

Exogenous shocks and real estate rental markets: An event study of the 9/11 attacks and their impact on the New York office market

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ABSTRACT: Any attempt to measure the impact of the 9/11 attacks is faced with the difficulty of separating the effects of the attacks from the impact of a wider economic recession and other simultaneous events. This study attempts to isolate the effect on New York office rental and vacancy rates by applying an event study methodology. The results support the hypothesis of significant effects of the September 11 attacks in the New York office market. These effects seem to be limited, however, in terms of their spatial and temporal impact. While the New York office market as a whole has demonstrated remarkable resiliency in the wake of the attack, the downtown market and particularly the World Trade Center submarket have been affected more clearly. Measured three years after the attack, however, cumulative abnormal changes in vacancy rates are moderate in the downtown submarket, indicating a much weaker medium-term impact of the attack than expected in its aftermath.

THE SEPTEMBER 11 attack obliterated 13.4 million square feet of office space in the World Trade Center (WTC) complex and seriously damaged another 17.7 million square feet in 23 surrounding buildings, affecting approximately 31.1 million square feet, or 10 percent of the total stock of Manhattan office space. Nearly 100,000 office workers were subsequently dispersed to over 1,000 different destinations, many of them within Manhattan and a few as far away as London and Tokyo. The secondary consequences and potential economic ripple effects of the attack on lower Manhattan and New York City as a whole are more difficult to grasp than the immediate impact. Over the years since 9/11, it has become evident that initial speculation about a mass exodus of office companies from Manhattan has been unfounded. There are concerns nevertheless that the long-term effects of 9/11 will pose a

continuing threat to lower Manhattan's economic health. The principal objective of this article is to elucidate the impact of the September 11 attack on the New York office market by using an event study methodology to analyze market mechanisms in the wake of the destruction of the World Trade Center.

1 THE IMMEDIATE IMPACT OF THE 9/11 ATTACKS ON OFFICE SPACE SUPPLY

In the aftermath of the September 11 attack, a number of important studies have been published, documenting the damage and giving detailed accounts of the whereabouts of displaced tenants (see, for example, Kelly 2002). This study presents a reevaluation of the impact of 9/11 on the New York office market four years after the recovery process began.

Any attempt to measure the impact of 9/11 on the job market, on the stock market, or on fiscal revenues is faced with the difficulty of separating the effects of 9/11 from the impact of a wider economic recession and other simultaneous events influencing the market. In the case of the office market, disentangling and isolating the effects of 9/11 seems easier because of certain inherent characteristics of real estate markets. The impact on the supply of office space is clearly discernible thanks to available data on the World Trade Center buildings themselves and on the damaged buildings that were gradually returned to the market after restoration.

The total amount of office space affected by the 9/11 terrorist attack is estimated at 31.1 million square feet, of which 13.4 million were completely destroyed and 17.7 million were found to be severely damaged (table 1). Destroyed were the seven buildings of the World Trade Center, which included the two landmark towers with a total square footage of 4.7 million square feet of office space each, and five other buildings ranging from 600,000 to 2 million square feet in size. Also destroyed was the Deutsche Bank building at 130 Liberty Street. The building sustained damage that was eventually deemed too extensive to repair in an agreement between Deutsche Bank, four insurance carriers, and the Lower Manhattan

Development Corporation (LMDC) in which the conclusion was reached to demolish and reconstruct the building.

To put the numbers in perspective, the destroyed space equals roughly the entire office stock of the city of Detroit. When the comparison is limited to prime office space, the damaged and destroyed space equals the inventory of major office locations such as Atlanta and Miami (Jones Lang Lasalle 2001). In the New York City office market, however, because of its vast size, the affected space makes up approximately 10 percent of the total inventory of New York City, though roughly 60 percent of downtown's class A space.¹

2 DATA AND METHODOLOGY

The event study approach was first laid out by Eugene Fama and his colleagues (1969) in a seminal paper and has since been applied to a wide variety of topics in economics and finance, typically with the objective of examining the impact of past occurrences on financial markets or particular industries and companies.

