RETHINKING MULTIFAMILY VALUATION IN NEW YORK CITY: THE IMPACT OF THE COVID-19 PANDEMIC ON APARTMENT PREMIUMS

A Thesis

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ABSTRACT

This thesis examines the changes in the valuation of apartments and the premiums paid based on spatial characteristics, demographics, amenities, and neighborhood qualities in post-pandemic New York City. It is argued that traditional factors, such as proximity to the Central Business District and other prime locations such as Central Park, subway stations, and popular retail destinations like Starbucks have become less attractive to tenants due to the pandemic's effects on living and working habits. The study further investigates the growing importance of amenities and retail space in the building to post-pandemic residents. The analysis is contextualized within the historical redlining practices that shaped New York City's neighborhoods, affecting the distribution of essential workers and remote workers across the city.

BIOGRAPHICAL SKETCH

Alexander Lee Kim is an M.S student at the School of Hotel Administration at Cornell University

To my wife, who has encouraged me to succeed when failure seemed to be inevitable.

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INTRODUCTION

The coronavirus has changed life drastically for everyone around the world, and impacts were most felt in dense cities, due to its highly transmissive nature. Before its outbreak, the world was pursuing the increase of shared spaces and trying to figure out how to get agglomeration benefits of human interaction in cities, corporations, and schools. All of a sudden, people did not want to be in crowded areas and governments instigated quarantine policies to help stall the spread of the virus. This was particularly evident in New York City, which has the highest number of cases and deaths per capita among U.S cities. As the pandemic worsened, people fled for larger dwellings in the suburbs in search of more personal space in the home and to increase square footage per dollar. Before we investigate the qualities these new-normal tenants are searching for, we must set the basis for how real estate has been valued throughout U.S history.

Real estate valuation in the U.S has a long and complex history. The difficulty of valuation compared to that of stocks and bonds lends more bias and interpretation and adds obstacles to the evolution of valuations methods. Real estate valuation is inherently more difficult than stock valuations due to several reasons involving illiquidity, heterogeneity, subjectivity, and locality. Real estate transactions occur much less frequently than stock trades, making it more difficult to obtain a market-driven price. The process of selling a property can take months, with many properties not selling for years, or even decades. On the other hand, stock prices are readily

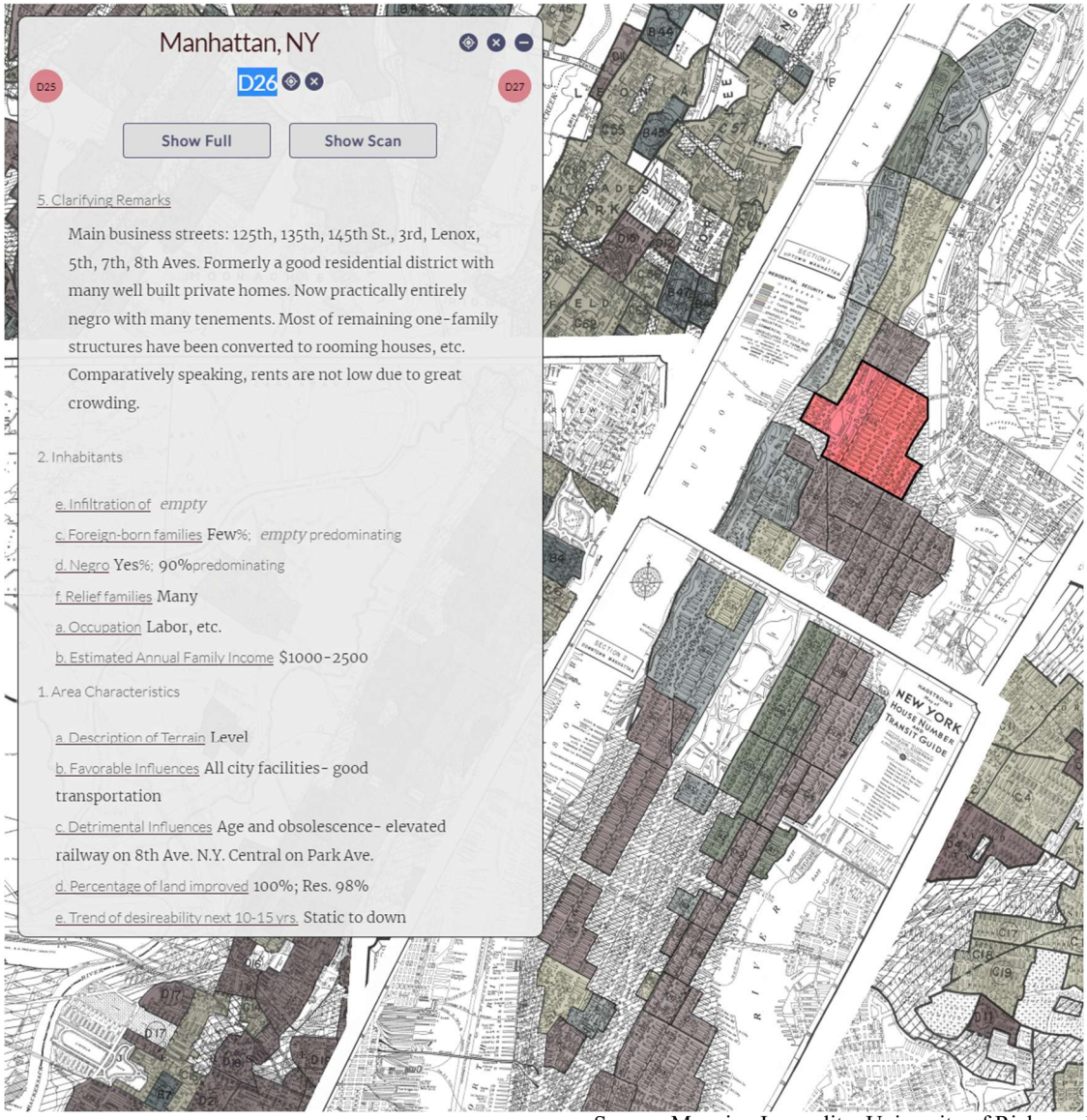
available on exchanges and stocks can be sold easily in a matter of seconds. Stocks, by nature, represent ownership in homogenous units of a corporation. A stock held by one stockholder in indistinguishable from one held by another stockholder. Real estate is heterogenous in nature, in that each plot of land or property is unique in shape, location, size, age, condition, and use. These unique attributes make direct comparison between different properties very difficult. Real estate valuation involves a great deal of subjectivity in comparison to stock valuation. Stocks are valued objectively by aggregating financial data, and the same is done for real estate through income approach appraisals. However, the potential for bias to make it into valuation is greater, due to heterogenic nature of real estate, such as location, condition, and age. Real estate markets are localized to a greater extent than stock markets. Real estate values are highly impacted by local market conditions, which make it more challenging for those who do not know the area.

