



Updating expectations: An analysis of post-9/11 returns[☆]

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Abstract

This study analyzes how three groups of market participants—insiders, analysts, and all other investors—revised their expectations on New York Real Estate Investment Trusts (REITs) in response to the catastrophic events of September 11, 2001. Our analysis reveals that, on the day when markets reopened, REITs with significant exposure to the New York area *outperformed* a broad REIT office index by 4.1%. However, we find that, according to several metrics of real market behavior, this anticipated superior performance of New York office properties did not materialize. Further analysis of market participants' activity in office REIT stocks indicates that insiders were the first to lower their expectations (e.g., 99.9% of their trades in REITs with New York exposure were sales in the month following 9/11), followed by analysts (the vast majority of them revised downward their expectations of NY REIT performance in the first weeks of November 2001, albeit heterogeneously so), and finally market prices adjusted to reflect the underlying real market behavior; indeed, abnormal REIT returns had disappeared by mid-November 2001. These dynamics are consistent with theories arguing that the cross-sectional correlation of insiders and analysts'

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information is an important determinant of trading and pricing patterns in semi-strong efficient market settings.

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1. Introduction

A critical aspect of asset pricing is the degree to which current prices accurately reflect informed investors' expectations of future cash flows. This topic has been the subject of a voluminous and diverse literature. Cowles (1933) began this debate by raising the issue of how well market participants react to information, initiating the vast literature addressing market efficiency.¹ Another important starting point in the analysis of stock market reactions to news is in the early behavioral economics research. An example is Kahneman and Tversky (1973), who suggested that individuals have a tendency to overweight recent news.² Numerous studies have documented market over-reaction.³ Other studies find under-reaction.⁴ In addition, researchers have documented that markets appear to be “too volatile,” in the sense that prices move much more than the levels justified by changes in “fundamentals.”⁵

Our study builds on this research by empirically examining how three separate classes of market participants—insiders, analysts, and all other investors—revised their expectations of returns on New York Real Estate Investment Trusts (REITs) in response to the catastrophic events of September 11, 2001. To allow our empirical analysis to be focused and tractable, we study the market presumably most affected: The metropolitan New York office real estate market. The attacks of 9/11 were unprecedented. Besides the horrific loss of human life, the devastation was immense. As of December 21, 2001, it was estimated that 13.4 million square feet of office space was destroyed, 12.1 million was damaged and remained closed, and only 5.6 million was damaged but could be re-opened.⁶

¹See also Fama, Fisher, Jensen, and Roll (1969), Jegadeesh (1990), and Jegadeesh and Titman (1995), as well as Fama (1991, 1998) and Schwert (2003) for relatively recent surveys of market efficiency.

²In particular, a number of studies have examined how bad news concerning a bank's clients can affect the price of bank stocks; see, for example, Smirlock and Kaufold (1987) or Sinkey and Carter (1999).

³DeBondt and Thaler (1985, 1987) address the link between mean reversion and investor over-reaction, showing that portfolios formed from poor performers had significantly higher abnormal returns than portfolios formed from good performers. The latter paper focuses on the impact of time varying risk premia. DeBondt and Thaler (1990) provide evidence of over-reaction in analysts' forecasts. Their paper builds on the earlier analysis of Elton, Gruber, and Gultekin (1984), who show that analysts over- (under-) estimate the growth in earnings of firms they believe would be good (bad) performers. More recently, Chan (2003) shows that bad news leads to significantly longer drift in prices than good news. See also Barrett, Heuson, Kolb, and Schropp (1987), Lamb (1995), Veronesi (1999), and Carter and Simkins (2002).

⁴Cohen, Gompers, and Vuolteenaho (2002) is a recent example. Daniel, Hirshleifer, and Subrahmanyam (1998) propose a theory of market under- and over-reactions based on investors' psychological biases.

⁵See Shiller (1981, 1989) for an introduction to this topic.

⁶See Grubb and Ellis (2001).

This event provides a unique setting to evaluate the speed and accuracy of belief revisions of insiders, analysts, and all other investors following external shocks. First, this tragedy was likely unanticipated by market participants and thus could not have been built into pre-existing market expectations and prices. Second, the period of market closure that followed the attack (from Tuesday, September 11 to the following Monday, September 17), the longest since the Great Depression (from March 4 to March 14, 1933 for President Franklin D. Roosevelt's Bank Holiday), gave investors ample time to digest the relevant information and to incorporate it into the prices that emerged when markets re-opened.⁷ Hence, our experiment is free from short-term "behavioral" effects. Third, the short- and long-term impact of 9/11 on the New York office market was ambiguous. From the supply side, one could reasonably have assumed that the destruction of a vast amount of prime office space would drive up the value of the remaining New York office properties.⁸ We call this argument the supply reduction effect. Conversely, one could have presumed that the resulting shocks to an already teetering economy would have plunged the city of New York and the nation into a deep recession, negatively affecting the price of real estate (and other) assets. We call this argument the recessionary shock effect.⁹ Finally, our data set, by allowing us to compare the real and financial market performance of office Real Estate Investment Trusts (REITs) with some New York exposure to those without any New York presence, also enables us to separate the local effects from the shocks that affected the entire U.S. office real estate market.

We are certainly not the first to investigate the impact of terrorist acts on real and financial markets. Unfortunately, as Karolyi (2006, p. 2) observes in his comprehensive survey of the extant literature on the topic, "... terrorism is not a recent phenomenon."¹⁰ Most of these studies examine the possibly "abnormal" impact of terrorist attacks on either economic activity, national stock markets, or individual firms directly or indirectly affected (e.g., Abadie and Gardeazabal, 2003; Straetmans, Verschoor, and Wolff, 2003; Chen and Siems, 2004; Guidolin and La Ferrara, 2005; Karolyi and Martell, 2006).¹¹ For instance, Karolyi and Martell (2006) find that, around the day of 75 such events, the average abnormal returns of publicly-traded companies in developed and emerging markets are large and negative. We contribute to this literature by analyzing both the *relation* between the financial and real underlying performance of office REITs as well as the behavior of different categories of financial market participants in the aftermath of September 11.¹² In that respect, the main hypothesis we test in this study is whether the speed with which those three categories of market participants (insiders, analysts, and all

⁷French and Roll (1986) provide an analysis of volatility during periods of market closure.

⁸The New York office area is the largest office market in the U.S., representing approximately 9% of its total urban office space. At the time of the September 11 attacks, the office vacancy rate in New York was only 3%.

⁹We document these conflicting stances in Section 4 by examining analysts' reports in the months following September 11.

¹⁰Using information from the U.S. Department of State, Karolyi and Martell (2006) list 881 acts of terrorism world-wide between 1995 and 2002.

¹¹Similarly, many studies examine the reaction of security prices to natural disasters. A (by no means comprehensive) list of recent examples includes Shelor, Anderson, and Cross (1990), Angboza and Narayanan (1996), and Lamb (1998). One exception is Poteshman (2006), who finds an unusually high level of put option buying for airline stocks a few days *before* 9/11.

¹²Relatedly, Glaser and Weber (2005) show that a randomly selected group of 86 individual investors with accounts at a German online broker interpreted the large drop in share prices in the German stock market in the first ten days after September 11 as temporary.

other investors) adjusted to the true underlying behavior of the realmarkets is consistent with the notion of semi-strong (rather than strong-form) market efficiency (e.g., Fama, 1970), i.e., whether their actions and the ensuing market prices rapidly responded to newly available public (rather than private) information. Each of these groups had a different information set and, presumably, based on the events on and following September 11, adjusted their beliefs about returns in different ways. Specifically, did insiders react faster than analysts, who in turn acted more quickly than all other investors? Our measurement of this speed of revision is necessarily indirect. We evaluate insiders' beliefs by their relative levels of selling and buying of office REITs. We evaluate analysts' beliefs by their recommendations on office REITs. Lastly, we evaluate all other investors' beliefs by measuring those REITs' stock price performance relative to a broad REIT index benchmark.

To this purpose, we analyze all public REITs that specialize in office properties, with the sole exception of the two office REITs that owned properties directly hit by the terrorist attack to downtown Manhattan.¹³ This allows us to assess the performance of the underlying office properties (i.e., the physical rather than the securitized assets) by the end of the last quarter of 2001. This horizon strikes a balance between being long enough for us to assess the economic impact of the event on the real markets, and being short enough so that unrelated factors do not contaminate our performance measurements.¹⁴ The resulting sample of 27 office REITs allows us to study market participants' expectations about the impact of September 11 on the remaining supply of New York office space, both in an absolute sense and in relation to other U.S. office properties. REITs provide an ideal structure for our empirical tests for a number of reasons: (i) because of the availability of data on REIT holdings, we can accurately estimate each REIT's exposure to the New York office market; (ii) detailed data on the performance of the underlying real asset markets are available; (iii) the performance of the office REITs with New York exposure can be benchmarked against office REITs without New York exposure to control for macro real estate market effects.

To survey our results briefly, we find evidence that the U.S. (office REIT) stock market behaved in a manner consistent with semi-strong market efficiency. This finding is remarkable in light of our prior observation that the event we examine was not only unprecedented in scale and scope but also likely unanticipated. Nevertheless, the activity of corporate insiders and analysts in the event's aftermath is inconsistent with strong-form market efficiency. Specifically, we show that the equity market initially anticipated that REITs with an exposure to the New York market would achieve significant gains relative to their benchmark, consistent with the supply reduction effect. REITs with exposure to the New York market experienced an average excess return of 4.1% from the close on September 10 to the close on September 17 relative to a broad REIT index. In contrast, the subsequent performance in the real asset market for office properties appeared to have reflected the recessionary shock hypothesis. According to several measures of real asset performance, New York properties experienced either a significantly negative or no

¹³These REITs are Brookfield Properties and TriZecHahn Corporation.

¹⁴Indeed, the impact on properties in the damaged areas involved highly complex insurance claims that were far from being resolved in the first three months after 9/11. The impact of September 11 on insurers is analyzed in depth by Doherty, Lamm-Tennant, and Starks (2003), who test the validity of several theoretical insurance models of external shocks.

abnormal performance with respect to similar office properties in the U.S. over the three-month horizon following the terrorist attack. Yet, we also find that the divergence between the equity market's assessment of the impact of the events of 9/11 on New York REITs and the corresponding resolution in the real markets quickly disappeared: The cumulative abnormal returns on New York REITs drifted to zero by early November.

New York REIT insiders were the first to accurately identify these developments. For the first eight months of 2001, insider trading patterns were almost identical for REITs with and without New York exposure. However, in the trimester after September 11, insider sales significantly exceeded insider purchases for REITs with New York exposure—and both the number of New York REIT insiders executing sales (purchases) and the number of shares they sold (bought) as a fraction of their prior share holdings increased (declined)—while the reverse was often true for non-New York REITs. For instance, in the month following the re-opening of U.S. financial markets, insider trading in REITs with New York exposure was 26 times insider trading in REITs of comparable total market capitalizations but without New York exposure; in addition, sales represented 99.9% of the total volume of insider trades in New York REITs, but just 68% of the total volume of insider trades in REITs with no New York properties. This divergence suggests that insiders of New York REITs used their information to increase the frequency of their selling activity, in anticipation of the subsequent negative performance of the real market. Analysts followed this trend, albeit with a delay and with historically highly heterogeneous earnings forecasts. For example, all the financial reports that we found issued in the ten days following 9/11 indicated that REIT analysts initially expected New York REITs to benefit from the reduction in supply. However, just one quarter later, the same analysts began to emphasize the fact that the anticipated increased Manhattan demand was being efficiently absorbed and lowered their price forecasts for New York REITs. This evidence on both the timing and intensity of the trading activity in office REITs and the dynamics of those REITs' stock prices in the aftermath of September 11 is consistent with theoretical studies arguing that the correlation among insiders and analysts' information endowments is an important determinant of trading and pricing patterns in semi-strong efficient market settings (e.g., Holden and Subrahmanyam, 1992; Foster and Viswanathan, 1996; Wang, 1998; Back, Cao, and Willard, 2000; Pasquariello and Vega, 2007).

The organization of the paper is as follows. Section 2 describes the relevant REIT data set. Section 3 presents and analyzes our empirical results. Section 4 investigates the significance of several alternative explanations for the office REITs' reaction to the events of September 11. Section 5 concludes.