The basic assumption of the event study methodology is that markets are information-efficient so that any new information about changes in market conditions will be reflected in changing asset prices of the affected industries. The portion of the price change attributable to this specific event (for example, the announcement of a merger) is measured as an "abnormal return." In other words, the abnormal return is the difference between the expected future price of an asset prior to the event and the observed price including the event. The expected price can be derived by estimating the parameters of the statistical relationship between Manhattan and the overall national office market with OLS regression.²

The datasets necessary to conduct this analysis were obtained from CoStar and Grubb & Ellis in quarterly format. The quoted rental rates are weighted averages of asking rents by submarkets and/or building. The World Trade Center submarket analyzed in the event study comprises a number of restored buildings in the vicinity of the destroyed WTC complex

including the World Financial Center and a number of other large office buildings (see figure 1 for submarket boundaries).

2.1 Definition of the Event Window

The first step of an event study is to define an estimation window and an event window. The estimation window is a sufficiently long time series of data before the onset of the event required to estimate the expected price of the asset. The occurrence of the event itself marks the end of the estimation window and the beginning of the event window. The sequence of data points that constitute the event window is determined either by a significance measure of abnormal changes for a specific event window or simply by the most recent available observation. In most event studies, the precise definition of the event window is plagued by the fact that information about an impending event— for example, a merger—can become available before the actual event, owing to news leaks. However, since the September 11 attack was a truly unpredictable event, the earliest possible beginning of the event window can be determined with great certainty. We therefore define the third quarter of 2001 as the first observation (T_1) and the fourth quarter of 2003 as the last observation (T_2) in the event window. The estimation window is specified as the quarterly time series from the first quarter of 1990 (T_0) through the second quarter of 2001, as shown in figure 2.

2.2 Estimation of Abnormal Changes and Cumulative Abnormal Changes

There are several ways to estimate the expected and abnormal changes of an asset (see MacKinlay 1997). To test the impact of the September 11 attack on the New York office market, we adopt here the *market model approach* because it is more accurate than a long-run mean measure or approaches based on assumed identical change rates in submarkets and aggregated markets. The expected return or change rate is expressed as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where R_{it} is the total return of asset i in period t , α_i is the baseline return of the asset in question, β_i is the coefficient for asset i in relation to R_{mt} , the overall market return, and ε_{it} is white noise, which is assumed to have a constant mean of zero and zero covariance. Conditional on the standard assumptions of OLS regression models, α_i and β_i are efficient estimators. In the context of this research, the market return rate R_{it} is proxied by the rental or vacancy rate of the Manhattan market or other submarkets, and R_{mt} is the corresponding rental or vacancy change rate of the overall U.S. office market. The abnormal change rate A_{it} is thus defined as:

$$A_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt} \quad (2)$$

The abnormal change rate is the difference between the actual observed ex post return minus the expected return, as calculated in equation 1 with estimation window data.³ In the present study, the abnormal change due to the 9/11 attack can be calculated through out-of-sample forecasting of the market model for all the periods constituting the event window (whose limits are denoted by T_1 and $T_{2,n}$). Assuming efficient markets, the *null hypothesis* is consequently:

$$H_0 = CA(T_1, T_{2,n}) = 0 \quad (3)$$

If the 9/11 attack has generated no abnormal changes over the defined event window, the mean abnormal change rate and the cumulative abnormal change rate should be

insignificantly different from zero. To test this hypothesis we define the average abnormal return as:

$$\bar{A}_i = \sum_{i=1}^N \hat{A}_{it} = \sum_{i=1}^N (R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}) \quad (4)$$

The total estimated impact or cumulative abnormal change over the defined period is calculated in the following manner:

$$CA(\tau_1, \tau_n) = \sum_{t=\tau_1}^{\tau_n} A_{it} \quad (5)$$

where τ_n are the time units (quarters) in the event window that are summed up to yield the cumulative abnormal change of the event. The variance of the cumulative abnormal change is calculated as:

$$\sigma_{CA_{it}}^2 = \frac{1}{N^2} \sum_{i=1}^N \sigma_i^2(T_1, T_{2,n}) \quad (6)$$

To test the null hypothesis, we apply a Z-test in the following form:

$$Z = \frac{CA(T_1, T_2)}{\sqrt{\sigma_{CA}^2}} \sim N(0,1) \quad (7)$$

If Z is significantly greater than zero, we reject the null hypothesis that the 9/11 attack had no significant effect on rents and vacancies in favor of the alternative hypothesis that the attack did have a significant impact. Since both A and CA are assumed to follow a normal distribution with zero mean and constant variance, the critical absolute test value for Z is 1.96 (for $p < .05$). If the absolute value of Z exceeds 2.58, the difference is also significant at the $p < .01$ level.