THEORETICAL BACKGROUND

Historical Redlining

Hindered by these obstacles, real estate valuation has seen many changes throughout history. Various methods involving appraisals and statistical analysis were implemented over time, including some controversial methods by the Home Owner's Loan Corporation in the 1930s. During the Great Depression, unemployment rates and mortgage defaults were skyrocketing, and foreclosures threatened the entire country (NYC, 2021). As an instrument of the New Deal implemented by President Franklin D. Roosevelt, the HOLC was established to help people keep their homes. The HOLC issued bonds and used the bonds to purchase distressed mortgages and often refinanced these mortgages for the borrower, so that the borrower would be left with more favorable interest rates and repayment periods. To better determine risk of default and loan sizing, the HOLC sent appraisers to cities across the U.S in hopes of understanding which loans they could guarantee (NYC, 2021). The appraisers graded neighborhoods based on condition of housing, transportation access, proximity to amenities, pollution, economic class, and ethnicity. Neighborhoods were categorized and color coded, or "redlined" on maps into four designations: Green for "Best", blue for "Still Desirable", yellow for "Definitely Declining", and red for "Hazardous" (NCRC, 2018). In the map description below, the appraiser for the Harlem area has noted that the neighborhood was "Formerly a good residential district with many well built private homes. Now practically entirely negro with many tenements" (HOLC).

Figure 1. HOLC Redlining



Source: Mapping Inequality, University of Richmond

Another area that is Manhattan Valley today has the following remarks from an appraiser. “There has been a small settlement of negroes on 99th St. for many years, apparently not spreading. The district may gradually improve” (HOLC). Other racist and discriminatory remarks used in redlining include “Infiltration of: Negroes, Italians, and Asiatics”, “Taken over by the working class”.

Redlined neighborhoods, predominantly occupied by minority groups, were considered high-risk areas for investment. As a result, banks denied mortgages or charged higher interest rates on those that lived in these areas. The redlined areas were starved of investment, and those who were not able to afford homes due to discrimination-charged increased cost of debt did not have access to the opportunity of the accumulation of generational wealth through property ownership. The repercussions of the redlining can be seen today; 74% of neighborhoods that the HOLC deemed as "Hazardous" are low to moderate income today (NCRC, 2018).

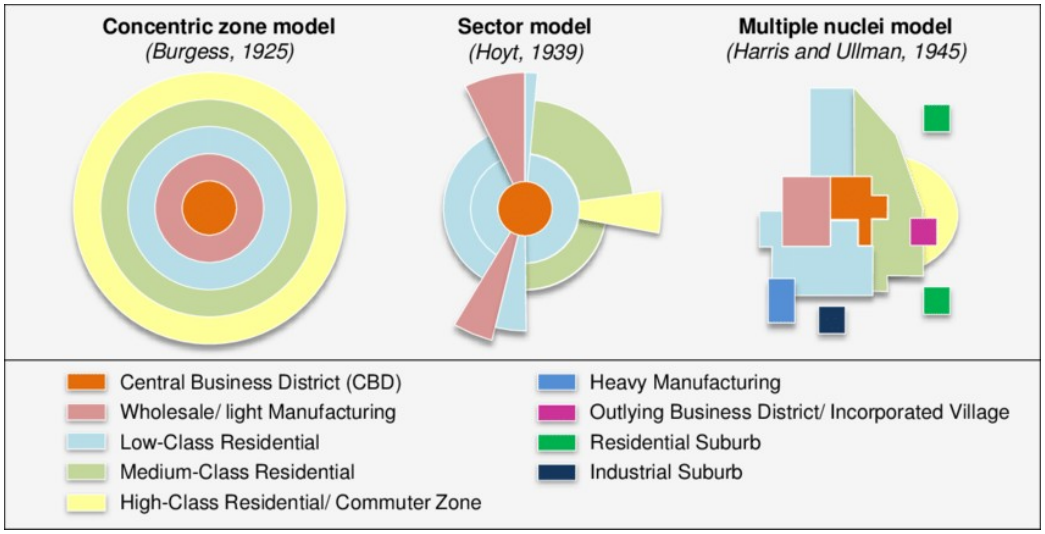
Although the classical urban models: concentric zone, sector, and multiple nuclei and the predictions that are derived from them are aging in a drastically developing world, they can be used as a foundation to think about the dispersion and placement of people throughout the city. The influence these models have on the real estate landscape and demographics of a city are crucial when thinking about real estate valuation throughout history. Ever since

