

**Evolution of Malls in the United States from 2010 to 2020: Evidence of  
Survival and Transaction**

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## **ABSTRACT**

Dramatic changes have taken place in the retail industry, and brick-and-mortar retail is facing severe challenges. This study empirically investigates the evolution of enclosed malls in the US from 2010 to 2020 by utilizing data from CoStar covering 1,556 enclosed malls, 130 thousand tenants, and 2,686 transactions. The overall market structure of enclosed malls is examined using the Herfindahl-Hirschman Index (HHI), and the result reveals the increasing level of concentration. The performance of enclosed malls is proxied by their survival, transaction, and valuation. The logit model and the hedonic pricing model are deployed to understand the implications of mall characteristics, tenant characteristics, market competition, and demography. The empirical result highlights the importance of mall size, age, renovation status, high-end anchor tenants, and experiential retailers to mall survival and valuation premium. The high level of market competition, household density, and household income imply a strong challenge to survival while boosting the valuation. This study analyzes the implications for retail investment and asset management concerning product design, tenant mix, and location strategy.

## **BIOGRAPHICAL SKETCH**

Danmei (Angela) Lin was born in Fujian, China. She obtained Bachelor of Science in Hotel Management from School of Hotel and Tourism Management, The Hong Kong Polytechnic University. She graduated with Second Upper Class Honours and was the recipient of Best Undergraduate Honours Thesis in 2018. From 2014 to 2018, she had chances to work with prestigious hospitality management companies including InterContinental Hotels Group (IHG), Four Seasons Hotels & Resorts and Swire Hotels. She was inspired to pursue further study in School of Hotel Administration, Cornell University, when she worked as a Research Analyst in Horwath HTL Shanghai Office, a leading hospitality consultancy run by Cornellians. During her years at Cornell, she extended her field into real estate, finance and data analysis.

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# 1 Introduction

Immense restructuring has taken place in the US retail sector, with the proliferation of e-commerce as one of the main drivers of this change. Abandonment, demolition, bankruptcy as well as mergers and acquisitions are not rare for physical retail spaces since a great number of them underperform. Although malls are the largest and most standardized form of brick-and-mortar retail outlets, with a wide variety of merchandise and services, they still face severe challenges.

Enclosed malls began as a form of retail establishment before World War II and became popular in the 1960s and 1970s (Roelfs, 2011). According to the International Council of Shopping Centers (ISCS, 2021), malls, as a subcategory of shopping centers, are a large agglomeration of retail brands with inward-facing stores connected by a common walkway. Based on their size and trade area, they are further divided into regional and super-regional malls. Regional malls normally have 40 to 80 stores, and their floor area ranges from 400,000 to 800,000 square feet. Super-regional malls are even larger, sometimes with a trade area beyond the border of a state. In addition to enclosed malls, power centers, lifestyle centers, community centers, neighborhood centers, and strip centers are also considered shopping centers with smaller gross leasable and trade areas. Some of them tend to be open-air or have a more flexible structure.

Enclosed malls have been facing various challenges, not only from intra-mall competition triggered by overbuilding but also from open-air centers featuring amenities and more ambiance. Moreover, concerns have been raised since 2000 that the prevalence of e-commerce reduces the need for brick-and-mortar retail spaces (Baen, 2000; Winograd, 2000). In 2000, e-commerce

accounted for less than one percent of total retail spending in the US. The figure reached 4.4 percent in 2010 and 14 percent in 2020 (U.S. Census Bureau, 2021). Retail company bankruptcies and store closings have become increasingly noticeable and have left enclosed malls with great operational and financial pressure (Tokosh, 2019).

In the past decade, facing intrinsic obsolescence and the brick-and-mortar retail apocalypse, the necessity and attractiveness of malls have been doubted (Tokosh, 2019). Dead malls have been widely noticed, and their presence has given rise to a series of dilemmas for city and regional development. Enclosed malls may have to downsize or convert their spaces for other uses (e.g., warehouses, distribution centers, medical offices, and residences) (Zhou & Clapp, 2015). The change of valuation in the capital market also reveals investor attitudes toward retail and logistic properties. According to Real Capital Analytics (2021a; 2021b), in 2010, the annual cap rate of industrial warehouses, 8.4 percent, was 10 basis points (bps) higher than the cap rate for shopping centers (8.3 percent). However, in 2019, industrial warehouses had become a more attractive asset class with a cap rate of 6.1 percent, decreasing 230 bps. Shopping centers remain at 7.2 percent, which may indicate that the market value for a retail property is lower compared to a logistics property with the same operating income.

Many studies have attempted to understand the success and failure of retail real estate. Most of them use cross-sectional data and try to understand how a single aspect, such as size, age, tenant mix, competition, and demography, is related to the performance of retail establishments. The results are not consistent and may vary across secondary types of retail real estate or geographic regions. The literature that attempts to understand mall performance multidimensionally and examines the evolution of retail establishments considering events (closure, expansion, transaction) and value spontaneously is limited.

The objective of this research is to address this research gap by analyzing the evolution of enclosed malls in the US for the past decade and exploring what drives their vicissitudes. Key questions include: 1) how the market structure of enclosed malls has changed in the past decade; 2) what kind of attributes are associated with crucial events happening to enclosed malls, namely closure, expansion, contraction and transaction; 3) what kind of attributes are associated with the premium in the transaction and assessment of enclosed malls. At a time when the brick-and-mortar retail sector in the US is facing unprecedented challenges and the need to restructure, the present study hopes to provide insights for understanding the dynamics of demand, supply, and market trends.

The remainder of this study is organized as follows: in the literature review chapter, definitions of key terms and relevant studies will be elaborated to further explain the motivation of this study. The data and empirical methods section will include an explanation and a summary of data statistics as well as research models. In the discussions chapter, findings will be presented with discussions on the theoretical and managerial implications. Lastly, conclusions will be drawn before the implications, limitations and future research directions are discussed in the final chapter.

## **2 Literature review**

The following session starts with the overview of market structure, which helps to sketch the understanding of enclosed mall evolution from 2010 to 2020. Since financial data (e.g., rent, revenue, net operating income) are not available, market, events and values are considered as three crucial perspectives to illustrate the evolution of enclosed malls. Besides market structure, three other aspects are considered as determining factors of above-mentioned issues, namely

mall characteristics, tenant characteristics and demography. To sum up the findings in literature, this section is ended with the conceptual framework of the study illustrating the research gap.

## **2.1 Market Structure**

Two overarching questions concerning the enclosed malls under the context of market structure are who enclosed malls are competing with and what the implications of competition are.

Researchers believe that the competitors go far beyond nearby enclosed malls but retail establishments of all kinds. The construction wave of malls can be driven by the increase of income and finally led to the high saturation of competition (Roelfs, 2011). However, the study from Des Rosiers et al. (2009) indicates that the negative impact this competition, which commonly brings down the profit level, can be relieved by the income rise. According to Howard and Davies (1993), increased level of competition is not the underlying cause for mall failure but rather the triggering mechanism, due to the existent of lenders, local government, famous retail brands and other stakeholders as the gatekeeper.

Intra-mall competition merely composites a small part of the pressure that malls have to face. Roelfs (2011) proxies the level of competition using the number of retail establishments and retail sales per capita (considered as a lagging indicator of retail development) in the county. He concludes that the growth rate of retail supply is positively related to the hazard rate of malls. Researchers have been trying to the competition from e-commerce since the beginning of the 21st century (Baen, 2000; Winograd, 2000). Multiple studies have noticed that low price merchandise is the most vulnerable category under the pressure of e-commerce (Dixon & Marston, 2002; Hendershott & Hendershott, 2000; Worzala et al., 2002). Scholars have noticed that e-commerce can hardly compete with brick-to-mortar retail in satisfying the individualized

and emotional needs of customers, which can be the competitive edge that retailers need to seize (Zhang et al., 2016).

“Overretailing”, too much retail space per capita, is associated with the decline and abandonment of retail establishments (Clapp et al., 2019). Enclosed malls encompassed higher operational cost compared to other shopping centers (Clapp et al., 2014). “Demalling”, turning an enclosed mall into a big box power center by reducing the gross leasable area, is driven by the tense of “overretailing”. Moreover, for retail operators, the existence of fierce competition lowers the value of the option to wait, which urges them to react to the environment and implement expansion or contraction with the hope to ensure their competitive advantage (Clapp et al., 2014).

Coiacetto (2009) conveys that the industrial economic perspective of competition can be applied to the real estate industry. He defines that real estate properties are highly heterogeneous under an oligopoly market structure. The level of concentration in the real estate industry may rise due to the ever-sophisticated customer demand and extensive regulations, where large players own competitive advantages including long planning horizon and excessive capital (Coiacetto, 2009). Although a high level of concentration indicates a lower level of risk (Lado-Sestayo et al., 2016), some studies have pointed out the danger behind a high level of market concentration. Chiu et al. (2013) believe that the failure and bankruptcy of companies increase when the degree of competition in an industry decreases. The study from the lodging sector denotes that a high level of market concentration can be associated with low efficiency and reduce the average expected survival (Lado-Sestayo et al., 2016).

## **2.2 Proxies for Performance**

Key operating metrics of enclosed malls, such as rent and net operating income are highly confidential. The level of concentration in the field of shopping centers is low and a great number of malls are owned by private companies. Consequently, the property-level financial metrics are also hardly accessible. The performance of enclosed malls can be reflected by their operation decisions, transaction price and assessment value.

### *2.2.1 Mall Closure*

There has been long-lasting interest in models predicting the business failure of companies for around half a decade. It can be dated back to Beaver (1966) whose work focuses on financial ratio and bankruptcies. Altman's Z-score (1968) develops the linear combination of financial metrics to predict the financial health of a business entity, which is still widely adopted by current finance professionals. Corporate failure is a wider idea beyond bankruptcy (Chiu et al., 2013). White (1989) believes that a state of long-run equilibrium is driven by competition where firms have to produce at minimum average costs in order to remain in existence. Inefficient firms with obsolete technologies and products excessing supply are eliminated when the market moves to the long-run equilibrium.

In 2011, Roelfs uses the hazard analysis to understand how competition and demography trends are related to enclosed mall construction and closure. He noticed the influence of nationwide investment trends and the economic cycle. Tokosh (2019) deploys the logistics model to analyze three key tenants of enclosed malls, Sears, JC Penney and Macy's. Their closure decisions may reveal the situation of the mall where the department store is located since retailers tend to close underperforming stores. The result highlights the importance of retail square footage, building age and the geographic region in deciding the fate of retail properties.

### *2.2.2 Expansion and Contraction*

According to McDonald and Siegel (1986), in the real estate context, the call (put) option is the right but not the obligation to increase (decrease) the size of investment at a given location. Real option theory believes that an increase in costs and (or) a decrease in expected revenue lower the value of call option but increase the value of the put option (Dixit, 1989; Williams, 1991). Clapp et al. (2014) further elaborate the expansion and contraction decisions in the context of shopping centers. The center can be expanded by adding gross leasable area and/or number of stores. They are both considered irreversible investment. The former involves the attainment of permit, construction and the disruption to daily operation. The latter is less costly but is far beyond pulling down or adding partitions, since the renegotiation of leases is a time-consuming task for the management. Based on data from 600 shopping centers in 11 Metropolitan Statistics Areas (MSA), they believe that increase in operating costs and a decrease in revenue per square foot lower the probability of expansion but increase the probability of contraction.

### *2.2.3 Transaction Probability*

Transaction is a widely studied event to understand business performance and market trends. Fisher et al. (2004) studies how the transaction frequency of investment-grade commercial real estate, including office, multifamily, industrial and retail, reacts to national, regional and location variables. The probability of property sale is considered a function of market, seller and property characteristics in the probit model. Properties older, smaller, with excess return compared to benchmark are more likely to be sold. They also emphasize the implication of the market cycle that more properties can be sold in an upward market more frequently due to a large amount of capital flowed into the market.

#### *2.2.4 Transaction Price and Assessment Value*

Besides critical business decisions, price is a relatively direct proxy for the performance of the property, since the discounted cash flow method is widely used to value the property in transactions, indicating the future profitability of the property. Rich literature has been working on the pricing of commercial real estate covering various asset classes including office, hotel, industrial, retail, multifamily and senior living. However, more research interest in the field of retail is allocated to rent than transaction price (Freybote, Simon & Beitelspacher, 2016).

Ghysels et al. (2007) study retail assets along with other major asset classes (e.g, office, industrial and multifamily), trying to construct the relationship between local economic variables and annually aggregated price of properties. Freybote et al. (2016) focusing on retail real estate and attempt to understand how the individual property sale price is associated with its general appearance and atmosphere.