The measurement of abnormal changes in event studies is typically based on monetary units. In the case of the office market, however, using data on asking rents in the office market may not give an entirely accurate representation of the temporal reaction to the 9/11 effect, since asking rents are known to be “sticky” and do not adjust to new information with the same speed as, for example, stock prices. Therefore, we also examine vacancy levels (including sublet), which respond to market shocks with shorter delays.

It might be argued that the U.S. office market data utilized to estimate the expected values for the New York market were also subject to effects from the September 11 attack, thus introducing a possible bias into the estimators that could lead to underestimating the true impact of 9/11 on the New York office market. Although the overall direct impact of the attack on the aggregated U.S. market was considerably lower than its impact on the New York market, it is nevertheless important to keep in mind that any effects and abnormal changes reported here are specific local effects and in excess of the broader and indirect 9/11 impact on the U.S. market.

2.3 Empirical Results

The results of the analysis for the event window $(T1, T2.1)$ are reported in table 2. The average abnormal changes (A^-) and the cumulative abnormal changes (CA) demonstrate clear differences among the analyzed areas in the calculated impact of the 9/11 attack. As indicated by the R square and F statistics, significance values of the regressions decrease

generally with the size of the geographic unit, giving rise to the assumption that smaller areas are more prone to idiosyncratic behavior over time than larger, aggregated markets. In the case of the World Trade Center submarket (which also comprises the World Financial Center and a number of other office buildings in the area), the regression is not significant at the 5 percent level, and therefore the reported abnormal changes have to be interpreted with caution.

In general, all the reported abnormal changes show the expected sign, a lower than predicted rent level and a higher than predicted vacancy rate. An intuitive assumption would be that the downtown and especially the World Trade Center submarkets exhibit higher abnormal changes than midtown or the overall Manhattan market. This is not unequivocally confirmed, however, by the results for the defined event window. Regarding rental values, the downtown market was indeed more strongly affected by the attack and is the only market where the null hypothesis of a nonsignificant impact can be rejected. In terms of vacancy rates, the opposite is the case. All markets exhibit a significant impact except downtown. Since the relationship between rents and vacancy rates is marked by significant lags, it seems advisable to inspect the quarterly changes after September 11, 2001, for both variables in more detail before redefining the event window.

Table 3 shows the quarterly abnormal changes for vacancy rates in the four examined areas. As expected, the initial impact in the third quarter of 2001 is highest in the downtown and WTC submarkets. The abnormal change data suggests, however, that the pattern was reversed about one year after the attack when changes in the vacancy rate exhibited a more positive pattern than expected, which continued throughout the period. The reason for the unexpectedly positive developments downtown might be the effect of the massive subsidies and revitalization efforts of multiple levels of government. An alternative explanation would be that this is simply a mean reversion effect, a counter movement to the jump in vacancy rates in the wake of September 11, 2001. The assumption underlying such an explanation is

that markets tend to return to long-run equilibrium prices after a one-time, non-persisting shock event.

The rent data reported in table 4 seem to support this argument. While rents fell precipitously in the downtown and WTC submarkets in the first quarter following the September 11 attack (see figure 3), these submarkets achieved higher than predicted positive change rates as conditions in lower Manhattan gradually improved and buildings and critical infrastructure links were restored. This phenomenon is especially pronounced in the WTC market in the fourth quarter of 2001, when rental rates trended up toward previous levels as a result of the efforts to clean up the area and restore damaged buildings. The effect, however, dissipated in the medium run, hinting at a possible structural problem in the World Trade Center submarket that may not be completely remedied until the area has been fully rebuilt as a major office cluster and transportation hub.

To test the null hypothesis of insignificant cumulative abnormal changes from the September 11 attack for a shorter period, we redefine the event window. Table 5 shows the results for the event window ranging from the third quarter of 2001 through the third quarter of 2002 (T1,T2.2 in figure 2). This time we find a more consistent pattern in the combination of rental and vacancy rates. Based on the statistical evidence for this event window, we reject the null hypothesis for the overall Manhattan and midtown markets but find a significant impact on the downtown market. The World Trade Center submarket exhibits highly significant results in terms of vacancies, but these results are not significant in terms of rents; this may be due to attempts by landlords to restore the previous levels of asking rents soon after 9/11 when in fact market conditions as reflected by vacancy rates were less favorable.