2. Data description

We construct our office REIT sample from the SNL Financial's REIT database.¹⁵ We use SNL's classification to obtain all REITs having an office property orientation (29 REITs), but exclude those with any exposure to downtown Manhattan (Brookfield Properties and TriZecHahn Corporation). This leaves a sample of 27 REITs, which we use in the analysis that follows. Since SNL reports the location and square feet of each property in a REIT's portfolio, we segment our sample of office REITs into those having a New York metropolitan area exposure and those without. We define the New York

¹⁵SNL Financial is the premier financial information provider for in-depth coverage of the real estate sectors.

metropolitan area as New York City, the outer boroughs (Brooklyn, Queens, Staten Island, The Bronx), Long Island (including Nassau and Suffolk), Westchester (including Rockland County), Southern Connecticut (including Fairfield, Hartford, and New Haven counties), and Northern New Jersey (including Bergen, Essex, Hudson, Morris, Passaic, Sussex, Union, and Warren counties). For each office REIT in our sample, we calculated the total square footage for its office properties in the New York metropolitan area. We scaled these figures by dividing each by the total square feet of office space in the entire REIT portfolio. This yields the percentage of an office REIT's square footage that is in the New York metropolitan Area (PctNYMetro).

We obtain close-to-close daily REIT returns and trading volumes from CRSP, the three-month Treasury Bill rate from the Federal Reserve,¹⁶ and the daily return on the Morgan Stanley REIT Index (MSREIT), a popular capitalization-weighted benchmark index of the most actively traded REITs, over the interval 01/02/1998–09/17/2001, from Bloomberg. Opening and closing daily prices for REITs as well as the Standard & Poor's S&P500 Index from the close on Monday, September 10, 2001 to the open and close of Monday, September 17, 2001 are from the website <http://finance.yahoo.com>. Daily returns on other value-weighted equity indexes are from the Center for Research in Security Prices (CRSP).

To assess the performance of the real markets we use the two most important valuation parameters in the real estate literature, the cap rate (i.e., the reciprocal of the EBITDA, Earnings Before Interest, Taxes, Depreciation and Amortization, a common measure of profitability) and the Net Asset Value (NAV). Liu and Mei (1992) show that the real market, as proxied by the cap rate, can predict equity REIT returns. Mei and Lee (1994) further find that the real estate premium found in Liu and Mei (1992) captures the systematic risk in the real estate market rather than real estate market imperfections. Damodaran and Liu (1993) find that NAVs contain information, by showing that insiders buy (sell) after they receive favorable (unfavorable) NAV news, especially for negative appraisals. Finally, Gentry, Jones, and Mayer (2004) reveal that investors can profit from the deviations of REIT stock prices from their NAVs; using REIT data since 1990, they find large positive excess returns result from buying stocks trading at a discount to NAV, and shorting stocks trading at a premium to NAV. The authors also find that the average price-to-NAV ratio is mean reverting toward one, implying that the aggregate price to NAV ratio can be used to predict aggregate REIT returns. NAVs and cap rates are also important tools for Wall Street REIT analysts. For example, according to A. G. Edwards (2000), "... a NAV analysis provides practical observations about the real estate value of a REIT relative to its public market valuation. A NAV analysis is also helpful on a relative basis in making decisions regarding the allocation of capital between direct real estate and real estate in the REIT format."

In this study, we take quarterly cap rates on real estate for New York and the nation, starting from the second quarter of 1994, from three sources:

1. The American Council of Life Insurance (ACLI) publication Investment Bulletin: Mortgage Commitments on Multifamily and Nonresidential Properties reported by 20 life insurance companies;
2. The National Real Estate Index (NREI) Market Monitor;
3. Korpacz Real Estate Investor Survey published by Price Waterhouse Coopers (PWC).¹⁷

¹⁶[Http://www.federalreserve.gov/releases/#daily](http://www.federalreserve.gov/releases/#daily).

¹⁷The three sources of data differ. The Korpacz Real Estate Investor Survey is a quarterly survey of expectations of returns on investment in institutional-grade, real property from major institutional equity real

We use quarterly cap rates in conjunction with EBITDA for each REIT taken from the SNL REIT database to calculate the NAV per share for each REIT.¹⁸ Each REIT's NAV is computed as the ratio between its trailing twelve-month EBITDA and its blended cap rate. Individual blend cap rates are weighted averages of either actual (from NREI and ACLI) or expectational (from PWC) cap rates for both New York and the U.S., with weights given by the REIT's exposure to the New York metropolitan area. In the next section, we compute the time series of internal rates of returns (IRRs) for each of the REITs in our sample as the percentage quarterly change in these NAVs to measure the actual performance of their underlying real assets following September 11.

3. Empirical results

3.1. Results from the financial markets

Table 1 presents the basic characteristics of the 27 REITs in our sample as of September 1, 2001. Each REIT was mainly involved in office properties, although three REITs with substantial holdings in the New York metropolitan area (Forest City Enterprises, Lexington, and Voronado) were more diversified. Our analysis focuses on the group of 12 that had significant exposure to New York office properties (except downtown Manhattan, by construction); we dub this group New York REITs.¹⁹ Of our New York REIT sample, three had over half of their total holdings in the New York area: SL Green (100%), Reckson Associates (93%) and Mack-Cali Realty (62%). The remaining 15 had no investment in the New York area. They represent a control sample in order to capture the more general effects of the event on the overall real estate market; we call this subset the national group.

Table 2 documents the stock market behavior of these REITs over the period from the close of the market on Monday September 10 to the open (column 2) and close (column 3) on Monday September 17, the first trading day after September 11. It is important to test the price behavior both at the opening, which incorporates the information over the period of the market closure, and, as a robustness check, at the close of the first trading day as well. The latter in fact captures the impact of any new information on the stock market's reaction to the crisis and is unaffected by distortions that can occur in opening prices. Panel A gives the unadjusted percentage change. The New York group gained an average of 1.998% at the open, but gave almost all of it back over the course of the trading day to close at a small average gain of 0.390%. Conversely, the national group opened 2.075% lower and then lost a further 1.291% to close at a loss of 3.366%. In both of these cases the

(footnote continued)

estate market participants. NREI reports actual transactions of large income-producing properties, including those of REITs and real estate operating companies. The resulting index attempts to keep quality constant by tracking only commercial real estate transactions that meet pre-specified property characteristics. The ACLI also reports actual transactions of institutional grade real properties made by 20 life insurance companies; however, it does not adjust for those properties' differing quality.

¹⁸When these data were missing from the SNL REIT database, we obtained them from the REITs' 10Q forms. NAVs per share are computed to control for share repurchases and secondary stock offerings.

¹⁹In our subsequent analysis, we adjust for the relative proportions of properties within and outside the New York area in each of these REITs.

Table 1

Sample REITs

This table provides basic information for each of the 27 REITs included in our sample as of September 1, 2001. The column labeled NY indicates the percentage of office space (in square feet) in the NY metro area in the portfolio of the corresponding REIT. The NY metro area includes New York City (but not downtown Manhattan), the outer boroughs (Brooklyn, Queens, Staten Island, The Bronx), Long Island (including Nassau and Suffolk), Westchester (including Rockland County), Southern CT (including Fairfield, Hartford, and New Haven counties), and Northern NJ (including Bergen, Essex, Hudson, Morris, Passaic, Sussex, Union, and Warren counties).

REIT name	Ticker	Property focus	Region	NY (%)
Alexandria Real Estate Equities	ARE	Office	WE	0.00
AmeriVest Properties	AMV	Office	SW	0.00
Arden Realty	ARI	Office	WE	0.00
Bedford Property Investors	BED	Office	WE	0.00
Boston Properties	BXP	Office	NE	18.37
Brandywine Realty	BDN	Office	MA	1.75
CarrAmerica Realty	CRE	Office	MA	0.00
Corporate Office Properties	OFC	Office	MA	3.19
Crescent Real Estate Equities	CEI	Office	SW	0.00
Duke Realty	DRE	Office	MW	0.00
Equity Office Properties	EOP	Office	MW	5.18
Forest City Enterprises	FCEA	Diversified/Other	MW	38.53
Glenborough Realty	GLB	Office	WE	4.58
Great lakes REIT	GL	Office	MW	0.00
Highwood Properties	HIW	Office	SE	0.00
HRPT Properties	HRP	Office	NE	32.29
Kilroy Realty	KRC	Office	WE	0.00
Koger Equity	KE	Office	SE	0.00
Lexington Properties	LXP	Diversified/Other	MA	8.55
Mack-Cali Realty	CLI	Office	MA	61.71
Mission West Properties	MSW	Office	WE	0.00
Parkway Properties	PKY	Office	SE	0.00
Prentiss Properties	PP	Office	SW	0.00
Prime Group Realty	PGE	Office	MW	0.00
Reckson Associates Realty	RA	Office	MA	93.48
SL Green Realty	SLG	Office	MA	100.00
Vornado Realty	VNO	Diversified/Other	MA	43.26

New York average is significantly greater than the national average at the 5% level. This indicates that the market believed that the entire real estate sector would suffer because of the event, but that (presumably because of the supply reduction effect) New York office REITs would appreciate in value. Similarly, the dispersion of returns was significantly higher (at least at the 10% level) for the New York group. The standard deviations at the open and close are in fact 5.683% and 3.493% for the New York group versus 1.676% and 2.344% for the national group. Panel B performs the same calculations with New York REIT returns relative to the S&P500 Index, which opened 4.624% lower than on September 10 and lost another 1.610% during the day. The New York group now shows a relative gain of 6.622% at the open and 6.624% at the close. Analogous inference is drawn from comparing New York REIT returns on September 17, 2001 to the performance on

Table 2

Market reaction

This table analyzes relative price changes of the REITs in our sample from the close on 09/10/2001 to the open and close of 09/17/2001. REITs with some NY metro exposure (see Table 1) are compared to those with none (Panel A) or to the Standard & Poor's S&P500 Index (Panel B), using one and two-tailed t -tests for average price changes and one-tailed F -tests for their variances. A “*”, “***”, or “****” indicate significance at the 10%, 5%, or 1% level, respectively, of the one-tailed t -test.

	Close-to-open	Close-to-close
<i>Panel A: REIT comparison</i>		
Average price change		
Some NY metro exposure	1.998%	0.390%
No NY metro exposure	−2.075%	−3.366%
t statistic	2.647***	3.337***
$P(T \leq t)$ one-tail	0.007	0.001
t critical one-tail	1.708	1.708
$P(T \leq t)$ two-tail	0.014	0.003
t critical two-tail	2.060	2.060
<i>Standard deviation of price change</i>		
Some NY metro exposure	5.683%	3.493%
No NY metro exposure	1.676%	2.344%
F statistic	0.087	0.450
$P(F \leq f)$ one-tail	0.000	0.081
F critical one-tail	0.390	0.390
<i>Panel B: NY REITs versus S&P500</i>		
Average price change		
Some NY metro exposure	1.998%	0.390%
S&P500	−4.624%	−6.234%
t statistic	3.521***	3.884***
$P(T \leq t)$ one-tail	0.000	0.000
t critical one-tail	1.648	1.648
$P(T \leq t)$ two-tail	0.000	0.000
t critical two-tail	1.965	1.965
Average standard deviation of price change		
Some NY metroexposure	5.683%	3.493%
S&P500	7.215%	6.572%
F statistic	0.620	0.282
$P(F \leq f)$ one-tail	0.151	0.004
F critical one-tail	0.467	0.467

that day of either a narrower index, the Dow Jones 30 Index, or broader ones, such as the CRSP value-weighted equity portfolio and each of its cap-based deciles.²⁰

Table 3 presents the cross-sectional correlations of the REIT groups. It shows that the correlation between the price change (close-to-open) on September 17, 2001 and both the amount of square footage and percentage of property held in the New York area are high (0.827 and 0.781, respectively) and statistically significant at the 1% level. Figs. 1a and b

²⁰By the end of September 17, 2001, the CRSP value-weighted equity index declined by 5.071%—while its large, mid, small, and micro caps portfolios were down by 3.314%, 3.345%, 5.183%, and 5.273%, respectively—with respect to the close on September 10, 2001. Similarly, the Dow Jones 30 Index lost 6.798% at the open on September 17, 2001 and an additional 1.320% throughout that day.

