Does Putting All Your Eggs in One Basket Add Value?
The Case of a Spatial Concentration of Same Industry Firms

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Crocker H. Liu [1]   Chen Zheng[2]   Bing Zhu[3]

[1] Cornell University, chl62@cornell.edu. Ithaca, NY, 14853-6201, US. Tel: +1 607 255 3739
[2] University of Reading, chen.zheng@henley.ac.uk. Reading, RG6 6AH, UK. Tel: +44 1183788402
[3] Technical University of Munich, b.zhu@tum.de. Arcisstraße 21, 80333 Munich, Germany. Tel: +49 8928925434

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Abstract

What are the valuation consequences when a building or its surrounding neighborhood is occupied primarily by a concentration of firms in the same industry? We find that office buildings have higher rents and a price premium if they are the beneficiaries of these agglomeration economies with knowledge spillovers the most likely channel of these agglomeration gains. Our results indicate that, for office buildings, agglomeration benefits exist at both the horizontal and vertical spatial levels. The results remain robust when we use specialization instead of density as the agglomeration measure. We also find that the stock market reacts favorably to buildings that enjoy these agglomeration economies. REITs' experience positive abnormal returns when acquiring a building located in a cluster of firms in the same industry, and negative abnormal returns when disposing of a building with a sizeable anchor tenant.

1. Introduction

Does a spatial concentration of same industry firms either within a given building and/or within a neighborhood result in higher (lower) cash flows and in turn a value premium (discount) for an office building? This is the purpose of our study. Ex-ante, it is unclear whether a value premium should exist for a building when a spatial concentration of similar tenants is present. From a finance perspective, investing in a building(s) in a given neighborhood is analogous to investing in a portfolio of lease contracts. An undiversified portfolio consisting of firms within a given industry sector should increase portfolio risk, requiring investors to demand a higher discount rate and therefore a lower price to undertake this risk. From an economic perspective however, positive spatial externalities known as agglomeration economies drive the spatial concentration of economic activities e.g., the financial sector on Wall Street or the technology sector in Silicon Valley. According to Duranton and Puga (2004), firms cluster to benefit from increased productivity opportunities that arise from the pooling of labor and knowledge spillovers in addition to sharing inputs and outputs[4]. These agglomeration economies suggest that firms should be willing to bid up rents when these positive externalities are present in a given building and/or neighborhood where the building is located ceteris paribus.

Although Rosenthal and Strange (2004) argue that all else equal, higher rents in a specific location should exist if agglomeration economies are present, until recently empirical studies have been unable to test this proposition due to the difficulty in obtaining rent data. The few studies which do support this conjecture have used aggregated rents applied to agglomeration economies in a neighborhood, or coarse measures of agglomeration (Drennan & Kelly, 2011; Jennen &

[4]See also Rosenthal and Strange (2004, 2020) for a detailed literature review.

Brounen, 2009; van der Vlist et al., 2021). One exception are the studies of Liu et al (2018b, 2020) who look at the spatial concentration of similar firms within buildings which they refer to as building specialization using rents on individual tenants. However, they do not consider whether higher rents associated with building specialization translates to a higher value premium for a given building. Higher rents don't necessarily result in a higher price for a building since the discount rate could also be higher due in part to the riskiness of its tenants. In addition to evaluating whether a higher or lower price for an office building is associated with a spatial concentration of tenants within a building and/or neighborhood, we also address several related questions. In particular, does within-building specialization exert a stronger effect on net income and prices than the neighborhood agglomeration, or vice versa? Does the income for a building benefit from neighborhood agglomeration if the concentration of same industry tenants in a building are associated with a different industry from the dominant industry (ies) in a neighborhood? What is the channel of agglomeration benefits on commercial real estate rents? How does the stock market react when a publicly traded firm buys or sells a building occupied primarily by tenants in the same industry? The exact effects of the spatial concentration of same industry firms within a building and/or within a neighborhood that the building is located within with respect to property rents, prices capitalization rates, and stock prices has remained unexplored to a large extent. Our study attempts to fill in this gap by using data on office building transactions of publicly traded Real Estate Investment Trusts (REITs), their tenant information, geocoded employment data in small geographies, in addition to the stock price reaction to purchases and sales of these office buildings.

We find that the clustering of economic activities both within a building (vertical) and in its neighborhood (horizontal) results in higher office rents and prices. However, we find that a rent or value premium for building only arises when its tenants benefit from spillovers by locating in the neighborhood that also specializes in its industry. We find that a lower risk premium is required when the building is associated with stronger spillovers of agglomeration, reflected in a lower capitalization rate. Finally, we find that the market generally rewards a REIT's acquisition of office buildings located in spatially concentrated neighborhoods and associated with stronger spillovers but punishes the disposition of buildings that have a strong concentration of tenants within the same industry. In other words, the stock market tends to favor buildings with tenants concentrated in the same industry and discounts buildings that have a diversified tenant base. Figure 1 highlights the key findings on the marginal effects of vertical and horizontal agglomeration. We find that on average buildings classified as having vertical agglomeration (building specialization) have a 18.55% higher net operating income (NOI) and an 18.55% higher selling price; buildings classified as having neighborhood spillover benefits have a 24.90% higher NOI and 30.55% higher selling price; and buildings that have both vertical and horizontal agglomeration benefits enjoy a 43.37% higher NOI and 49.10% higher selling price compared to buildings that have neither vertical nor horizontal agglomeration.

<<Put Figure 1 Here >>

Our study contributes to the literature in several ways. First, we are able to directly quantify and test the extent to which agglomeration economies impact office rents via the knowledge spillover channel. Disentangling the spillover channel from the labor market pooling and input sharing mechanisms of agglomeration economies is possible for two reasons. By focusing solely on office buildings which are primarily occupied by firms in service industries, it provides a simple setting to test for spillover effects. Drennan and Kelly (2011) and Rosenthal and Strange (2020) have both noted that the input sharing and labor market pooling channels are naturally weakened given the essence of the service businesses. Drennan and Kelly (2011) argue that service industries in urban centers benefit from spatial concentration due to enhanced information and knowledge spillovers; such benefits should in turn be reflected in rents. Focusing on the advertising agency industry in Manhattan which is heavily influenced by information flows, Arzaghi and Henderson (2008) find that an agent is willing to pay a higher rent in order to be a neighbor to other agents, a finding that is likely to reflect knowledge spillovers. Second, while we argue that the agglomerative gains in office rents are driven by the positive spillover externalities, knowledge spillovers are more likely to exist at smaller spatial levels and within the same industry (Arrow, 1962; Marshall, 1890; Romer, 1986; Rosenthal & Strange, 2020). Therefore, the spillover effect on office rents is most prominent when the building's largest tenant is from the same industry concentration that is spatially present in the neighborhood. Using building-level tenant data and geocoded establishment-level employment data at a more granular geographical level, we are able to link the within-building industry concentration (if any) with the spatial concentration of an industry (if any) at the neighborhood level. This allows us to test whether the tenants' agglomeration gains are capitalized in the rents and values of an office building.

Another distinguishing feature of our study is that we provide initial evidence on the stock market's perceptions about agglomeration economies within a building as well as in its neighborhood. Intuitively, it is natural to expect that stock market investors should reward positive agglomeration gains. Empirically however, it is difficult to estimate the real effects. Using purchase and sale transactions of publicly traded REITs, we are able to conduct an event study, allowing us to identify stock price reactions around the acquisition or disposition of an office building with various degrees of vertical and horizontal agglomeration economies.

Finally, our use of disaggregated measures for both property values and levels of agglomeration allows us to address several unaddressed empirical issues at a more granular level. More specifically, the results of prior studies are based on the pooled effects of agglomeration e.g., all buildings are treated as if they are homogenous. Drennan and Kelly (2011) find that office rents in CBD areas are higher than suburban areas in markets with a higher concentration of producer service employment, providing initial evidence of agglomeration economies on rents. Similarly, Koster et al. (2014) find that firms have an increased willingness to pay higher rent in the CBD areas due to higher spatial concentrations of firms. The limitation of these studies is the authors' use of average rent in geographical areas or time periods which ignores the heterogeneity of individual buildings and their locational characteristics. Since agglomeration economies are conditional on spatial proximity (Rosenthal & Strange, 2020), it is widely acknowledged that the agglomeration benefits are stronger within a closer proximity. In particular, knowledge spillovers only function at narrow spatial levels (Arzaghi & Henderson, 2008; Bayer et al., 2008; Briant et al., 2010; Charlot & Duranton, 2004; Hellerstein et al., 2011; Kerr & Kominers, 2015; Li, 2014; Moretti, 2004; Rosenthal & Strange, 2001, 2003, 2008). The empirical challenge of modelling agglomeration effects lies in the potential endogeneity issue that arises from unobservable locational attributes. The larger the geographical area used to measure the level of agglomeration, the more unobserved characteristics potentially exist to obfuscate the estimation results. By geocoding the building addresses, we are able to measure the horizontal agglomeration with establishment-level employment data at a very granular level, e.g., 3-kilometer ring of individual office buildings, which minimizes the endogeneity issues caused by other externalities and provides a laboratory for testing knowledge spillovers. Recent studies show that agglomeration economies could also exist within a building (Liu et al., 2018a, 2018b, 2020; Rosenthal & Strange, 2020). While these studies capture vertical concentration of tenants in the same industry by sorting the vertical spatial pattern, employment density as well as the rent gradients among the tenants, we go a step further to examine the impact of within-building agglomeration on property values with manually collected tenant information. As the commercial real estate literature focuses primarily on the horizonal pattern of urban environments, our study adds to the limited understanding about how economic activities within a building as well as the surrounding neighborhood outside a building impact its value.

The remainder of the paper is organized as follows. Section 2 reviews the relevant literature and discusses the channels of agglomeration. The data, variables, and empirical strategy is described in Section 3. Section 4 discusses the estimation results on property values and the robustness tests while Section 5 presents our findings on the stock market's reactions to property transactions with various degrees of agglomeration. Section 6 concludes.