In summary, we find evidence of significant effects of the September 11 attack in the New York office market. These effects seem to be limited, however, in terms of their spatial and temporal impact. While the Manhattan office market as a whole has demonstrated remarkable

resiliency in the wake of the attack (measured in reported rents and vacancy rates), the downtown market and particularly the World Trade Center submarket have been affected more clearly. Therefore, it is not surprising that rent levels are lower than expected and vacancy levels are higher than expected in these markets when compared to estimates derived from historic time-series data. Measured two years after the attack, however, cumulative abnormal changes in vacancy rates are moderate in the downtown submarket, indicating a much weaker medium-term impact of the attack than expected in its aftermath.

3 DISSAGGREGATION BY BUILDING HEIGHT

The 9/11 attacks had an unequal impact on various spatial submarkets, as the preceding section demonstrates. Apart from the impact on spatial submarkets, a further assumption to be investigated is that tenants would shun prominent skyscrapers in response to the 9/11 attack. The susceptibility of famous buildings and very tall buildings to terrorist attacks in the future might lead tenants in search of office space to move to low-height and “lowprofile” buildings instead of the most prestigious and conspicuous buildings, which were favored locations before 9/11. Norman Miller and his colleagues (2003), along with Torto Wheaton Research (2002), postulate, however, that these so-called trophy buildings are still coveted by both tenants and investors and that there is no flight from tall buildings due to psychological reasons and fear of new attacks. By analyzing a set of seven high-profile trophy buildings, Torto Wheaton Research shows that these buildings exhibited below-average vacancy rates one year after the attack. Miller et al. (2003) envision, however, that adverse affects will harm the marketability of a few truly famous office buildings, such as the Empire State Building.

To test this assumption, it is important to distinguish between “trophy” buildings and “tall” buildings (despite a large overlap of the two categories). There are several buildings in

Manhattan that are considered trophy, or “toptier,” but not all of these buildings are in the group of the thirty or even fifty tallest buildings in Manhattan. Conversely, not all of the thirty tallest office buildings in Manhattan are considered trophy. As far as a discounting of market values for fear of future terrorist attacks is concerned, it is simply the height of an office building that evokes concerns about being the target of another terrorist attack rather than the rating of a building by brokerage professionals or any measures of value and rental income. Figure 4 compares the vacancy rates of two sets of buildings (forty or more stories and fifty or more stories) extracted from the CoStar (2001) building database. (Samples are weighted by rentable building area.) The vacancy rate, which is a leading indicator and thus more appropriate to reveal trends than rental rates, shows that the tallest buildings (fifty or more stories) in particular recorded a sharp hike in vacancies after 9/11. Despite the fact that vacancy rates declined and approached the values of the average market in the following quarters, they still remain above market average and significantly above rates for buildings forty or more stories high. The difference becomes even more pronounced when fifty-story-or-higher buildings are eliminated from the forty-story-plus subset of buildings. The category of buildings between forty and forty-nine stories high shows significantly lower vacancies for these buildings. In general, it is evident that the expected flight of tenants from tall office buildings did not occur in the first three years following the attack. The data point to a potential problem for the tallest office buildings (fifty stories or higher), at least in the first three years following the attack. This might be attributed to a psychological effect among office tenants perceiving some of the tallest structures in the city as potential targets of terrorist attacks and seeking to avoid them, but the impact of this effect on overall vacancy in the affected buildings appears to be small and is likely to dissipate barring another incident involving tall office buildings.

Moreover, analyzing a list of displaced tenants (Grubb & Ellis, 2002) shows that most tenants in the database moved to buildings with more than twenty, but fewer than forty stories. A

smaller percentage moved to buildings with forty to forty-nine stories, and a few large tenants decided to move to buildings with fifty or more stories. Overall, only a small share of the displaced tenants contained in the subsample moved to buildings with fewer than twenty stories. These findings underline the conclusion that there is no clear evidence of an aversion effect for either tenants in general or the group that was immediately affected by the attack.

4 CONCLUSIONS AND FURTHER WORK

More than three years after 9/11, there is scant evidence that the attack will have a long-lasting impact on the Manhattan office market. Particularly in the submarkets of midtown Manhattan, no significant impact could be detected beyond the market adjustment process that took place in the two quarters following 9/11. Lower Manhattan, however, was more deeply affected by the attack and its various consequences.

The Manhattan office market as a whole does not show any signs of lasting economic damage. Of the companies that decided not to return to lower Manhattan after 9/11, the majority relocated to midtown Manhattan. An industry analysis demonstrated that both urbanization and localization economies were at play in the relocation process and that companies preferred to settle in preexisting large industry clusters in Manhattan. Taken together, the core markets of midtown and downtown Manhattan captured about 80 percent of the stream of displaced tenants after 9/11, while areas outside of these two core clusters captured only 20 percent, which bodes well for Manhattan's ability to remain a prime office location even in the face of a severe crisis.