The disruption of price brought by distress sale has been widely investigated. Aroul and Hansz (2014) denote that 20 percent is a generalized discount tied with foreclosure sales based on various empirical studies in residential real estate from 1985 to 2010. Aroul et al. (2020) enhance their previous research and discover that the discount varies across market price segment and market cycle. When it comes to commercial properties, Richardson (2012) and Singh (2020) both investigate a wider range of distress conditions (e.g., REO sale, short sale, auction sale) for offices and hotels respectively. REO sale has the strongest magnitude of discount while auction sale has the smallest.

The vital model for real estate valuation is the hedonic pricing model developed by Rosen (1974). The underlying logic of the hedonic pricing model is attributing the price of a product to

its observed characteristics. Under the real estate context, property can be considered as a kind of good and its value is based on its distinct attributes.

While transaction price is able to directly depict the value of real estate, the infrequency of sales makes the value of a majority of property unavailable or outdated. Given that, the assessment value, which is remeasured yearly by the local government as the base for property tax, serves as the alternative to form the understanding of the mall performance (Leung et al., 2018). Although assessment value tends to be lower than the fair market price, studies have uncovered a strong positive correlation between assessed value and transaction price.

## **2.3 Factors Associated with Mall Performance**

Although operational and financial metrics can proxy the performance of malls more directly, observed characteristics of malls and tenants, as well as the market situation provide a profound understanding of the overall market trends and illustrate the mechanism behind events and figures.

### *2.3.1 Mall Characteristics*

Mall characteristics are mainly time-irrelevant, and the management can hardly amend it without thorough renovation. The size of retail establishments has always been considered as a predominant factor for the success of the business. Major studies agree that firms of smaller size are more likely to fail compared to larger ones. According to the Retail Activity Allocation model from Oppenheim (1991), the two predominant features of a shopping center's attractiveness are size and the proximity to target customers, which determine the market share of the shopping center. However, the reason behind it remains complicated. Some believe that larger firms, with abundant resources, are more resilient to face adverse environmental changes.

Although malls are large-scale retail establishments in general, the size can still vary within this category. The ICSC sets 400,000 square feet as the lower threshold of the mall size and some mega malls can reach over 1,000,000 square feet. The number of tenants, size of tenants, layout and amenities as well as the trade area are remarkably diverse among malls of different sizes. In the context of shopping centers, the size may embed two-side effects. Larger malls, generally with more tenants, can provide more variety, which helps the reduction of search cost and transportation cost of customers, but also implies fiercer competition among tenants, which has the potential to bring down the sale price and eventually the rental income (Konishi & Sandfort, 2003). Additionally, Clapp et al. (2014) find that larger enclosed malls have a higher level of flexibility to tackle environment change by taking the option to expand or contract.

Although enclosed malls are predominantly located in suburban (Longstreth, 1997), some practitioners tend to categorize them by their location. Urban or even CBD areas can have enclosed malls, while their layout can be unlike those in suburban neighborhoods due to the difference in area density. The study from Zhou and Clapp (2015) denotes that retail openings are unfavorable of CBD location but prefers a shorter distance to CBD, which indicating the suburbanization trend. Some real estate studies have found a positive relationship between architecture features and rental rates and property value (Gat, 1998; Nase et al., 2013; Vandell & Lane, 1989).

Arguments about the relationship between age and corporate failure are mixed and some studies focusing on the success of venture suggest that the non-linear model. The “Death Valley Curve” indicates that the early stage of the venture embeds a high likelihood of failure (Elrod & Tippett, 2002). Meanwhile, the understand of the business life cycle points out the decline stage for business entities where they can hardly adapt to environmental change and the competitive

advantages are weakened by obsolescence (Aziz & Dar, 2006). However, up to the knowledge of the author, no literature has measured specified life stage for retail real estate and the age of the decline stage is ambiguous. Roelfs (2011) argues that in the context of enclosed malls, data on age reflects the age of the retail location, instead of the obsolescence of the building due to frequent renovation. Renovation is a crucial decision that mall management needs to make, which often includes the update of exterior and/or interior, addition of leasable area and/or amenities as well as reconfiguration of vacated areas. The lack of renovation leaves the property outdated and greatly weakens its competitive advantage, which sometimes indicates lack of fund due to poor performance or even signals the demise.

### *2.3.2 Tenant Characteristics*

Unlike mall characteristics, tenant characteristics are relatively dynamic due to the ongoing leasing activities. Although enclosed malls tend to have long-term leases, 50-year in some extreme cases, the number of tenants and square feet occupied vary because of lease rollover or unexpected termination. The vacancy/occupancy rate can directly reflect the vitality of the enclosed mall. Liu and Liu (2013) denote that tenanting strategy of enclosed mall landlords are associated with company level return based on their study of retail REITs return in the U.S. They consider the replacement of bankrupt tenants a crucial opportunity to boost the performance.

Anchor store is a distinct characteristic of shopping centers (Foster, 1968), which has attracted strong research interest. They tend to be widely known retail chains occupying a large amount of leasable area. Traditionally, department stores were the predominant form of anchor stores and considered as the main driver of foot traffic and provide externalities to smaller, less-known specialty stores. According to Houston and Nevin (1981), how consumers perceive a department

store's merchandise offerings, service quality, and price range will influence the department store's drawing power, as well as the overall image of the shopping center. A number of anchor stores are built-to-suit with the lease signed before the construction. Various aspects of the shopping center can be influenced by the choice of anchor inevitably, including leasing, financial negotiations, building treatment, architectural style, parking, signage, and landscaping (Anikeeff, 1996).

Anchor tenants are not equal (Gould et al., 2005). Vitorino (2012) subdivides major anchor stores into three categories based on their quality of merchandise, reputation and geographical distribution, which have been widely adopted by retail researchers (Leung et al., 2018; Zhou & Clapp, 2015). This kind of differentiation can explain the difference in the mall's sale and rent. However, the utility of anchor stores has been doubted since the doom of brick-and-mortar retail and the bankruptcy of famous brand names such as Sears left malls with high vacancy and severe cut of rent, due to the co-tenancy agreement. The study from Leung, Liu and Zhou (2018) finds the adverse relationship between the proportion of space devoted to anchor tenants and the property assessment value. The underlying logic suggests that the high proportion of anchor tenants implies a lack of diversity, which is less appealing to customers.

Besides anchor tenants, specialty stores have attracted increasing interest from researchers since the service- and experience-oriented concepts can hardly be replaced by e-commerce and have the potential to be the competitive advantage of brick-and-mortar retail (Leung et al., 2018). Enclosed malls, with large trade area and sufficient space, are suitable location for experience-oriented retail, full services restaurants, movie theatre and other active entertainment. The study from Leung et al., (2018) stresses that the non-tradable specialty stores have resilience when

facing the challenges from E-Commerce and the capability to complement the traditional form of goods merchandise in enclosed malls.

### *2.3.3 Demography*

Location attributes are another extensively discussed topic in real estate literature and various technics have been introduced to understand their impact on property value and important events such as closure or new construction. The traditional form is to employ location dummies in the model, while some studies reveal that more complicated methods such as Principal Component Analysis or Cluster Analysis can have better explanatory power. County is accepted as an appropriate level for demography data since it is roughly equivalent to the trade area of anchor stores in enclosed malls (Clapp et al., 2019). More dynamic analysis of trade area is made possible by geospatial statistics which can provide demography information of the trade area based on Euclidean distance, travel time or origin-to-destination analysis of each customer (Des Rosiers et al., 2009; Leung et al., 2018)

The study of Retail Attractiveness started in Reilly's Gravity Model in 1929, which emphasizes the amount of population near the retail establishment (Ling & Smersh, 1996). This emphasis was adopted by Christaller (1966) who developed the Central Place Theory. According to his idea, population, population density and income level are three crucial demography to measure Retail Attractiveness, which guides the estimation of sales potential. When it comes to enclosed malls, dated back to 1972, Cohen's study depicts the evolution of enclosed malls and considers the city population as the most appropriate predictor for the new construction (Kellerman, 1985). Aiming to measure the customer base and purchase power, a bundle of additional variables has been tested, including daytime employment, retail spending, bank deposit (Roelfs, 2011). Besides, customers are not considered as a homogenous group but defined by their sex, ethnicity

group, age group, education level and family structure (Lachman & Brett, 1996). Traditionally, the target customers of enclosed malls are “married couple with kids”. However, more than 20 years ago, researchers have noticed the rise of single-person household and wondered how this shift influenced retail.

The trends are sometimes more crucial than demographic figures. Roelfs (2011) raises the argument that the areas with a stable income level, no matter high and low, can support the enclosed malls, while the decrease of income implies the demise of the enclosed mall. The study from Leung et al., (2018) also points out that malls located in areas with higher population density growth can reach higher assessed value. Facing numerous aspects that location attributes can cover, some scholars try to provide a standardized rating that answers the question of what a good demography profile should look like. Malpezzi and Shilling (2000) develop six economic fundamental factors that mimic the S&P stock rating standards focusing on employment and income and adapting them in forms of absolute value, growth rate and semi-standard deviation of growth rate.

## **2.4 Conceptual Framework and Research Gaps**

The following figure illustrate the research framework of this study by listing the five aspects of dependent variables and four areas of independent variables. Arrows show the research interest of previous studies. The studies from Roelfs (2011) and Leung et al. (2018) focus on enclosed malls nationwide, while other scholars do not have exactly the same scoop of research. Clapp et al. (2014) are interested in shopping centers in 11 MSAs, Fisher et al. (2004) investigate a board concept of commercial real estate nationwide and Freybote et al. (2016) work with retail storefront in Los Angeles. The aim of this study is to examine all possible relationship between

below dependent variables and independent variables, which helps build up the comprehensive understanding of enclosed mall evolution.

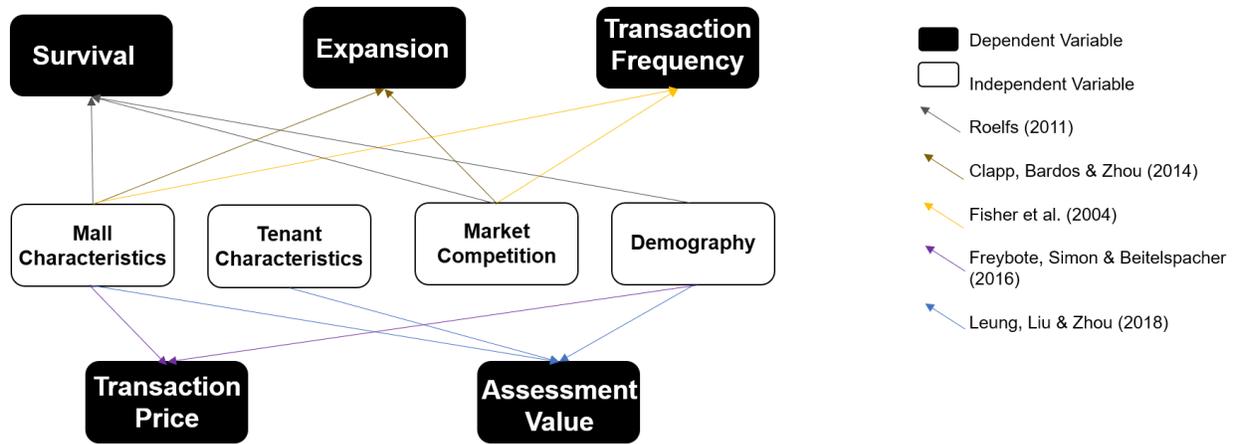


Figure 1 Conceptual Framework

### 3 Data

#### 3.1 Market Structure

This study deploys the “Market” concept from CoStar, a leading commercial real estate database. It can be loosely considered as the equivalent to Core Base Statistics Area (CBSA). 368 markets cover 1,406 malls in 2010 (92.93 percent of total enclosed malls). This concept serves as a reference for investors and other real estate professionals when they would like to know the supply, demand, rent and investment return of a certain area. Mall per Capita (square feet per person) shows the intensity of direct competition. Figure 2 illustrates the enclosed mall space per capita across the nation by standard deviation. It can be noticed that large metropolitan areas have a slightly low amount of space per capita compared to the national average, while remote areas in the Midwest and South may have a higher amount of space due to the scarcity of population. Additionally, the retail space per capita malls reflect the supply and demand relation of all retail establishments and the total population. Other Centers per Capita reveals the

substitute and complimentary supply from power centers, community centers, neighborhood centers and strip centers.