Table 3

Cross-sectional REIT correlations

This table reports cross-sectional correlations between observed price changes (from the close on Monday September 10, 2001 to the open of Monday September 17, 2001) for the REITs in our sample, their square footage in the New York metropolitan area (NY metro, including Northern NJ, Southern CT, Long Island, and Westchester, but excluding downtown Manhattan), and their percentage square footage in the New York metropolitan area (PctNYMetro, computed as the ratio between New York metropolitan office square feet and square feet of office space in the entire REIT portfolio). A “***”, “****”, or “*****” indicate significance at the 10%, 5%, or 1% level, respectively.

	Price change	NY metro	PctNYMetro
Price change	1.000		
NY metro	0.827***	1.000	
PctNYMetro	0.781***	0.842***	1.000

plot those percentage price changes versus the corresponding REIT’s amount of square footage in the New York metropolitan area and percentage exposure to that market, respectively. In both cases, the (unreported) slope is positive (and statistically significant at the 1% level) and there is clustering of negative returns for REITs with zero New York exposure. This evidence provides further support to the notion that the shock to supply was an important factor in driving upward New York REITs’ market prices on September 17, 2001.

In Table 4 we estimate the excess REIT market reaction to the events of September 11. There is an extensive real estate asset pricing literature assessing the relevance of several economic and financial factors for the stock market performance of publicly traded real estate companies (e.g., Chan, Hendershott, and Sanders, 1990; Ling and Naranjo, 1996, 2002, 2003; Karolyi and Sanders, 1999; Ling, Naranjo, and Ryngaert, 2000). In that respect, Kallberg, Liu, and Trzcinka (2000) show that a one-factor return generating process with a broad REIT index as the factor performs as well as more complex multi-factor models (e.g., including returns on government bond portfolios and/or on size-based, growth-based, and value-based stock portfolios). We therefore use the following return generating process to compute “normal” and “abnormal” returns:

$$r_{it}^{\text{CC}} - r_{Ft} = \alpha_i + \beta_i(r_{Mt} - r_{Ft}) + \varepsilon_{it}, \quad (1)$$

where r_{it}^{CC} is the return on REIT i from the close on day $t - 1$ to the close on day t , r_{Ft} is the yield on the 90-day Treasury bill on day t , and r_{Mt} is the return on day t on the Morgan Stanley REIT index. Eq. (1) is estimated over the interval January 2, 1998–September 10, 2001 for each of the REITs in the sample. We then use those coefficients to compute normal (i.e., benchmark) close-to-close REIT returns $\hat{r}_{iT^*}^{\text{CC}}$ on day $T^* = \text{September 17, 2001}$, i.e., from the close on September 10 to the close on September 17. The resulting R^2 s are quite high for daily data, averaging about 21%. The average estimates of α_i and β_i in Eq. (1) are -0.0002 and 0.925 , respectively, indicating satisfactory performance of the benchmark. The national group showed no abnormal returns as well: each of the estimated α_i s is in fact statistically insignificant.

According to Table 4, the 12 REITs with exposure to the New York metropolitan area out-performed the overall U.S. real estate market by 4.1% on average: $r_{iT^*}^{\text{CC}} - \hat{r}_{iT^*}^{\text{CC}} = 0.041$ in row NY of Table 4. This figure is statistically significant at the 1% level using either

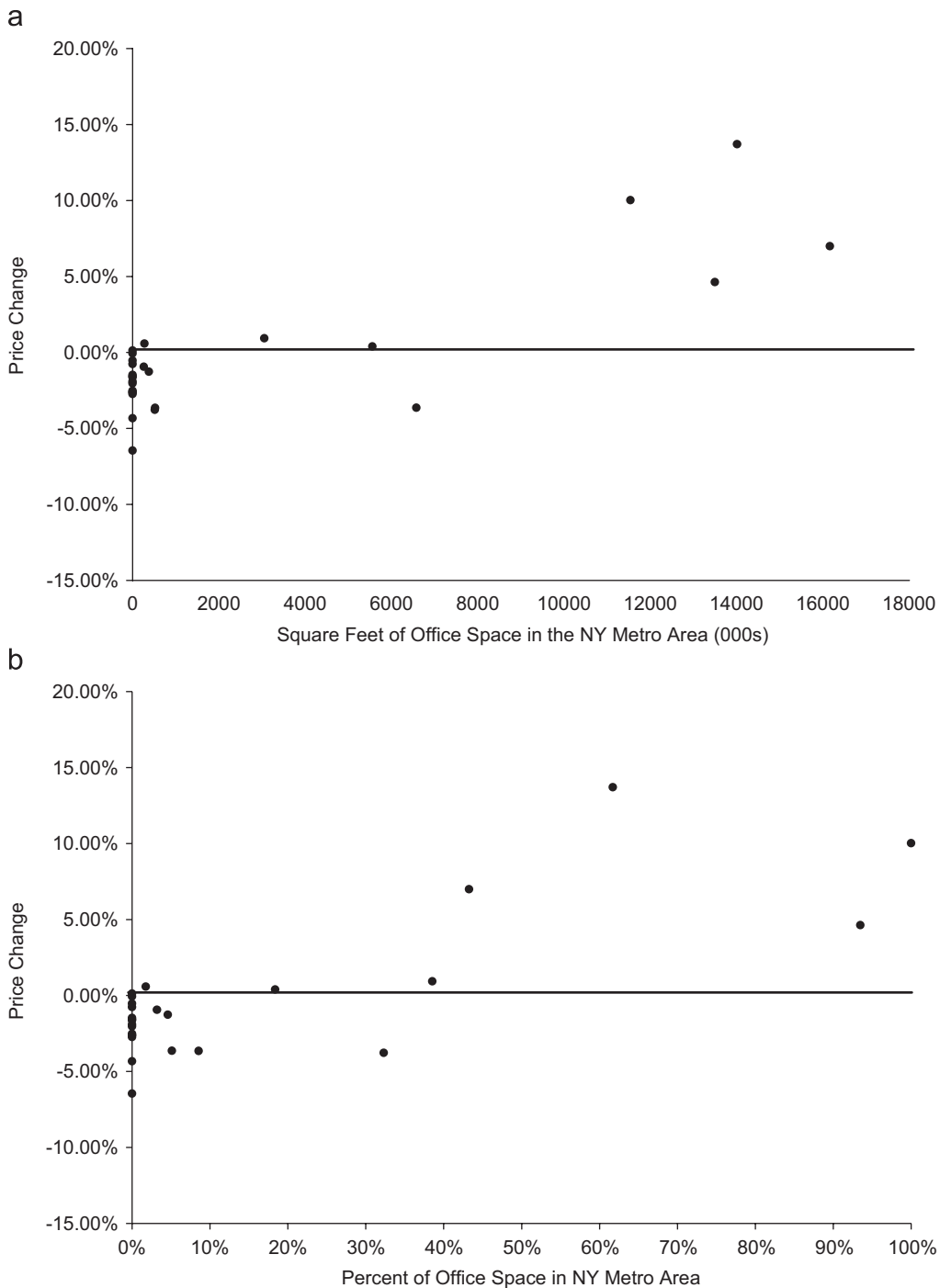


Fig. 1. Price changes for office REITs. These figures plot the price change for each of the REITs in our sample, from the close on Monday September 10, 2001 to the open on Monday September 17, 2001, with respect to their corresponding amount of office space in the NY metro area (excluding downtown Manhattan), measured in square feet (000s, a) and in percentage of total square footage (b).

sample standard errors or bootstrapped standard errors computed over the widest available sample period outside the event window (from September 18, 2001 to December 31, 2002) for 100 sets of 12 randomly selected REITs among the universe of office REITs in our sample (listed in Table 1) as of September 1, 2001 (column p_{boot} in Table 4). The superior performance of the New York REIT group was even more pronounced at the opening of trading. Normal close-to-close New York REIT returns $\hat{r}_{i\tau^*}^{\text{CC}}$ from Eq. (1) are estimated to be about 5.7% lower than the corresponding return from the close on September 10 to the open on September 17, r_{it}^{CO} . Furthermore, estimated abnormal returns are the greatest for REITs for which close-to-open returns r_{it}^{CO} are positive on September 17; 88% of those REITs had office properties in New York.

3.2. Results from the real markets

The above evidence suggests that the REIT equity markets anticipated that the supply reduction effect would dominate the recessionary shock effect and thus moved the prices of REITs with New York exposure significantly higher than REITs without New York exposure. We now turn our attention to the actual performance of the underlying real assets over the three months that followed the event. This interval was chosen in order to have enough time for the key uncertainty surrounding the crisis to be resolved, but short enough so that other exogenous factors do not begin to play an important role in real asset returns.

Based on the observations in Section 2, we use a variety of measures of real market performance based on expectational and realized data in order to present a robust analysis. In particular, we focus on different measures of quarterly internal rates of return (IRRs) for each of the REITs in the sample. We define REIT i 's IRR in quarter τ , $irr_{i\tau}$, as the percentage change in its NAV over that period. Then, we compare those IRRs to benchmark IRRs given by weighted averages of New York and national real rates of return. Specifically, we compute excess IRRs in three steps. First, we compute “normal” quarterly real rates of return for NY office REITs estimating the following regression over the time period 1994.Q2 to 2001.Q2 (29 observations):

$$irr_{\tau}^{\text{NY}} - r_{F\tau} = \alpha + \beta(r_{US\tau} - r_{F\tau}) + \eta_{\tau}, \quad (2)$$

which mimics Eq. (1) using rates of return from real rather than financial markets.²¹ Here irr_{τ}^{NY} and $r_{US\tau}$ are the estimated New York and nation-wide real estate IRR in quarter τ , respectively, from the Korpacz Data Index, which is constructed with a variety of measures of real market performance (see Section 2), while $r_{F\tau}$ is the yield on the 90-day Treasury bill over quarter τ . Second, the resulting estimated coefficients $\hat{\alpha} = 0.003$ and $\hat{\beta} = 0.831$, are used to compute “normal” NY REIT returns, $\widehat{irr}_{\tau^*}^{\text{NY}} = irr_{\tau^*}^{\text{NY}} - \hat{\eta}_{\tau^*}$ for $\tau^* = 2001. Q4$, to control for the impact of the idiosyncratic events of September 11 on the NY office business. The R^2 of 83% indicates that Eq. (2) does an excellent job of describing NY REITs' real returns. Finally, excess IRR for each REIT in quarter $\tau^* = 2001. Q4$ is computed as the difference between its quarterly IRR, $irr_{i\tau^*}$, and the corresponding benchmark $irr_{i\tau^*}^{\text{B}} = \omega_i \widehat{irr}_{\tau^*}^{\text{NY}} + (1 - \omega_i)r_{US\tau^*}$, where ω_i is the percentage of the REIT i 's office space in the NY metro area reported in Table 1.

²¹Since REIT IRRs can be computed only at the quarterly frequency, we estimate Eq. (2) over the longest interval for which those quarterly data are available to us. Nonetheless, the results that follow are virtually identical when estimating Eq. (2) over a shorter interval equivalent to that used for the estimation of Eq. (1), i.e., 1998.Q1 to 2001.Q2 (just 14 observations).