2. Literature Review and Proposition

2.1 Economies of Agglomeration

A large literature confirms the positive externalities of agglomeration and provides material evidence that firms benefit from being in clusters of economic activities. While empirical studies have found evidence in various countries to support all of Marshall's three proposed agglomeration mechanisms – labor market pooling, input sharing and knowledge spillovers, it is worth noting that the majority of these studies are based on manufacturing industries (see, e.g., Audretsch and Feldman (1996), Duranton and Overman (2005), Ellison and Glaeser (1997), Ellison et al. (2010), Greenstone et al. (2010), Rosenthal and Strange (2001), Jofre-Monseny et al. (2011), Martin et al. (2011), and Moretti (2004)). Melo et al. (2009) conducts a meta-analysis of 34 empirical studies, most of which focus on the manufactory sector, and find that the positive agglomeration effects on productivity or wages exist across various countries or model specifications. Agglomeration economies also exist in other industry sectors such as wholesales and retails (Charlot & Duranton, 2004; Eberts & McMillen, 1999; Guven et al., 2019; Rosenthal & Strange, 2005) and services (Arzaghi & Henderson, 2008; Dekle & Eaton, 1999; Drennan & Kelly, 2011; Kerr & Kominers, 2015; Koster et al., 2014; Morikawa, 2011), with a variation in the magnitudes and channels of the effects. Rosenthal and Strange (2020) review a range of research and conclude that, regardless of the industries, geographical scales and the mechanisms, agglomeration economies decay with distance. They also point out that knowledge spillovers are likely to attenuate the most rapidly among Marshall's three agglomeration types as these effects largely depend on human interactions and communications, which is evidenced in Arzaghi and Henderson (2008), Billings and Johnson (2016), Ellison et al. (2010), Greenstone et al. (2010) and Rosenthal and Strange (2001).

2.2 Agglomeration and Office Values

White the agglomeration literature is dominated by studies on productivity and wages, rents should also capture agglomeration economies (Rosenthal & Strange, 2004). Arzaghi and Henderson (2008) identify a significant agglomeration pattern in the advertising industry in Manhattan and argue that such agglomeration is driven by knowledge spillovers. They also find that the benefits of being closer to the center of the advertising industry are capitalized in rents as an advertising agent is willing to pay a higher rent to neighbor other advertising agents. Drennan and Kelly (2011) conduct a panel analysis of the average rent in 120 real estate markets in the US and find that CBD rents are significantly higher than the suburban rents in the primary real estate markets and such a difference is driven by the employment density of producer service industries.

Koster et al. (2014) extend the study to rents of all commercial properties and find that general agglomeration of economic activities has a positive effect on a firm's willingness to pay the rent.

In the commercial real estate literature, Jennen and Brounen (2009) find that rental rates are higher when the office buildings are located in office clusters in the Amsterdam market although they do not measure the agglomeration of economic activities. A more recent study by van der Vlist et al. (2021) finds that property-level cap rates are lower if the offices are located in areas with job clustering. While job clustering is a better proxy for agglomeration than office clustering, aggregated employment density without any consideration of specific industries can only generate limited inferences as agglomeration economies are clearly different across sectors.

Focusing on the office rents and service industries, the findings by Arzaghi and Henderson (2008) and Drennan and Kelly (2011) suggest that it is the knowledge spillovers that are primary sources of service industry agglomeration, which is ultimately capitalized in rents. As our study also exclusively focuses on the office buildings which are mainly occupied by service industries, we follow this line of research and develop our theoretical framework around the knowledge spillover channel.

There are two agents to consider when examining the agglomeration effects on individual buildings - tenants and property managers. An office building hosts tenants from various industries; each tenant is a company or an establishment within the building's neighborhood which could be affected by the agglomeration. Meanwhile, the tenants form a unique vertical pattern of industry composition within a building and in turn could be affected by the vertical agglomeration. A building can also be viewed as a unit in the neighborhood; in this sense, a building is comparable to a firm or a plant in urban agglomeration studies and the key agent is the property owner or manager. To understand the agglomerative effects on office values, we need to explore the agglomeration at the horizontal as well as the vertical levels and estimate their effects on different property value components.

2.3 Knowledge Spillovers and Willingness to Pay

In general, knowledge spillover effects are closely tied to the literature on a firm's choice of location. This literature focuses on the characteristics of the region where a firm chooses to locate such as agglomeration externalities, lower transport costs arising from proximity to customers, and knowledge spillovers which can improve a firm's productivity and operation efficiency (Figueiredo et al., 2002). Knowledge quickly disseminates among neighboring firms in industry clusters through spying, imitation, and the rapid inter-firm movement of highly skilled labor (Aharonson et al., 2007; Glaeser et al., 1992; Glascock et al., 1998). Consequently, the choice of location may be endogenous to knowledge spillovers: firms are motivated to choose a location that maximizes their net spillovers as a function of the locations' knowledge activities, their own capabilities, and competitors' anticipated actions (Barrios et al., 2006; Chidlow et al., 2009; Devereux et al., 2007). Francis et al. (2016) find that CEO compensation is significantly higher for urban agglomerate firms, suggesting that firms are willing to pay a premium for knowledge spillovers and highly skilled labor associated with spatial clustering.

Arzaghi and Henderson (2008), however, point out that wage equations only partially capture the agglomeration economies as it ignores the benefits that are capitalized into commercial rents as well as the variation in rents across regions, a critical issue for high-end services industries. The knowledge spillover effects on individual buildings are more noticeable in our study for two reasons. First, compared to input sharing and labor market pooling, knowledge spillovers are localized in nature (Rosenthal & Strange, 2020). The spillover effects, such as information sharing, exchange of ideas and networking, are found to function within close spatial proximity as well as within the same industry (Ahlfeldt et al., 2015; Arzaghi & Henderson, 2008; Hsieh & Moretti, 2019; Rosenthal & Strange, 2001, 2003; Rosenthal & Strange, 2005). By using the Graphic Information System (GIS), we are able to capture the agglomeration around individual buildings at fine geographical level (3km in our study). Therefore, the benefits of near neighbor clustering should be largely capitalized by office rents. Second, knowledge spillovers are found to be the dominant sources of agglomeration economies in service and retail industries (Arzaghi & Henderson, 2008; Billings & Johnson, 2016; Drennan & Kelly, 2011; Koster et al., 2014; Rosenthal & Strange, 2020), in addition to the innovative sectors (Matray, 2021), given the centrality of networking, information as well as education in these industries. The majority of the tenants in our sample are from service and retail industries, who, according to this line of literature, would be willing to pay a premium in rent for the spillover benefits of agglomeration. In addition to the horizontal agglomeration, Liu et al. (2018a, 2018b) find that agglomeration economies also exist within individual buildings and a tenant should benefit from locating in a building that is mostly occupied by its industry, consequently leading to higher rents.

2.4 Knowledge Spillovers and Property Operation

The agglomerative effects on office values can also be transmitted via property operation in several ways. First, the literature has recorded the positive externalities of agglomeration in human capital and found that managers become better in denser areas through interactions and networking with other managers (Francis et al., 2016). The skills of property managers could also benefit from knowledge spillovers, resulting in better property operation. Second, when tenants are attracted to business locations with agglomeration benefits, this creates tenant pooling which makes it easier for the property managers to attract and maintain a good tenant base, leading to a lower vacancy rate and higher rental income (van der Vlist et al., 2021). Jennen and Brounen

(2009), for example, find that office clustering generates higher rental incomes in the Amsterdam office market. Third, from investors' perspective, the liquidity risk of a property is lower when it is located in an area with higher economic density. As a result of positive locational externalities, it is easier for the buyer to maintain the current tenant base or redeploy the building, resulting in higher liquidation value, hence a lower risk premium and a higher selling price (Liu et al., 2019).

Therefore, the above arguments generate four testable hypotheses: 1) *Office buildings with vertical or horizontal agglomeration have higher rents and a price premium.; 2) The agglomeration effects on office rents and prices are channelled through knowledge spillovers. 3) The agglomeration benefits are reflected in capitalization rates. 4) The market rewards (punishes) the acquisition (disposition) of office buildings associated with agglomeration benefits.*

3. Data and Methodology

Our empirical strategy proceeds sequentially in three stages. First, we map the industry composition within an office building as well as in the neighborhood surrounding the office building, followed by measuring the vertical and horizontal agglomeration levels. Second, we estimate the impacts of vertical and horizontal agglomeration on office rents, prices and capitalization rates at the time of transactions. Third, we use an event study to investigate how the stock market reacts to the acquisition and disposition of office buildings with various agglomeration economies.

3.1 Sample

Our sample includes office building transactions conducted by listed REITs in the US from 2014 to 2020, which allows us to estimate the stock market reactions. The data on net operating income, prices and cap rates at the time of transactions is collected from S&P Market Intelligence, RCA and CoStar. Building level tenant information including occupied space, tenant name, and tenant industry sector, as well as building characteristics is manually collected from CoStar. As CoStar only records current tenants, we restrict our sample to a relatively short period to reflect the average lease duration in the office sector.[5] Due to the missing data (mainly on cap rates), our final sample includes 456 office transactions made by 57 REITs, occupied by 5,396 tenants. Table 1 presents the industry distribution of the tenants in our sample based on their occupied floor size. Our sample cover tenants from 21 industry sectors, with Professional, Scientific, and Technical Services, and Finance and Insurance occupying most of the rentable areas (26.0% and 23.7%, respectively). With the exception of manufacturing tenants (10.8%), the other tenants are also mainly from customer services industries including Information (8.2%), Publication Administration (5.6%), Retail and Wholesale Trade (4.6%), Social Work (4.2%), etc., providing a reasonable setting to test our knowledge spillover channel.

<< Put Table 1 here >>

3.2 Measuring Neighborhood Agglomeration

We define the neighborhood at a fine geographical level in order to capture the knowledge spillovers. The problem associated with using a zip code area is that some buildings, as shown in Figure 2, may locate near or on the border of a zip code area. As a result, the economic activities in the zip code area where the building locates may not reflect the actual degree of agglomeration surrounding the building. Therefore, instead of using the zip code areas, we use GIS to map a building's neighborhood as a 3-km radius area (referred to as 3-km ring hereafter) surrounding it.

[5] A JLL acritical points out that in the US office leases on average last for seven years. Please see https://www.jll.co.uk/en/trends-and-insights/workplace/office-leases-are-getting-shorter

<< Put Figure 2 here >>

The agglomeration level of a 3-km ring is measured in three steps. First, we estimate the employment density, calculated as the number of jobs per square meter, in each zip code area across the nation. Specifically, we use data from the Zip Code Business Patterns (ZCBP) database for local job distributions. While the ZCBP database comes at the NAICS level, it should be noted that ZCBP only reports the number of establishments at the zip code level, not the exact employment number. However, each establishment is categorized into 12 groups based on the employment size: below 4 employees, between 5 to 9 employees, between 10 and 19 employees, between 20 and 49 employees, between 50 and 99 employees, between 100 and 249 employees, between 250 and 499 employees, between 500 to 999 employees and more than 1,000 employees. Therefore, we use the imputed total employment calculated as the median number of employees in each group multiplied by the number of establishments in each group.