Variable Name	Frequency	Percent	N	Mean	Median	Min	Max	S.D.
Market								
In CoStar Market	1,406	92.93						
Outside Costar Market	107	7.07						
Mall per Capita			1,406	4.74	4.36	0.48	16.55	1.71
Retail per Capita			1,406	57.52	58.18	34.75	100.21	9.86
Other Center per Capita			1,345	21.23	20.35	7.58	34.05	5.65

Table 1 Market Structure in 2010

## Enclosed Mall Space per Capita, 2010

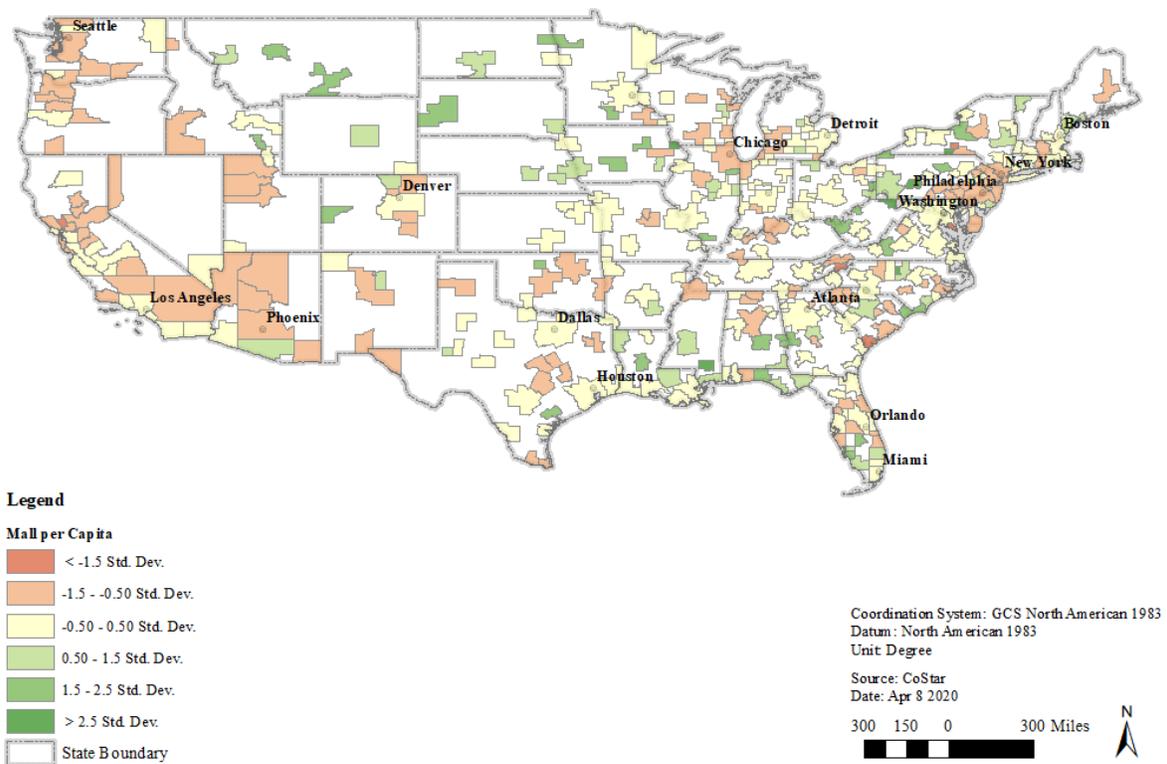


Figure 2 Enclosed Mall Space per Capita in 2010

### 3.2 Mall and Tenant Characteristics

The list of enclosed malls was downloaded from CoStar in both April 2010 and February 2020.

It contains basic information about the enclosed mall including size and location. The first

version covers 1,513 samples in 2010 and the second has 1,138 samples in 2020. Direct comparison between the list of shopping centers now and ten years ago shows the difference in the count, center type, size, and tenants. CoStar also archives transaction press releases and marketing brochures for sale or lease, which capture the situation of the center at a certain time point. On a local level, newspapers provide commentary on the impact that shopping centers have on the community and economy. These reports tend to be more qualitative and provide additional information about the opening, closing and transformation of shopping centers and the rationale of the decision. When written records about the mall are limited, Google Earth is a good supplement for visual information with its historical imagery function, which reflects the status of the site directly.

Enclosed malls are categorized into three types and created a full list with 1,551 records. Dead mall refers to retail establishments that were recognized as regional/super regional malls in 2010 but not recognized in 2020. New malls are enclosed malls not appearing on the 2010 list but the 2020 list. Some of them were built before 2010 and expanded into regional or super regional centers in the past decade, while there are also newly constructed malls. For the rest of the enclosed malls that survive throughout the past decade, they are considered as "operating malls". The frequency of each type is listed in Table 2, from where we can notice a 25 percent drop in the number of enclosed malls in the past decade. Figure 3 visualizes the distribution of 1,551 enclosed malls across the nation, which closely follows the density of population and concentrates in large metropolitan areas.

<b>Type of Change</b>	<b>Frequency</b>	<b>Percent</b>
Dead mall	413	26.7
New mall	43	2.8
Operating mall	1,095	70.6

*Table 2 Status of Enclosed Malls*

## Survival and Closure of Enclosed Malls from 2010 to 2020

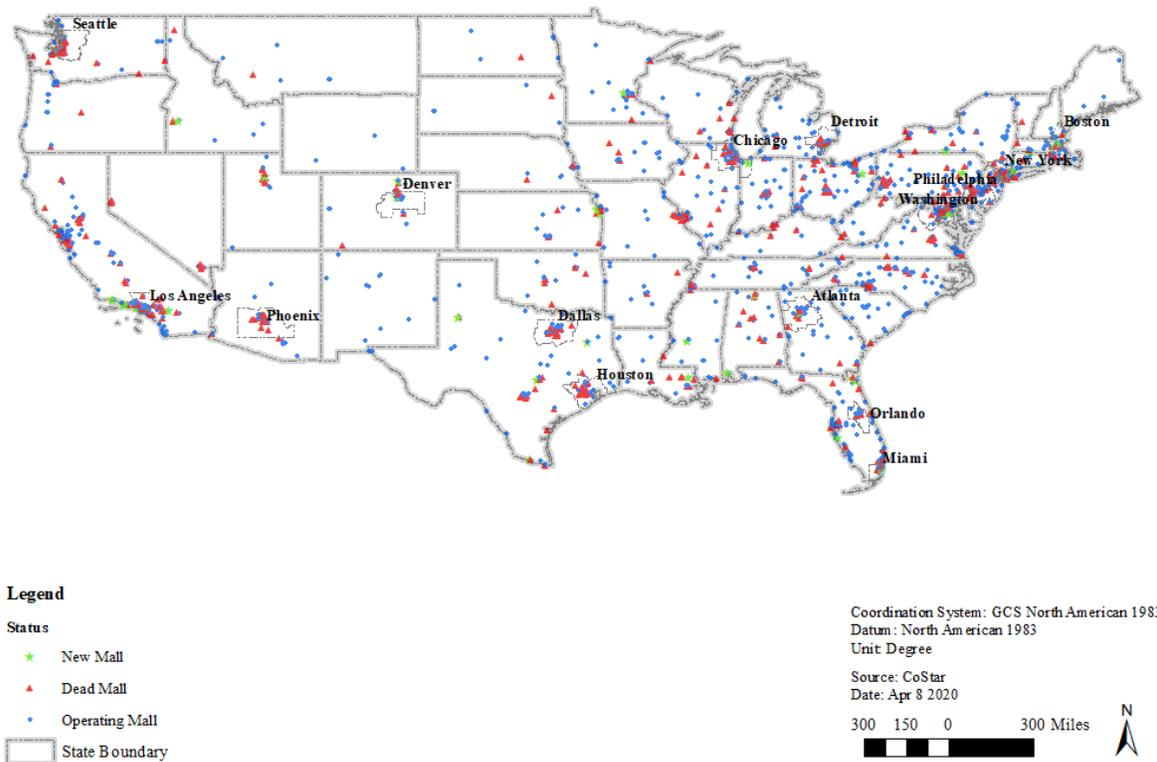


Figure 3 Status of Enclosed Malls

As for tenants, their info was manually collected from CoStar mall by mall with the name, square footage occupied, number of employees, Standard Industrial Classification (SIC) code and whether it is an anchor tenant recognized by the mall. In the year 2010, the tenant list contains 138,114 tenants in those centers, approximately 96 tenants each mall. The median number of anchors in each enclosed mall is 4 and 50.5 percent of GLA is occupied by them. The number of enclosed mall tenants in 2020 went down to around 90,000, 71 tenants per mall with the median occupancy. Each enclosed mall tends to have 3 anchor tenants and they take up 33.3 percent of GLA.

Based on the scoring system for department stores from Zhou et al. (2015) the anchor quality score ranges from 0 to 19 with a median at 6 in 2010. The mall will receive one points for having an anchor in the low-price type (e.g., BJ's Wholesale Club, Costco, Sears, Target and Walmart), two points for an anchor in the medium-price type (e.g., Burlington Coat Factory, JC Penney, Stein Mart and Ross Dress for Less) and three points for an anchor in the high-price type (e.g., Bloomingdale's, Macy's, Neiman Marcus, Nordstrom). The distribution of total score is highly left-skewed with several super regional malls in large metropolitan areas having several prestige department stores and a majority of enclosed malls only having one or two moderate-quality brand names. Apple store is selected as the representative for experiential retail and 11.3 percent of enclosed malls in 2010 had it.

One of the major data cleaning effort this study has made is that it tries to redefine tenant classification to understand that whether the proportion of service tenants has been improved during 2010 to 2020. Although the dataset from CoStar provides SIC classification for most tenants, this classification system works for merchandise retailers by listing the exact merchandise they are selling, e.g., women's apparel, but treats service tenants roughly. In order to have a better understanding of service tenants in enclosed malls, a manual data cleaning process has to be implemented and the source of information including the official website of malls and brands, social media platforms run by the business as well as inquiry through phone call.

The seven-category classification system was developed and refined gradually to demonstrate the space allocation in enclosed malls. The Lodging category includes hotels in enclosed malls, which is commonly seen in super regional malls that have trade area beyond the state boulder. Tenants in the Food & Beverage category includes full services restaurants, fast food restaurant,

bars, coffee shops and stores serving snacks or other non-alcoholic drinks. The Sports & Entertainment category include fitness centers, movie theaters, arcades and other active entertainment (e.g., escape room, trampoline). The Personal Services category provides personal cares (e.g., hair salon, nail salon), repairment and rental. Some professional services provider such as accountants, real estate brokers and health care professionals may also rent the space in enclosed malls and they are considered as the Professional Services category. The Public Services category includes a wide range of space, including townhalls, local authorities as well as religious venues.

As shown in Table 3, Merchandise Retailers take a predominant proportion of space in enclosed malls in both 2010 and 2020, although the ratio decreased by 5.1 percent in 2020. The proportions of space occupied by Food & Beverage and Sports & Entertainment have increased. Although the space of Sports & Entertainment tenants has almost doubled for the past ten years, the total space taken up by these two categories is still less than 15 percent. The transformation in enclosed malls towards a more service and experience focused tenant mix is slow and minor due to the existent of long-term lease with merchandise retailers as well as the fact that the mall management can exert limited influence on large department stores who own their space in the mall.

<b>Category</b>	<b>2010</b>	<b>2020</b>
Lodging	0.30 percent	0.70 percent
Food & Beverage	4.80 percent	6.10 percent
Sports & Entertainment	3.70 percent	7.00 percent
Personal Services	2.90 percent	2.40 percent
Professional Services	2.50 percent	2.70 percent
Public Services	0.80 percent	1.80 percent
Merchandise Retailers	85.30 percent	79.20 percent

*Table 3 GLA Percentage of Tenant Categories in 2010 and 2020*

In 2010, a typical enclosed mall will be at age of 33 and has a 30 percent probability to be recently renovated (renovated after 2000). The enclosed mall has the median gross leasable area at 800,000 square feet. When it comes to the year 2020, the median age of enclosed malls is 44 and only 19 percent are renovated in the past ten years. Given the shrinkage in the number of enclosed malls, the median size of enclosed malls in 2020 has increased to 845 thousand square feet, around 5.6 percent larger than the figure ten years ago, which indicates the consolidation in the retail business. When the same sample of enclosed malls are compared for their GLA in both 2010 and 2020, the median rate of increase is 3.10 percent. If the 10 percent increase (decrease) is set as the cutoff (Clapp et al., 2014), 103 enclosed malls added the number of tenants while 838 malls cut the number. In terms of mall GLA change, 283 enclosed malls were expanded their GLA while 199 were contracted in the ten-year period. Table 4 shows definition of key variables for mall and tenant characteristics. Data in 2010 and 2020 are listed in Table 5 and the comparison is in Table 6.