The Monocentric City

Historically, a large body of research has established that most early cities were established from feudal estates and marketplaces. From an economic perspective, "the city is a settlement that inhabitants of which live primarily off trade and commerce rather than agriculture" (Weber, 1921). The existence of a regular rather than an

occasional exchange of goods is important for the city to establish economic versatility (Weber, 1921).

Figure 2. Concentric Zone Model



Markets in early cities allowed inhabitants to exchange ideas, goods, and services which further bolstered urbanization. They would be in the city center, which was mostly commercial in nature and denser. As cities became larger, they eventually needed to grow both outwards and upwards. Cities also required more and faster methods of transportation as they grew in area. Large population clusters will be found along large transportation routes in cities. Dwellings are usually smaller towards the city center and larger towards suburban and rural locations. All these characteristics come together for a myriad of economic dynamics that can produce predictions of how people will behave or how the market will move.

These dynamics and the effect they have on land use was first pioneered by Johann Henrich von Thünen in his original work when he set out to identify the efficient dispersion of different agricultural activities throughout a city. In his model, Thünen argues that different agricultural activities will occupy different sectors of the city due to different production, transportation costs, and yields (1966). These activities will then locate most effectively according to the costs involved, how affordable the rent is compared to profits, etc. Naturally, the different activities will form rings around the city.

The monocentric city structure suggested by William Alonso, Edwin Mills, and Richard Muth in their model, the Alonso-Mills-Muth model expands upon that of Thünen and the Concentric Zone Model of Ernest Burgess regarding the urban economy. There are some basic assumptions that one must grasp when interpreting the model. The German geographer Walter Christaller first introduced central-place theory in his book *Central Places in Southern Germany* (1933). The assumptions utilized by Christaller would be used in other monocentric theories as well. The first key assumption when examining Christaller's work, the Burgess Urban Land Use Model, and the Alonso-Mills-Muth model and is that all or most jobs are located in the Central Business District(CBD). This simplified assumption has limitations in that this is not always true in cities around the world, but still provides a useful framework for understanding urban economics and land use. Secondly, access to the CBD is only a function of distance. With this assumption, the landscape is uniform and flat without topographic disruptions; imagine a very dense network of uncongested roads. All

households in the area are similar; they have the same income, preferences, size, happiness/satisfaction levels. They also only commute to work in the model, and do not take additional trips for other reasons. Households also use the same transportation mode and therefore have the same commuting costs for an equal distance. Commuting is costly for the household; there are financial costs that are a function of distance to the city center and there are time costs that are a function of time and opportunity costs. If we accept the parameters d = distance to the city center (in miles), g = commuting cost per miles (in dollars), then the total cost of commuting is $C(d,g) = d \times g$. If households earn income y, then they have disposable income $y - d \times g$ to spend on costs in addition to commuting. In this model, consumers require and consume two goods: b = *bread(sustenance)* and q = *Housing(sqft)* with p = *Price*. Therefore, $y - d \times g = p \times q + b$, or household income less commuting costs would be equal to and available for cash spent on food and housing. Due to the equilibrium condition that all hypothetical households are satisfied and happy, the conclusions of the model state that on the supply side, rent/sqft decreases and dwelling size increases as the distance to the CBD increases. On the supply side, the price of land decreases and building height decreases as distance to the CBD increases. Because land is much more expensive in the CBD than in the suburbs, developers build very high to take every advantage of the plot of land. Because rent is more expensive closer to the CBD, housing in the vicinity is smaller than those in the suburbs. Therefore, population density decreases as the distance to the CBD increases.