Second, we can measure the total employment density within a 3-km ring of each individual building based on the employment density at the zip code level. Specifically, it is calculated as the average zip code level job density weighted by the size of each zip-code area covered in the 3-km ring, i.e., the shadow areas inside the ring in Figure 2. The neighborhood employment density of building *i* is represented by Equation (1):

$$NDensity_i = \sum_1^K W_{i,k} D_k \quad (1)$$

where $W_{i,k}$ is the share of building i's 3-km ring covered by zip code k; D_k is the job density in zip code *k*; and K is the total number of zip code areas that the 3-km ring covers. The size of the zip-code area within a 3-km ring is identified using GIS software. We upload the coordinates of each property into the system and draw a 3-km circle buffer for each property, which is then intersected with the zip code areas, so that we can determine the parts and the exact sizes of zip-code areas contained in each 3-km ring.

While $NDensity$ captures the average employment density, it does not allow us to estimate the incremental value of having agglomeration advantages. Therefore, as a final step, we rank all the zip code areas across the nation according to their employment density and compare $NDensity$ of each building to the top 1% threshold density of the ranking. We only consider a building as actually having neighborhood agglomeration, and then create an agglomeration dummy $NDensity\_D$ equal to 1, if $NDensity$ is larger than the 1% threshold; 0 otherwise, presented as follows:

$$NDensity\_D_i = \begin{cases} 1, \ if \ NDensity_i > top \ 1\% \ threshod \ of \ zip \ code \ ranking \\ 0, \ otherwise \end{cases} \qquad (2)$$

3.3 Measuring Within-Building Agglomeration

Agglomeration economies can operate within individual buildings (Rosenthal & Strange, 2020). Liu et al. (2018a) find that specialized buildings are associated with productivity spillovers and such benefits are dependent on the existence of the anchor tenant in the building. Following this study, we use the share of the floor size that is occupied by the anchor tenant within a building to capture the within-building specialization level. Similarly, to model the incremental values, we consider a building as having vertical agglomeration advantages when the anchor tenant occupies more than 90% of the building. The within-building agglomeration dummy is created as follows:

$$BAnchor\_D_i = \begin{cases} 1, if \max\left(\frac{S_{i,h}^{TEN}}{S_i}\right) > 90\% \\ 0, otherwise \end{cases} \quad (3)$$

where $S_{i,l}^{TEN}$ is the rented area occupied by tenant h in building i; S_i is the total rentable area in building i. The threshold is set at 90%. Figure 3 presents the sample distribution by the largest tenant shares. More than half of the office buildings in our sample have an anchor tenant that occupies over 50% of the rentable areas. Approximately 30% of our office buildings are rented to a single tenant. The overall average share of space occupied by the largest tenant is 59% (Table 3).[6]

<< Put Figure 3 here >>

3.4 Proxy for Knowledge Spillover Channel

While $NDensity$ captures the general agglomeration of economic activities in a building's neighborhood, it does not capture whether the building's specialization is the same as the neighborhood specialization. According to the Marshall-Arrow-Romer (MAR) model, knowledge is predominantly industry-specific. As a result, knowledge spills over between firms within the same industry (Arrow, 1962; Marshall, 1890; Romer, 1986). For example, a building that is mostly

[6] We also use different thresholds to define the dummies of neighborhood and within-building agglomeration. The results are reported and discussed in Section 4.

occupied by IT tenants can enjoy only limited, if any at all, agglomeration benefits if it is located in a cluster of insurance companies. We argue that the agglomerative gains in office rents are driven by the knowledge spillovers. The spillover effect is most prominent when the building's anchor tenant is in the industry that neighborhood also specializes in. Therefore, to test the spillover channel, we need a measure to link the building and neighborhood industry specialization (*BNSpillover*). To realize this, we firstly identify the industry sectors of all the tenants in a building. Secondly, for each individual building, we measure the employment density of the largest tenant's industry in its 3-km ring; to avoid bias, we exclude the employment within the building, as presented in Equation (4):

$$BNSpillover_i = \frac{\sum_1^K W_{i,k} E_k^{SIC_{i,h}} - E_i^{SIC_{i,h}}}{Are\ of\ 3km\ Ring}, \tag{4}$$

where h is the largest tenant in building i; $E_k^{SIC_{i,h}}$ is the employment number of h's industry in zip code area k that is covered in the 3-km ring of building i; $W_{i,k}$ is the share of building i's 3-km ring covered by zip code k; $E_i^{SIC_{i,h}}$ is the employment number of h's industry in building i. Similarly, we rank the zip code level job density in h's industry across the nation and create a dummy $BNSpillover\_D$, which is equal to 1 if $BNSpillover$ is larger than the top 1% threshold; 0, otherwise, presented as follows:

$$BNSpillover\_D_i = \begin{cases} 1, & if\ BNSpillover_i > top\ 1\%\ threshod\ of\ zip\ code\ ranking \\ 0, & otherwise \end{cases} \tag{5}$$

<< Put Figure 4 here >>

Figure 4 presents an illustration of the measurements of within-building industry specialization and the proxy for spillovers. For Building X, we draw a 3-km circle around its location coordinates and map out the industry composition based on the zip code level employment data as presented in Figure 1. Assume the 3-km neighborhood surrounding Building X consists of four industries - Information, Finance and Insurance, Retail and Utilities - and Building X is occupied by four tenants with the largest tenant from Finance and Insurance industry. For Building X, the vertical agglomeration level ($BAnchor_X$) is calculated as the share of the floor size occupied by Tenant 2. And $BAnchor\_D_X$ equals 1 $BAnchor_X$ is larger than 90%. $BNSpillover_X$ is calculated as the number of employees in Finance and Insurance industry in the 3-km ring area, excluding the employment in Finance and Insurance industry inside Building X, divided by the area of a 3-km circle. In other words, for every given building, $BNSpillover_i$ captures the density of employment in the industry of the largest tenant sector in its neighborhood. If a building mainly occupied by IT firms is located in Silicon Valley, $BNSpillover_i$ will be relatively high, because IT workers are concentrated in Silicon Valley; consequently, the spillover effects will be stronger. $BNSpillover\_D_X$ equals 1 if $BNSpillover_X$ is larger than the top 1% threshold of the national zip code density ranking in the Finance and Insurance sector.

3.5 Building Transaction Information, Building Characteristics and REITs

The dependent variables are the price per square meter, net operating income per square meter, and capitalization rate at the time of transactions. Aside from the agglomeration measures, we also control for: 1) building characteristics including the property size, age, number of stories, quality rating of the property and green building certificate (LEED or Energy Star label; 2) location characteristics including the transportation quality in the neighborhood, whether it is a suburban area, whether it is located in a core real estate market and MSA fixed effects; 3) time and REIT fixed effects. Detailed definitions of all the variables are presented in Table 2. The summary statistics of all the variables are reported in Table 3. In our sample, the average transaction price is 3,120 USD/m2, the average NOI is 202 USD/m2, and the average yield is around 7%. The offices in our sample have an average size of 1,555 m2 with 9 floors, an average of 26 years and four Stars for quality rating. Around 36% of the buildings have the LEED and/or Energy Star Label. Regarding the location characteristics, about 49% of the buildings are located in suburban areas. Additionally, we also collect the performance of the building's owners – REITs. Following Drennan and Kelly (2011) who find that agglomeration effects on rents are stronger in core markets, we define the buildings as located in the core real estate markets if they locate in either Tier 1 or 2 markets as defined by Drennan and Kelly (2011). There are 108 office buildings in our sample that are located in the core markets.

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4. Agglomeration Effects on Office Values

4.1 Horizontal and Vertical Agglomeration

First, we separately estimate the impact of horizontal and vertical agglomeration on various components of property values at the time of transaction. Second, we estimate the channel by adding the proxy for the spillovers between the building and its neighborhood. Finally, we run a complete model including vertical and horizontal agglomeration variables as well as the spillover proxy. The specifications are as follows:

$$y_i = \alpha + \beta_N NDensity\_D_i + \gamma X_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \quad (6)$$

$$y_i = \alpha + \beta_B BAnchor\_D_i + \gamma X_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \quad (7)$$

$$y_i = \alpha + \beta_S BNSpillover\_D_i + \gamma X_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \quad (8)$$

$$y_i = \alpha + \beta_N NDensity\_D_i + \beta_B BAnchor\_D_i + \beta_S BNSpillover\_D_i + \gamma X_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \quad (9)$$

where y_i represents the log of price, log of net operating income, or cap rate of office building *i* at the time of transaction. $NDensity\_D_i$, $BAnchor\_D_i$ and $BNSpillover\_D_i$ measure the neighborhood and within-building agglomeration as well as the spillover effects in the year of transaction, as defined in Section 3. X_i represents a vector of building and location characteristics, as defined in Table 2. D_i^Y is the transaction year fixed effects, D_i^F is the REIT firm fixed effects and D_i^{MSA} is the MSA location fixed effects.

The regression results of horizontal and vertical agglomeration are reported in Table 4, where Models (1) and (2) report estimates on rents; (3) and (4) report estimates on prices; (5) and (6) report estimates on cap rates. We find positive effects of agglomeration, at both horizontal (**NDensity_D**) and vertical (**BAnchor_D**) levels, on office rents and prices, all of which are significant at 5% levels, suggesting that both the density of neighborhood economic activities and the anchor appearance within the building exert positive externalities in the rental incomes and prices. We do not find any significant results on cap rates.

Specifically, we find that buildings located in neighborhoods with a high employment density, i.e., larger than the top 1% threshold of the national ranking of zip code area density, on average generate 39% higher rental incomes and 44% higher prices than those buildings with no considerable neighborhood employment, indicating the existence of agglomeration economies at the neighborhood level. These results provide empirical support to Rosenthal and Strange (2004) and Arzaghi and Henderson (2008) who argue that rents could also be used as a measure of agglomeration economies other than wages and productivity, as well as adding to the empirical evidence in Drennan and Kelly (2011) who use aggregated rents. We also find that buildings with sizeable anchor tenants, i.e., occupying more than 90% of the rentable areas, on average generate 19% higher rental incomes and selling prices, in line with the recent studies by Liu et al. (2018a, 2018b, 2020) who argue that agglomeration economies also function vertically within buildings. Our results also add empirical support to Rosenthal and Strange (2020) who argue that the vertical agglomeration benefits are likely to be driven by the presence of anchor tenants.