To be sure, a more decentralized development of office space and a more dynamic increase in office workers in the wider CMSA region outside of Manhattan— processes that have been evolving for at least two decades—are likely to continue over the next years. Although security concerns are likely to accelerate this development at least temporarily as firms seek to create

backup facilities and distribute key functions across various locations to protect their operations, preliminary analysis of the period after 9/11 shows that agglomeration economies and firm efficiency criteria are restraining and mitigating such dispersion tendencies in Manhattan. Moreover, Manhattan has clearly been able to retain a competitive productivity advantage in the office-using industries. In fact, Manhattan's productivity differential in the office-using industries over both the national and the regional average has continued to increase even since 9/11.

Three years after the attack, lower Manhattan has demonstrated considerable progress in overcoming this crisis both physically and economically. A total of 31.1 million square feet of office space were affected in lower Manhattan, of which 14.8 million were destroyed and 19.6 million damaged and eventually restored. The affected space makes up less than 10 percent of the total inventory of New York City but accounts for roughly 60 percent of downtown's class A space. The sudden loss of more than 100,000 jobs and a large portion of its office inventory sent lower Manhattan, which had been struggling for much of the last three decades, into a severe economic crisis.

However, the majority of businesses directly affected by the attack have opted to remain in the downtown area or have returned there after the damaged buildings were restored. The rebuilding process is well under way, and the first office tower to be rebuilt on the World Trade Center site, Building 7, with 52 stories and 1.7 million square feet of office space, is expected to open in early 2006. Rental rates and building vacancies seem to have stabilized after the lower Manhattan market weakened dramatically in the quarters following 9/11.

Despite the progress made to date, the lower Manhattan office market faces some serious challenges for the next few years. Office employment in the area is considerably lower than it was before the 9/11 attack, and it remains to be seen whether the losses can be fully recovered before the completion of the rebuilding process around 2015. Considering that the

area has traditionally been more volatile owing to the dominance of finance and technology industries, a full recovery is possible once these key sectors demonstrate sustained job growth again. In the long run, however, it is critical that lower Manhattan diversify its economy and attract a broader cross-section of office-using industries to the area.

Both the exploratory data analysis and the event analysis demonstrate that markets reacted efficiently and predictably to the 9/11 attack. Among the most notable phenomena are the downward corrections in occupied space across Manhattan when displaced tenants had the choice of leasing new space after 9/11. On the aggregate, companies rented about 15 percent less space than they had occupied in the affected buildings. Space reduction was particularly pronounced in high-priced buildings and submarkets, such as Park Avenue and Grand Central. Moreover, the set of so-called trophy buildings proved to be less affected by the recession than the general market, a finding that runs counter to initial assumptions about the future of office high-rises. Only the tallest buildings in the city (fifty or more stories) exhibited slightly higher vacancies after 9/11, arguably because of an aversion to the very tallest and most famous structures in the city as potential targets of further terrorist attacks.

In addition to a drastic reduction in leased space, the accommodation of displaced tenants within the existing office space portfolio of large companies contributed further to lower occupancy rates than had been expected after the destruction of 10 percent of the inventory. This phenomenon, also known as backfill, caused overall absorption to be negative in the quarters following 9/11, since the positive demand created by displaced tenants was more than offset by losses incurred in the accelerated recession. Positive absorption of approximately 7 million square feet of office space in various submarkets of Manhattan can be attributed to tenants who were displaced by the 9/11 attack. This figure is much lower than expected given the square footage of the destroyed buildings. Approximately half of the anticipated demand dissipated through backfill into existing space, reduced staff, subleasing, and more economical space usage per office worker.

The full impact of the September 11 attack is still unknown after more than three years. The rent implications of 9/11-related factors such as increased security and insurance costs as well as government subsidies to New York City are not entirely clear at this point. Moreover, the recovery trajectory of the lower Manhattan market needs to be explored in detail with an econometric model, which could take into account a number of factors that influence supply and demand. Further research is required to answer these questions as longer time series of data become available to separate short-term adjustment processes from long-term impacts.

