure addresses multicollinearity issue and it should reveal the independent effect of the foreign presence in each city.

RESULTS AND ANALYSIS

The results of the first stage regressions are presented in Exhibit 2. Column (1) is the basic CW model as in equation (1). Model 2 estimates the FGLS model and subsequent models add further controls in Models 3 and 4 as represented by equation (4). In the base Model 1 we find that a simple OLS model estimates the expected positive relationships between risk free rate and lagged cap rate and contemporaneous cap rate. However, no statistically significant effect is found for real rent ratio on cap rates. This finding is not consistent with the results of the CW models in the US who identified a statistically significant negative effect. The coefficient on lagged cap rate is approximately 0.4. This is largely similar to the results of the CW model finding for the US metro areas and is consistent with similar substantial momentum (i.e. serial correlation) in the formation of capitalization rates. The real risk-free rate coefficient has the expected positive sign and is statistically significant. Model 2 model uses FGLS (feasible generalized least squares) regression. FGLS is less prone to bias from heteroscedasticity. It provides some reassurance that the results are broadly similar to Model 1.

When the basic model is extended to include additional variables, the coefficients remain stable. Model 3 incorporates a capital market risk variable – corporate bond spread. As expected, this has a statistically significant positive effect on cap rates. It is notable that the Real Rent Ratio is now statistically significant and has a positive sign. It suggests that all else equal where real rents are above their long term average, cap rates tend to be higher. This is consistent with rational expectations by investors. This is in contrast to the CW finding of a significant negative coefficient. In all further models, a significant positive effect is identified for real rent ratio. Model 4 incorporates debt flow (Debt % of GDP). As expected, it has statistically significant

negative effect on cap rates. Model 5 introduces the level of foreign investment and World City ranking variables (as explained in equation (5)). As expected, both have small but statistically significant negative effect on office cap rates. However, as explained above, these models suffer from potential omitted variable bias.

In Model 6, we test whether the results from Model 5 are biased by potential endogeneity issues as explained above (based on equation (9)). The dependent variable here is the residual error from Model 4. The residual error is the component of the cap rate that the model is unable to explain and is therefore determined by other variables. In order to control for the fact that foreign investment and cap rate may be both linked to a city's economic importance, we also incorporate a city's score from a World City ranking as proxied by the number of offices of Advanced Producer Services (APS) firms. The results are consistent with our theoretical expectations. There is a significant negative effect of World City ranking on cap rate. In addition, there is a small additional significant effect of the level of foreign investment on cap rate. As expected, this effect is negative i.e. an increase in foreign investment leads to a fall in cap rate. Essentially, Model 6 confirms that the specification in Model 5 and the significant coefficient estimate for foreign investment in Model 5 do not suffer from endogeneity bias. When we address the econometric biases such as unobserved heterogeneity, simultaneous determination and dynamic panel bias in Model 6, the results remain statistically significant. Therefore, it is reasonable to interpret the results of Model 5 as relatively unbiased i.e. a 100 basis points increase in foreign share of total investment in a US metropolitan office market causes about an 8 basis points decrease in the market cap rate as reflected by Model 5. If we run this model without New York, then the effect size is about 7 basis points.

Exhibit 2: Panel Data Models Explaining Cap Rate Dynamics across 38 US Cities (2001-2013)