The coefficients of other control variables in Table 4 are generally in line with expectations. Larger buildings and older buildings tend to have a lower transaction price and NOI. We find that taller buildings have slightly higher selling prices, in line with previous empirical findings (Fuerst & McAllister, 2011; Goodman & Smith, 2021; Nase et al., 2019). Consistent with Fuerst and McAllister (2011) and Holtermans and Kok (2019), we also find that green buildings achieve significantly higher selling prices and lower yields, indicating the existence of a green premium. As expected, we find that offices located in core real estate markets generate higher NOI, and are associated with lower risk premiums, hence are transacted at higher prices.

<<Put Table 4 here>>

4.2 Knowledge Spillovers

To test the knowledge spillover channel, we firstly add our proxy for spillovers (**BNSpillover_D**) to the specification alone and then run a full specification with the horizontal and vertical agglomeration measures, as presented in Equation (8) and (9). We hypothesize that the value of a building increases as a result of positive spillover externalities from industry concentration at the neighborhood level if the building's largest tenant is from that industry. The regression results are reported in Table 5, where Models (1) and (2) report estimates on rents; (3) and (4) report estimates on prices; (5) and (6) report estimates on cap rates.

The spillover proxy coefficients are positive and strongly significant in rent and price equations. We find that a building on average generates a 25% to 29% higher NOI, and a 31% to 35% higher transaction price, when it is located in a neighborhood with a high density of employment in its largest tenant's industry, i.e., larger than the top 1% threshold of the national ranking of zip code area density in this industry. More importantly, when we include the spillover proxy, horizontal and vertical agglomeration measures in the same specifications (Model (2) and (4)), the coefficients of the general agglomeration of neighborhood economic activities (**NDensity_D**) are no longer significant while the spillover proxy coefficients remain positive and strongly significant. This finding suggests that simply locating in a neighborhood with clustering of economic activities does not enhance office values; the value creation is conditional on the building catering for an anchor tenant in the industry that the neighborhood specializes in. In other words, the tenants benefit from locating in buildings that are close neighbors (with 3 kilometers in our model specifications) to a cluster of firms in the same industries; such benefits are then capitalized in the property rents and prices, supporting our knowledge spillover channel. Given that more that 75% of the tenants in our sample office buildings are from service or customer service industries, our results provide empirical evidence to the literature which argues that knowledge spillovers are likely to be the dominant agglomeration type in the service industries (Arzaghi & Henderson, 2008; Billings & Johnson, 2016; Drennan & Kelly, 2011; Rosenthal & Strange, 2020).

Albeit weak, we also find that the spillover benefits are also captured by the cap rates, consistent with previous studies which find lower risks associated with buildings located in areas with more concentrated economic activities (Jennen & Brounen, 2009; van der Vlist et al., 2021)

<< Put Table 5 here>>

4.3 Industry Specialization vs. Diversity

While our study adopts the density measure of agglomeration which captures the scale economies, there are two other common measures – specialization and diversity. Specialization measures the concentration of a given industry whereas diversity measures how diverse the industries are within a geographical area. We use these two measures as alternatives to our main agglomeration measures in order to test how sensitive the results are to different measures.

First, we use the standard measurement – the location quotient, to quantify the neighborhood specialization (**NSpec**), similar to the production structure specialization index used by Tao et al. (2019) and van der Panne (2004). For building *i*, the neighborhood specialization in the year of transaction is calculated as Equation (10):

$$NSpec_i = \frac{1}{\mathrm{L}} \sum_{l=1}^{L} \left\{ \left[(E_{l,i}^{3km} - E_i^{SIC_{i,l}}) / \sum_l E_{l,i}^{3km} \right] / \left[E_l^{nation} / E^{nation} \right] \right\}, \tag{10}$$

where i stands for office building i. l represents the industry sector that exists in the 3-km ring of building i; l= $1,\ldots L$. $E_{l,i}^{3km}$ is the employment in industry sector l in the 3-km ring. $E_i^{SIC_{i,l}}$ is the employment in industry sector l in building i. $\sum_l E_{l,i}^{3km}$ is the total employment in the 3-km ring surrounding building i. E_l^{nation} is the national employment in industry sector l and E^{nation} is the total national employment.

While **NSpec** measures the general specialization level in the neighborhood, we also need to link the building with its neighborhood by measuring the specialization level of the building's largest industry sector in its 3-km neighborhood. Therefore, we create the variable **BNSpec** as Equation (11):

$$BN\_Spec_{h,i}^{SCI_{h,i}} = \left[(E_{h,i}^{3km} - E_i^{SIC_{i,h}})/\sum_l E_{l,i}^{3km}\right]/\left[E_l^{nation}/E^{nation}\right], \tag{11}$$

where h is the largest industry sector within building i. $E_{h,i}^{3km}$ is the employment in industry sector h in the 3-km ring. $E_i^{SIC_{i,h}}$ is the employment in industry sector h in building i. Other variables remain the same.

We then use **NSpec** and **BNSpec** to replace **NDensity_D** and **BNSpillover_D** respectively. All the other specifications remain the same and the results are reported in Panel A of Table 6. While **NSpec** has returned no significant estimates, the coefficients of **BNSpec** are positive and strongly significant in the rent and price equations, suggesting that when a building mainly caters for an industry that is highly specialized in its neighborhood it generates a higher rental income and selling price. This result is consistent with our main findings and van der Panne (2004) who argue that knowledge spillovers mainly exist within the same industry. More importantly, it provides further empirical support to our proposed channel - it is the knowledge spillovers between tenants and other firms in the same industry in the neighborhood that consequently leads to higher rents and prices of office buildings.

In contrast to Marshall's localization and specialization externalities, Jacobs (1969) proposes diversification externalities and argues that the diversity of industries induces cross-fertilization of ideas among firms, leading to increased productivity in a city. To test that it is the Marshallian rather than the Jacobian model that drives the office values as we have predicted, we construct two measures for the neighborhood and within-building industry diversity (**NDiv** and **BDiv** respectively) based on the Hirschman–Herfindahl index (HHI) as follows:

$$NDiv = 1 - \sum_{l=1}^{L} \left(\frac{E_{i,l}^{3km} - E_i^{SIC_{i,l}}}{E_i^{3km}} \right)^2, \tag{12}$$

where $E_{i,l}^{3km}$ and $E_i^{SIC_{i,l}}$ are defined as in Equation 10. $E_{i,l}^{3km}$ is the number of employees in industry sector *l* in the 3-km ring surrounding building *i*. $E_i^{SIC_{i,l}}$ is the employment in industry sector *l* within building *i*. Therefore, $\sum_{l=1}^{L} \left(\frac{E_{i,l}^{3km} - E_i^{SIC_{i,l}}}{E_i^{3km}} \right)^2$ measures the concentration of industry sectors outside the building; $1 - \sum_{l=1}^{L} \left(\frac{E_{i,l}^{3km} - E_i^{SIC_{i,l}}}{E_i^{3km}} \right)^2$ measures the neighborhood industry diversity.

Building diversity is measured in a similar way:

$$BDiv = 1 - \sum_{l=1}^{L} \left(\frac{S_{i,l}^{TEN}}{S_i} \right)^2, \quad (13)$$

where $S_{i,l}^{TEN}$ is the rented area occupied by tenants in sector l within building i. S_i is the total occupied area of building i. Therefore, $\sum_{l=1}^{L} \left(\frac{S_{i,l}^{TEN}}{S_i} \right)^2$ measures the concentration of industry sectors inside the building; $1 - \sum_{l=1}^{L} \left(\frac{S_{i,l}^{TEN}}{S_i} \right)^2$ measures the within-building industry diversity.

We then use the **NDiv** and **BDiv** to replace **NDensity_D** and **BNSpillover_D** respectively. Naturally, when we use the diversity measures, the variable linking the building and neighborhood specialization is no longer valid. All the other specifications remain the same and the results are reported in Panel B of Table 6. We find no significant results on neighborhood industry diversity (**NDiv)**, suggesting that it is the Marshallian rather than the Jacobian model that holds, further strengthening our main findings and arguments. Meanwhile, **BDiv** coefficients are negative and significant on NOI and transaction prices, suggesting that a building generates lower rental income and price when it caters for a diversity of industries. This finding is consistent with the commercial real estate literature which generally regards a concentrated tenant base and the presence of anchor tenants as an advantage (Chacon, 2021; Chen et al., 2020; Liu & Liu, 2013; Liu et al., 2018a; Lu-Andrews, 2017; Nase et al., 2019; Zheng & Zhu, 2021).

<<Put Table 6 here>>

4.4 Alternative Threshold for Agglomeration

For the agglomeration benefits to be reflected in rents and prices, what is the minimum required concentration level of economic activities? In order to answer this question, we gradually relax the thresholds for the agglomeration dummies, and estimate the full specification as shown in Equation (9). First, we reduce the neighborhood agglomeration threshold to top 5% of the national ranking of the zip code level density and the within-building agglomeration threshold to 75% rentable area occupied by the largest tenant. The new agglomeration dummies are defined as follows while the other definitions remain the same:

$$NDensity\_D_i = \begin{cases} 1, & if\ NDensity_i > top\ 5\%\ threshod\ of\ zip\ code\ ranking \\ 0, & otherwise \end{cases} \tag{14}$$

$$BAnchor\_D_i = \begin{cases} 1, if\ \max\left(\frac{S_{i,h}^{TEN}}{S_i}\right) > 75\% \\ 0, \qquad\qquad otherwise \end{cases} \tag{15}$$

$$BNSpillover\_D_i = \begin{cases} 1, & if\ BNSpillover_i > top\ 5\%\ threshod\ of\ zip\ code\ ranking \\ 0, & otherwise \end{cases} \tag{16}$$

Second, we further reduce the thresholds for horizontal and vertical agglomeration dummies to 10% and 25% respectively. The results are reported in Table 7. In Panel A, while within-building agglomeration (**BAnchor_D**) remain positive on rents and prices, we see a sharp decrease in the significant levels of the coefficients. Also, the spillover proxy (**BNSpillover_D**) no longer impacts on rents. In Panel B, when the thresholds are further relaxed, all the agglomeration effects disappear, indicating that it requires a considerable agglomeration level for the positive externalities to be manifested in office values.