Appeal of City Centers Post-COVID

Before the pandemic, firms believed that offices were critical to productivity, culture, and winning the war for talent. Demand for densification, open-office designs, hoteling, and co-working was significantly high (McKinsey, 2020). In the aftermath of the Coronavirus outbreak, New Yorkers began to change their living habits and amended their demand for space in a myriad of ways. According to Gupta et al. (2022), "Physical occupancy in the major U.S office markets fell from 95% at the end of February 2020 to 10% at the end of March 2020….gradually creeping back to 47% by mid- September 2022". Although remote work had been picking up steam since the 80's in the U.S, the pandemic forced firms to learn how to work effectively from home. Many firms have instigated permanent or hybrid remote work arrangements, and several have moved to cheaper and/or less dense cities. There is a heightened concern from the City of New York over low office occupancies and plans to utilize empty office buildings for other required uses. Demand for office space in NYC has waned significantly post-COVID; between the end of 2019 and the end of 2020, the entire NYC office stock experienced a 44.8% reduction in value (Gupta et al, 2020). McKinsey's (2020) research found the following:

> Estimates suggest that early this April, 62 percent of employed Americans worked at home during the crisis, compared with about 25 percent a couple of years ago. During the pandemic, many people have been surprised by how quickly and effectively technologies for videoconferencing and other forms of digital collaboration were adopted. For many, the results have been better than imagined. According to McKinsey research, 80 percent of people questioned report that they enjoy working from home. Forty-one percent say that they are

> more productive than they had been before and 28 percent that they are as productive. Many employees liberated from long commutes and travel have found more productive ways to spend that time, enjoyed greater flexibility in balancing their personal and professional lives, and decided that they prefer to work from home rather than the office. Many organizations think they can access new pools of talent with fewer locational constraints, adopt innovative processes to boost productivity, create an even stronger culture, and significantly reduce real-estate costs.

In their study, Stuart S. Rosenthal, William C. Strange, and Joaquin A. Urrego found extensive evidence that the value firms place on city centers are sharply decreasing. Pre-COVID, commercial rent on new long-term leases in 89 U.S urban areas declined 2.3% per mile from the city center and increased 8.4% with a doubling of zipcode employment density. Post-COVID, the downward sloping commercial rent gradient associated with distance to city center fell sharply in transit-oriented cities, but not in car-oriented cities. The premiums for local density and proximity to a transit station also decreased significantly. “COVID reduced the value of density by an important amount: the elasticity of rent with respect to local density fell by 2% for both transit-oriented and car-oriented cities (Rosenthal et al, 2022). It appears the benefits of agglomeration have lessened due to fears of disease risk and increase of remote work. If firms place less value on the proximity of office space to city centers, their employees will move in the same direction when considering where to live.

When the pandemic first arrived in the US, many New Yorkers fled to temporary weekend houses and rentals. Especially after the shutdown, many were fearful of virus transmission and thought the benefits of socializing in NYC were extinguished. One of the major draws of life in the city was due to the benefits arising from a highly dense metropolitan area; increased agglomeration benefits and knowledge spillover supported symbiotic relationships between New Yorkers. As people started to realize that COVID would not be eradicated short term, they accepted long term strategies of living with COVID. According to the office of New York City Comptroller Brad Lander (2021), "In a typical year, a tally of change of address forms for New York City shows a net loss of movers – that is, the number of move-outs exceeds the number of move-ins (excluding international move-ins) – but from 2019 to 2020, the net loss more than tripled. Excluding moves marked as "temporary," net out-migration from the city increased by an estimated 130,837 from March 2020 through June 2021, as compared to pre-pandemic trends." From March to May 2020, the first three months of the pandemic, 60% of movers from the city indicated their move was temporary. By November 2021, 79% of net moves had been marked permanent. The wealthiest New Yorkers were the most likely to leave; Those in the wealthiest 10% were 4.6 times more likely to leave than other residents during 2020. Moves from wealthier neighborhoods were also more likely to be temporary. Half of net-out moves from the top 10% of wealthiest neighborhoods were marked as temporary, compared to 44% in the next wealthiest decile and less than 30% in the next group (Lander, 2021).

Flight to Quality and Amenity Wars

In more recent months, the lessened government restrictions coupled with the return of entertainment and some office workers attracted more movers to the city. According to Goldberg (2022), the U.S faces a deficit of more than 3 million homes, with inventory low in the New York Metropolitan Area. The demand for more housing is so strong that it is leading property owners to convert office buildings into residences in Manhattan. The Office and Multifamily asset classes experienced a strong "Flight to Quality". Class A properties in Manhattan were more likely to maintain a high and profitable occupancy rate, while those of lower quality lost much of their tenants. Employees were willing to commute to work more if they enjoyed being at the workplace more. The same interactions were seen in multifamily; as many households amassed increased funds due to not going out as much and received stimulus checks from the government. Many left for the suburbs, so that their money could buy them more square footage than was previously possible. Others searched for higher quality dwellings in the city, so that they could work from home and spend most of their time at the home.

In the search for quality, renters and owners scoured low inventory for properties with the best amenities: health/fitness/wellness assistance, beauty services, medical services, and retail space on the ground floor.

METHODOLOGY

When analyzing the multiple variable regressions, it is crucial to note the conclusions of the monocentric city model and the valuable framework they offer for comprehending the economic dynamics of real estate valuation in New York City during the COVID-19 pandemic. These conclusions illuminate the forces shaping the residential market and the behavior of distinct resident groups, including essential workers and those with remote work capabilities.