	(1) Log(Cap Rate)	(2) Log(Cap Rate)	(3) Log(Cap Rate)	(4) Log(Cap Rate)	(5) Log(Cap Rate)	(6) Log(Cap Rate) **Residual** (using Model 4)
Log(cap rate)$_{t-1}$	0.436***	0.481***	0.290***	0.117**	0.301***	
	(9.69)	(13.49)	(8.34)	(2.89)	(7.27)	
Real risk free rate $_{t-1}$	0.025***	0.031***	0.028***	0.029***	0.026***	
	(5.31)	(9.18)	(9.86)	(11.13)	(8.42)	
Log(Real rent ratio) $_{t-1}$	0.246	0.290	0.568**	0.707***	0.688***	
(orthogonalised after Model 1)	(1.02)	(1.38)	(3.07)	(3.99)	(3.34)	
Risk_premium $_{t-1}$			0.104***	0.129***	0.102***	
(orthogonalised after Model 1)			(11.87)	(14.29)	(10.06)	
Debt availability $_{t-1}$				-0.003***	-0.002***	
				(-7.24)	(-3.75)	
Log(number of APS firms) $_{t-1}$					-0.026***	-0.026***
					(-6.04)	(-28.09)
Foreign% $_{t-1}$					-0.0008***	-0.0004***
					(-2.90)	(-28.27)
Constant	1.116***	1.015***	1.247***	1.563***	1.225***	0.045***
	(11.70)	(13.29)	(18.31)	(19.95)	(15.74)	(49.33)
Model Specifications	OLS City Fixed Effects (FE)	FGLS Panel-AR(1) City FE	FGLS Panel-AR(1) City FE	FGLS Panel-AR(1) City FE	FGLS Panel-AR(1) City FE	FGLS Panel-AR(1) City FE
Sample (annual)	38 cities 2001-2013	38 cities 2001-2013	38 cities 2001-2013	38 cities 2001-2013	38 cities 2001-2013	38 cities 2001-2013
N	408 (R^2=0.44)	408	408	408	408	408

Note: Robust standard errors are computed and t-statistics are reported within parentheses. ***p<0.01; **p<0.05; *p<0.1.

CONCLUDING REMARKS

In the last decade, there has been a growing body of work investigating the scale and determinants of cross-border real estate investment flows. Whilst market participants often presume a positive effect on prices due to the presence of foreign buyers, there has been no empirical investigation. Whilst there are some *a priori* grounds to expect that internationally diversified investors may have lower risk premiums than local investors, the empirical evidence has been relatively sparse in this respect. Broadly, it suggests that foreign investors tend to focus on large, 'recognised' assets and that there is a positive effect of foreign investment on prices.

In addition, there are methodological challenges in isolating the effect of foreign investment on capitalization rates. The key issue is that both foreign investment levels and capitalization rates are likely to be jointly determined by interdependent variables such as real estate market maturity and transparency, economic vitality and market risk. In this paper, we counteract these problems by modelling the determinants of the variance in capitalization rates that is not explained by 'standard' variables such as risk free rates and rental growth expectations. Using orthogonalization procedures to identify and isolate the 'pure' effects of potential determinants of variance in capitalization rates unexplained by the standard variables, we find that there is a statistically significant negative effect of foreign investment on capitalization rates. Put simply, when controls are introduced to account for the expectation that cities with low capitalization rates and *high levels of foreign investment* are likely to be in the mature real estate markets of the most economically significant US cities, the finding of a negative effect of foreign investment on capitalization rates remains robust.

Clearly, the transmission of demand from foreign investors to real estate prices is likely to be complex. This first attempt to address the question has raised numerous further questions. Given that the US has been a net exporter of real estate capital flows, to what extent is foreign investment producing net increases in capital flows to office investment? Anecdotal evidence suggests that foreign investors tend to invest in premium real estate locations and assets. However, we know very little about the range of types of foreign investors and it is reasonable to infer that there would be variations in foreign investors' risk preference and investment strategies. Such variation may lead to different levels of price effects. Are price effects being felt only in specific markets and is segmentation in the office investment market increasing? To what extent are such clientele effects likely to be temporary or persistent? In an increasingly globalized investment market, there are major taxonomic challenges. Does it make sense to categorize global investment organizations with a local presence employing local personnel with

in-depth local knowledge and experience as foreign? Whilst there are major methodological and data challenges, this has been a first attempt in measuring the effects of foreign investment levels on local commercial real estate prices. Consistent with findings in other capital markets, we observe a positive and plausible effect on price levels.

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Appendix 1

Correlation Matrix

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Cap rate (1)	1.00						
Foreign% (2)	-0.02	1.00					
Log(real rent ratio) (3)	0.12	0.04	1.00				
Log(no. of APS firms) (4)	-0.20	0.19	-0.00	1.00			
Real T-bond yield (5)	0.15	-0.02	**0.56**	0.00	1.00		
Risk premium (6)	0.42	-0.05	-0.01	0.00	0.18	1.00	
Debt availability (7)	-0.13	-0.05	**-0.70**	-0.00	**-0.57**	**0.37**	1.00

Note: Variables with more than 25% correlation are specified in regression after the orthogonalization process.