<b>Variable Name</b>	<b>Description</b>	<b>Measurement</b>
<i>Mall Characteristics</i>		
Mall GLA	Enclosed mall Gross Leasable Area	Log of square footage
Mall Age	Year since the enclosed mall was built	Years
Renovation	Dummy variable for renovation taken within 10 years	1 for renovated
Mall Occupancy	Space occupied by tenants divided by Mall GLA	Ratio
<i>Tenant Characteristics</i>		
Number of Tenants	Number of stores the enclosed mall has	
Number of Anchors	Number of anchor store recognized by the enclosed mall	
Anchor Number percent	Number of anchors divided by number of mall tenants in total	Ratio
Anchor GLA percent	Square feet occupied by anchors divided by Mall GLA	Ratio
Anchor Quality	Computed score based on positioning of department store anchors	
Apple Store	Dummy variable for having the Apple Store in the mall	1 for having the Apple Store
<i>Change from 2010 to 2020</i>		
Mall Status	Dummy variable for mall status change from 2010 to 2020	1 for survival, 0 for closure
Number of Tenants Change	Change rate of number of tenants from 2010 to 2020	Ratio

GLA Change	Change rate of mall GLA from 2010 to 2020	Ratio
Expansion - Number of Tenants	Dummy variable for tenant number expansion	1 for number of tenants change percent more than 10 percent
Contraction - Number of Tenants	Dummy variable for tenant number contraction	1 for number of tenants change percent less than -10 percent
Expansion - Size	Dummy variable for mall GLA expansion	1 for GLA change percent more than 10 percent
Contraction - Size	Dummy variable for mall GLA contraction	1 for GLA change percent less than -10 percent

Table 4 Variable of Interest – Mall and Tenant Characteristics

Variable Name	Value	Freq	Pct	N	Mean	Median	Min	Max	S.D.
<i>2010</i>									
Mall GLA				1,347	13.54	13.60	10.60	14.90	0.53
Mall Age				1,347	32	33	1	214	17.65
Renovation	0	894	66.37						
	1	453	33.63						
Mall Occupancy				1,347	75.15	77.65	7.73	107.47	40.41
Number of Tenants				1,347	102.53	96	2	496	68.49
Number of Anchors				1,347	4.03	4	0	17	2.15
Anchor Number percent				1,347	11.67	3.88	0	100	40.77
Anchor GLA percent				1,347	49.46	50.26	0	100	24.22
Anchor Quality				1,347	5.37	6	0	19	3.47
Apple Store	0	1,195	88.72						
	1	152	11.28						
<i>2020</i>									
Mall GLA				1,138	13.63	13.65	11.82	15.13	0.48
Mall Age				1,138	42.73	44	1	224	17.38
Renovation	0	926	81.37						
	1	212	18.63						
Mall Occupancy				1,137	74.03	75.25	13.18	102.23	41.38
Number of Tenants				1,138	79.43	71	1	359	48.95
Number of Anchors				1,138	2.59	2	0	13	1.72
Anchor Number percent				1,138	4.2	3.26	0	57.14	4.21
Anchor GLA percent				1,138	40.52	42.96	0	97.96	21.14
Anchor Quality				1,138	5.44	5	0	17	3.26
Apple Store	0	946	83.13						
	1	192	16.87						

Table 5 Summary Statistics - Mall and Tenant Characteristics in 2010 and 2020

Variable Name	Value	Freq	Pct	N	Mean	Median	Min	Max	S.D.
Mall Survival	0	418	27.63						
	1	1,095	72.37						
Number of Tenants Change				1,013	19.82	-20.59	-98.9	882.35	90.01
GLA Change				1,013	3.06	0.41	80.16	178.4	22.23
Expansion - Number of Tenants	0	910	89.83						
	1	103	10.17						
Contraction - Number of Tenants	0	175	17.28						
	1	838	82.72						
Expansion - Mall GLA	0	770	73.12						
	1	283	26.88						
Contraction - Mall GLA	0	814	80.36						
	1	199	19.64						

Table 6 Summary Statistics – Mall and Tenant Characteristics Change from 2010 to 2020

### 3.3 Transaction and Assessment

CoStar provides records of assessment value each year and transactions, although some malls or transactions are not covered. Table 7 includes the explanation of variables of interest and Table 8 provides the summary statistics. In 2010, 939 enclosed malls have a median total assessed value of \$18,400,000 . The 2020 data has 1,014 observations. The median total assessed value in 2020 is \$25,300,000 .

Variable Name	Description	Measurement
<b>Mall Level</b>		
Complete Transaction	Dummy variable for transaction	1 for being sold completely
Non-Distressed Transaction	Dummy variable for transaction condition	1 for being sold completely without distressed condition
Distressed Transaction	Dummy variable for transaction condition	1 for being sold completely under distressed condition
Total Assessment Value 2010	Total dollar value assigned to the mall to measure applicable taxes in 2010	Log of dollar value
Assessment Value per Sqft 2010	Dollar value per sqft assigned to the mall to measure applicable taxes in 2010	Log of dollar value
Total Assessment Value 2020	Total dollar value assigned to the mall to measure applicable taxes in 2020	Log of dollar value
Assessment Value per Sqft 2020	Dollar value per sqft assigned to the mall to measure applicable taxes in 2020	Log of dollar value
<b>Transaction Level</b>		
<i>Transaction Price</i>		
Total Transaction Price (Complete)	Total sale price of mall	Log of dollar value
Total Transaction Price (Complete & Distress)	Total sale price of mall under distressed condition	Log of dollar value
Total Transaction Price (Complete & Non-Distress)	Total sale price of mall not under distressed condition	Log of dollar value
Unit Transaction Price (Complete)	Sale price per sqft of mall	Log of dollar value
Unit Transaction Price (Complete & Distress)	Sale price per sqft of mall under distressed condition	Log of dollar value
Unit Transaction Price (Complete & Non-Distress)	Sale price per sqft of mall not under distressed condition	Log of dollar value
Total Transaction Price (Partial)	Total sale price of partial transaction	Log of dollar value
Total Transaction Price (Partial & Distress)	Total sale price of partial transaction under distressed condition	Log of dollar value
Total Transaction Price (Partial & Non-Distress)	Total sale price of partial transaction not under distressed condition	Log of dollar value
Unit Transaction Price (Partial)	Sale price per sqft price of partial transaction	Log of dollar value
Unit Transaction Price (Partial & Distress)	Sale price per sqft price of partial transaction under distressed condition	Log of dollar value
Unit Transaction Price (Partial & Non-Distress)	Sale price per sqft price of partial transaction not under distressed condition	Log of dollar value

*Building Characteristics*

Secondary Type	Categorical variable	Retail storefront, restaurant, sports & entertainment, supermarket etc.
Size	Building size	Log of Square Footage
Age	Building age at transaction	Years
Renovation	Dummy variable for renovation taken within 10 years before transaction	1 for renovated
Parking Ratio	Number of parking spaces divided by mall square footage in thousands of feet	Ratio
Floor Area Ratio	Building size divided by land area	Ratio
Suburban	Dummy variable for location type	1 for locating in suburban area
Star Rating	Nominal variable	1 star to 5 star

*Transaction Characteristics*

Transaction Year	Nominal variable	from 2010 to 2019 inclusively
Distress	Dummy variable for sale condition	1 for distress transaction
Bulk	Dummy variable for sale condition	1 for bulk transaction
Holding Period	Categorical variable	Short (<=3yrs), Medium (<=10yrs), Long (10yrs+)

*Buyer Characteristics*

Buyer Type	Categorical variable	Public, Institutional, Private Equity, Private, User
Buyer Origin	Categorical variable	Local, National, Foreign

*Table 7 Variable of Interest - Transaction & Assessment*

<b>Variable Name</b>	<b>Freq</b>	<b>Pct</b>	<b>N</b>	<b>Mean</b>	<b>Median</b>	<b>Min</b>	<b>Max</b>	<b>S.D.</b>
<b>Property Level</b>								
Complete Transaction								
	0	1,187	78.45					
	1	326	21.55					
Non-Distressed Transaction								
	0	1,279	84.53					
	1	234	15.47					
Distressed Transaction								
	0	1,421	93.92					
	1	92	6.08					
Total Assessment Value 2010			939	16.63	16.73	3.09	20.65	1.85
Unit Assessment Value 2010			936	3.91	4.13	-9.81	9.44	1.85
Total Assessment Value 2020			1014	16.73	17.04	3.09	20.39	1.85
Unit Assessment Value 2020			1011	3.98	4.32	-9.81	8.76	1.82
<b>Transaction Level</b>								
<i>Transaction Price</i>								
Total Transaction Price (Complete)			295	16.46	16.42	7.03	20.95	1.72
Total Transaction Price (Complete & Distress)			179	16.85	16.95	7.03	20.95	1.90
Total Transaction Price (Complete & Non- Distress)			116	15.88	16.04	10.77	18.95	1.18
Unit Transaction Price (Complete)			293	3.60	3.56	-2.41	8.39	1.47
Unit Transaction Price (Complete & Distress)			177	4.17	4.37	0.47	8.39	1.41
Unit Transaction Price (Complete & Non- Distress)			116	2.75	2.83	-2.41	5.30	1.12

Total Transaction Price (Partial)		2,391	14.79	14.73	6.91	20.73	1.45
Total Transaction Price (Partial & Distress)		1,980	14.90	14.81	6.91	20.73	1.40
Total Transaction Price (Partial & Non-Distress)		411	14.26	14.29	8.88	18.45	1.54
Unit Transaction Price (Partial)		2,389	4.82	5.02	-1.83	8.95	1.33
Unit Transaction Price (Partial & Distress)		1,978	5.04	5.23	-1.83	8.95	1.23
Unit Transaction Price (Partial & Non-Distress)		411	3.73	3.84	-0.46	6.72	1.25

*Building Characteristics*

Secondary Type

Auto Services	101	4.22
Bank	101	4.22
Department Store	293	12.25
Food & Beverage	538	22.50
Other Asset Classes	28	1.17
Other Retail	621	25.97
Sports & Entertainment	58	2.43
Retail Store Front	651	27.23

Size		2,684	10.35	10.25	6.31	14.51	1.74
Age		2,488	36	35	1	130	21

Renovation

0	1,915	71.30
1	771	28.70

Suburban

0	304	11.32
1	2,382	88.68

Star Rating

1	544	20.25
2	1,687	62.81
3	455	16.94

*Transaction Characteristics*

Transaction Year

2010	120	4.47
2011	142	5.29
2012	249	9.27
2013	250	9.31
2014	298	11.09
2015	339	12.62
2016	360	13.40
2017	274	10.20
2018	284	10.57
2019	370	13.78

Distress

0	2,159	80.38
1	527	19.62

Bulk	0	2,201	81.94
	1	485	18.06
Holding Period	Long	1,128	44.01
	Medium	715	27.90
	Short	720	28.09
<i>Buyer Characteristics</i>			
Buyer Type	Public	387	16.25
	Institutional	350	14.70
	Private Equity	189	7.94
	Private	1,300	54.60
	User	155	6.51
Buyer Origin	Local	271	11.27
	Nation	2,034	84.57
	Foreign	100	4.16

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*Table 8 Summary Statistics - Transaction and Assessment*

For transaction records, the unit of analysis is building, and malls can have multiple buildings which may have different owners and can be transacted separately. Records are subdivided to complete transactions and partial transactions based on the transaction size. Complete transactions are involved with buildings having no secondary type and size no less than 50 percent of the enclosed mall. While partial transactions refer to the sale of smaller buildings (under 50 percent) or buildings with a specific use. To summarize secondary types, eight categories are created including auto services (e.g., car dealer, car washer), bank, department store, food & beverage (e.g., restaurant, fast food), other asset classes (e.g., garage, warehouse, medical office), other retail (e.g., drug store, supermarket), sports & entertainment (e.g., movie theater, fitness center) and retail storefront (retail property without a specific use). 326 complete transactions have involved 271 enclosed malls, while only 295 records have information about the sale price which can be used for the hedonic pricing model. They have a median total price of \$ 13,500,000 and a median size of 457,386 sqft. For 2,538 partial transactions involving 662

malls, 2,391 records have the sale price. The median total price is \$2,500,000 and the median size is 17,110 sqft. 11 percent of transactions are department stores, 23 percent are restaurants and only 3 percent are sports and entertainment venues.