Table 5a reports estimated excess IRRs measured using the percentage quarterly change in Net Asset Value (NAV) for each REIT in the sample computed using three different blend (i.e., weighted) cap rates: The NREI data in columns 3 and 4, the ACLI data in columns 5 and 6, and the expectational data from PWC in columns 7 and 8 (see Section 2). The most striking result is the difference between the ensuing average abnormal real returns and the estimated excess REIT returns in Table 4. According to Table 5a, average excess real market performance for the REITs in our sample over the last quarter of 2001 was either statistically significantly negative or zero in each of their subsets sorted on the basis of the performance of their stock on September 17, 2001. According to Table 4, those REITs' stock performance was instead much more heterogeneous on that day. In particular, Table 5a shows that the real abnormal returns to the New York REITs over the

Table 5a
Real asset behavior: NAV, IRR, & blend cap rates

This table reports estimates of excess quarterly REIT internal rates of return (or IRR (irr_{it^*})) for 2001.Q4. Excess IRRs are computed in three steps. First, we estimate the following market model for the New York City IRR Korpacz Index ($irr_{NY\tau}$):

$$irr_{\tau}^{NY} - r_{F\tau} = \alpha + \beta(r_{US\tau} - r_{F\tau}) + \eta_{\tau}, \tag{2}$$

where $r_{F\tau}$ is the 3-month Treasury Bill rate and $r_{US\tau}$ is the quarterly U.S. IRR Index from Korpacz Data (computed on unleveraged, all cash transactions). The model of Eq. (2) is estimated over 29 quarterly observations between 1994.Q2 and 2001.Q2. Second, the resulting coefficients' OLS estimates, $\hat{\alpha} = 0.0027$ (and a t -statistic of 2.27) and $\hat{\beta} = 0.8305$ (and a t -statistic of 11.66), with $R^2 = 83.43\%$, are then used to measure the "normal" NY IRR $\widehat{irr}_{\tau}^{NY}$. Finally, excess IRR for each REIT when $\tau^* = 2001.Q4$ is computed as the difference between the percentage quarterly change in Net Asset Value (NAV) per share with respect to 2001.Q3, irr_{it^*} , and its benchmark $irr_{it^*}^B = \omega_i \widehat{irr}_{it^*}^{NY} + (1 - \omega_i)r_{US\tau^*}$, where ω_i is the percentage of the REIT i 's office space in the NY metro area reported in Table 1. Each REIT's NAV is computed as the ratio between its TTMNOI and its blend cap rate. A REIT's TTMNOI is the difference between its Trailing Twelve Months Total Rental Revenue and its Property Operating Revenues. Individual blend cap rates are weighted averages of either actual (from NREI and ACLI) or expectational (from PWC) weighted cap rates for both New York and the U.S. (see Section 2), with weights given by the REIT's exposure to the NY metro area (in Table 1). For each excess IRR we report its mean (μ) and standard deviation (σ) across various subsets of the sample (all REITs in Table 1, REITs with positive or negative $r_{IT^*}^{CC}$, REITs with or without NY metro area exposure, and REITs with positive or negative $r_{IT^*}^{CO}$, where $T^* = 09/17/2001$). A "**", "****", or "****" indicate significance at the 10%, 5%, or 1% level, respectively, using sample standard errors, while p_{boot} is the p -value for the two-tailed t -test based on bootstrapped standard errors computed over the first half of 2002 for 100 sets of N randomly selected REITs among the universe of office REITs as of September 1, 2001 (27 REITs in Table 1). Column NY indicates the corresponding percentage of REITs with office space in the NY metro area, excluding downtown Manhattan.

	N	$irr_{it^*}^{NREI} - irr_{it^*}^B$			$irr_{it^*}^{ACLI} - irr_{it^*}^B$			$irr_{it^*}^{PWC} - irr_{it^*}^B$			NY (%)
		μ	σ	$p_{boot}(\%)$	μ	σ	$p_{boot}(\%)$	μ	σ	$p_{boot}(\%)$	
Total	27	-0.048**	0.09	0.00	-0.013	0.09	0.00	-0.034*	0.09	0.00	44
$r_{IT^*}^{CC} \geq 0$	7	-0.028	0.05	0.27	0.011	0.06	2.33	-0.037**	0.05	0.00	71
$r_{IT^*}^{CC} < 0$	20	-0.056**	0.10	0.00	-0.021	0.10	0.00	-0.034	0.11	0.00	35
NY	12	-0.059	0.13	0.00	-0.021	0.13	0.00	-0.060	0.13	0.00	100
NO NY	15	-0.040***	0.05	0.00	-0.007	0.05	2.35	-0.014	0.05	0.00	0
$r_{IT^*}^{CO} \geq 0$	8	-0.072	0.16	0.00	-0.033	0.16	0.00	-0.081	0.15	0.00	88
$r_{IT^*}^{CO} < 0$	19	-0.038***	0.05	0.00	-0.005	0.05	5.67	-0.015	0.05	0.00	26

Table 5b

Real asset behavior: NAV, IRR, & U.S. cap rates

This table reports estimates of excess quarterly REIT internal rates of return (or IRR (irr_{it})) for 2001.Q4. Excess IRRs are computed in three steps. First, we estimate the following market model for the New York City IRR Korpacz Index (irr_{NYt}):

$$irr_t^{NY} - r_{Ft} = \alpha + \beta(r_{US\tau} - r_{F\tau}) + \eta_t, \tag{2}$$

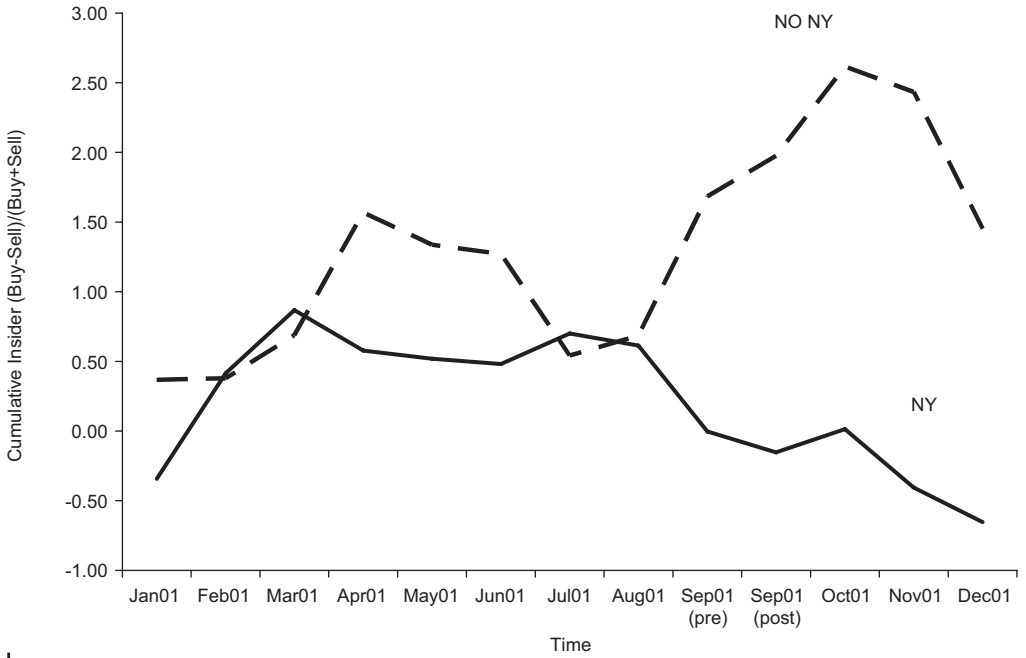
where r_{Ft} is the 3-month Treasury Bill rate and $r_{US\tau}$ is the quarterly U.S. IRR Index from Korpacz Data (computed on unleveraged, all cash transactions). The model of Eq. (2) is estimated over 29 quarterly observations between 1994.Q2 and 2001.Q2. Second, the resulting coefficients' OLS estimates, $\hat{\alpha} = 0.0027$ (and a t -statistic of 2.27) and $\hat{\beta} = 0.8305$ (and a t -statistic of 11.66), with $R^2 = 83.43\%$, are then used to measure the “normal” NY IRR \widehat{irr}_t^{NY} . Finally, excess IRR for each REIT when $\tau^* = 2001.Q4$ is computed as the difference between the percentage quarterly change in Net Asset Value (NAV) per share with respect to 2001.Q3, irr_{it^*} , and its benchmark $irr_{it^*}^B = \omega_i \widehat{irr}_{it^*}^{NY} + (1 - \omega_i)r_{US\tau^*}$, where ω_i is the percentage of the REIT i 's office space in the NY metro area reported in Table 1. Each REIT's NAV is computed as the ratio between its TTMNOI and the U.S. cap rate. A REIT's TTMNOI is the difference between its Trailing Twelve Months Total Rental Revenue and its Property Operating Revenues. Individual U.S. cap rates are either actual (from NREI and ACLI) or expectational (from PWC) cap rates for the U.S. (see Section 2). For each excess IRR we report its mean (μ) and standard deviation (σ) across various subsets of the sample (all REITs in Table 1, REITs with positive or negative $r_{it^*}^{CC}$, REITs with or without NY metro area exposure, and REITs with positive or negative $r_{it^*}^{CO}$, where $T^* = 09/17/2001$). A “***”, “**”, or “****” indicate significance at the 10%, 5%, or 1% level, respectively, using sample standard errors, while p_{boot} is the p -value for the two-tailed t -test based on bootstrapped standard errors computed over the first half of 2002 for 100 sets of N randomly selected REITs among the universe of office REITs as of September 1, 2001 (27 REITs in Table 1). Column NY indicates the corresponding percentage of REITs with office space in the NY metro area, excluding downtown Manhattan.

	N	$irr_{it^*}^{NREI} - irr_{it^*}^B$			$irr_{it^*}^{ACLI} - irr_{it^*}^B$			$irr_{it^*}^{PWC} - irr_{it^*}^B$			NY(%)
		μ	σ	$p_{boot}(\%)$	μ	σ	$p_{boot}(\%)$	μ	σ	$p_{boot}(\%)$	
Total	27	-0.059***	0.09	0.00	-0.026	0.09	0.00	-0.033*	0.09	0.00	44
$r_{it^*}^{CC} \geq 0$	7	-0.060***	0.04	0.01	-0.026	0.04	0.01	-0.034*	0.04	0.00	71
$r_{it^*}^{CC} < 0$	20	-0.059**	0.11	0.00	-0.026	0.11	0.00	-0.033	0.11	0.00	35
NY	12	-0.083**	0.13	0.00	-0.050*	0.13	0.00	-0.058**	0.13	0.00	100
NO NY	15	-0.040***	0.05	0.00	-0.007	0.05	1.30	-0.014	0.05	0.00	0
$r_{it^*}^{CO} \geq 0$	8	-0.104*	0.03	0.00	-0.071	0.03	0.00	-0.078	0.03	0.00	88
$r_{it^*}^{CO} < 0$	19	-0.040***	0.05	0.00	-0.007	0.05	0.10	-0.014	0.05	0.00	26

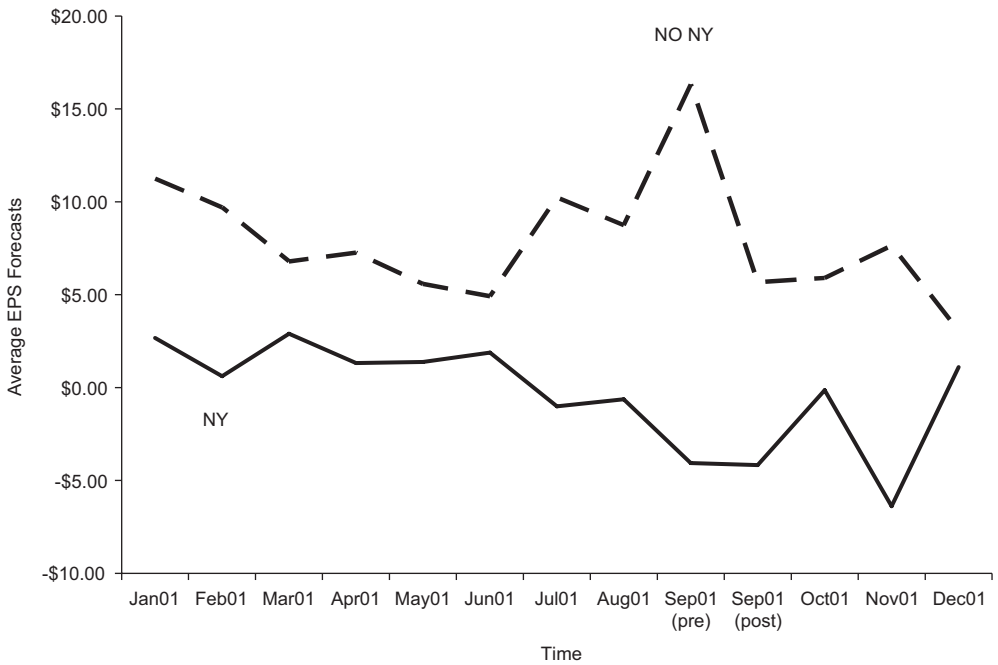
quarter immediately following 9/11 were always negative, in contrast to their positive relative performance in the financial markets over the period of market closure (4.1% in Table 4). However, these returns are only statistically significant when using bootstrapped