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NOTES

- ¹ Figures for the total inventory of office space differ widely among providers of market data because of diverging definitions of geographic areas and types of buildings. Total inventory figures used in this study are based on the definitions and data provided by Grubb & Ellis (2001)
- ² Since the number of independently estimated cross-sectional data is very limited in contrast to firm-level event studies, no further measures regarding cross-sectional heteroskedasticity and covariability are taken here.
- ³ James M. Patell (1976) suggests that the values obtained for the event window period have to be adjusted because they are bound to have a higher variance than the residuals of the estimation window. For the purpose of the present study, the values of abnormal returns are not standardized, since this does not change the results significantly (see Brown and Warner 1985).

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TABLE 1 NEW YORK OFFICE SPACE DESTROYED OR DAMAGED BY 9/11 TERRORIST ATTACK, BY OFFICE CLASSIFICATION

	Size (Square Feet)	Occupied (Square Feet)	Class
Destroyed buildings			
1 World Trade Center	4,761,416	4,507,467	A
2 World Trade Center	4,761,416	4,576,215	A
7 World Trade Center	2,000,000	2,000,000	A
5 World Trade Center	783,520	780,873	A
4 World Trade Center	576,000	561,491	A
6 World Trade Center	537,694	537,694	A
1 Bankers Trust Plaza	1,415,086	1,415,086	A
Destroyed total	13,420,046	12,963,740	
Damaged buildings			
130 Cedar	135,000	135,000	C
90 West	350,000	350,000	A
90 Church	950,000	950,000	B
140 West	1,171,540	1,171,540	B
101 Barclay	1,226,000	1,226,000	A
125 Barclay	273,900	273,900	C
22 Cortlandt	668,110	625,282	B
2 World Financial Center	2,591,244	2,006,577	A
100 Church	1,032,000	822,642	B
1 Liberty Plaza	2,121,437	1,874,584	A
4 World Financial Center	2,083,555	2,073,615	A
1 World Financial Center	1,461,365	702,999	A
3 World Financial Center	2,263,855	2,167,611	A
Damaged total	17,743,092	15,794,836	
Overall total	31,163,138	28,758,576	

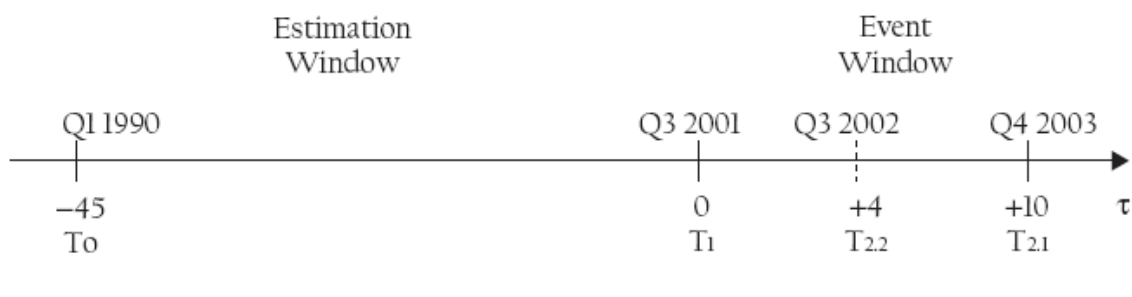
Source: Grubb & Ellis (2002).

FIGURE 1 MANHATTAN SUBMARKETS AND LOCATIONS OF DISPLACED WORLD TRADE CENTER TENANTS, BY INDUSTRY



Note: Grubb & Ellis (2004).

FIGURE 2 TIMELINE FOR EVENT STUDY OF SEPTEMBER 11 ATTACK



Source: Author's compilation.

TABLE 2 MODEL RESULTS AND ABNORMAL CHANGES DUE TO THE SEPTEMBER 11 ATTACK FOR EVENT WINDOW Q3 2001 THROUGH Q4 2003

	Average Abnormal Changes A	Cumulative Abnormal Changes CA	Z Statistic	R Square	T of β_1	F	Durbin- Watson
Rent							
Manhattan	-0.64%	-6.94%	-1.81	0.517	7.023	37.410***	2.099
Midtown	-0.68	-6.81	-1.78	0.462	6.116	30.024***	2.158
Downtown	-1.15	-13.53	-3.89***	0.323	4.147	17.195***	1.651
World Trade							
Center submarket	-0.35	-3.46	-0.33	0.144	2.391	5.716*	1.402
Vacancy							
Manhattan	0.080	0.42	3.53***	0.291	3.606	13.004***	1.759
Midtown	0.18	1.77	2.63***	0.258	3.955	15.644***	2.101
Downtown	0.07	0.73	1.05	0.363	4.462	19.911***	1.943
World Trade							
Center submarket	0.49	4.93	2.46***	0.145	2.432	5.915*	1.425