<< Put Table 7 here>>

4.5 Alternative Spatial Proximity

To test the decaying of agglomeration effects, we increase the size of the neighborhood to 5-km and 7-km ring areas. The definitions of all the variables remain the same. Results are reported in Table 8. While the coefficient of the spillover proxy remains significant on prices and cap rates, it is no longer significant in the rent equation. This result is consistent with the widely-acknowledged argument that knowledge spillovers only exist at narrow spatial levels and agglomeration economies decay with distance (Rosenthal & Strange, 2020). There are two possible explanations for not finding any decaying pattern on prices and cap rates: First, the agglomeration effects on office buildings are attributed to the tenants who are willing to pay higher rents in order to enjoy the positive externalities; therefore, it should be directly reflected on rents. When the spatial proximity increases, the withdrawal on rents is also immediate. Second, a bigger neighborhood contains more locational unobservables that are likely to affect the risk profile and the valuation of the property.

<< Put Table 8 here>>

4.6 Other Robustness Tests

Table 9 reports results on three other robustness tests. As the employment data is imputed, we also use the count of establishments to calculate the density of economic activities. The definitions of agglomeration dummies remains the same. While coefficients of **BNSpillover_D** on prices and cap rates remain similar to the main results in Table 5, it is no longer significant in the rent equation. As knowledge spillovers are largely dependent on human interactions (Marshall, 1890; Rosenthal & Strange, 2020), the information flow, exchange of ideas or networking should be better captured by employment counts (Arzaghi & Henderson, 2008). Therefore, this result is not unexpected. In Panel B, we add a control variable for the total assets of tenants as a proxy for the tenant quality. The estimates on **BNSpillover_D** remain similar to the main results in Table 5; however, **BAnchor_D** is no longer significant. This might be caused by the reduced sample size as we can only get asset information on listed tenants. In Panel C, instead of using GIS mapping, we simply use the zip code area as the neighborhood units, which is a common method in the literature (Liu et al., 2018b; Rosenthal & Strange, 2001). The results are reported in Panel C and remain largely unchanged.

<< Put Table 9 here>>

5 Market's Perception

As a final step, we investigate the market's perception towards the agglomeration economies at the individual building level. We use an event study to evaluate how the stock market reacts to a REIT's acquisitions and dispositions of office buildings with various degrees of horizontal and vertical agglomeration. We use abnormal returns as our risk-adjusted performance criterion. We first estimate the expected return for each REIT *i* using the EPRA REIT return as the market factor as follows:

$$r_{t,i} - r_{ft} = a_i + b_i EPRA_t + \varepsilon_{t,i}, \tag{17}$$

where $r_{t,i}$ is the daily return on day t for REIT i and r_{ft} is the corresponding risk-free rate as proxied by the yield on the one-month Treasury Bill. We also use the Fama-French model as an alternative and results are reported in the following robustness tests. The estimated coefficients are used to calculate the abnormal return ($AR_{t,d,i}$) as follows:

$$AR_{t,i} = r_{t,i} - r_{ft} - \hat{a}_i - \hat{b}_i EPRA_t. \tag{18}$$

The risk-adjusted abnormal return ($AR_{t,i}$) is estimated for each REIT *i* in each day *t* within the event window of days D_1 through to D_2, where D_1 and D_2 are the beginning and ending days of the event window. To estimate $\hat{a}_i$ and $\hat{b}_i$, 250 trading days prior to the beginning day of the event window are used. The risk-adjusted abnormal return is based on the out-of-sample prediction. We then use individual abnormal returns to calculate the cumulative abnormal returns at the security level. The cumulative abnormal return for each REIT *i* across time is calculated by adding up the individual daily abnormal returns over the event window (D_1 to D_2), as follows:

$$CAR_i(D_1, D_2) = \sum_{d=D1}^{D2} AR_{d,i}. \tag{19}$$

We next study the impact of horizontal and vertical agglomeration on cumulative abnormal returns separately as follows:

$$CAR_i(D_1, D_2) = \alpha + \theta NDensity\_D_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \tag{20}$$

$$CAR_i(D_1, D_2) = \alpha + \varphi BAnchor\_D_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \tag{21}$$

$$CAR_i(D_1, D_2) = \alpha + \vartheta BNSpillover\_D_i + D_i^Y + D_i^F + D_i^{MSA} + e_i, \quad (22)$$

where $CAR_i(D_1, D_2)$ is the cumulative abnormal return around the acquisition and disposition of the office building. $NDensity\_D_i$, $BAnchor\_D_i$ and $BNSpillover\_D_i$ are defined as before. Similarly, we control for time, firm, and MSA fixed effects.

Table 10 reports our results using the cumulative abnormal returns two days after the acquisition and disposition as the dependent variable. The coefficients of **NDensity_D** and **BNSpillover_D** are positive and significant on the cumulative abnormal returns around the acquisition, suggesting that, at the neighborhood level, both the general agglomeration of economic activities and the agglomeration in the industry that the building specializes in are valued by the market. The market rewards a REIT if it acquires buildings associated with neighborhood agglomeration benefits; but does not punish it for selling buildings with neighborhood agglomeration. This result implies that the market values the locational advantages and believes that with locational advantages, the office buildings can attract high-quality tenants. Meanwhile, we find that the market does punish a REIT for selling a building with a considerable anchor appearance. As REITs are expected to hold and manage properties, rather than speculatively trading properties, the market regards stable anchor tenants as a value-added advantage. In other words, getting rid of a building with a strong anchor tenant is viewed as a negative signal.

<< Put Table 10 here>>

We also run the model on abnormal returns over various event windows. Table 11 presents the results including 21 trading days (D1=-10, D2=10), 11 trading days (D1=-5, D2=+5), 5 trading days (D1=-2, D2=+2), 3 trading days (D1=-1, D2=+1), 1 trading day (D1=0, D2=+1), 3 trading days (D1=0, D2=+2), 6 trading days (D1=0, D2=+5), and 11 trading days (D1=0, D2=+10). In the event of acquisitions, the significant impact of neighborhood agglomeration lasts through Day 5 post acquisition. We find significantly negative results on the cumulative abnormal returns over 11 trading days (D1=0, D2=+10) around dispositions, which seems to suggest a slower market punishment. However, it should be noted that the longer the event window, the more confounding events there will be.

<< Put Table 11 here>>

Alternatively, we also calculate the risk-adjusted abnormal returns using the Fama-French model plus the REIT market factor, as follows:

$$r_{t,i} - r_{ft} = a_i + b_{1,i} r_t^M + b_{2,i} SMB_t + b_{3,i} HML_t + b_{4,i} WML_t + b_{5,i} EPRA_t + \varepsilon_{t,i}, \tag{23}$$

The data is obtained from Ken French's website. The factors comprise a market return index (r_t^M), the difference between the returns on diversified portfolios of small stocks and big stocks (SMB), the difference between the returns on diversified portfolios of high (value) and low (growth) book-to-market stocks (HML), and the 'winners minus losers' (WML). The results are reported in Table 12 and remain robust.

<< Put Table 12 here>>

6. Conclusion

Does diversification pay? From a real estate perspective, diversification means leasing a building to tenants who are in many different industries to reduce the risk of having too much exposure to a single industry. If an industry concentration exists in a given neighborhood where the most probable tenants belong to the same industry group such as information technology in Silicon Valley then this might exacerbate the leasing to a diversified set of tenants. However, is it necessarily "bad" for a building to have an undiversified tenant mix especially with respect to rents charged and valuation implications? Our study investigates the impact of within-building agglomeration and neighborhood agglomeration on office values.

We find that the clustering of economic activities within a building's neighborhood exerts a positive effect on its rents and prices. We further find weak evidence suggesting that such agglomeration benefits are also capitalized in the cap rates. However, we find no significant impact of general neighborhood agglomeration. Rather, the impact is only salient when the building's concentration of tenants in the same industry matches the agglomeration of the same industry in the neighborhood, consistent with the MAR model. This suggests that agglomeration gains arise from the knowledge spillovers tenants enjoy when they choose a location that caters to their sector; industry clientele effects appear to matter. Our findings provide additional insights to studies which argue that agglomeration economies attenuate and are stronger within close proximity and industries, and that the knowledge spillover effects are more prominent in service industries. This study also provides further empirical support that rents reflect the presence of agglomeration economies; rent is another effective agglomeration measure in addition to productivity, wages and employment metrics.

We find that when more than 90% of a building is occupied by an anchor tenant, it can generate on average 18.5% higher rental income and 18.6% higher selling price. This suggests that vertical industry composition does matter especially if there is an anchor tenant in the same industry that is present in that building (Liu et al., 2018a, 2018b, 2020; Rosenthal & Strange, 2020). As the anchor tenant takes up more space in the building, the more positive the impact is with respect to rent and the value of the building. While our study focuses on tenant sectors with respect to *individual* buildings, it also contributes to the recent empirical findings that a concentrated tenant base (a few tenants that account for most of the revenues in a real estate portfolio) generates higher rental income (Chacon, 2021; Zheng & Zhu, 2021).

Our use of REIT transaction data also allows us to study how the stock market reacts to the acquisition and disposition of a building that is subjected to varying degrees of horizontal and vertical agglomeration. Overall, the stock market views neighborhood agglomeration as an advantage. Consequently, the price reaction is positive to the purchase of buildings with strong spillover benefits. This is also consistent with the choice of firm location studies in finance literature, which suggests that there are positive knowledge spillover externalities associated with a firm's location choice.