Fig. 2. REIT insider trading and analysts' EPS forecasts: NY REITs versus NO NY REITs. Fig. 2(a) The cumulative sums of the ratios $(BUY_t - SELL_t)/(BUY_t + SELL_t)$, where BUY_t and $SELL_t$ are the total number of shares bought and sold, respectively, by insiders in month t , between January 2001 and December 2001, for the REITs in our sample with some exposure to the NY metro area excluding downtown Manhattan (NY, solid line) and for the REITs with no such exposure (NO NY, dashed line), described in Table 1. The data are obtained from WRDS (Wharton Research Data Services) TFN Insider Filing Data Files, which contain all insider activity as reported on SEC forms 3, 4, 5, and 144. (b) The monthly average of 1-year ahead earnings per share (EPS) forecasts for REITs with and without New York exposure over the same sample period. The forecasts data are obtained from I/B/E/S (Institutional Brokers Estimate System) and are available for 21 of the 27 office REITs in our sample (Table 1), 10 of which have New York exposure.

a



b



standard errors computed over the widest available sample period outside the event window (the first half of 2002, column p_{boot} in Table 5a): sample average abnormal real returns for NY REITs, $irr_{it^*} - irr_{it^*}^B$, based on each of the three measures above, were -5.6% , -2.1% , and -6.0% (with sample t -statistics of -1.59 , -0.56 , and -1.61), respectively. In addition, although the real market performance of the national group was somewhat higher according to each of our three metrics, the differences between the two groups are never statistically significant. Still, this comparison is somewhat inappropriate because of the different benchmarks used to compute abnormal performance in the two groups. Similarly, REITs that had positive returns at the open on September 17, 2001 ($r_{iT^*}^{CO} \geq 0$) under-performed those REITs with negative returns at the open ($r_{iT^*}^{CO} < 0$) by 3.3% , 2.8% , and 6.7% , respectively, while REITs that increased in price from close-to-close out-performed those that lost in two of the three cases (using NREI and ACLI measures). Nonetheless, none of these differences is statistically significant.

Table 5b reports the same analysis when NAVs are calculated with only U.S. cap rates, to ensure that our results are not driven by the procedure used to compute blend cap rates. The results parallel those obtained in Table 5a. The under-performance of the New York group is now more pronounced, and significantly negative, for each of the three measures. When comparing those negative excess real returns across subsets of our sample, we again find that the New York group under-performed the national group, although now the differences are much larger: about 4.3% using either NREI, ACLI, or PWC data. However, REITs that gained or lost during the first trading day had virtually identical performance. Moreover, none of these differences is statistically significant, as in Table 5a. We obtained similar results (not reported here) by computing REIT IRRs from changes in their Net Equity Values (NEV), equal to their NAVs minus Debt.

Finally, we further investigate the real performance of the New York office market by computing four additional measures of real estate market dynamics commonly used by practitioners: the nominal rent index, the going-in cap rates, the expectational IRR, and the NEVs defined above. We find that (i) the nominal rent index for New York declined by 4.6% (versus an average of 2.6% for the rest of the U.S.)²²; (ii) the in-going cap rates for New York actually increased by 10.1% , yet less so than the average of 10.6% for markets outside New York²³; (iii) expectational IRRs for New York increased by 33 basis points versus an average decrease of 18 basis points for the rest of the U.S.²⁴; (iv) NEVs for the first three months following 9/11 were not significantly different across the REITs with or without New York exposure in our sample. Overall, this evidence, although somewhat mixed, corroborates our earlier analysis of excess IRRs: the real performance of New York REITs was either weaker than or not statistically different from that of REITs with no such exposure.

4. Analyzing the adjustments to real market conditions

Our analysis suggests that, while New York office REITs experienced significantly positive abnormal stock market returns from the close on September 10 to the close on

²²Source: Torto-Wheaton.

²³Source: American Council of Life Insurance (ACLI).

²⁴Source: Price Waterhouse Coopers (Korpacz).

September 17, 2001, this superior performance did not materialize in the real asset markets. Specifically, in the quarter following September 11, the real asset markets in New York significantly *under-performed* relative to both their benchmarks and REITs without New York exposure, regardless of the measure of real asset performance employed. Armed with these results, we now turn to the major issue raised in this study: How quickly did each of the three groups of market participants we consider, insiders, analysts, and all other REIT equity investors, adjust to the real market conditions? To address this issue, we first examine the trading behavior of insiders in the months before and after 9/11. Secondly, we investigate the recommendations of REIT analysts around the event. Finally, we examine the abnormal returns on New York REITs in the months subsequent to the World Trade Center (WTC) attacks. As noted earlier, semi-strong (but not strong-form) market efficiency would imply that insiders (because of their superior information set) should react first, followed by analysts (because of their superior access to insiders' information) and, lastly, the revised expectations of all other investors should reduce REIT abnormal returns.

4.1. REIT insiders

Fig. 2a and Table 6 perform the first of these tests. Fig. 2a plots the cumulative sums of scaled differences between total insider purchases (BUY_t) and sales ($SELL_t$) in office REITs with (solid line) or without (dashed line) exposure to the New York metropolitan area in each month of 2001, $(BUY_t - SELL_t)/(BUY_t + SELL_t)$, as in Rozeff and Zaman (1988). Table 6 reports additional summary statistics on REIT insiders' trading activity over the same period. The data are from WRDS (Wharton Research Data Services) TFN Insider Filing Data Files.²⁵ There is a large body of empirical evidence indicating that the trading activity of insiders may be motivated mainly by their information advantage with respect to all other market participants (e.g., Seyhun, 1986, 1988; Rozeff and Zaman, 1988; Damodaran and Liu, 1995). In addition, Seyhun (1990) finds that in the immediate aftermath of the October 1987 Crash, corporate insiders successfully exploited stock market overreaction by purchasing their companies' shares in record numbers. Accordingly, we conjecture that if insiders correctly believed that the prices of REITs with New York exposure would ultimately decline relative to their peers after 9/11, then we should see a relatively higher amount of selling by the insiders of New York REITs in the first few months following the attack.

Fig. 2a suggests that the cumulative ratios for REITs with and without New York exposure were similar prior to September 11. During that interval, sales were approximately 46% of all insider trades—and average monthly ratios $(BUY_t - SELL_t)/(BUY_t + SELL_t)$, in Panel A of Table 6, were positive—for both groups, indicating a common preponderance of insiders' purchases. However, in the first three months after September 11, insider sales exceeded insider purchases for NY REITs and the corresponding average monthly ratios $(BUY_t - SELL_t)/(BUY_t + SELL_t)$ turned negative, while insider purchases continued to be

²⁵This database, available at <http://wrds.wharton.upenn.edu>, contains all insider activity as reported on SEC forms 3, 4, 5, and 144. According to the WRDS documentation, "Corporate insiders are defined broadly to include those that have 'access to non-public, material, insider information' and these insiders are required to file SEC form 3, 4, and 5 when they trade in their company's stock." We were unable to compute dollar amounts for these trades because, in many cases, the actual transaction prices were not reported.

Table 6

REIT insiders and analysts

This table reports summary statistics for the activity of REIT insiders and analysts over a pre-9/11 interval (January 2001 to September 10, 2001) and post-9/11 interval (September 17, 2001 to December 2001) for the REITs in our sample with some exposure to the NY metro area excluding downtown Manhattan (NY) and for the REITs with no such exposure (NO NY), described in Table 1. Specifically, Panel A reports averages of the monthly ratios $(BUY_t - SELL_t)/(BUY_t + SELL_t)$, where BUY_t and $SELL_t$ are the total number of shares bought and sold, respectively, by insiders in month t . Panels B and C report averages of the monthly ratios between either BUY_t and $SELL_t$, respectively, and the corresponding insiders' share holdings in month $t - 1$. Panels E and F report averages of the number of insiders either purchasing or selling their shares, respectively, in any given month. Panel D reports averages of REIT analysts' monthly dispersion of earnings forecasts defined as the standard deviation of these forecasts divided by the absolute value of their mean, when covered by 2 or more analysts, from I/B/E/S. Earnings forecasts are available for 6 New York REITs and 9 REITs without New York exposure. A ***, **, or ***** indicate significance at the 10%, 5%, or 1% level, respectively, of the corresponding time-series or cross-sectional differences between the above statistics, assessed using two-sample, heteroskedastic, two-tailed t -tests (whose p -values are also reported).

2001:	pre 9/11	post 9/11	post-pre	p -value	pre 9/11	post 9/11	post-pre	p -value	pre 9/11	post 9/11	post-pre	p -value
<i>Panel A: Insider trading ratio $(BUY_t - SELL_t)/(BUY_t + SELL_t)$</i>												
NO NY	0.947	2.119	1.172***	1.00%	45.9%	43.5%	-2.3%	85.58%	18.9%	21.9%	3.0%	70.07%
NY	0.425	-0.300	-0.725***	0.61%	38.5%	32.9%	-5.6%	60.48%	28.5%	29.8%	1.2%	54.11%
NY-NO NY	-0.522**	-2.419***			-7.3%	-10.6%			9.6%	7.9%		
p -value	2.74%	0.06%			43.05%	45.22%			23.12%	47.66%		
<i>Panel D: Dispersion of analysts' forecasts</i>												
NO NY	1.224	1.138	-0.086	89.05%	3.55	2.05	-1.50***	0.50%	2.07	1.65	-0.42	27.72%
NY	0.434	0.352	-0.082	58.64%	3.84	3.50	-0.34	68.23%	2.41	3.10	0.69	69.40%
NY-NO NY	-0.790**	-0.786			0.30	1.45			0.34	1.45		
p -value	4.08%	14.68%			66.95%	12.76%			50.10%	26.08%		

prevalent for REITs without New York exposure. These cross-sectional and time-series differences, reported in panel A of Table 6, are both economically meaningful and statistically significant (at the 1% level). Hence, the resulting cumulative insider trading ratio in Fig. 2a trended downward and eventually turned negative by December 2001, while the cumulative ratio for the national group continued to trend upward. Consistently, both the number of New York REIT insiders executing purchases (Panel E of Table 6) and the number of shares they purchased as a fraction of their prior share holdings (Panel B of Table 6) declined. The opposite is true for their selling activity (in Panels F and C of Table 6, respectively). Yet, in both cases the estimated differences are not statistically significant. Overall, the divergence in selling and buying patterns emerging from Fig. 2a and Tables 6 indicates that insiders of the New York group used their information advantage to increase the frequency and intensity of their selling activity.

The analysis of each of the trades reported by REIT insiders offers further evidence on the nature of their trading activity after September 11. In particular, we focus on the first month following the terrorist attack. Over this sample period, the total amount of trading by insiders of REITs not exposed to the New York area was relatively small, totaling only \$0.9 million. Of these trades, 68% were sales; yet a single one, executed on September 17, 2001, dominated that balance, amounting to \$0.57 million. In contrast, trades by insiders of the New York group totaled \$23.4 million. Of this total, about 99.9% were sales. These observations confirm our earlier finding of significantly higher selling by New York REIT insiders immediately after 9/11, and are consistent with the notion that insiders believed the U.S. stock market had temporarily overvalued those securities relative to other office REITs.

4.2. REIT analysts

The second part of our analysis focuses on the behavior of REIT analysts following September 11. We searched Investext for analyst reports regarding the impact of the WTC attacks on REITs issued around the time of the attack.²⁶ As a specific illustration, we focus on analysts' reports for Mack-Cali (CLI), the NY REIT followed by the largest number of analysts in our sample.²⁷ On August 16th, 2001 Morgan Stanley issued a note maintaining its position that Mack Cali was expected to "under perform" (even though they beat analyst estimates) based on erosion in market fundamentals and on the expected acceleration of their disposition program, which was expected to dilute earnings.²⁸ This negative opinion was partly based on management's lowering expected 2001 earnings to reflect potential occupancy erosion in their portfolio, the sustainability of rental rates, and the timing of the company's ongoing capital recycling program. Prior to 9/11, REIT analysts from other investment banks held a similar opinion about the New York market and Mack-Cali in particular as Table 7 shows.

All the reports that we found issued in the 10 days following 9/11 indicated that REIT analysts expected New York area REITs to benefit from the anticipated scramble for space

²⁶Investext is currently the world's largest online database of company and industry investment research reports. These reports are not generally available through public channels.