1. Price/rent per square foot decreases from the city center: Convenience and accessibility to the city center come with a premium; pay more rent to have lower commuting costs
2. Dwelling size increases from the city center: Land is cheaper further away from the CBD, it is more affordable to build larger homes in the suburbs
3. Land value decrease from the city center: reduced accessibility and increased commuting costs
4. Building height decreases from the city center: High cost of land towards the city center incentivizes developers to build higher in the city center to maximize returns from the expensive land
5. Density decreases form the city center: Lower cost of land and larger dwelling sizes decrease density in the suburbs

The first conclusion, which posits that price/rent per sqft decreases with distance from the city center, underscores the premium traditionally associated with central

locations, particularly in dense urban environments such as New York City. However, with the increased prevalence of remote work during the pandemic, the value of proximity to the central business district diminished for many individuals, particularly remote workers. Consequently, this shift in priorities led to a heightened demand for suburban or out-of-state properties, where residents could benefit from more space and lower living costs.

Despite the general trend of relocating away from the city center, essential workers who could not work remotely faced different considerations. The second and fifth conclusions—dwelling size increases and density decreases from the city center—help clarify why essential workers were more inclined to remain in the city. Numerous essential jobs require a physical presence in specific locations, such as hospitals, grocery stores, or public transit hubs, which are often situated in denser urban areas. Therefore, essential workers prioritized proximity to their workplaces, even if it entailed residing in smaller dwellings or paying higher rents.

Moreover, the third and fourth conclusions—land prices and building height decrease with distance from the city center—suggest that the city center is typified by high land prices and taller buildings, resulting in higher residential density. This density supports a broad array of urban amenities and services catering to essential workers, including public transportation, shops, and healthcare facilities. In contrast, suburban or rural areas may not provide the same level of accessibility and convenience.

An additional explanation for the divergent residential location choices between essential workers and remote workers may lie in the potential impact of historical redlining on the distribution of housing and employment opportunities. Redlining has generated enduring spatial inequalities concerning access to quality housing, education, and employment; these disparities may have influenced the decisions of both essential and remote workers during the pandemic. For instance, essential workers might have encountered more significant barriers to relocating due to financial constraints or limited housing options in suburban or rural areas.

The independent variables I used in this apartment real estate valuation model are year in which apartment was built, year in which it was renovated, whether or not the apartment has first floor retail, whether or not the location is in Brooklyn, Downtown, Midtown South, Staten Island, Upper Manhattan, and Upper West Side, distance to Midtown, distance to the closest subway station, distance to the closest Starbucks, proximity to Central Park, median household income, share of Black residents, share of Asian residents, share of workers that walk to work, whether or not it is owner occupied. Notably, I introduced several variables in addition to distance to the city center, rent premiums associated with proximity to subway stations and employment density explored by Rosenthal, Strange, & Urrego (2021). Through geocoding and spatial analysis, I was able to find distances from each property that saw transactions Pre and Post COVID to different boroughs and neighborhoods in NYC and to the closest subways station and to the closest Starbucks. Starbucks locations were used as a proxy for demand for non-essential retail. I used the log of the distance from

apartments to Central Park to emphasize that the value to proximity declines exponentially as we move away from the location.

I started with 32 variables but omitted certain variables to increase the adjusted r^2 to 0.34. Variables were limited to the aforementioned list of 18 to improve the predictive nature and robustness of the valuation model. Locations in boroughs and neighborhoods are categorical variables, whereas the distances, median household income, racial share of residents, and year that it was built/renovated are numerical. I introduced dummy variables for existence of first floor retail space and whether it is owner occupied with a "1" that indicates yes and "0" that indicates no. The summary of the variables of interest for this study is tabulated below. I performed a series of single variable regressions to determine the significance of each variable and ran a multivariable regression. I ran the multivariable regression five times, omitting insignificant variables each time to increase the r^2 and to make the model as simple as possible.

THE DATA

This paper explored data from CoStar, a widely-used real estate database which contains detailed commercial real estate transaction information. I used New York City apartment transactions data from 2010-2023 and separated the dataset according to the date former President Donald Trump declared the U.S COVID outbreak a public health emergency. The separation allows for comparative analysis to determine how the same variables affected transactions value Pre and Post-COVID. The summary of descriptive statistics from the CoStar data is tabulated below.

	Manhattan	Brooklyn	Bronx	Queens	Staten Island	NYC
Mean Apt Price	$24,361,811	$12,483,311	$8,135,144	$13,446,476	$14,001,560	$17,356,832
Median Apt Price	$8,499,781	$5,400,000	$5,000,000	$6,100,000	$7,800,000	$6,625,000
Max Apt Price	$1,117,947,368	$530,000,000	$115,000,000	$324,723,173	$58,700,000	$1,117,947,368
Min Apt Price	$320,000	$290,000	$300,000	$750,000	$1,275,000	$290,000
Mean Price/Unit	$544,043	$324,710	$140,134	$248,293	$143,225	$387,072
Median Price/Unit	$416,667	$248,152	$130,053	$213,750	$108,209	$263,158
Max Price/Unit	$4,571,429	$1,688,219	$1,000,000	$1,086,957	$500,000	$4,571,429
Min Price/Unit	$29,091	$29,688	$18,555	$25,417	$37,014	$18,555
Mean Price/sqft	$666	$361	$155	$303	$163	$461
Median Price/sqft	$585	$280	$142	$268	$141	$325
Max Price/sqft	$5,505	$1,634	$1,117	$2,219	$344	$5,505
Min Price/sqft	$51	$30	$28	$15	$50	$15
Mean Year Built	1920	1937	1931	1953	1967	1930
Median Year Built	1910	1930	1927	1935	1972	1923
Max Year Built	2021	2023	2021	2023	2009	2023
Min Year Built	1827	1840	1888	1900	1920	1827