Figure 1 Marginal Effects of Vertical and Horizontal Agglomeration on Office Rents and Prices

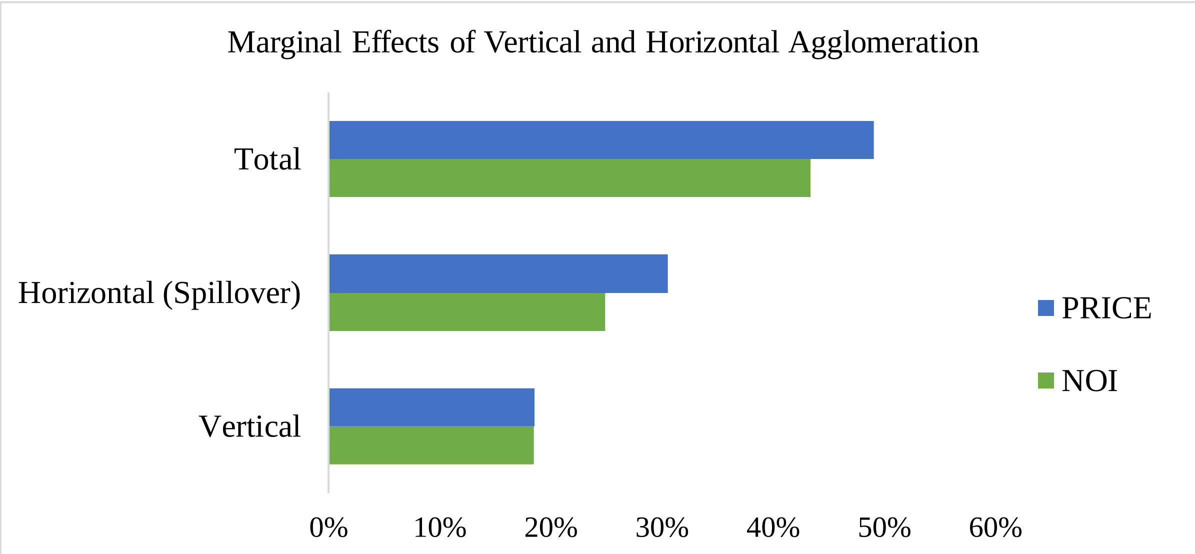


Figure 2 GIS Mapping of Neighborhoods

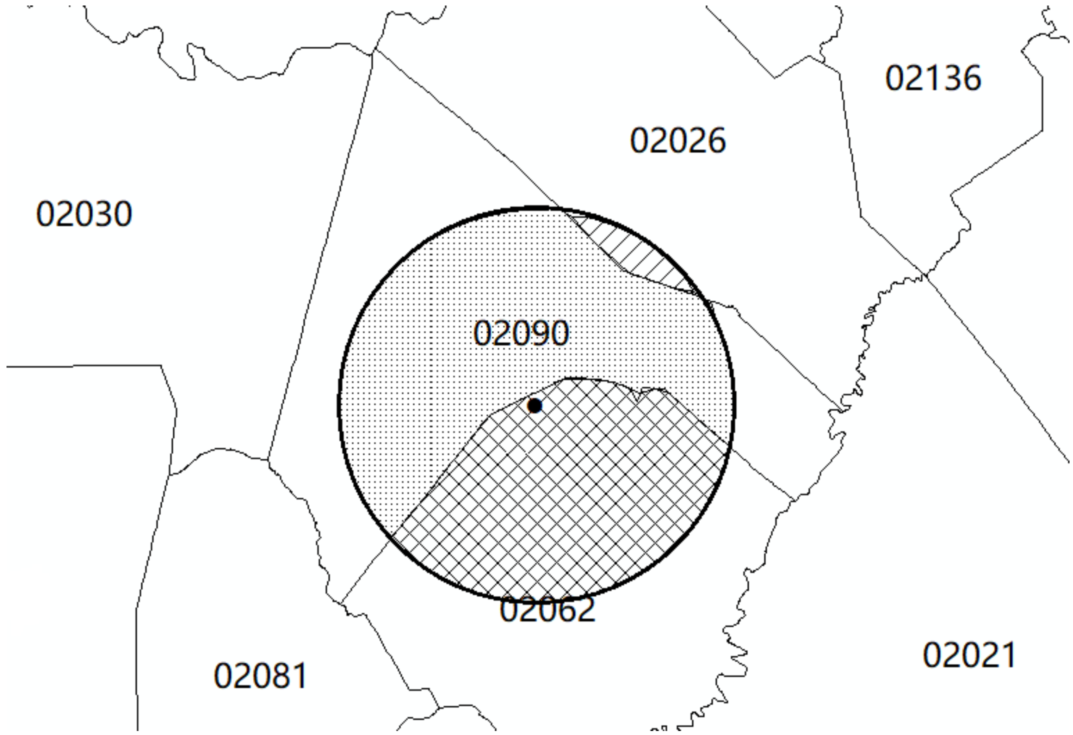


Figure 3 Distribution of Shares of Largest Tenants within Buildings

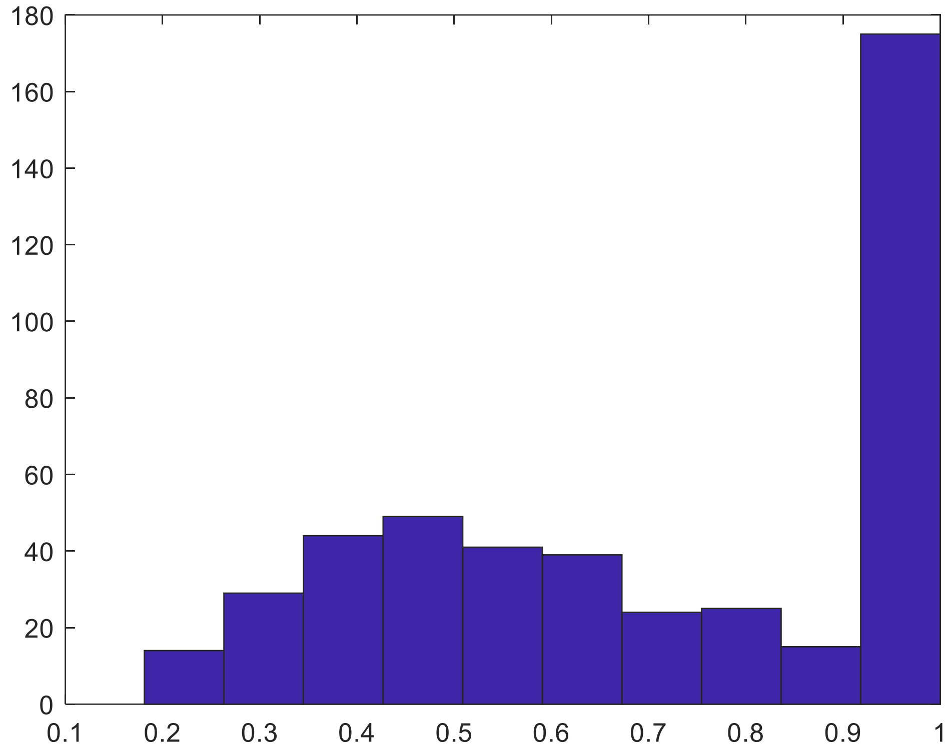
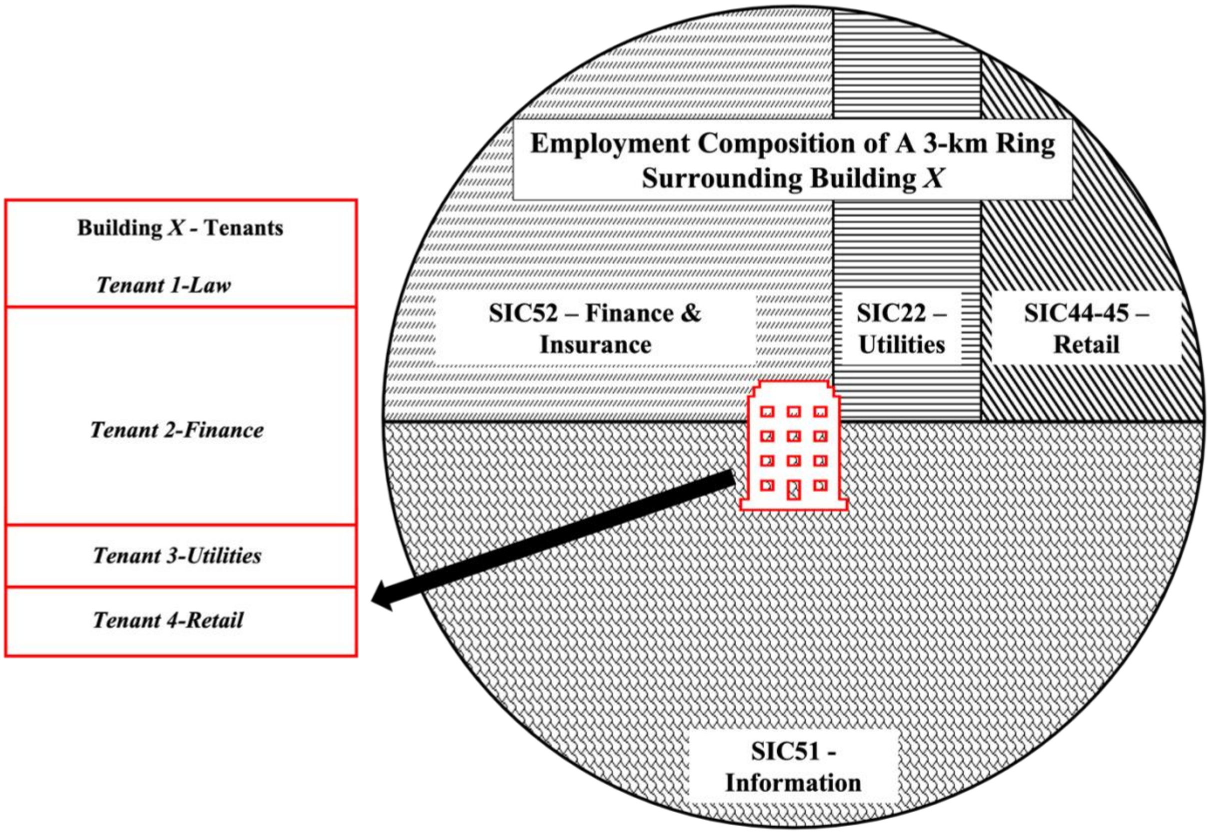