²⁷In addition, Mack-Cali had a sizable presence in the New York metropolitan area as of September 1, 2001 (about 62% of its office properties, based on square footage, according to Table 1).

²⁸This report, Whyte (2001), was the last analyst report issued on Mack-Cali prior to the attack on the World Trade Center.

Table 7

Analysts' recommendations for Mack-Cali (CLI)

This table displays various analysts' assessment of the impact of the WTC attacks on Mack-Cali (CLI) and their subsequent recommendations, from Investext. We collect analysts' reports issued immediately prior to the attack, issued 10 days subsequent to the attack, and published up to one quarter after the event.

REIT: Mack-Cali (CLI)						
Date of Report	Analyst	Recommendation	Change of target	Price target	EPS 01 <i>E</i>	EPS 02 <i>E</i>
16-Aug-01	Morgan Stanley	Underperform	\$26 to n.a.	n.a.	\$3.64	\$3.81
18-Sep-01	Morgan Stanley	Outperform	n.a. to \$32	\$32	\$3.66	\$3.89
12-Nov-01	Morgan Stanley	Neutral	\$32 to n.a.	n.a.	\$3.66	\$3.74
9-Aug-01	Lehman Brothers	Market Perform	n.a.	\$30	\$3.65	\$3.89
2-Oct-01	Lehman Brothers	Buy	n.a.	\$34	\$3.67	\$3.96
9-Nov-01	Lehman Brothers	Buy	n.a.	\$34	\$3.64	\$3.81
10-Aug-01	Bank of America	Underperform	n.a.	n.a.	\$3.68	\$3.96
21-Sep-01	Bank of America	Market Perform	n.a. to \$32	\$32	\$3.70	\$4.02
8-Nov-01	Bank of America	Market Perform	\$32 to n.a.	n.a.	\$3.66	\$3.77
10-Aug-01	Salomon Smith Barney	Neutral	n.a.	\$30	\$3.67	\$3.90
21-Sep-01	Salomon Smith Barney	Outperform	n.a.	\$33	\$3.67	\$4.10
8-Nov-01	Salomon Smith Barney	Outperform	n.a.	\$33	n.a.	\$3.73
10-Aug-01	Deutsche Bank	Market Perform	n.a.	\$28	\$3.65	\$3.80
8-Nov-01	Deutsche Bank	Buy	n.a.	n.a.	\$3.65	\$3.80
9-Nov-01	Deutsche Bank	Market Perform	n.a.	n.a.	\$3.65	\$3.70
30-Mar-01	CS First Boston	Hold	n.a.	n.a.	N?A	n.a.
18-Sep-01	CS First Boston	Strong Buy	n.a.	\$34.50	\$3.65	\$3.85

in both Midtown and in NJ, CT, Long Island, and Westchester based on an expected tightening of office market space in the short run. For example, from [Axelrod \(2001\)](#), "... the taking out of 25 million square feet of Manhattan office space has dramatically tightened the entire NYC metro office market which stood at 7.5% vacancy (direct and sublease, Manhattan only) at the end of Q201. However, for the rest of the national office markets, a recession is a decided negative." Given this anticipated reduction in supply, analysts raised their target price for REITs having a New York presence. From [Raiman, Dembski, Habermann, and Schwalbe \(2001\)](#), "... in response to shrinkage of office supply in Manhattan—and its positive implication on the tri-state market, we are raising our target price to \$34-\$35 on Mack-Cali Realty given its office concentration in the Tri-State area."

However, analysts just one quarter later emphasized the fact that the anticipated occupancy pressure was not offset with increased Manhattan demand. As noted in [Litt \(2001\)](#), "... the vast amount of 'phantom vacancy' that appeared in Manhattan following the attack will likely limit some of the upside we expected in Mack-Cali's 2002 occupancy as many displaced tenants have found space in Manhattan." [Taylor and Goebel \(2001\)](#) agreed, stating that "... the WTC impact was short lived ... tenants in midtown New York have been rethinking their space needs and giving up space. This has relaxed the tightness in the NYC market that had driven demand to Harborside (in Jersey City, NJ).

Like most investors and analysts, we thought there'd be a benefit from the loss of space in Manhattan. We thought it would be short term, but not this short." Finally, Paolone (2001) noted in a report made available on November 7, 2001 that "... at this point, much of the scramble for space is over as a result of September 11th and the bigger impact is on the negative side as demand wanes." As shown in Table 7, Morgan Stanley, Lehman Brothers, Bank of America, and Salomon Smith Barney all initially raised their earnings estimates immediately following 9/11, but then all lowered those estimates between November 8 and 12, 2001. Deutsche Bank issued no updates to its August 10 earnings forecasts in response to the terrorist attack until it confirmed them on November 8, only to reduce its 2002 earnings estimates the following day. CS First Boston issued a strong buy on September 18, 2001 but released no further report until May of 2002. The timing and content of analysts' recommendations on the other NY REITs in our sample over that period provide a strikingly similar picture. For instance, of the analysts that published earnings estimates for REITs with NY exposure both in the two weeks following 9/11 and in either October or the first two weeks of November, downgrades out-numbered upgrades by more than three to one.

Further evidence on office REIT analysts' recommendations prior to and following September 11 comes from the analysis of Institutional Brokers Estimate System (I/B/E/S) data. Specifically, we collect those analysts' earnings per share (EPS) one-year ahead forecasts for each of the 27 office REITs in our sample (in Table 1) for which such data are available (21 REITs in total, 10 with New York exposure). We then plot (in Fig. 2b) the mean EPS forecasts for office REITs with (solid line) or without (dashed line) exposure to the New York metropolitan area in each month of 2001. Fig. 2b suggests that in the months preceding the WTC attack, Wall Street analysts were becoming increasingly pessimistic exclusively about the performance of New York office REITs. Indeed, average EPS forecasts between January and September 2001 (excluding post-9/11 data) are \$8.11 for the latter and only \$0.84 for the former. In the immediate aftermath of September 11, office REIT analysts more than halved their EPS forecasts for REITs with no New York exposure, presumably because of the expected recessionary shock effect of the terrorist attack on the U.S. economy. Despite this, and consistent with the discussion above, NY REIT analysts first increased their EPS forecasts, presumably conjecturing that the supply reduction effect would dominate any recessionary shock effect on the market for office space in the New York metropolitan area. It is only by the end of 2001 that EPS forecasts for both groups of REITs appear to converge.

In conjunction with the apparent reversals in NY REITs' mean EPS forecasts in 2001, their analysts' opinions were also generally heterogeneous. Panel D of Table 6 reports averages of those analysts' monthly dispersion of earnings forecasts, computed as their monthly standard deviation (when available for *two* or more analysts) divided by the absolute value of their mean, as in Diether, Malloy, and Scherbina (2002).²⁹ Dispersion in analysts' EPS forecasts was statistically unchanged in both REIT groups in the last quarter of 2001. Differences of opinion among New York REIT analysts were the lowest throughout the sample period. Yet, those differences—even in the first few months after September 11 (about 35% of the absolute mean forecasts)—are greater than all but the highest dispersion quintile estimated by Diether, Malloy, and Scherbina (2002, Table 2) for

²⁹In our sample, dispersion of earnings forecasts can be computed for 6 New York REITs and 9 REITs without New York exposure.

the universe of U.S. stocks between 1983 and 2000.³⁰ Overall, the above evidence indicates that New York REIT analysts (weakly more homogeneously than their national colleagues, but significantly less so than historical pre-9/11 averages) reversed their initial positive outlook—which conflicted with a negative outlook for the U.S. office REIT market—approximately two months after 9/11.

4.3. All other investors

Lastly, we examine the abnormal returns on New York REITs following 9/11. Indeed, if the relative values of New York REITs were actually declining, we would expect to see all market participants eventually revise their initial expectations rationally, and then the positive abnormal returns registered on September 17, 2001 (reported in Table 4) eventually decline (towards zero) as well. This third test is performed in Fig. 3, which plots cumulative abnormal returns (CARs, solid line) and their corresponding 95% confidence intervals (dashed lines) for the 12 NY REITs from September 17, 2001 to December 31, 2001 (consistent with Table 5), as well as these REITs' aggregate trading volume (in millions of U.S. dollars). We also plot 95% confidence intervals for those CARs based either on bootstrapped standard errors (dotted lines, over 100 replications) computed over the widest available sample period outside the event window (from January 2, 2002 to December 31, 2002) or on standard errors computed by bootstrapping over the same interval for 100 sets of 12 randomly selected REITs among the universe of office REITs in our sample (Table 1) as of September 1, 2001 (thin solid lines), under the null hypothesis of no cumulative excess returns.³¹ CARs are generated by first computing close-to-close abnormal returns (ARs) estimated using the market model of Eq. (1) over the interval January 2, 1998–September 10, 2001 (in Table 4) and then aggregating them over time and across REITs.

CARs of NY REITs are initially highly positive and significant, as a result of the relatively superior performance of this group immediately after September 11. However, the solid line drifts quickly downward, crossing the upper bound of the OLS confidence interval in early November before reaching zero immediately afterwards. In the following weeks, the CARs remain relatively small and often statistically indistinguishable from zero. In comparison, and consistent with Tables 2 and 4, CARs of the 15 REITs with no NY exposure listed in Table 1 (starred line in Fig. 3) are instead negative, statistically significant, and steadily declining until early November and virtually unchanged afterwards.³² Accordingly, aggregate NY REIT trading volume is higher and volatile in the first few days after the terrorist attacks, but lower and steady afterwards.³³ Hence, Fig. 3 shows that although the markets initially expected that 9/11 would have a positive impact on New York REITs (and traded on this expectation), those REITs' prices quickly reflected the underlying behavior of the real markets (reported in Tables 5). In contrast, the stock market performance of REITs without New York exposure mirrored

³⁰For instance, dispersion of analysts' EPS forecasts averages 10.5% of their absolute mean within the fourth dispersion quintile in Table 2 of Diether, Malloy, and Scherbina (2002).

³¹Confidence intervals constructed by repeatedly randomly selecting among the 15 REITs without New York exposure lead to the same inference.

³²Confidence intervals for these CARs nearly overlap with those for the CARs of REITs with NY exposure; thus, they are not displayed in Fig. 3.

³³The marked, temporary increase in NY REIT aggregate trading volume in early October 2001 is due to Standard & Poors' decision to include office REITs in the S&P500 index after the close of trading on October 9.

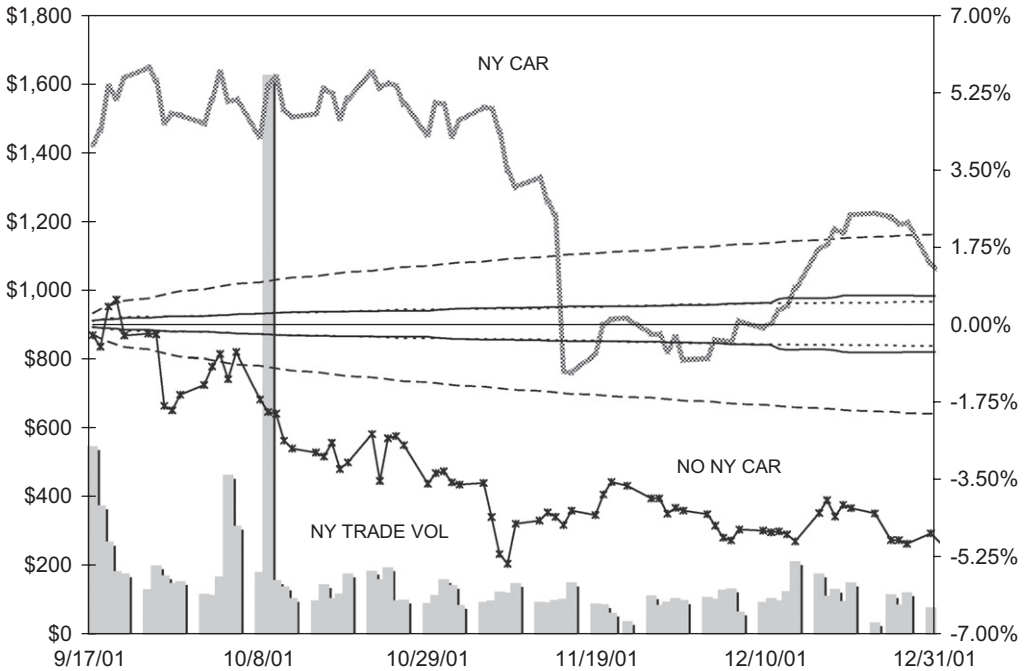


Fig. 3. Cumulative abnormal returns for NY REITs. This figure plots cumulative abnormal returns (CARs, solid line, right axis) and their corresponding 95% confidence intervals (dashed lines, right axis) for the 12 REITs with some exposure to the NY metro office market excluding downtown Manhattan (NY), as well as their aggregate trading volume (in millions of U.S. dollars, left axis) over the interval 09/17/2001–12/31/2001. The CAR series are generated by first estimating the following market model for close-to-close daily REIT returns (r_{it}^{CC}):

$$r_{it}^{CC} - r_{Ft} = \alpha_i + \beta_i(r_{Mt} - r_{Ft}) + \varepsilon_{it}, \tag{1}$$

where r_{Ft} is the 3-month Treasury Bill rate and r_{Mt} is the daily return on the Morgan Stanley REIT Index (MSREIT), over the interval 01/02/1998–09/10/2001 (as reported in Table 4), then computing abnormal returns (ARs) from Eq. (1) as the difference $r_{it}^{CC} - \hat{r}_{it}^{CC}$ for each of the REITs in the two subsamples, and finally cumulating ARs over time and aggregating them across REITs. We also plot 95% confidence intervals based either on bootstrapped standard errors computed over the widest available sample period outside the event window 01/02/2002–12/31/2002 (dotted lines, right axis, over 100 replications), or on standard errors computed by bootstrapping over the same interval for 100 sets of 12 randomly selected REITs among the universe of office REITs in our sample—27 REITs in Table 1—as of September 1, 2001 (thin solid lines, right axis), under the null hypothesis of zero CARs, as well as CARs of the 15 REITs with no New York exposure listed in Table 1 (starred line, right axis).