RESULTS

	Dependent variable:				
			PricePU		
	(1)	(2)	(3)	(4)	(5)
type_apartment	183,779.60	137,184.60	83,895.68		
	(129,470.20)	(108,276.10)	(78,639.25)		
type_condo	158,569.10	109,257.20			
	(171,855.80)	(156,288.00)			
type_coop	150,132.10				
	(234,251.10)				
type_senior					
Yr_built	-688.32	-689.58	-720.28	-827.36*	-795.71*
	(481.44)	(479.91)	(476.88)	(474.65)	(475.14)
Yt_reno	2,643.32***	2,678.08***	2,701.03***	2,755.91***	2,735.49***
	(556.94)	(553.16)	(550.13)	(548.58)	(547.03)
Retail	121,760.90***	122,526.10***	123,375.80***	123,401.40***	125,393.80***
	(18,124.57)	(18,056.36)	(17,970.82)	(17,943.37)	(17,924.20)
is_brooklyn	93,557.45*	78,135.90*	79,988.22*	80,820.52**	
	(56,004.00)	(42,499.80)	(41,963.11)	(39,592.89)	
is_bronx	54,843.46				
	(71,729.30)				
is_downtown	211,982.40***	200,958.80***	200,875.90***	191,321.60***	115,950.90***
	(54,013.55)	(48,127.21)	(46,005.17)	(44,052.02)	(32,444.21)
is_midtown_east	-53,404.52	-52,026.08	-54,273.41		
	(53,630.37)	(47,835.64)	(45,604.06)		
is_midtown_south	110,049.40***	103,779.10***	106,045.10***	102,571.60***	96,099.27***
	(38,064.69)	(31,907.88)	(29,195.21)	(24,771.08)	(23,802.23)
is_midtown_west	-871.18				
	(52,755.74)				
is_queens	-5,287.87				
	(95,234.39)				
is_staten_island	758,289.70**	737,678.40**	804,062.70***	856,246.00***	707,375.70**
	(324,977.80)	(314,678.00)	(300,085.20)	(294,652.80)	(291,254.00)
is_upper_east_side	-7,206.42	-11,078.79			
	(38,188.54)	(34,535.61)			
is_upper_manhattan	87,116.42	56,253.01	53,220.20	53,270.18	
	(53,515.60)	(34,543.69)	(33,049.22)	(32,477.95)	
is_upper_west_side					
distance_to_midtown	-54,330.65***	-49,694.88***	-51,224.78***	-48,107.34***	-41,954.86***
	(11,135.44)	(8,998.17)	(7,974.71)	(7,256.08)	(5,609.00)
closest_subway	-196,295.80***	-200,277.10***	-207,556.40***	-216,397.70***	-166,194.20***
	(68,566.71)	(68,120.31)	(66,643.25)	(65,498.54)	(62,710.11)
distance_starbucks	26,114.16	22,093.96	22,735.03	21,835.49	18,604.37**
	(17,591.29)	(14,222.13)	(14,112.35)	(14,078.83)	(9,378.74)
hhincomeE	1.69***	1.71***	1.70***	1.54***	1.91***
	(0.36)	(0.35)	(0.33)	(0.29)	(0.26)
share_college	-198,236.40	-197,064.50	-182,949.90		
	(140,616.10)	(137,736.30)	(123,148.90)		
share_white	54,900.31	46,174.76			
	(109,414.40)	(106,940.90)			
share_black	-114,134.80	-99,369.89	-119,184.80*	-114,937.10*	
	(97,314.04)	(93,058.82)	(70,104.07)	(68,227.51)	
share_asian	-229,093.80*	-242,128.70*	-279,458.30**	-262,514.70**	
	(129,776.90)	(128,741.80)	(108,962.30)	(106,318.60)	
share_pubtransworkers	272,287.50	298,338.30			
	(514,650.60)	(507,597.20)			
share_bikeworkers	-496,819.70	-487,256.70	-221,132.80		
	(559,958.80)	(553,911.90)	(224,790.40)		
share_walkworkers	-618,209.70	-649,671.10	-374,078.10***	-307,848.90***	
	(495,375.40)	(485,135.50)	(106,846.40)	(93,437.41)	
owneroccupied	243,488.40***	242,736.50***	245,204.20***	270,327.30***	282,366.00***
	(81,221.15)	(80,720.72)	(75,886.25)	(73,834.21)	(73,599.72)
renteroccupied					
povertyrate	22.48	302.07			
	(1,524.70)	(1,488.69)			
Constant	-3,511,267.00***	-3,531,984.00***	-3,411,862.00***	-3,337,695.00***	-3,583,301.00***
	(1,315,156.00)	(1,303,714.00)	(1,293,807.00)	(1,280,956.00)	(1,276,052.00)
Observations	1,673	1,673	1,673	1,673	1,673
R2	0.34	0.34	0.34	0.33	0.33
Adjusted R2	0.33	0.33	0.33	0.33	0.32
Note:					*p<0.1; **p<0.05; ***p<0.01