Transaction data provides additional information about the building, including building star rating and location type. 62 percent of buildings are rated 3-star with 1-star and 5-star rare to be seen. Unlike the tradition classification of buildings by building class, star rating based on nationwide standard, which makes the results more comparable around the nation. For the convenience of analysis, 1 point is assigned to buildings with the 1- or 2- star rating. 2 points are assigned to 3-star buildings and 3 points for higher ratings. Most buildings are located in suburban areas. Figure 3 shows the momentum of transactions from 2010 to 2020. Generally speaking, the distribution of transaction volume is and does not have a strong cyclical pattern. A peak appeared in 2015 with the highest transaction volume and unit price. The data also covers the buyer type, buyer origin and holding period. Private buyers, national buyers and long-term holders are the most common situation. When it comes to sale conditions, 18 percent of records are the bulk transaction and 20 percent of records are involved with distress conditions (including foreclosure, auction sale and REO sale).



Figure 4 Transaction Volume from 2010 to 2019

### 3.4 Demography

The 2010 Census and following American Community Surveys provide abundant demography data for this research. County is selected since its size is similar to the trade area radius of typical malls and there are 669 counties from all 50 states in the data set. This study is interested in variables including population (household density and its 10-year growth rate), income (median household income and its 10-year growth rate), age distribution (population under the age of 65), gender distribution (female ratio), household structure (single-person household). The exact measurement of these variables in be found in Table 9 and their summary statistics can be found in Table 10.

Variable Name	Description	Measurement
Age below 65	Population aged below 65 divided by population in total	Ratio
Female	Female population divided by population in total	Ratio
Single Person Household	Single-person households divided by households in total	Ratio
Median Household Income	Numeric variable	Log of dollar value
Household Density	Number of households divided by land area in total	Person per Square Miles
Median Household Income Growth	10-year growth rate of county median household income	Ratio
Household Density Growth	10-year growth rate of county household density	Ratio
State	Categorical variable	50 states and Washington D.C.

*Table 9 Variable of Interest-Demography*

Variable Name	N	Mean	Median	Min	Max	S.D.
Age below 65	1,474	87.34	87.80	66.10	93.60	3.20
Female	1,474	51.00	51.02	40.31	54.17	0.99
Single Person Household	1,474	10.62	10.68	3.53	21.75	2.54
Median Household Income	1,474	10.85	10.83	10.20	11.69	0.23
Household Density	1,474	7.86	7.91	3.24	12.75	1.23
Median Household Income Growth	1,474	1.60	1.60	-1.78	4.26	0.83
Household Density Growth	1,474	0.98	0.74	-2.77	6.82	1.08

*Table 10 Summary Statistics-Demography*

## 4 Empirical Methods

This chapter goes through empirical methods that tend to answer above mentioned research questions, including the adoption of the Herfindahl-Hirschman Index, logit model and hedonic pricing model.

#### 4.1 Measurement of Market Concentration

The Herfindahl-Hirschman Index (HHI) is adapted as a useful measurement of market concentration since it reflects the number and size distribution of firms in a market. HHI has been used as the competition benchmark index by the Department of Justice for antitrust purpose since 1982 (Rhoades, 1995).

$$HHI = S_1^2 + S_2^2 + S_3^2 + \dots + S_n^2$$

$S_i^2$  = firm market share

#### 4.2 Logit Model

The logit model is a widely used model when analyzing corporate failure and it is believed to provide accurate classification within-sample (Collins & Green, 1982; Premachandra et al., 2011). Clapp et al. (2014) uses ordered logit model to analyze the decision of expansion and contraction simultaneously. The survival is be treated as a realization of a random variable  $Scenario_i$  and it follows the binomial distribution  $Scenario_i \sim B(n_i, \pi_i)$ .  $n_i$  is the binomial denominator and  $\pi_i$  is the probability. The dataset provides abundant variables to understand the survival of enclosed malls. Different combinations of variables are included in the model and some may have to be excluded from this variable due to poor data quality or high collinearity. The mathematical expression of the logit model is as follows:

$$logit(\pi_i) = \beta_0 + W\beta_1 + X\beta_2 + Y\beta_3 + Z\beta_4 + \varepsilon_i$$

where  $i$  signals the  $i$ th enclosed malls.  $W$ ,  $X$ ,  $Y$  and  $Z$  are  $n \times k_j$  matrix of (exogenous) hedonic characteristics of mall, tenant, demography and market competition.  $\beta_s$  are  $k_j \times 1$  parameter vectors of enclosed mall's observed characteristics and the error term  $\varepsilon$  is for all variations that

the model is not able to explain. Besides survival, other events are analyzed using the logit model as well, including expansion, contraction, complete transaction, distress transaction and partial transaction of enclosed malls. All models are based on the data in 2010.

### 4.3 Hedonic Pricing Model

The prevalent hedonic pricing model is used to value enclosed malls based on both assessment value and transaction price. Natural logarithm of assessment value and transaction price is taken to fulfill the requirement of the Ordinary Least Square (OLS) model. Total value/price and value/price per square feet are included since the mall owners may have different strategies for value maximization, some emphasizing the total value and some others focusing on unit value (Freybote et al., 2016; Leung et al., 2018). The mathematical expressions of the hedonic pricing model of the complete transaction are as follow:

$$\ln\text{TotalValue}_i = \beta_0 + V\beta_1 + W\beta_2 + X\beta_3 + Y\beta_4 + Z\beta_5 + \varepsilon_i$$

$$\ln\text{SFValue}_i = \beta_0 + V\beta_1 + W\beta_2 + X\beta_3 + Y\beta_4 + Z\beta_5 + \varepsilon_i$$

where  $i$  signals the  $i$ th transaction.  $V$ ,  $W$ ,  $X$ ,  $Y$  and  $Z$  are  $n \times k_j$  matrix of (exogenous) hedonic characteristics of mall, demography, market competition, transaction and buyer.  $\beta$ s are  $k_j \times 1$  parameter vectors of enclosed mall's observed characteristics and the error term  $\varepsilon$  is for all variations that the model is not able to explain. All time-relevant variables are collected from the year of transaction. In the models for partial transaction,  $V$  will be the matrix for property characteristics and secondary property will be added as one of the hedonic characteristics to this matrix. To understand the disruption from distress transaction, both the complete and partial transaction data are divided to the non-distress and distress subsets.

For assessment value, the covariates are slightly different and they can be expressed in the following equations:

$$\ln\text{TotalValue}_i = \beta_0 + W\beta_1 + X\beta_2 + Y\beta_3 + Z\beta_4 + \varepsilon_i$$

$$\ln\text{SFValue}_i = \beta_0 + W\beta_1 + X\beta_2 + Y\beta_3 + Z\beta_4 + \varepsilon_i$$

where  $i$  signals the  $i$ th transaction.  $W$ ,  $X$ ,  $Y$  and  $Z$  are  $n \times k_j$  matrix of (exogenous) hedonic characteristics of mall, tenant, demography, market competition.  $\beta$ s are  $k_j \times 1$  parameter vectors of enclosed mall's observed characteristics and the error term  $\varepsilon$  is for all variations that the model is not able to explain. All data are collected in the year of assessment, namely 2010 and 2020.

## **5 Discussions**

### **5.1 Market Structure**

The market concentration level in both 2010 and 2020 are calculated and listed in Table 11 with the situation in 2010 is visualized in Figure 5. According to the Antitrust Division in U.S. Department of Justice (2021), a market with an HHI below 1,500 can be considered as having a low level of concentration. In this case, most markets with a low level of concentration are large metropolitan areas. Markets in smaller metropolitan areas have a higher level of concentration and some even have only one enclosed mall in the whole market.

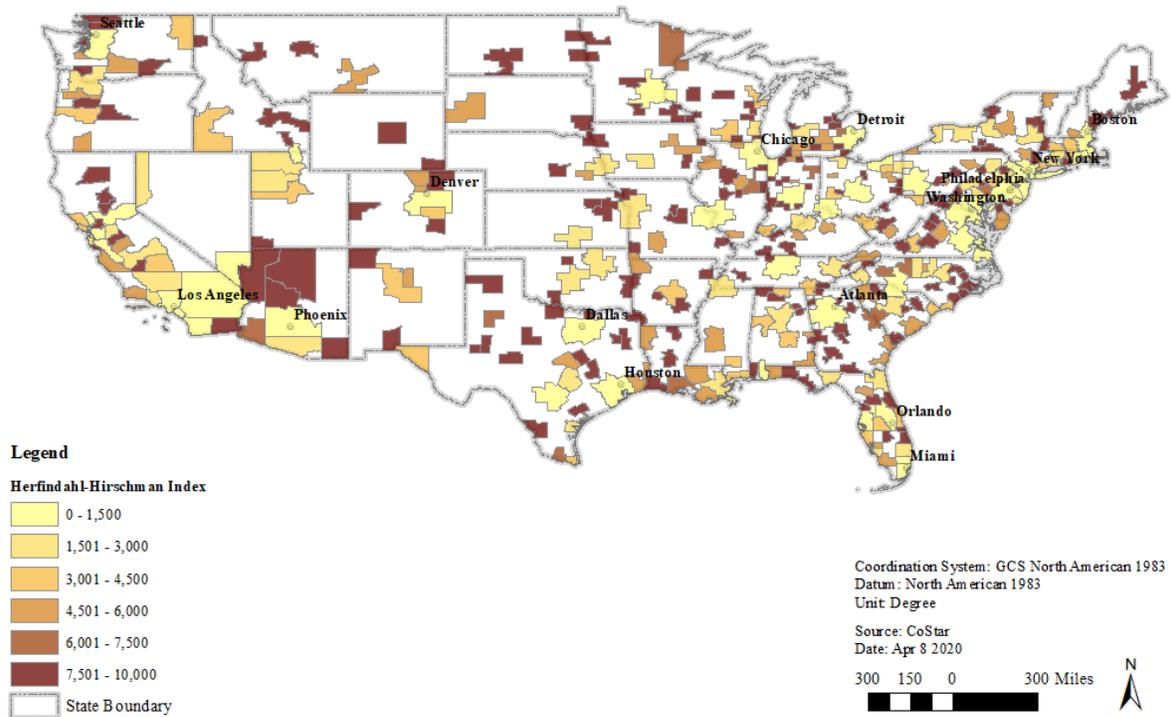


Figure 5 HHI of Enclosed Malls in 2010

The median HHI that enclosed malls were facing in 2010 was 1,571 while the number jumped to 2,139 in 2020 with a 36 percent increase. Philadelphia is the market that has the lowest HHI in both 2010 and 2020. Most markets with HHI below 1,500 in 2010 experienced an increase in the market concentration level except Denver and San Diego. A t-test is conducted to confirm the hypothesis that the market concentration level in 2020 is significantly higher than it was in 2010 with a p-value lower than 0.000. This result is in line with previous summary statistics that the U.S. had fewer but larger enclosed malls in 2020 than ten years ago. Coiacetto (2009) attributes the accelerated level of market concentration in residential real estate to the growing sophistication of investment and operation. This conclusion can be expanded to commercial real estate, especially the retail real estate sector where the planning, design, leasing and operation phases all require precise professionalism.