their underlying real performance with little delay. Interestingly, the sharp decline in the abnormal returns of NY REITs exhibited in Fig. 3 begins on November 7 and lasts until November 19, i.e., around the time analysts started revising downward their EPS forecasts for those REITs (e.g., the sequence of downgrades for Mack-Cali between November 8 and 12, 2001 in Table 6). This is consistent with the notion that financial markets eventually reacted to negative analysts' reports on NY REITs' future earnings.

4.4. Real and financial market frictions

While it is impossible to rigorously evaluate the possible reasons for those estimated differences in timing, sign, or magnitude of the reactions of real and financial markets, as well as of various groups of market participants, to the events of 9/11, two (related) issues are clear. First, analysts and the financial markets initially anticipated that the supply reduction effect in the New York metro area would be sufficient to generate relatively superior returns to NY office REITs. However, as we documented above, this superior performance did not materialize, at least not in the short run. Second, insiders identified (and exploited) most rapidly this perceived temporary overvaluation of New York office REITs in the U.S. stock market.

Real estate practitioners primarily attribute the first, real disparity to two sources. In essence, these arguments involve the fact that employers laid off workers faster than they could layoff space. This factor, coupled with excess space known as “shadow”³⁴ space by New York metro area employers, resulted in a sufficient supply of space for displaced tenants. According to Grubb and Ellis (2001), by December 2001, permanently displaced tenants contracted to take only 48% as much space as they had formerly occupied. In addition, since September 11, New York companies that were not directly affected re-evaluated their space needs and offered an additional 10.1 million square feet of space available for sublet. Much of this additional sublet space came from Wall Street firms. Consequently, the number of displaced tenants that were expected to lease new space somewhere in Manhattan was not as large as anticipated.

In addition to a reduction in the demand for space, corporations also downsized their workforce in the post 9/11 period. In New York City, the securities industry alone lost 9,800 jobs; a total of 31,100 private sector jobs were lost in 2002, as the unemployment rate rose to 8.4%. Besides the resulting increase in vacancy, the anticipated increase in rents did not materialize in part due to the Real Estate Board of New York’s (REBNY) written memo to its members that “Any member owner, firm, or broker found to be taking advantage of this terrible tragedy will be expelled from the Real Estate Board.”³⁵ While some critics might argue that expectations might not have been realized because tenants moved out of the New York metro area, Table 8 shows that only a small portion (5.4%) of

³⁴The National Association of Realtors (NAR) (2003) defines shadow space as space that isn’t being occupied by the tenant but isn’t being actively marketed either. Shadow space is a difficult number to obtain. In an RCA (Realtors Commercial Alliance) Report dated Fall 2003, Torto Wheaton research estimated that nationwide, shadow space represents an additional 3% of unoccupied space that is not reflected in vacancy numbers. Mitchell Stein, CEO of Julien J. Studley Inc., a commercial leasing agent, stated in the same report that shadow space for Manhattan accounts for between 2.5% to 3.5% (10 to 14 million square feet) of unoccupied space. Shadow space exists not only because firms can lay off workers faster than they can lay off space but also because companies worry they won’t be able to find space in the future and thus take more than they presently require. There are other reasons that space remains in the shadows. These reasons include the fact that very small amounts of space are difficult to lease and that space with only one to two years remaining on a lease is unmarketable except to very flexible tenants. Also, the cost to reconfigure the space to make it subleaseable might not be justified.

³⁵According to the information reported on the website http://www.property-mag.com/property/Winter02/coverstory_print.html, REBNY urged its members not to take advantage of displaced tenants when negotiating lease rates and suggested using rental rates in place prior to September 11. REBNY also asked brokers to waive their usual commissions and fees in assisting displaced tenants who required short-term (less than 12 months) leases.

Table 8

WTC tenant relocation summary

This table reports the number of tenants occupying at least 10,000 square feet of office space in the buildings directly involved in the events of September 11, 2001 who had to relocate, as of July 2002. The attack destroyed or damaged 21 office buildings in downtown Manhattan, including the World Trade Center (WTC). The 21 buildings contained 31.2 million square feet of office space and 30.3 million square feet of that space or 97% was occupied. The six buildings that made up the WTC, all of which were destroyed in the terrorist attack, contained 13.4 million square feet of office space and were 96% occupied. Percentages of the total number of relocated tenants (186) are in parentheses. Source: http://www.tenantwise.com/wtc_relocate.asp.

Pre 9/11-tenant location	Post 9/11-tenant relocation					Total
	Midtown	Downtown	New Jersey	Elsewhere	Undecided	
Destroyed buildings	40 (21.5%)	14 (7.5%)	11 (5.9%)	7 (3.8%)	3 (1.6%)	75 (40.3%)
Damaged buildings	24 (12.9%)	80 (43.0%)	1 (0.5%)	3 (1.6%)	3 (1.6%)	111 (59.7%)
Total	64 (34.4%)	94 (50.5%)	12 (6.5%)	10 (5.4%)	6 (3.2%)	186 (100.0%)

tenants relocated outside of the metro area. The overwhelming majority of displaced tenants (84.9%) chose to remain in New York City.

We also consider the possibility that the discrepancy between the relative performance of financial and real markets for the NY REITs in our sample following September 11 may be due, at least in part, to the arrival of idiosyncratic news affecting those REITs between September 10 and September 17, 2001. We check for this argument by examining all relevant information events taking place for each of the 27 REITs in our sample over that interval of time. The ensuing sequence of these events (from Lexis-Nexus), reported in Table 9, suggests that none of the REITs under examination experienced information shocks significant enough to bias our statistical analysis, i.e., to contribute to the abnormal returns estimated in Table 4.

The evidence in Sections 4.1 and 4.2 may shed light on the second, financial disparity. Recent theoretical studies argue that, in semi-strong efficient market settings à la Kyle (1985), both the timing and intensity of the trading activity of better informed agents are crucially related to whether those agents perceive their informational advantage to be homogeneously shared among them (e.g., Holden and Subrahmanyam, 1992; Foster and Viswanathan, 1996; Wang, 1998; Back, Cao, and Willard, 2000; Pasquariello and Vega, 2007). In particular, these studies show that homogeneously informed insiders are likely to engage in a non-cooperative “rat race”—to trade larger amounts sooner—to extract rents from their informational advantage before similarly informed competitors do so. In these circumstances, market prices rapidly incorporate new information. When more heterogeneously informed, those insiders are instead more likely to act as quasi-monopolists, by engaging in a “waiting game”—by trading smaller amounts later—to extract rents from their informational advantage after differentially informed competitors have dissipated theirs. This strategic trading activity ultimately delays the process by which new information is incorporated into market prices. Accordingly, our analysis suggests that many New York REIT insiders almost uniformly sold large fractions of their share

Table 9
News arrivals

This table reports the news events taking place for each of the REITs in our sample between Monday September 10, 2001 and Monday September 17, 2001. Panel A lists news for REITs with no NY metro exposure (defined in the notes to Table 1) and Panel B for REITs with some NY metro exposure, excluding downtown Manhattan. The column labeled NY indicates the percentage of office space (in square feet) in the NY metro area in the portfolio of the corresponding REIT. Source: Lexis-Nexus.

REIT name	Ticker	09/10	09/11	09/12	09/13	09/14	09/15	09/16	09/17	NY (%)
<i>Panel A: News for REITs with no NY metro exposure</i>										
Alexandria Real Estate Equities	ARE	None	None	None	None	None	None	None	None	0.00
AmeriVest Properties	AMV	None	None	None	None	None	None	None	None	0.00
Arden Realty	ARI	None	None	None	Declares dividend	None	None	None	None	0.00
Bedford Property Investors	BED	Gets \$150M credit revolver	None	None	None	Declares dividend	None	None	None	0.00
CarrAmerica Realty	CRE	None	None	None	None	None	None	None	None	0.00
Crescent Real Estate Equities	CEI	None	None	None	None	None	None	None	None	0.00
Duke Realty	DRE	None	None	None	None	None	None	None	None	0.00
Great lakes REIT	GL	None	None	None	None	None	None	None	None	0.00
Highwood Properties	HIW	None	None	None	None	None	None	None	None	0.00
Kilroy Realty	KRC	None	None	None	None	None	None	None	None	0.00
Koger Equity	KE	None	None	None	None	None	None	None	Declares dividend	0.00
Mission West Properties	MSW	None	None	None	None	None	None	None	None	0.00
Parkway Properties	PKY	None	None	None	None	None	None	None	None	0.00
Prentiss Properties	PP	Gets 81,224 sqfeet with Deltek	None	None	Loses lease for One Atlantic Center (GA)	None	None	None	None	0.00

holdings in the immediate aftermath of the WTC attack (Fig. 2a and Table 6), and that these trades were profitable (Fig. 3). In contrast, it took about two months for the plausibly less (and more heterogeneously, Panel D of Table 6) informed New York REIT analysts and all other investors to conform their forecasts and prices to the negative real performance of the New York office market reported in Table 5.³⁶

5. Conclusions

The ability of financial markets to process available information quickly and accurately is the cornerstone of modern theories of market efficiency. This study examined how three different groups of market participants—insiders, analysts, and the general market—revised their beliefs in response to a dramatic and unexpected event, the terrorist attacks on September 11, 2001, and how their reactions compared to the subsequent behavior of the real asset markets. To that end, we analyzed the dynamics of returns of REITs exposed to the New York metropolitan area. Two of the unique aspects of this study are that (i) the events of September 11 were unprecedented and likely unanticipated, hence could not have been built into the market's prior expectations and prices, and (ii) the potential impact of those events on REIT returns was ambiguous, since it was uncertain if the resulting reduced supply of office space in New York (the supply reduction effect) would dominate the negative repercussions of 9/11 for the local and national economy (the recessionary shock effect). A further distinguishing feature of our study—as compared to the extant literature on the economic and financial consequences of unanticipated catastrophic events, either natural or man-made—is that we focus on the speed with which these three groups of markets participants were able to incorporate the performance of the underlying real asset market in the aftermath of the WTC attack into their expectations for REITs' financial performance.