Figure 4 Illustration of Spillover Proxy



$$BAnchor_X = \frac{Floor\ Size\ Occupied\ by\ Tenant\ 2}{Total\ Rentable\ Floor\ Area\ in\ Building\ A}\ (\%)$$

$$BAnchor\_D_X = 1, if\ BAnchor_X > 90\%$$

$$BNSpillover_X = \frac{Employment\ of\ SIC52\ in\ the\ Ring - Employment\ of\ Tenant\ 2}{Area\ of\ The\ 3{-}km\ Ring}$$

$$BNSpillover\_D_X = 1, if\ BNSpillover_X > \text{Top 1\% Threshold}$$

Table 1 Distribution of Tenant Industry Sector

Sector	Description	Occupied Area (1,000 m^2)	Share
11	Agriculture, Forestry, Fishing and Hunting	84	0.08%
21	Mining, Quarrying, and Oil and Gas Extraction	677	0.62%
22	Utilities	2339	2.15%
23	Construction	1317	1.21%
31-33	Manufacturing	11728	10.79%
41/42	Wholesale Trade	2280	2.10%
44-45	Retail Trade	2678	2.46%
48-49	Transportation and Warehousing	685	0.63%
51	Information	8936	8.22%
52	Finance and Insurance	25791	23.73%
53	Real Estate and Rental and Leasing	3639	3.35%
54	Professional, Scientific, and Technical Services	28281	26.02%
55	Management of Companies and Enterprises	150	0.14%
56	Administrative and Support and Waste Management and Remediation Services	2733	2.51%
61	Educational Services	1409	1.30%
62	Health Care and Social Assistance	4594	4.23%
71	Arts, Entertainment, and Recreation	522	0.48%
72	Accommodation and Food Services	2010	1.85%
81	Other Services	2741	2.52%
91/92	Public Administration	6034	5.55%
99	No classifiable Establishments	68	0.06%
Sum		108,694	

Table 2 Variable Definition

Variable	Definition
Dependent Variables	
PRICE	Property purchase price per square meter at the time of transaction
NOI	Net operating income per square meter at the time of transaction
CAP	Property capitalization rate at the time of transaction
Agglomeration Measures	
NDensity_D	Dummy that equals 1 if the employment density in a building's neighborhood is bigger than the top 1% threshold of the national ranking of zip code level density
BAnchor_D	Dummy that equals 1 if a building's largest tenant occupies over 90% of its rentable area
BNSpillover_D	Dummy that equals 1 if the neihhbourhood employment density in the building's largest tenant industry (exludcing the employment in this industry within the building) is bigger than the top 1% threshold of the national ranking of zip code level density in this industry
Building Characteristics	
SIZE	Property size in m2
AGE	Property age in years
STORE	Log of number of stories in a building
QUALITY	Quality rating of the property
ECO	Dummy that equals 1 if the building has LEED or Energy Star label
Location Characteristics	
TRANS	Transportation quality in the building area, measured as the sum of dummy variables for bus line, car charging, commuter rail and metro/subway
SURBURBAN	Dummy that equals 1 if the property is located in suburban areas
Core Markets	Dummy that equals 1 if the property is located in Tier 1 or 2 markets as classified by Drennan and Kelly (2011): Tier 1markets are defined as primary, strong core markets which are above 70 million square feet, and the ratio of CBD space to total, 33.8%. Seven MSAs comprise this subset. Tier 2 markets are primary, weak core markets which are above the mean in market size, but below the mean of CBD space as a percent of total inventory. There are six MSAs in this subset.

Table 3 Summary Statistics

	Mean	Std	Max	Min
Horizontal Agglomeration (NDensity)				
Job Density > 99% zip code area	16.0%	36.7%	1	0
Job Density > 95% zip code area	56.6%	49.6%	1	0
Job Density > 90% zip code area	78.7%	41.0%	1	0
Vertical Agglomeration (BAnchor)			1	0
Share of Anchor Tenant> 90%	34.7%	47.6%	1	0
Share of Anchor Tenant> 50%	53.5%	49.9%	1	0
Share of Anchor Tenant> 25%	73.7%	44.1%	1	0
Spillover (BNSpillover)			1	0
Same Sector Job Density > 99% zip code area	20.0%	40.0%	1	0
Same Sector Job Density > 95% zip code area	56.6%	49.6%	1	0
Same Sector Job Density > 90% zip code area	71.3%	45.3%	1	0
Building Transaction Information				
PRICE (USD/m2)	3,120	3,003	27,252	13
NOI (USD/m2)	202	166	1,561	1
Caprate	7.01%	1.70%	16.40%	2.38%
Building Characteristics				
SIZE (m2)	1,555	1032	6723	2
AGE	26	18	114	0
STORE	9	12	83	1
QUALITY	4	1	5	2
ECO	0.355	0.473	1	0
TRANS	0.470	0.765	3	0
SURBURBAN	0.488	0.500	1	0
Core Market	23.68%	42.56%	1	0
Owners' Information				
Daily return	-0.02%	8.46%	907.68%	-909.38%

Table 4 Agglomeration Effects on Rents, Prices and Cap Rates

Dependent Variable	NOI	NOI	PRICE	PRICE	CAP	CAP
	(1)	(2)	(3)	(4)	(5)	(6)
NDensity_D (99%)	0.3948**		0.4381**		-0.1623	
	(0.1899)		(0.1898)		(0.4625)	
BAnchor_D (90%)		0.1860**		0.1895**		-0.0611
		(0.0736)		(0.0735)		(0.1824)
SIZE	-0.1834***	-0.1896***	-0.1949***	-0.2019***	0.0514	0.0574
	(0.0509)	(0.0493)	(0.0509)	(0.0492)	(0.1240)	(0.1221)
AGE	-0.1282***	-0.1205**	-0.1275***	-0.1185**	0.0400	0.0262
	(0.0490)	(0.0480)	(0.0490)	(0.0479)	(0.1194)	(0.1189)
STORY	0.0577	0.0828	0.0850	0.1141*	-0.1644	-0.1874
	(0.0606)	(0.0600)	(0.0606)	(0.0599)	(0.1477)	(0.1487)
QUALITY	0.0267	0.0319	0.0575	0.0635	-0.1741	-0.1858
	(0.0689)	(0.0666)	(0.0689)	(0.0666)	(0.1679)	(0.1652)
ECO	0.0955	0.0741	0.1486**	0.1280*	-0.4461**	-0.4451**
	(0.0725)	(0.0706)	(0.0725)	(0.0705)	(0.1766)	(0.1749)
TRANS	0.0088	0.0368	0.0336	0.0646	-0.1797	-0.1963
	(0.0521)	(0.0501)	(0.0521)	(0.0500)	(0.1270)	(0.1241)
SUBURBAN	-0.1473*	-0.1446*	-0.1538*	-0.1497*	0.0751	0.0680
	(0.0860)	(0.0836)	(0.0859)	(0.0835)	(0.2095)	(0.2072)
Core Markets	0.0851	0.3514***	0.2244	0.5028***	-0.8383**	-0.8459***
	(0.1673)	(0.1120)	(0.1672)	(0.1119)	(0.4076)	(0.2776)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs	456	465	456	465	456	465
R2	0.4734	0.5082	0.5424	0.5720	0.4529	0.4536

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of price (PRICE), log of NOI (NOI) or cap rate (CAP). NDensity_D is the neighborhood agglomeration dummy equal to 1 if the employment density in a building's neighborhood is bigger than the top 1% threshold of the national ranking of zip code level density. BAnchor_D is the within-building agglomeration which equals 1 if a building's largest tenant occupies over 90% of its rentable area. Other control variables are as defined in Table 2. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 5 Knowledge Spillover Channel

Dependent Variable	NOI	NOI	PRICE	PRICE	CAP	CAP
	(1)	(2)	(3)	(4)	(5)	(6)
NDensity_D (99%)		0.3088		0.1167		-0.0204
		(0.1904)		(0.2922)		(0.4695)
BAnchor_D (90%)		0.1847**		0.1855**		-0.0484
		(0.0744)		(0.0741)		(0.1834)
BNSpillover_D (99%)	0.2896***	0.2490**	0.3475***	0.3055***	-0.4515*	-0.4470*
	(0.1079)	(0.1087)	(0.1075)	(0.1082)	(0.2629)	(0.2681)
SIZE	-0.1771***	-0.1817***	-0.1871***	-0.1936***	0.0382	0.0397
	(0.0508)	(0.0504)	(0.0506)	(0.0502)	(0.1237)	(0.1242)
AGE	-0.1460***	-0.1299***	-0.1489***	-0.1300***	0.0680	0.0641
	(0.0493)	(0.0492)	(0.0491)	(0.0490)	(0.1201)	(0.1212)
STORY	0.0476	0.0691	0.0722	0.1008*	-0.1393	-0.1458
	(0.0606)	(0.0610)	(0.0604)	(0.0612)	(0.1477)	(0.1505)
QUALITY	0.0095	0.0232	0.0373	0.0476	-0.1538	-0.1563
	(0.0687)	(0.0683)	(0.0685)	(0.0681)	(0.1674)	(0.1683)
ECO	0.1001	0.0885	0.1539**	0.1364*	-0.4500**	-0.4474**
	(0.0722)	(0.0716)	(0.0719)	(0.0715)	(0.1759)	(0.1766)
TRANS	0.0195	0.0159	0.0448	0.0379	-0.1744	-0.1763
	(0.0512)	(0.0517)	(0.0510)	(0.0515)	(0.1248)	(0.1274)
SUBURBAN	-0.1339	-0.1274	-0.1375	-0.1302	0.0517	0.0500
	(0.0858)	(0.0851)	(0.0855)	(0.0847)	(0.2091)	(0.2098)
Core Markets	0.1801	-0.0052	0.3158**	0.3576	-0.6980**	-0.6846*
	(0.1291)	(0.1692)	(0.1287)	(0.2987)	(0.3146)	(0.4172)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
MSA FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
No. of obs	456	456	456	456	456	456
R2	0.4776	0.4902	0.5487	0.5616	0.4571	0.4572

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of price (PRICE), log of NOI (NOI) or cap rate (CAP). NDensity_D is the neighborhood agglomeration dummy equal to 1 if the employment density in a building's neighborhood is bigger than the top 1% threshold of the national ranking of zip code level density. BAnchor_D is the within-building agglomeration dummy which equals 1 if a building's largest tenant occupies over 90% of its rentable area. BNSpillover_D is the spillover dummy which Other control variables are as defined in Table 2. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 6 Specialization vs. Diversity

Dependent Variable	**NOI**	**PRICE**	**CAP**
	(1)	(2)	(3)
Panel A: Industry Specialization			
NSpec	0.0129	0.0169	-0.0355
	(0.0132)	(0.0150)	(0.0463)
BAnchor	0.1868	0.1732	0.1176
	(0.1144)	(0.1218)	(0.2080)
BNSpec	0.0592**	0.0664***	-0.0511
	0.0129	(0.0255)	(0.0625)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4797	0.5479	0.4670
Panel B: Industry Diversity			
NDiv	-0.6038	-0.1608	-4.6281
	(1.1792)	(1.1094)	(3.2238)
BDiv	-0.2810**	-0.2566*	-0.0918
	(0.1309)	(0.1345)	(0.2737)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	455	455	455
R2	0.4749	0.5407	0.4552