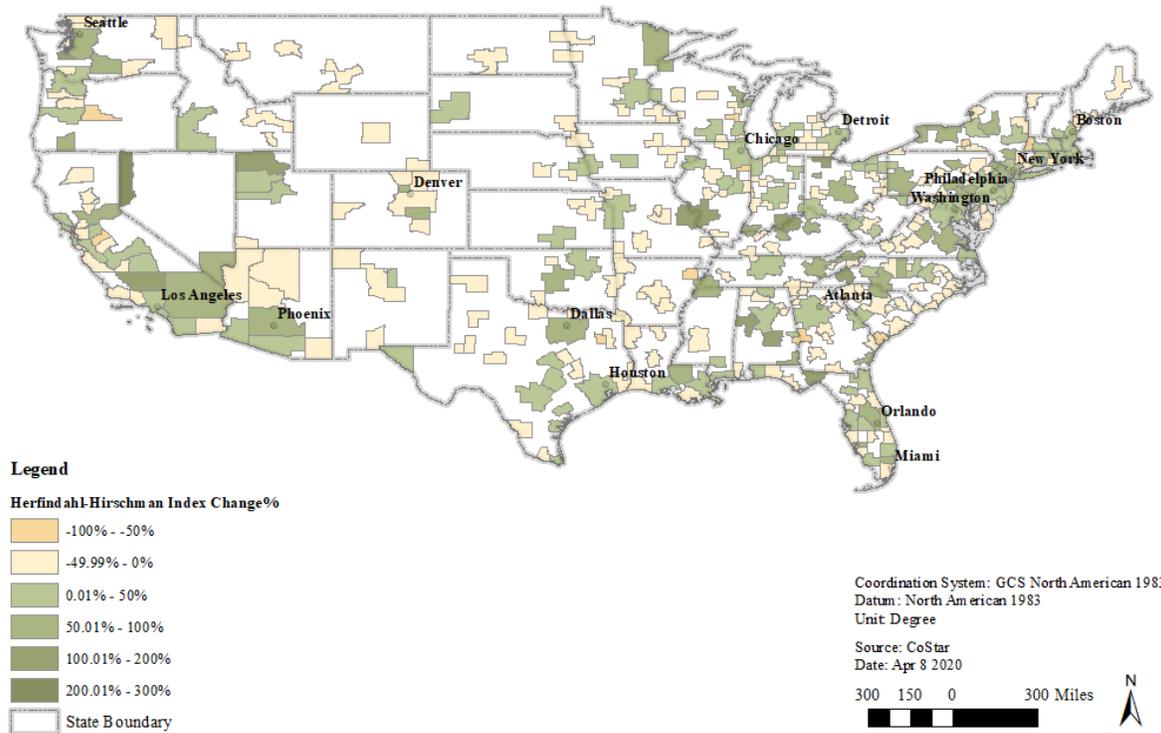


Figure 6 HHI Change of Enclosed Malls from 2010 to 2020

Variable Name	N	Mean	Median	Min	Max	S.D.
Market HHI 2010	1,405	2,902	1,571	337	10,000	3,135
Market HHI 2020	1,070	3,573	2,139	415	10,000	3,327

Table 11 Summary Statistics - Market Concentration in HHI

Difference	Std. Err.	t	P-value
-321.089	33.426	-9.606	0.000

Table 12 T-Test Result for HHI Difference

## 5.2 Survival

Intense real estate and corporate finance literature has looked into the selection of dependent variables. Various statistical methods have been adopted including the step-wise regression, Principal Component Analysis (PCA) and LASSO (Das et al. (2020), Malpezzi and Shilling (2000) and Pereira et al. (2016)) . Some other researchers, such as Roelfs (2011) and Leung et al.

(2018) prefer a more intuitive way to select variables to support the overall storytelling. After trying various model specifications, exact independent variables are selected considering previous studies, multicollinearity and the fit of models. Table 13 is the correlation table for independent variables. Most variables are correlated at a low level and none of them is higher than 0.6. The variation inflation factor (VIF) test is conducted to check the existence of multicollinearity. In Table 14, no VIF value is higher than 10, which indicates no salient multicollinearity issue.

	<b>Mall GLA</b>	<b>Mall Occupancy</b>	<b>Mall Age</b>	<b>Renovation</b>	<b>Apple Store</b>	<b>Anchor Quality</b>	<b>Other Centers per Capita</b>	<b>Household Density</b>	<b>Median Household Income</b>	<b>Density Growth</b>	<b>Income Growth</b>
Mall GLA	1										
Mall Occupancy	0.026	1									
Mall Age	0.0287	-0.0381	1								
Renovation	0.1389	0.0745	0.1264	1							
Apple Store	0.3176	0.1321	-0.0196	0.0132	1						
Anchor Quality	0.4610	0.5079	-0.0178	0.1183	0.273	1					
Other Centers per Capita	0.1118	-0.0009	-0.1347	0.0001	0.022	0.0882	1				
Household Density	0.2318	-0.0656	0.1559	0.0048	0.1577	-0.0216	0.0032	1			
Median Household Income	0.1414	-0.0364	-0.0052	0.0186	0.1887	-0.0085	-0.1389	0.2597	1		
Density Growth	-0.0409	0.0258	-0.2368	-0.0074	-0.0062	0.0829	0.3063	-0.375	0.1717	1	
Income Growth	-0.0688	-0.0193	-0.0139	0.0383	0.0278	-0.0549	-0.3219	-0.0699	0.3785	0.0817	1

*Table 13 Correlation Table for Variables included in the Logit Model for Survival*

<b>Variable</b>	<b>SQRT VIF</b>	<b>VIF</b>	<b>Tolerance</b>	<b>R-Squared</b>
Mall GLA	1.58	1.26	0.6311	0.3689
Mall Occupancy	1.47	1.21	0.6802	0.3198
Mall Age	4.49	2.12	0.2226	0.7774
Mall Age (Quadratic Term)	4.26	2.06	0.2347	0.7653
Renovation	1.07	1.03	0.9386	0.0614
Apple Store	1.19	1.09	0.8424	0.1576
Anchor Quality	1.95	1.39	0.5139	0.4861
Other Centers per Capita	1.35	1.16	0.7386	0.2614
Household Density	1.49	1.22	0.669	0.331
Median Household Income	1.51	1.23	0.6632	0.3368
Density Growth	1.6	1.26	0.6254	0.3746
Income Growth	1.35	1.16	0.7386	0.2614
<b>Mean VIF</b>	<b>1.94</b>			

*Table 14 Variance Inflation Factor of Variables*

Table 15 shows the results for logistics regression with the highest Pseudo R-squared at 32.6 percent, which partially explain the probability of survival. Consistent with previous studies in real estate and corporate finance (Roelfs, 2011), larger malls are more likely to survive. High occupancy is also the indication for strong performance and high likelihood of survival. The age and the probability of survival has a U-shape relationship, which means the youngest and the oldest malls are less likely to survive. In Model 5, the coefficient for age is 0.0398914 and the coefficient for age squared is -.0003986. The maximum value of survival probability is at around 50 years. This trend can be validated by Figure 7 which plot the year built of 1,513 malls in 2010 and categorized them into survival malls and dead malls. In 2010, there were still 41 enclosed malls were built before 1950. However, more than half of them were closed down in the 2010s. They might be too old to stay competitive. Meanwhile, newly built malls also have a high likelihood that they cannot survive the first decade. 159 enclosed malls were constructed between 2001 and 2010 and unfortunately, in 2020, 47 percent of them have been no longer listed as enclosed malls. Malls with recent renovation, an Apple Store and high anchor quality scores are more likely to survive. It is noticeable that the magnitude of Apple Store is strong. The

indication can be both sides. On one hand, malls with an Apple Store, a representative of experiential retailer, are more attractive to customers. On the other hand, the result may show the success of the location strategy of Apple, by picking the most resilient and strong players in the enclosed mall section. The results show that higher supply of other shopping centers per capita is negatively related to the probability of survival, which is in line with the findings of Roelfs (2011) that higher level of retail supply in the area will increase the probability of closure. These models also discover that high level of household density and median household income contribute to the survival of enclosed malls in the county, corresponding the idea from Clapp et al. (2014) that potential retail revenue in a market can be proxied by the number of households and the median household income. Although Leung et al. (2018) find the positive relationship between household density growth the property value, the high growth rate of neither household density nor median household income can contribute to the probability of survival. In the study of Roelfs (2011) using hazard analysis, he also denotes that the adverse demography trends are crucial to mall closure.

	1	2	3	4	5
Mall GLA	3.632*** (11.45)	4.122*** (11.78)	2.806*** (6.92)	3.036*** (6.77)	3.891*** (7.64)
Mall Occupancy		0.024*** (6.86)	0.010*** (2.58)	0.009** (2.50)	0.011*** (2.68)
Mall Age		0.040*** (3.08)	0.034*** (2.68)	0.030** (2.35)	0.040*** (2.94)
Mall Age (Quadratic Term)		-0.000*** (-2.87)	-0.000** (-2.52)	-0.000** (-2.23)	-0.000*** (-2.62)
Renovation		0.520*** (3.05)	0.517*** (3.00)	0.577*** (3.01)	0.601*** (2.89)
Apple Store			1.165** (2.55)	1.380*** (2.99)	1.514*** (3.31)
Anchor Quality			0.238*** (5.94)	0.228*** (5.65)	0.188*** (4.22)
Other Centers per Capita				-0.078***	-0.091***

				(-4.97)	(-4.86)
Household Density					-0.336***
					(-3.71)
Median Household Income					-1.205**
					(-2.46)
Density Growth					0.067
					(0.60)
Income Growth					0.167
					(1.32)
Constant	-20.102***	-25.405***	-17.768***	-17.436***	-6.856
	(-10.95)	(-12.32)	(-7.45)	(-6.66)	(-1.31)
Observations	1347	1334	1334	1145	1134
Pseudo R <sup>2</sup>	0.105	0.233	0.273	0.297	0.326

(1) z statistics in parentheses

(2) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 15 Logit Model Estimates – Survival

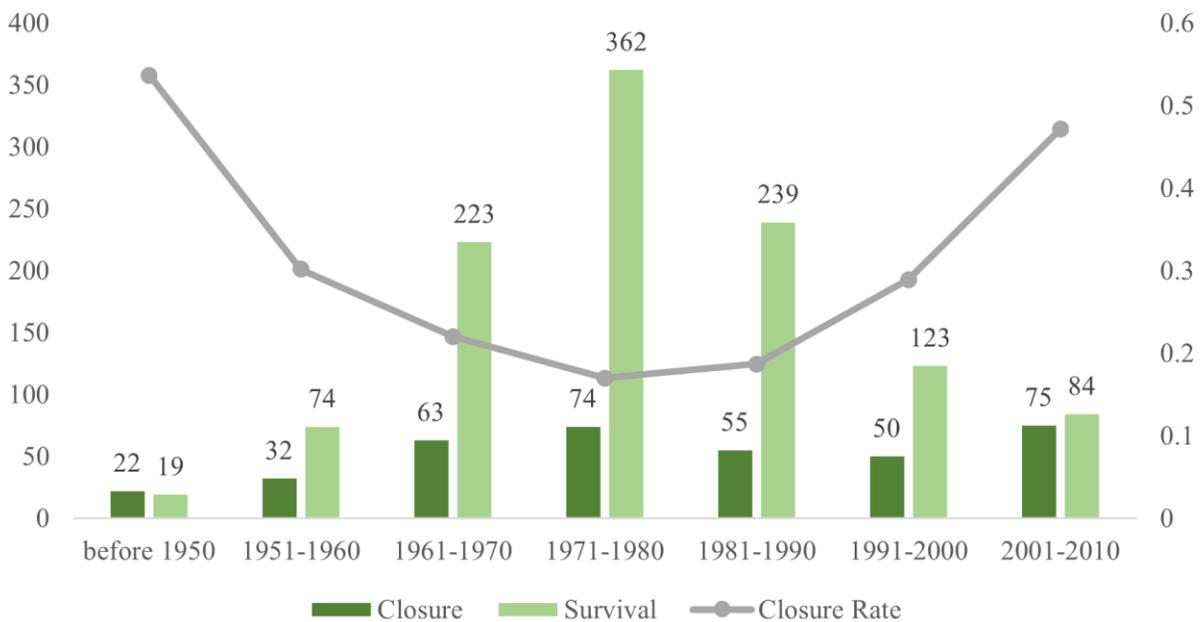


Figure 7 Pace of Enclosed Mall Construction and Closure

### 5.3 Expansion and Contraction

Although the overall market concentration level and the median value of mall GLA have increased, the decision about expansion and contraction varies across malls. The expansion and contraction decisions are not supposed to be considered as the direct indication of business

performance, but a more comprehensive reaction to both operation situation and market potential. The results for the expansion and contraction decision of enclosed malls tell a complicated story. The dataset contains only retail establishments recognized as enclosed malls by CoStar in both 2010 and 2020.

Table 16 shows the estimates of three models focusing on the Mall GLA change. All three models indicate that larger malls are more likely to contract and less likely to expand, while smaller malls are more likely to expand and less likely to contract. The clue of this trend can be found in the summary statistics that malls in 2020 have a smaller standard deviation in terms of GLA than the data in 2010. The mall occupancy is significant in the OLS model indicating that malls with higher occupancy are more likely to increase the GLA with a small magnitude. One percent increase of mall occupancy in 2010 is associated with a 0.077 percent change of mall GLA. The implications of Apple Store and Anchor Quality are in the same direction. Enclosed malls with an Apple Store and department store anchors of higher quality are more likely to increase mall GLA and less likely to contract. The results regarding household density is partially in line with the findings of Clapp et al. (2014) who believe that higher potential revenue, proxied by the number of households and household income in the trade area, increase the likelihood of expansion and decrease the likelihood of contraction, although the significance of household income has not been detected.