Source: Grubb & Ellis (2004).
*p < .10; **p < .05; ***p < .01

TABLE 3 QUARTERLY ABNORMAL CHANGES IN VACANCY RATES DUE TO THE SEPTEMBER 11 ATTACK

	Manhattan	Midtown	Downtown	WTC
Q3 2001	0.59	0.16	0.95	2.76
Q4 2001	-0.38	-0.09	-0.49	1.67
Q1 2002	-0.25	-0.18	0.00	2.96
Q2 2002	0.48	0.05	1.47	2.22
Q3 2002	-0.01	-0.07	0.44	-1.51
Q4 2002	-0.15	0.30	-1.09	-0.66
Q1 2003	0.07	0.63	-0.47	0.05
Q2 2003	0.13	0.37	-0.31	-0.40
Q3 2003	-0.10	0.00	-0.20	-0.96
Q4 2003	0.41	0.59	0.42	-1.21

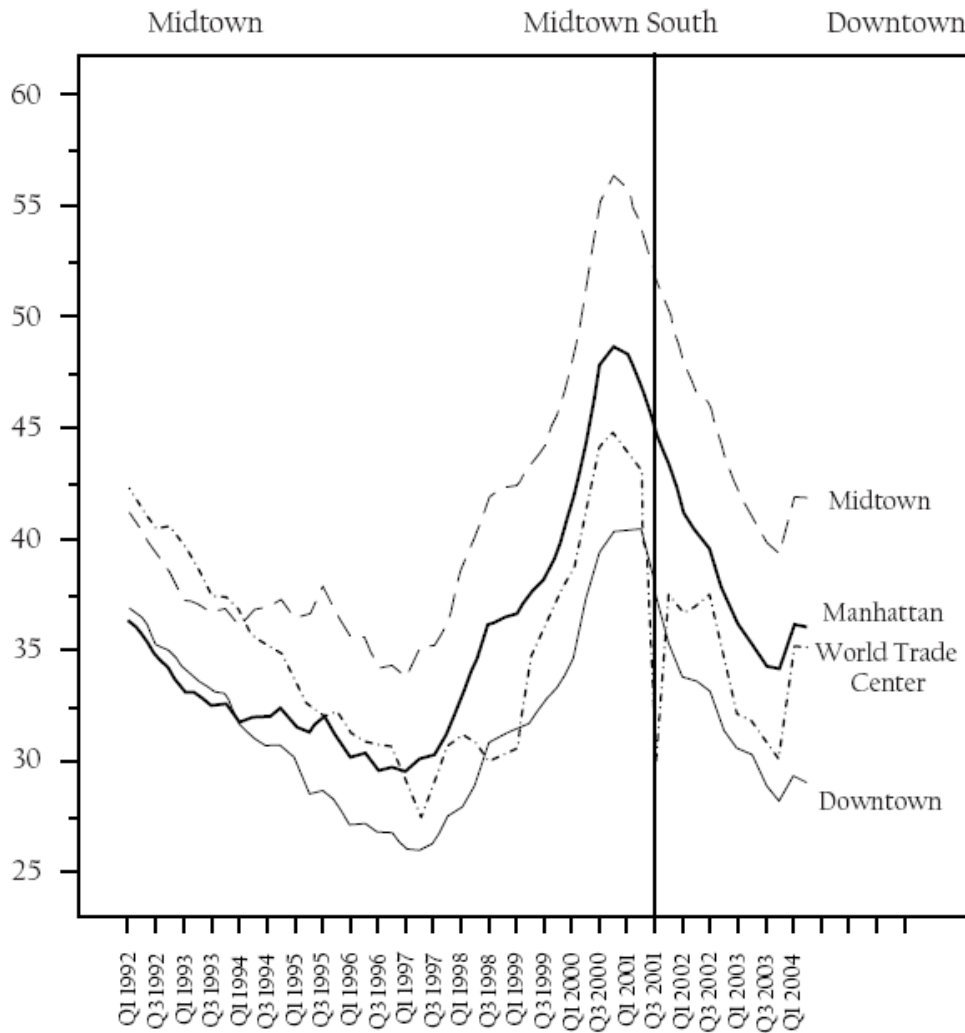
Source: Grubb & Ellis (2004).