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of NOI (NOI), log of price (PRICE), or cap rate (CAP). NSpec is the neighborhood industry specialization. BAnchor is the share of the largest tanant within a building. BNSpec is the specialization level of the building's largest industry sector in its neighborhood. NDiv is the neighborhood industry diversity. BDiv is the tenant industry diversity within a building. Other control variables are as defined in Table 2. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 7 Relaxed Threshold for Agglomeration Measures

Dependent Variable	NOI	PRICE	CAP
	(1)	(2)	(3)
Panel A: Job Density > Top 5% , Achor Tenant > 75%			
NDensity_D (95%)	0.1338	0.1536	-0.2074
	(0.1030)	(0.1024)	(0.2525)
BAnchor_D (75%)	0.1244*	0.1236*	-0.0348
	(0.0756)	(0.0752)	(0.1855)
BNSpillover_D (95%)	0.1049	0.1333*	-0.2081
	(0.0778)	(0.0774)	(0.1908)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
R2	456	456	456
No. of obs	0.4853	0.5569	0.4581
Panel B: Job Density > Top 10% , Achor Tenant > 25%			
NDensity_D (90%)	0.1511	0.1087	0.1793
	(0.1023)	(0.1024)	(0.2495)
BAnchor_D (25%)	0.0645	0.0491	0.1671
	(0.0764)	(0.0764)	(0.1863)
BNSpillover_D (90%)	-0.0176	0.0062	-0.1612
	(0.0815)	(0.0815)	(0.1987)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4775	0.5451	0.4560

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of NOI (NOI), log of price (PRICE), or cap rate (CAP). In Panel A (B), NDensity_D is the neighborhood agglomeration dummy equal to 1 if the employment density in a building's neighborhood is bigger than the top 5% (10%) threshold of the national ranking of zip code level density. BAnchor_D is the within-building agglomeration dummy which equals 1 if a building's largest tenant occupies over 75% (25%) of its rentable area. BNSpillover_D is the spillover dummy which equals 1 if the neighborhood employment density in the building's largest tenant industry (excluding the employment in this industry within the building) is bigger than the top 5% (10%) threshold of the national ranking of zip code level density in this industry. Other control variables are as defined in Table 2. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 8 Different Spatial Proximity

Dependent Variable	NOI	PRICE	CAP
	(1)	(2)	(3)
Panel A: 5km Ring Area			
NDensity_D	0.1575	0.1265	0.2463
	(0.1039)	(0.1058)	(0.2503)
BAnchor_D	0.1813***	0.1808***	-0.0383
	(0.0571)	(0.0615)	(0.1669)
BNSpillover_D	0.1266	0.3160**	-1.2177**
	(0.1154)	(0.1296)	(0.5092)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4822	0.5551	0.4729
Panel B: 7km Ring Area			
NDensity_D	-0.0236	0.0327	-0.4061
	(0.2803)	(0.2808)	(0.6709)
BAnchor_D	0.1857**	0.1805**	-0.0000
	(0.0755)	(0.0747)	(0.1806)
BNSpillover_D	0.2086	0.3348**	-1.3002***
	(0.1592)	(0.1654)	(0.3811)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4890	0.5613	0.4798

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of NOI (NOI), log of price (PRICE), or cap rate (CAP). The neighborhood is defined as 5-km ring area in Panel A and 7-km ring area in Panel B. NDensity_D is the neighborhood agglomeration dummy equal to 1 if the employment density in a building's neighborhood is bigger than the top 1% threshold of the national ranking of zip code level density. BAnchor_D is the within-building agglomeration dummy which equals 1 if a building's largest tenant occupies over 90% of its rentable area. BNSpillover_D is the spillover dummy which equals 1 if the neighborhood employment density in the building's largest tenant industry (excluding the employment in this industry within the building) is bigger than the top 1% threshold of the national ranking of zip code level density in this industry. Other control variables are as defined in Table 2. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 9 Robustness Tests

Dependent Variable	NOI	PRICE	CAP
	(1)	(2)	(3)
Panel A: Establishments			
NDensity_D (99%)	0.0914	0.0723	0.3262
	(0.1885)	(0.1874)	(0.4563)
BAnchor_D (90%)	0.1815**	0.1763**	-0.0002
	(0.0754)	(0.0750)	(0.1826)
BNSpillover_D (99%)	0.1741	0.3146**	-1.0186***
	(0.1390)	(0.1382)	(0.3366)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4808	0.5534	0.4670
Panel B: Control for Tenant Quality			
NDensity_D (99%)	0.1405	0.3030	-0.9415
	(0.2479)	(0.2423)	(0.6097)
BAnchor_D (90%)	0.0549	0.0784	-0.1679
	(0.1183)	(0.1156)	(0.2910)
BNSpillover_D (99%)	0.3734**	0.3435**	0.1317
	(0.1443)	(0.1410)	(0.3547)
Tenant Total Assets	-0.0142	-0.0168	0.0361
	(0.0174)	(0.0170)	(0.0427)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	219	219	219
R2	0.6323	0.7014	0.5959
Panel C: Zip Code Area			
NDensity_D (99%)	0.1005	0.0485	0.3253
	(0.0891)	(0.0892)	(0.2207)
BAnchor_D (90%)	0.1765**	0.1801**	-0.0576
	(0.0745)	(0.0745)	(0.1845)
BNSpillover_D (99%)	0.2359**	0.2710***	-0.2527
	(0.0974)	(0.0975)	(0.2414)
Control Variables	Yes	Yes	Yes
Fix Effects	Y,M,F	Y,M,F	Y,M,F
No. of obs	456	456	456
R2	0.4952	0.5599	0.4572

Note: This table reports the results of cross-sectional regressions. The dependent variable is log of NOI (NOI), log of price (PRICE), or cap rate (CAP). In Panel A, NDensity_D and BNSpillover_D are defined by the same method based on count of establishment instead of employment. In Panel B, we add a control variable of tenant total assets. In Panel C, we use the zip code area as the neighborhood. All the other control variables remain the same as in Table 5. Transaction year, REIT firm and MSA fixed effects are included. Standard errors are reported in parenthesis. ***, ** and * denote significance at the 1%, 5% and 10% level, respectively.

Table 10 Event Study - Abnormal Return of REITs

	Acquisition CAR(0,+2)	Acquisition CAR(0,+2)	Acquisition CAR(0,+2)	Disposition CAR(0,+2)	Disposition CAR(0,+2)	Disposition CAR(0,+2)
	(1)	(2)		(3)	(4)	
NDensity_D	0.0250**					
	(0.0123)					
BAnchor_D		0.0044				
		(0.0062)				
BNSpillover_D			0.0241**			
			(0.0096)			
NDensity_D				-0.0052		
				(0.0087)		
BAnchor_D					-0.0146**	
					(0.0061)	
BNSpillover_D						-0.0079
						(0.0118)
FE	Y,M,F	Y,M,F	Y,M,F	Y,M,F	Y,M,F	Y,M,F
No. of obs	78	80	78	187	194	187
R2	0.3600	0.3266	0.3594	0.3557	0.3176	0.3584

Note: This table reports the regression results on the cumulative abnormal returns over a 2-day event windows (D1=0, D2=+2). The agglomeration variables are defined as in Table 2.

Table 11 Various Event Windows

	Acquisition			Disposition		
	NDensity_D	BAnchor_D	BNSpillover_D	NDensity_D	BAnchor_D	BNSpillover_D
-10;+10	0.0013	0.0027	0.0192	0.0074	0.0018	0.0010
	(0.0329)	(0.0116)	(0.0123)	(0.0136)	(0.0122)	(0.0220)
-5;+5	0.0289***	-0.0014	0.0073	0.0039	-0.0005	0.0060
	(0.0110)	(0.0068)	(0.0121)	(0.0099)	(0.0092)	(0.0134)
-2;+2	0.0162***	0.0039	-0.0017	0.0070	-0.0170**	0.0030
	(0.0051)	(0.0063)	(0.0073)	(0.0102)	(0.0084)	(0.0073)
-1;+1	0.0129	-0.0025	0.0058	0.0040	-0.0050	-0.0105
	(0.0158)	(0.0047)	(0.0048)	(0.0084)	(0.0079)	(0.0067)
0;+1	0.0173**	-0.0013	0.0055	-0.0022	-0.0093	-0.0113
	(0.0078)	(0.0044)	(0.0056)	(0.0058)	(0.0062)	(0.0081)
0; +2	0.0250*	0.0044	0.0241**	-0.0052	-0.0146**	-0.0079
	(0.0128)	(0.0064)	(0.0106)	(0.0085)	(0.0067)	(0.0109)
0; +5	0.0327**	-0.0027	0.0299***	-0.0084	-0.0093	-0.0153
	(0.0138)	(0.0062)	(0.0109)	(0.0106)	(0.0071)	(0.0110)
0; +10	0.0097	-0.0046	0.0112	-0.0224*	-0.0131	-0.0292**
	(0.0268)	(0.0102)	(0.0115)	(0.0122)	(0.0094)	(0.0137)

Note: This table reports abnormal returns over various event windows, including 21 trading day (D1=-10, D2=10), 11 trading days (D1=-5, D2=+5), 5 trading days (D1=-2, D2=+2), 3 trading days (D1=-1, D2=+1), 1 trading day (D1=0, D2=+1), 3 trading days (D1=0, D2=+2), 6 trading days (D1=0, D2=+5), and 11 trading days (D1=0, D2=+10). The agglomeration variables are defined as in Table 2.

Table 12 Fama-French Model + REIT Market Return

	Acquisition			Disposition		
	NDensity_D	**BAnchor_D**	**BNSpillover_D**	**NDensity_D**	**BAnchor_D**	**BNSpillover_D**
-1;+1	-0.0012	-0.0044	0.0131*	0.0022	-0.0051	-0.0098
	(0.0185)	(0.0054)	(0.0077)	(0.0080)	(0.0066)	(0.0095)
0;+1	0.0121**	-0.0062	0.0020	-0.0078	-0.0095	-0.0158
	(0.0060)	(0.0051)	(0.0070)	(0.0061)	(0.0063)	(0.0106)
0; +2	0.0173**	-0.0053	0.0171**	-0.0155	-0.0143*	-0.0170
	(0.0073)	(0.0072)	(0.0087)	(0.0109)	(0.0087)	(0.0169)

Note: This table reports the regression results on the cumulative abnormal returns over a 2-day event windows (D1=0, D2=+2) using various models. The agglomeration variables are defined as in Table 2.

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