	OLS	Logit	
	percent Change of Mall GLA	Expansion	Contraction
Mall GLA	-39.295*** (-5.35)	-1.758*** (-3.35)	3.382*** (-5.14)
Mall Occupancy	0.077*** (-2.96)	0.001 (-0.36)	-0.006 (-1.37)
Mall Age	-0.101 (-0.74)	-0.005 (-0.37)	0.025* (-1.81)

Mall Age (Quadratic Term)	0.000 (-0.27)	0.000 (-0.99)	0.000 (-1.25)
Renovation	1.483 (-0.98)	0.128 (-0.78)	-0.204 (-1.10)
Apple Store	6.064** (-2.50)	0.238 (-1.05)	-0.860*** (-3.19)
Anchor Quality	1.034*** (-3.29)	0.041 (-1.39)	-0.105** (-2.37)
Other Centers per Capita	0.068 (-0.31)	-0.001 (-0.07)	0.015 (-0.83)
Household Density	3.313*** (-2.77)	0.176** (-2.17)	-0.106 (-1.06)
Median Household Income	3.421 (-0.52)	0.164 (-0.40)	-0.247 (-0.50)
Density Growth	1.093 (-0.92)	0.029 (-0.30)	0.094 (-0.88)
Income Growth	-1.559 (-1.06)	-0.021 (-0.20)	0.145 (-1.12)
Constant	172.743** (-2.20)	5.906 (-1.24)	-17.980*** (-3.06)
Observations	858	858	858
R <sup>2</sup>	0.0990	0.0185	0.0788

(1) t statistics in parentheses and Adjusted R<sup>2</sup> for OLS model

(2) z statistics in parentheses and Pseudo R<sup>2</sup> for Logit models

(3) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

(4) State dummies are added as control variables for the OLS model

*Table 16 OLS and Logit Estimates for Mall GLA Change*

Table 17 shows the estimates of six models involved with tenant number change, both mall GLA in 2010 and number of tenants in 2010 are tried as the independent variable. The models including the number of tenants in 2010 have higher explanation power than models with mall GLA in 2010. Two kinds of models have similar indications regarding the size of the mall. The probability of a more than 10 percent increase of tenant number is negatively correlated with mall GLA and the number of tenants in 2010. The probability of a more than 10 percent decrease of tenant number is positively correlated with the number of tenants in 2010. Occupancy matters in all cases however the direction is different from the previous OLS estimate for mall GLA change. The results imply that malls with a lower level of occupancy are more likely to increase the number of tenants and vice versa. The results of age indicate that the increase of age is

negatively correlated with the tenant number change in percentage. In line with mall GLA change, malls with an Apple Store or high-end department store anchors are more likely to increase tenant number and less likely to contract. Household density in the local area plays an important role in five out of the six cases, while the household density growth rate matters for the contraction of tenant numbers. Consistent with the findings from Clapp et al. (2014), high household density is positively related to the change of tenant numbers.

	OLS		Logit - Expansion		Logit - Contract	
	GLA	Number of Tenants	GLA	Number of Tenants	GLA	Number of Tenants
Mall GLA	21.737 (-0.79)		-2.121** (-2.46)		0.702 (0.89)	
Number of Tenants		-0.492*** (-6.36)		-0.032*** (-6.59)		0.027*** (7.42)
Mall Occupancy	-0.706*** (-4.74)	-0.600*** (-4.64)	-0.067*** (-6.66)	-0.042*** (-4.87)	0.033*** (4.10)	0.020*** (2.96)
Mall Age	-1.883*** (-2.81)	-2.067*** (-3.28)	-0.049** (-2.04)	-0.036* (-1.83)	0.042* (1.91)	0.040* (1.88)
Mall Age (Quadratic Term)	0.013** (2.03)	0.014** (2.47)	0.000 (1.32)	0.000* (1.70)	0.000 (-1.33)	0.000 (-1.37)
Renovation	2.637 (0.45)	8.683 (1.42)	0.077 (0.28)	0.088 (0.26)	0.097 (0.47)	0.015 (0.06)
Apple Store	5.727 (0.87)	26.778*** (4.32)	0.418 (1.03)	1.899*** (3.45)	-0.650** (-2.22)	-1.914*** (-5.28)
Anchor Quality	-5.666*** (-4.00)	-0.879 (-0.88)	0.105 (1.44)	0.160** (2.42)	0.019 (0.31)	-0.107** (-2.08)
Other Centers per Capita	-0.592 (-0.78)	-0.145 (-0.20)	-0.038 (-1.33)	-0.013 (-0.47)	0.038* (1.88)	0.024 (1.10)
Household Density	1.245 (0.29)	7.757** (2.20)	0.405*** (2.68)	0.532*** (3.93)	-0.355*** (-3.27)	-0.556*** (-5.11)
Median Household Income	42.218 (1.62)	47.166* (1.84)	0.991 (1.29)	1.575** (2.12)	-0.728 (-1.43)	-1.438*** (-2.62)
Density Growth	2.288 (-0.41)	2.837 (-0.53)	0.132 (-0.92)	0.186 (-1.18)	-0.271** (-2.40)	-0.360*** (-2.81)
Income Growth	-11.023 (-1.57)	-10.03 (-1.47)	-0.21 (-1.30)	-0.185 (-0.97)	0.125 (-0.94)	0.122 (-0.83)
Constant	-400.975 (-1.15)	-345.027 (-1.26)	2.076 (-0.24)	-17.903** (-2.30)	4.17 (-0.64)	17.076*** (-3.03)

Observations	847	847	858	858	858	858
R <sup>2</sup>	0.1742	0.2373	0.3381	0.4721	0.1841	0.3226

- (1) t statistics in parentheses and Adjusted R<sup>2</sup> for OLS model
- (2) z statistics in parentheses and Pseudo R<sup>2</sup> for Logit models
- (3) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01
- (4) State dummies are added as control variables for the OLS model

*Table 17 OLS and Logit Estimates for Number of Tenants Change*

## 5.4 Transaction Probability

The models to estimate the probability of transaction have a probability ranged from 4.22 percent (non-distressed transaction) to 10.12 percent (distressed transaction). The numbers seem to be relatively low but the similar study from Fisher et al. (2004) also gets Pseudo R-squared from 5.9 percent to 12.2 percent. More variance of distressed transaction probability is explained than non-distressed transaction probability. In line with the findings from Fisher et al. (2004), smaller properties are more likely to be sold. However, the results for mall age are complicated. In distressed conditions, older malls are more likely to be sold while in non-distressed conditions, younger malls are more likely to be sold. All results indicate that malls with an Apple Store are less likely to be sold, the coefficient in the distressed model is higher than the non-distressed model. In general, the probability of transaction is negatively related to the local area density. In the case of distressed conditions, higher household density indicates a lower probability of transaction. In the case of non-distressed sales, the household density growth rate matters. It is hard to predict the investment return based on available information. According to Fisher et al. (2004), owners who believe that they have captured abnormal short-term returns and the return advantage will be diminished in the long run are more likely to sell the commercial property. The type of seller is controlled in these models and institutional owners are more likely to sell enclosed malls. Pension fund and investment managers are more actively involved in non-

distressed sales while banks are common sellers under the distressed condition due to the existent of REO sales.

	All	Distressed	Non-Distressed
Mall GLA	-1.109*** (-2.70)	0.360 (0.58)	-1.354*** (-3.03)
Mall Occupancy	0.000 (-0.16)	-0.002 (-0.77)	0.001 (0.41)
Mall Age	-0.011 (-1.29)	0.122*** (2.68)	-0.026*** (-2.93)
Mall Age (Quadratic Term)	0.000 (1.14)	-0.002** (-2.37)	0.000*** (2.82)
Renovation	-0.104 (-0.63)	-0.460 (-1.61)	0.023 (0.12)
Apple Store	-1.119*** (-3.41)	-2.111** (-2.01)	-0.841** (-2.42)
Anchor Quality	0.045 (1.63)	0.007 (0.17)	0.044 (1.36)
Other Centers per Capita	-0.005 (-0.31)	0.018 (0.75)	-0.013 (-0.77)
Household Density	-0.129 (-1.62)	-0.398*** (-2.91)	-0.002 (-0.02)
Median Household Income	0.315 (0.78)	-0.388 (-0.53)	0.607 (1.39)
Density Growth	-0.204** (-2.15)	-0.030 (-0.17)	-0.214** (-2.06)
Income Growth	0.039 (0.36)	-0.047 (-0.28)	0.036 (0.30)
Public	0.28 (1.39)	0.061 (0.16)	0.366* (1.65)
Institutional	1.003*** (4.21)	1.257*** (3.56)	0.649** (2.43)
Private Equity	0.545 (1.25)	0.915 (1.37)	0.248 (0.48)
Constant	3.114 (0.69)	0.486 (0.07)	0.356 (0.07)
Observations	1134	1134	1134
Pseudo R <sup>2</sup>	0.0515	0.1019	0.0422

(1) z statistics in parentheses

(2) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

Table 18 Logit Estimates for Transaction Frequency

## 5.5 Transaction Price

Transaction records are divided into four sets based on whether it is a complete transaction and whether it is under the distressed condition. Both total price and unit price are examined. With abundant information about the property and the transaction, the results indicate a strong fit for the data. Year and state dummies are not included in the results in order to make the tables more readable. Table 19 lists the results of complete transactions, which indicates that the price of non-distressed transactions is related to the quality and location of the property, while the price of distressed transactions is more buyer and sale condition specified. Enclosed malls with an urban location, recent renovation and high star ratings are more likely to reach a premium in non-distressed transactions. The price in distressed transactions may fail to reflect these basic characteristics.

	Non-Distressed		Distressed	
	Total Price	Unit Price	Total Price	Unit Price
Size	0.865*** (7.42)	-0.105 (-0.92)	0.748*** (3.95)	-0.253 (-1.33)
Mall Age	-0.008 (-0.56)	-0.008 (-0.49)	-0.016 (-0.26)	-0.016 (-0.26)
Mall Age (Quadratic Term)	0.000 (1.10)	0.000 (0.89)	0.000 (0.49)	0.000 (0.50)
Renovation	0.407** (2.31)	0.361* (1.84)	0.362 (1.03)	0.362 (1.03)
Suburban	-0.525* (-1.90)	-0.647** (-2.12)	-0.122 (-0.26)	-0.123 (-0.26)
Star	0.497*** (2.87)	0.537*** (2.79)	0.381 (1.41)	0.383 (1.41)
Other Centers per Capita	-0.001 (-1.51)	-0.000 (-1.10)	0.001 (1.12)	0.001 (1.11)
Public Buyer	-0.009 (-0.04)	-0.21 (-0.89)	0.347 (0.81)	0.348 (0.82)
Institutional Buyer	0.204 (0.98)	0.284 (1.25)	0.28 (0.65)	0.28 (0.65)
Private Equity Buyer	0.113 (0.61)	0.165 (0.8)	0.858* (1.93)	0.858* (1.93)
Foreign Buyer	0.401 (1.07)	0.471 (1.24)	3.833*** (6.29)	3.834*** (6.29)

Local Buyer	-0.231 (-0.79)	-0.282 (-0.96)	-0.752* (-1.80)	-0.756* (-1.80)
Medium-Term Hold	-0.079 (-0.42)	-0.133 (-0.65)	0.364 (1.05)	0.363 (1.05)
Short-Term Hold	0.003 (0.01)	0.032 (0.12)	0.367 (1.07)	0.368 (1.07)
Bulk Sale	0.043 (0.22)	0.159 (0.7)	0.939* (1.96)	0.941* (1.96)
Household Density	0.030 (0.21)	0.035 (0.24)	0.128 (0.54)	0.127 (0.54)
Median Household Income	-0.638 (-0.46)	0.787 (0.51)	4.118 (1.47)	4.134 (1.47)
Density Growth	-0.022 (-0.22)	-0.085 (-0.80)	-0.092 (-0.50)	-0.092 (-0.50)
Income Growth	-0.023 (-0.14)	0.039 (0.22)	0.431 (1.51)	0.433 (1.52)
Constant	7.303 (1.18)	0.451 (0.07)	-15.371 (-1.32)	-15.435 (-1.33)
Observations	144	144	108	108
Adjusted R <sup>2</sup>	0.7587	0.6406	0.4307	0.3787

(1) t statistics in parentheses

(2) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

(3) State dummies are added as control variables for the OLS models

*Table 19 OLS Estimates for Transaction Price - Complete Transactions*

The results for partial transactions provide an interesting insight into how different secondary property types in enclosed malls are valued in transactions, which may contribute to the understanding of how different kinds of businesses perform in enclosed malls. The first thing to notice is the severe discount of department stores, compared to the reference group, retail storefronts. The past ten years has witnessed the downfall of series of well-known department store brands and the attractiveness of department stores has been doubted (Tokosh, 2019). Scholars at the beginning of 2000 have discussed the superiority of department stores as anchor tenants (Konishi & Sandfort, 2003). Visiting department stores provide customers with a lower price for the same product and lower search cost, due to the variety and distinct brand image possessed by department stores, than visiting specialty stores in the same mall. However, these kinds of advantages seem to be diminished by the prevalence of e-commerce and the wide

adoption of omnichannel among brick-and-mortar retailers. The transparency of price and product offering lower the attractiveness of department stores, especially those targeting price-sensitive customers. Properties serving food & beverage reach the highest premium according to the OLS estimates, which may imply the interesting popularity of service tenants in enclosed malls. However, the transaction price of Sports & Entertainment facilities is not significantly higher than the retail storefronts.