TABLE 4 QUARTERLY ABNORMAL CHANGES IN RENTAL RATES DUE TO THE SEPTEMBER 11 ATTACK, THIRD QUARTER 2001 TO FOURTH QUARTER 2003

	Manhattan	Midtown	Downtown	WTC
Q3 2001	0.36%	0.39%	-3.16%	-29.44%
Q4 2001	-1.32	-1.01	-4.81	31.69
Q1 2002	-1.01	-0.82	-0.68	0.58
Q2 2002	-1.65	-1.87	0.51	2.00
Q3 2002	0.94	1.31	0.86	3.81
Q4 2002	-1.72	-1.53	-2.62	-5.00
Q1 2003	-3.77	-3.78	-2.11	-6.93
Q2 2003	-1.48	-2.01	0.13	0.17
Q3 2003	-1.29	-1.41	-3.17	-1.48
Q4 2003	4.00	3.92	1.54	1.13

Source: Grubb & Ellis (2004).

FIGURE 3 RENTAL RATES OF THE SUBMARKETS ANALYZED IN THE EVENT STUDY (CONSTANT DOLLARS), FIRST QUARTER 1992 TO FIRST QUARTER 2004



Source: Grubb & Ellis (2004).

Note: N = 183.

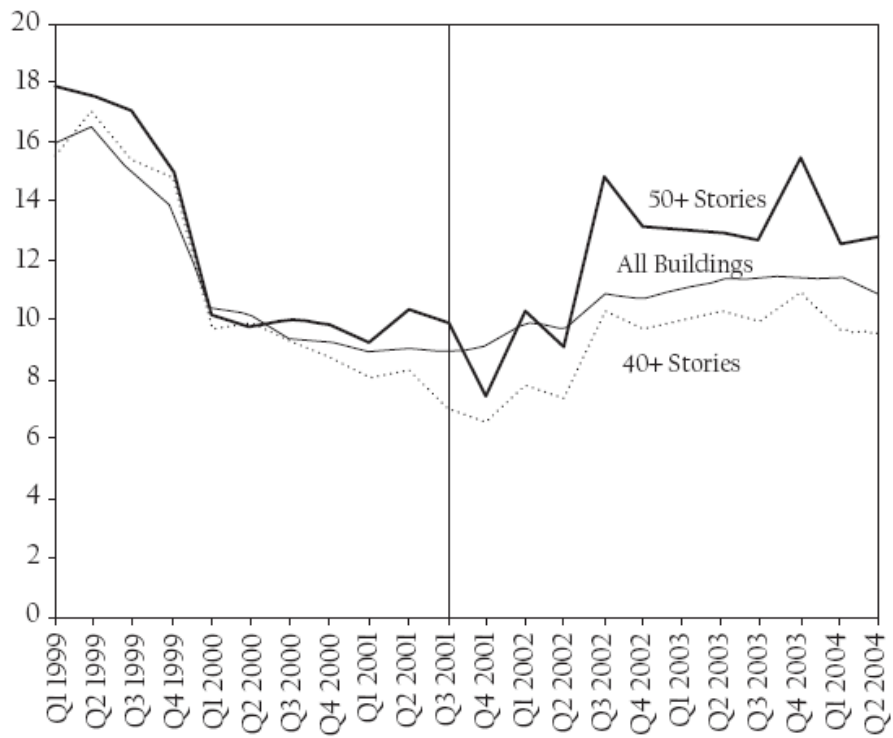
TABLE 5 AVERAGE AND CUMULATIVE ABNORMAL CHANGES IN RENTS AND VACANCY RATES FOR A SHORTER EVENT WINDOW (Q3 2001 THROUGH Q3 2002)

	Average Abnormal Changes \bar{A}	Cumulative Abnormal Changes CA	Z Statistic
Rent			
Manhattan	-0.53%	-2.67%	-1.533
Midtown	-0.40	-2.00	-1.78
Downtown	-1.46	-7.29	-3.77***
World Trade Center submarket	-0.35	-3.46	0.56
Vacancy			
Manhattan	0.09	0.42	1.725
Midtown	-0.02	-0.12	-0.96
Downtown	0.48	2.37	3.100***
World Trade Center submarket	1.62	8.11	2.896***

Source: Grubb & Ellis (2004).

***p < .01.

FIGURE 4 VACANCY RATES IN OFFICE BUILDINGS OF VARIOUS HEIGHTS, MANHATTAN, FIRST QUARTER 1999 TO FIRST QUARTER 2004



Source: CoStar (2004).