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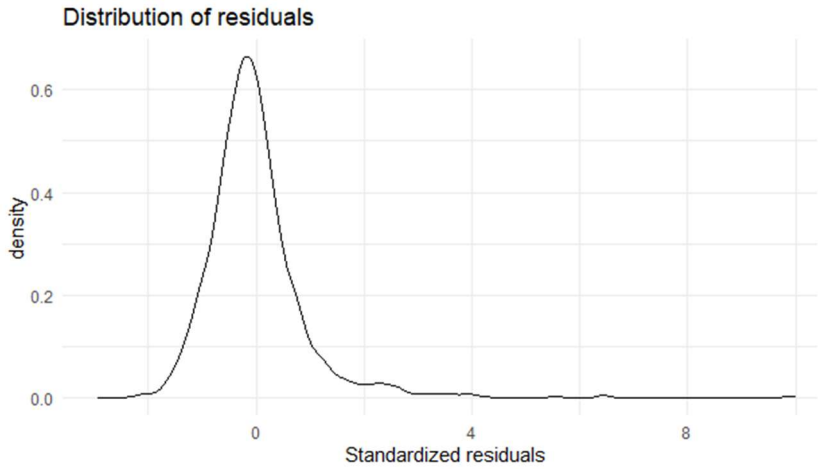
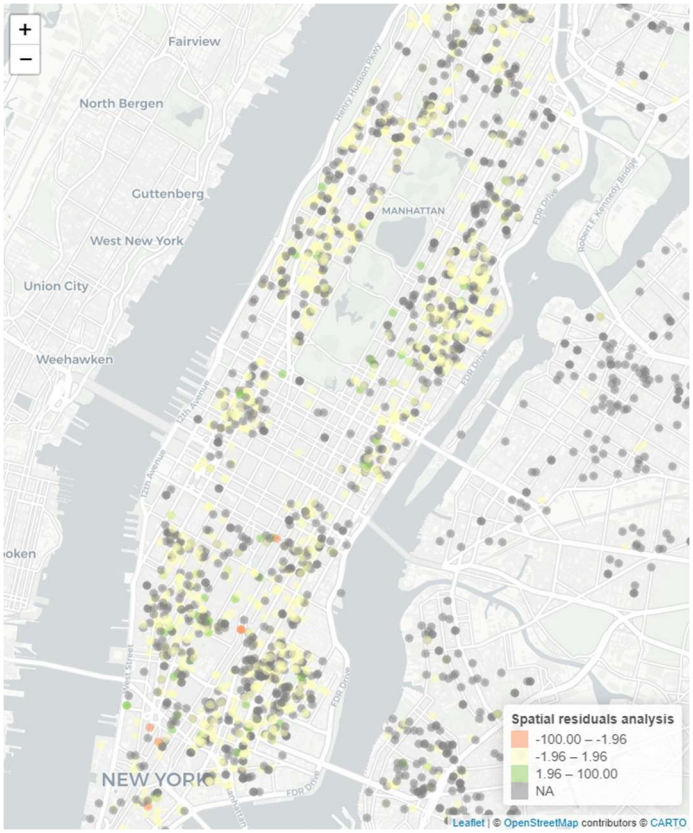
Upon graphing the standardized residuals, we can assume that the model is working well, due to the normal distribution. However, when we go into detail by graphing the residuals on the map, we can see some properties highlighted in green that have errors greater than 2. There seem to be clusters of buildings around Central Park, Midtown, and Times Square that are undervalued. Because distance to midtown is already included as a variable, our next step is to include the distance to Central Park and Times Square as variables.

All variables regarding Times Square are not statistically significant at the 90% level, so they will be omitted. A variable that represents proximity within 0.2 miles of Central Park increased the adjusted r^2 from 0.33 to 0.35. This means that my new model explains 35% of the variability of NYC apartment prices. I am satisfied with this value because it is still a huge advantage in multi-family investments.





Effects of IVs on Price/Unit

Year Built: Variable is not statistically significant at 90% level

Year Renovated: One unit increase of IV increases PricePU by $2960.88

Retail Space: The existence of retail amenities in multifamily increases PricePU significantly

Location: Properties located in these submarkets tend to be priced higher in PricePU

Distance to Midtown: Apartment values decrease as we travel further away from Midtown

Distance to Closest Subway Station: Property values are lower if located further away from a subway station

Distance to Closest Starbucks: Not significant, which is interesting because it was significant in previous models

Proximity within 0.2 miles to Central Park: Being really close(within 0.2 miles) to Central Park brings a large premium

Median Household Income: Families with higher incomes live in more expensive dwellings

Percentage of Blacks: Areas with higher Black population tend to have lower apartment values

Percentage of Asians: Areas with higher Asian population tend to have lower apartment values

Percentage of Workers that Walk to Work: Areas with high walking commutes tend to have lower values

Percentage of Owner Occupied Properties: An owner-occupied apartment is likely to have a higher value than a renter-occupied one