Unlike complete transactions, size and building age matter for all kinds of scenarios. For non-distressed transactions, renovation, urban location and high star rating contribute to transaction premium as they do in complete transactions. Additionally, short- and medium-term holders of the property are likely to receive less in the transaction than long-term holders. In bulk transactions, properties are valued higher with all other factors controlled. The importance of median household income and its growth are recognized in partial transactions. In non-distressed transactions, higher median household income is associated with a higher price. However, interestingly, in distressed transactions, a higher income growth rate is associated with a lower price.

	Non-Distressed		Distressed	
	Total Price	Unit Price	Total Price	Unit Price
Auto Services	-0.124 (-1.09)	-0.043 (-0.37)	0.451 (1.22)	0.435 (1.24)
Bank	0.324** (2.39)	0.365*** (2.61)	0.236 (0.58)	0.239 (0.59)
Department Store	-0.307*** (-3.36)	-0.240** (-2.52)	-0.510*** (-3.37)	-0.514*** (-3.42)
Food & Beverage	0.381*** (5.66)	0.383*** (5.48)	0.415** (2.58)	0.426*** (2.61)
Other Asset Classes	0.234 (1.27)	0.125 (0.62)	-0.289 (-0.77)	-0.464 (-0.88)
Other Retail	0.200*** (3.05)	0.209*** (3.07)	0.025 (0.21)	0.044 (0.37)
Sport & Entertainment	-0.073	-0.141	-0.072	-0.055

	(-0.44)	(-0.86)	(-0.30)	(-0.22)
Size	0.623***	-0.357***	0.780***	-0.214***
	(25.55)	(-14.00)	(16.51)	(-4.48)
Mall Age	-0.024***	-0.021***	-0.032***	-0.029***
	(-7.09)	(-5.79)	(-3.53)	(-3.00)
Mall Age (Quadratic Term)	0.000***	0.000***	0.000*	0.000*
	(6.48)	(5.24)	(1.91)	(1.73)
Renovation	0.120**	0.122**	0.103	0.16
	(2.10)	(2.06)	(0.75)	(1.12)
Suburban	-0.492***	-0.511***	0.149	0.157
	(-5.31)	(-5.23)	(0.55)	(0.58)
Star	0.228***	0.268***	0.086	0.107
	(5.48)	(6.13)	(0.97)	(1.17)
Other Centers per Capita	0.000	0.000	-0.000	-0.000
	(0.36)	(0.85)	(-0.26)	(-0.13)
Public Buyer	-0.011	-0.065	0.232	0.151
	(-0.18)	(-0.99)	(0.93)	(0.57)
Institutional Buyer	0.131*	0.188**	0.631***	0.582***
	(1.76)	(2.44)	(2.92)	(2.65)
Private Equity Buyer	-0.137*	-0.178**	0.979***	1.013***
	(-1.66)	(-2.14)	(3.55)	(3.52)
User	-0.207**	-0.235***	0.187	0.181
	(-2.45)	(-2.66)	(0.93)	(0.90)
Foreign Buyer	-0.015	0.199*	-0.412	-0.163
	(-0.14)	(1.68)	(-0.92)	(-0.32)
Local Buyer	-0.315***	-0.315***	-0.024	-0.078
	(-3.97)	(-3.96)	(-0.15)	(-0.45)
Medium-Term Hold	0.125**	0.143**	-0.127	-0.115
	(2.23)	(2.42)	(-0.91)	(-0.82)
Short-Term Hold	0.128**	0.191***	-0.019	-0.075
	(2.15)	(3.15)	(-0.15)	(-0.54)
Bulk Sale	0.118**	0.264***	-0.010	-0.001
	(2.09)	(4.47)	(-0.05)	(-0.00)
Household Density	0.035	0.057	-0.003	-0.037
	(0.97)	(1.52)	(-0.03)	(-0.34)
Median Household Income	1.380***	1.380***	0.559	1.878
	(2.85)	(2.77)	(0.47)	(1.07)
Density Growth	-0.035	0.005	0.045	0.000
	(-1.04)	(0.14)	(0.48)	(0.00)
Income Growth	-0.047	-0.051	-0.240**	-0.299**
	(-0.98)	(-1.03)	(-1.98)	(-2.27)
Constant	2.079	1.407	2.974	-2.700
	(0.95)	(0.63)	(0.58)	(-0.36)
Observations	1494	1494	333	333
Adjusted R <sup>2</sup>	0.6137	0.4806	0.7667	0.6398

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(1) t statistics in parentheses

(2) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

(3) State dummies are added as control variables for the OLS models

*Table 20 OLS Estimates for Transaction Price - Partial Transactions*

## 5.6 Assessment Value

The models for assessment value have a mediocre level of explanation power with Adjusted R-squared ranging from 23.75 percent (unit value in 2020) to 31.33 percent (total value in 2010).

The models can explain more differences in total price than unit price. The trend that larger and malls have a premium in valuation, especially the total value, is consistent with the finding of Leung et al., (2018) who work with a different set of enclosed mall assessment values. Older malls have a discount in valuation. This may be attributed to the inevitable obsolescence which can hardly be cured by renovation (Roelfs, 2011). Similar to the results of transaction price, the OLS estimates for assessment value also show the emphasis on tenant quality and population density. In 2010, enclosed malls with an Apple Store had a significantly higher valuation than those without one. In 2020, both the Apple Store and the quality of anchor tenants matter. More high-end anchor tenants are related to the premium in valuation Having a department store of high price type instead of medium price type (one unit increase of anchor quality score) will contribute to a 5.5 percent increase of total assessment value and an 8.3 percent increase of unit assessment value.

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	2010		2020	
	Total	Unit	Total	Unit
Mall GLA	2.364*** (6.52)	0.764** (2.05)	0.737*** (2.73)	0.094 (0.31)
Mall Occupancy	0.005*** (2.96)	0.001 (0.79)	0.087 (0.59)	0.223 (1.40)
Mall Age	-0.020** (-2.45)	-0.037*** (-4.09)	-0.001 (-0.04)	-0.020* (-1.66)
Mall Age (Quadratic Term)	0.000* (1.89)	0.000*** (3.41)	0.000 (-0.63)	0.000 (-0.80)

Renovation	0.023 (0.16)	-0.089 (-0.60)	-0.177 (-1.06)	0.017 (0.10)
Apple Store	1.024*** (5.65)	1.053*** (5.68)	0.705*** (4.25)	0.926*** (5.00)
Anchor Quality	0.016 (0.67)	-0.021 (-0.88)	0.055** (2.41)	0.083*** (3.22)
Other Centers per Capita	-0.016 (-0.98)	-0.004 (-0.26)	0.001* (1.82)	0.000 (-0.18)
Household Density	0.223** (2.57)	0.253*** (2.86)	0.130 (1.39)	0.097 (0.95)
Median Household Income	-0.574 (-1.33)	-0.428 (-0.95)	-0.274 (-0.29)	-0.089 (-0.10)
Density Growth	0.160* (1.91)	0.137 (1.59)	0.470*** (3.24)	0.420*** (2.76)
Income Growth	-0.058 (-0.51)	-0.072 (-0.62)	-0.157 (-1.27)	-0.054 (-0.54)
Constant	9.255* (1.81)	4.636 (0.87)	7.406 (1.32)	3.320 (0.56)
Observations	738	735	747	743
Adjusted R <sup>2</sup>	0.3133	0.2623	0.2544	0.2375

(1) t statistics in parentheses

(2) \* p < 0.10, \*\* p < 0.05, \*\*\* p < 0.01

(3) State dummies are added as control variables for the OLS model

## 6 Implications

Managerial implications can be driven from this study for developers, managers and investors of enclosed malls or be expanded to a wider range of retail real estate. Key takeaways among the findings include the decision about mall size, tenant quality and location strategies. Larger malls are more likely to survive and reach a premium in valuation. Higher quality tenants, with high-end merchandise offering and unique experience, may also lead to a higher likelihood of survival and a stronger valuation premium. Although the size matters, it is not the sole determinant of enclosed malls. It can be imagined as a feedback loop that larger malls are more attractive to high-end anchor tenants and experiential retailers. Meanwhile, tenants with higher quality contribute to the revenue of malls and save them from downsizing or closure. For potential

developers of enclosed malls, if the size of the land parcel and other zoning requirements are not suitable for a large-scale enclosed mall, an open-air center or other formats of retail establishments may be a more feasible choice. Price-sensitive customers may not be a good target segment for enclosed malls, since they are likely to turn to more attractive price offering online and not care much about service and experience.

In terms of location strategy, investors should notice the risk of enclosed malls in high density areas. They are less likely to survive but are rewarded by higher valuation in both transactions and the assessment. Meanwhile, they are more likely to expand due to the positive trend of household density, which urges investors to have quick reactions to the ever-consolidated markets. Meanwhile, the hedonic pricing models reveal the mismatch between the pricing of distressed properties and their quality. There may be chances for investors to acquire recently renovated high quality retail properties in distressed sales with a low price.

## **7 Limitation and Further Research**

Due to the constraint of time and data, the study has several major limitations, which pave the way out for further research. Firstly, year-by-year data of enclosed malls are not available. The ten-year interval between the two data sets leaves a severe gap for the changes and uncertainty. The closure year of enclosed malls is unknown and hard to define without the annual list, which is a crucial instrument for the hazard analysis to understand the dynamic of survival and closure. The loss of year-by-year data also masks the operating status of enclosed malls, such as gross leasable area, occupancy and tenanting information. Although they may not be drastically different from the 2010 or 2020 cross, the change may influence the transaction decision and valuation.

Secondly, although e-commerce has been widely regarded as the driver of retail restructuring, the study is not able to factor its influence into any of the models. The depiction of market competition is confined to brick-to-mortar retail. The result of this study can inspire scholars for more refined models or acute experimental studies to proxy the impact of e-commerce on brick-and-mortar retail.

Thirdly, various studies have accounted for spatial dependences when trying to understand the pricing of real estate. Spatial models deploy information from spatially close transactions, taking into account the well-observed tendency that sites close together have similar values (Freybote et al., 2016). The understanding of spatial dependences in the performance of real estate helps investors to draw proper economic inference and diversify their portfolio (Downs & Slade, 1999; Hayunga & Pace, 2010). A spatial-temporal autoregressive model is a reasonable choice for further research to investigate how the price of enclosed malls and reduce the bias from location and time.

## **8 Conclusion**

This study deploys data from CoStar from 2010 to 2020 to understand the evolution of enclosed malls in the U.S. by investigating their survival, transaction and valuation. The examination of the overall market structure shows the distinct increase of market concentration in enclosed malls.

When it comes to property level data, enclosed malls are becoming fewer and larger from 2010 to 2020. The closure of enclosed malls is associated with the mall characteristics, tenant characteristics, market competition and local demography. Large size, recent renovation, high occupancy, high-end department store tenants, experiential retail store are signals for the mall's

survival. In terms of location, enclosed malls in the area with less competition from other shopping centers, less population density and less median household income are more likely to survive, which may imply that enclosed malls in intensely populated urban areas are facing more severe challenges. Similarly, the frequency of distress sales can be explained by those indicators. However, the non-distress transactions or expansion option can hardly be explained by above-mentioned factors.

Mall and tenant characteristics contribute to the premium in transactions, while intense competition and positive demography trends can also boost the valuation. The hedonic pricing model depicts other worth noticing factors in transactions. Malls with recent renovation, high building quality and urban location are more likely to reach premium in the non-distressed condition but not the distressed condition. It reveals the popularity of secondary property types. Food & beverage is the favorable type while the value of department stores have been diminished. When we compared the 2010 and 2020 assessment values, it can be noticed that the significance of tenant quality has raised.

Lastly, this study attempts to illustrate the evolution of enclosed malls in the ten years from various perspectives with rudimentary explanations. The results shed light on further research to understand the dynamics of retail performance, retail property valuation and corporate decision making theoretically and empirically.

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