Pre-COVID

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-3099350.9455	1516342.1407	-2.044	0.041146	*
Yr_built	-1309.3008	541.6961	-2.417	0.015776	*
Yt_reno	3093.5597	651.2579	4.750	0.00000224378283	***
Retail	137194.9641	19842.6606	6.914	0.00000000000716	***
is_brooklyn	88733.1102	45251.3380	1.961	0.050091	.
is_downtown	177291.1435	47211.9399	3.755	0.000180	***
is_midtown_south	115019.5732	28112.5283	4.091	0.00004534668779	***
is_staten_island	816829.6469	342751.4511	2.383	0.017299	*
is_upper_manhattan	75951.0624	35761.8792	2.124	0.033863	*
is_upper_west_side	NA	NA	NA	NA	
distance_to_midtown	-41360.7029	8100.9122	-5.106	0.00000037541048	***
closest_subway	-204442.4410	72204.9684	-2.831	0.004701	**
distance_starbucks	22259.1796	15663.5677	1.421	0.155518	
close_CP	292448.5482	41479.4097	7.050	0.00000000000280	***
hhincomeE	1.5872	0.3197	4.965	0.00000077105568	***
share_black	-158509.9119	76057.3939	-2.084	0.037335	*
share_asian	-217557.8220	115651.2675	-1.881	0.060160	.
share_walkworkers	-406667.9621	102462.4170	-3.969	0.00007588592904	***
owneroccupied	275174.1406	81910.7705	3.359	0.000802	***

Post-COVID

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-6204544.1163	2187722.8452	-2.836	0.004941	**
Yr_built	712.9624	900.0876	0.792	0.429051	
Yt_reno	2620.7338	910.6454	2.878	0.004350	**
Retail	124913.9842	38659.6565	3.231	0.001399	**
is_brooklyn	125298.4726	77093.3699	1.625	0.105362	
is_downtown	375603.7894	116772.8317	3.217	0.001469	**
is_midtown_south	198442.1447	50456.2100	3.933	0.000109	***
is_staten_island	410332.9439	552259.6599	0.743	0.458175	
is_upper_manhattan	469.8400	74151.8974	0.006	0.994950	
is_upper_west_side	NA	NA	NA	NA	
distance_to_midtown	-44798.5137	15577.9745	-2.876	0.004378	**
closest_subway	-100000.7635	165998.8681	-0.602	0.547442	
distance_starbucks	10700.4727	29428.2981	0.364	0.716455	
close_CP	43236.0978	100950.1094	0.428	0.668807	
hhincomeE	1.3809	0.6269	2.203	0.028530	*
share_black	-61694.6036	143435.5578	-0.430	0.667478	
share_asian	-369134.5883	256715.6544	-1.438	0.151710	
share_walkworkers	67660.0192	216126.4967	0.313	0.754498	
owneroccupied	138116.8404	161195.5475	0.857	0.392361	

We can posit that Year Renovated, Retail Space, Downtown/Midtown South location, Proximity to Midtown, Proximity to Central Park, and Median Household Income all have a relatively strong effect on PricePU. In terms of spatial analysis, we can assume that prices will be highest in areas that are closest to Midtown, Downtown, and Central Park with a slightly lower effect (but significant) in areas with a subway stations and a Starbucks nearby.

By looking at the Distance to Midtown and Closest Subway variables pre-COVID and post-COVID, we can see a sharp decrease in p values and a contraction of t values. This shows that retail spaces and proximity to Midtown/Subway Station has become

less statistically significant post-COVID on the impact to PricePU values in NYC. The contracted t-values show that the coefficients are less significantly different from zero after the outbreak. The effect of these variables on the PricePU value has lessened after the outbreak of COVID in the US. Therefore, we cannot reject the hypothesis that these implicit values have changed. It is less important for people to have short commutes to midtown and be close to the subways since the percentage of WFM jobs increased in NYC.

This effect cannot be seen on the existence of retail space in apartments. We were expecting a decrease in p-value for Retail post COVID, but we observed the opposite. The t-value has also decreased significantly. Further analysis must be done so that it can be determined that decreased transactions of apartments post-COVID is not affecting the value. Is it important to note that retail spaces are very important in the valuation of apartments even in post-COVID. We can assume that it was significantly important pre-COVID as well.

Variables such as proximity to nearest hospital, number of floors, lease term may have different implications post-COVID. Although it may be too difficult to amass all lease terms of properties in the dataset, we can test for other variables by extracting more census/spatial data in the future.

One substantial addition to future research would be to alter the dependent variable Price per Unit by controlling for the variance in square footage of apartment units. In

tandem, controlling the number of bedrooms by implementing dummy variables would make the NYC Multifamily Valuation Model more robust. By controlling the square footage, we may be able to hedge against the variance of rentable area pre-COVID and post-COVID. This is particularly important for my future research as it will help the premise of the newsworthy exodus of the wealthy from NYC during the pandemic. The number of bedrooms is also in line with this notion, since the value of an apartment unit can also be associated with how many bedrooms and bathrooms it may have.

Additional focus should be put on the variable regarding Year Built and Year Renovated. Although years are essentially linear in nature, it may not be the case when it pertains to apartments in NYC. For example, although the quality of an apartment may improve the more recently it is built, but apartments built in 1930-1940 may be more valuable than those built in 1950-1960. Furthermore, an apartment renovated 20 years ago may not be too different than one renovated 30 years ago. The implementation of dummy variable may introduce more controls into the study.

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