We find economically and statistically significant evidence of a divergence between financial and real markets' assessment of the impact of the events of September 11 on New York REITs' valuations. Indeed, returns on New York office REITs from the close on September 10 to the close on September 17 and returns in the underlying real markets over the following quarter moved in opposite directions. New York REITs showed a significantly positive abnormal return of 4.1%, while the corresponding real markets over the last quarter of 2001 experienced either significantly negative or zero abnormal returns computed using three popular measures of real performance in the real estate literature. Specifically, our analysis reveals that, in the short run, REITs with significant exposure to the New York market outperformed REITs without any New York exposure; in contrast, in the underlying real asset markets, New York properties experienced either significantly negative or no abnormal performance with respect to similar office properties in the U.S. over the first quarter following 9/11. These latter results also provide additional evidence on the resiliency of real product markets in response to catastrophic events. According to our analysis, the New York real estate market was in fact able to absorb an enormous shock without suffering huge price increases or severe shortages. This is consistent with the findings of Davis and Weinstein (2002, 2004) for post World War II Japan and other settings.

³⁶Consistently, Easley, O'Hara, and Paperman (1998) provide evidence that analysts' recommendations for a sample of NYSE stocks are generally based on public, rather than private, information.

Consistent with notions of semi-strong—but inconsistent with strong-form—market efficiency, we also find that insiders updated their expectations more accurately and faster than analysts, who in turn revised their expectations more accurately and faster than all other investors. Specifically, insiders were the first to lower their expectations and homogeneously adjust their trading activity consistently with the real market. For example, in the month following the re-opening of U.S. financial markets, insider trading in REITs with New York exposure was 26 times insider trading in REITs of comparable total market capitalizations but without New York exposure. Further, sales represented 99.9% of the total volume of insider trades in New York REITs, but just 68% of the total volume of insider trades in REITs with no New York properties. Analysts were almost as quick to adjust their recommendations, albeit more heterogeneously so: after being initially optimistic about the New York office market, by early November most REIT analysts had lowered their EPS and stock price targets for New York REITs; however, the dispersion of their earnings forecasts, already historically high prior to September 11, did not significantly decline afterwards. Lastly, REIT stock prices adjusted to reflect the underlying real market behavior; indeed, abnormal REIT returns had disappeared by the end of November 2001. These findings are remarkable since they suggest that both financial and real markets responded efficiently to a massive, unprecedented, and wholly unexpected shock to the economy.

Finally, we investigate some plausible explanations for the differences in the behavior of real and financial markets following the events of 9/11. In particular, we explore whether confounding news and information heterogeneity could have contributed to both the observed timing and intensity of the trading activity in office REITs and the initial run-up of their stock prices. We could not identify any significant idiosyncratic information shock taking place during the ensuing one-week market shut-down for any of the REITs in our sample. The weaker-than-expected real performance of NY REITs appears instead to be related to the ability of many downtown firms to reduce space requirements, after the forced relocation, and to lower-than-expected actual vacancy rates, as argued by real estate practitioners. As interestingly, the trading and pricing dynamics of NY office REITs described above are compatible with the implications of models of trading that relate price informativeness and volume in semi-strong efficient markets to the extent to which insiders and analysts are differentially informed (e.g., Holden and Subrahmanyam, 1992; Foster and Viswanathan, 1996; Wang, 1998; Back, Cao, and Willard, 2000; Pasquariello and Vega, 2007).

References

- Abadie, A., Gardeazabal, J., 2003. The economic cost of conflict: a case study of the Basque country. *American Economic Review* 93, 113–132.
- Angboza, L., Narayanan, R., 1996. Catastrophic shocks in the property-liability insurance industry: evidence on regulatory and contagion effects. *The Journal of Risk and Insurance* 63, 619–637.
- Axelrod, S., 2001. Morning meeting note. Lehman Brothers, September 21, 2001.
- Back, K., Cao, H., Willard, G., 2000. Imperfect competition among informed traders. *Journal of Finance* 55, 2117–2155.
- Barrett, W., Heuson, A., Kolb, R., Schropp, G., 1987. The adjustment of stock prices to completely unanticipated events. *The Financial Review* 22, 345–354.
- Carter, D., Simkins, B., 2002. Do markets react rationally? The effect of the September 11th tragedy on airline stock returns. Working paper, Oklahoma State University.

- Chan, K., Hendershott, P., Sanders, A., 1990. Risk and return on real estate: evidence from equity REITs. *Real Estate Economics* 18, 431–452.
- Chan, W., 2003. Stock price reaction to news and no-news: drift and reversal after headlines. *Journal of Financial Economics* 70, 223–260.
- Chen, A., Siems, T., 2004. The effects of terrorism on global capital markets. *European Journal of Political Economy* 20, 349–366.
- Cohen, R., Gompers, P., Vuolteenaho, T., 2002. Who underreacts to cash-flow news? Evidence from trading between individuals and institutions. *Journal of Financial Economics* 66, 409–462.
- Cowles, A., 1933. Can stock market forecasters forecast? *Econometrica* 1, 309–324.
- Daniel, K., Hirshleifer, D., Subrahmanyam, A., 1998. Investor psychology and security market under- and over-reactions. *Journal of Finance* 53, 1839–1885.
- Damodaran, A., Liu, C., 1995. Insider trading as a signal of private information. *Review of Financial Studies* 6, 79–120.
- Davis, D., Weinstein, D., 2002. Bones, bombs, and break points: the geography of economic activity. *American Economic Review* 92, 1269–1289.
- Davis, D., Weinstein, D., 2004. A search for multiple equilibria in urban industrial structure. NBER Working Paper No. 10252.
- DeBondt, W., Thaler, R., 1985. Does the stock market overreact? *Journal of Finance* 40, 793–805.
- DeBondt, W., Thaler, R., 1987. Further evidence on investor overreaction and stock market seasonality. *Journal of Finance* 42, 557–581.
- DeBondt, W., Thaler, R., 1990. Do security analysts overreact? *American Economic Review* 80, 52–57.
- Diether, K., Malloy, C., Scherbina, A., 2002. Differences of opinion and the cross section of stock returns. *Journal of Finance* 57, 2113–2141.
- Doherty, N., Lamm-Tennant, J., Starks, L., 2003. Insuring September 11th: market recovery and transparency. *The Journal of Risk and Uncertainty* 26, 179–199.
- Easley, D., O'Hara, M., Paperman, J., 1998. Financial analysts and information-based trade. *Journal of Financial Markets* 1, 175–201.
- Edwards, A.G., 2000. Equity office properties.
- Elton, E., Gruber, M., Gultekin, M., 1984. Professional expectations: accuracy and diagnosis of errors. *Journal of Financial and Quantitative Analysis* 19, 351–363.
- Fama, E., 1970. Efficient capital markets: a review of theory and empirical work. *Journal of Finance* 25, 383–417.
- Fama, E., 1991. Efficient markets II. *Journal of Finance* 46, 1575–1617.
- Fama, E., 1998. Market efficiency, long-term returns and behavioral finance. *Journal of Financial Economics* 49, 283–306.
- Fama, E., Fisher, L., Jensen, M., Roll, R., 1969. The adjustment of stock prices to new information. *International Economic Review* 10, 1–21.
- Foster, F., Viswanathan, S., 1996. Strategic trading when agents forecast the forecasts of others. *Journal of Finance* 51, 1437–1478.
- French, K., Roll, R., 1986. Stock return variances: the arrival of information and the reaction of traders. *Journal of Financial Economics* 17, 5–26.
- Glaser, M., Weber, M., 2005. September 11 and stock return expectations of individual investors. *Review of Finance* 9, 243–279.
- Gentry, W., Jones, C., Mayer, C., 2004. REIT reversion: stock price adjustments to fundamental value. Working Paper, Columbia University.
- Grubb and Ellis Research, 2001. NYC's office market—a post 9-11 update. December.
- Guidolin, M., La Ferrara, E., 2005. The economic effects of violent conflict: evidence from asset market reactions. St. Louis FED Working Paper No. 2005–066A.
- Holden, G., Subrahmanyam, A., 1992. Long-lived private information and imperfect competition. *Journal of Finance* 47, 247–270.
- Jegadeesh, N., 1990. Evidence of predictable behavior of security prices. *Journal of Finance* 45, 881–898.
- Jegadeesh, N., Titman, S., 1995. Overreaction, delayed reaction, and contrarian profits. *Review of Financial Studies* 8, 973–993.
- Kahneman, D., Tversky, A., 1973. On the psychology of prediction. *Psychological Review* 80, 237–251.
- Kallberg, J., Liu, C., Trzcinka, C., 2000. The value added from investment managers: an examination of funds of REITs. *Journal of Financial and Quantitative Analysis* 35, 387–408.

- Karolyi, A., 2006. The consequences of terrorism for financial markets: what do we know? Working Paper, Ohio State University.
- Karolyi, A., Martell, R., 2006. Terrorism and the stock market. Working Paper, Ohio State University.
- Karolyi, A., Sanders, A., 1999. The variation in economic risk Premiums in Real Estate Returns. *Journal of Real Estate Finance and Economics* 17, 245–262.
- Kyle, A., 1985. Continuous auctions and insider trading. *Econometrica* 53, 1315–1335.
- Lamb, R., 1995. An exposure-based analysis of property-liability insurer stock values around hurricane Andrew. *The Journal of Risk and Insurance* 62, 111–123.
- Lamb, R., 1998. An examination of market efficiency around hurricanes. *The Financial Review* 33, 163–172.
- Ling, D., Naranjo, A., 1996. Economic risk factors and commercial real estate returns. *Journal of Real Estate Finance and Economics* 14, 283–307.
- Ling, D., Naranjo, A., 2002. Commercial real estate return performance: a multi-beta, cross-country analysis. *Journal of Real Estate Finance and Economics* 24, 119–142.
- Ling, D., Naranjo, A., 2003. The dynamics of REIT capital flows and returns. *Real Estate Economics* 31, 405–434.
- Ling, D., Naranjo, A., Ryngaert, M., 2000. The predictability of equity REIT returns. *Journal of Real Estate Finance and Economics* 20, 117–136.
- Litt, J., 2001. Mack-Cali (CLI): occupancy pressure not offset with increased Manhattan demand. *Salomon Smith Barney*, November 8, 2001.
- Liu, C., Mei, J., 1992. The predictability of returns on equity REITs and their co-movement with other assets. *Journal of Real Estate Finance and Economics* 5, 401–418.
- Mei, J., Lee, A., 1994. Is there a real estate factor premium. *Journal of Real Estate Finance and Economics* 9, 113–126.
- National Association of Realtors. 2003. RCA (Realtors Commercial Alliance) Report, vol. 4, Issue 4, Fall, p. 4.
- Paolone, A., 2001. Reckson Associates. *CIBC World Markets*, November 7.
- Pasquariello, P., Vega, C., 2007. Informed and strategic order flow in the bond markets. *Review of Financial Studies* 20, 1975–2019.
- Poteshman, A., 2006. Unusual option market activity and the terrorist attacks of September 11, 2001. *Journal of Business* 79, 1703–1726.
- Raiman, L., Dembski, M., Habermann, J., Schwalbe, J., 2001. Morning meeting note. *Credit Suisse First Boston*, September 17, 2001.
- Rozeff, M., Zaman, M., 1988. Market efficiency and insider trading: new evidence. *Journal of Business* 61, 25–44.
- Schwert, G., 2003. Anomalies and stock market efficiency. In: Constantinides, G., Harris, M., Stulz, R. (Eds.), *Handbook of the Economics of Finance*, vol. 1. Elsevier Press, Amsterdam, pp. 1–5.
- Seyhun, N., 1986. Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics* 16, 189–212.
- Seyhun, N., 1988. The information content of aggregate insider trading. *Journal of Business* 61, 1–24.
- Seyhun, N., 1990. Overreaction or fundamentals: some lessons from insiders' response to the market crash of 1987. *Journal of Finance* 45, 1363–1388.
- Shelor, R., Anderson, D., Cross, M., 1990. The impact of the California earthquake on real estate firms' stock value. *The Journal of Real Estate Research* 5, 335–340.
- Shiller, R., 1981. Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review* 75, 421–436.
- Shiller, R., 1989. *Market Volatility*. MIT Press, Cambridge, MA.
- Sinkey, J., Carter, D., 1999. The reaction of bank stock prices to news of derivatives losses by corporate clients. *Journal of Banking and Finance* 21, 1725–1743.
- Smirlock, M., Kaufold, H., 1987. Bank foreign lending, mandatory disclosure rules and the reaction of bank stock prices to the Mexican debt crisis. *Journal of Business* 60, 347–364.
- Straetmans, S., Verschoor, W., Wolff, C., 2003. Extreme U.S. stock market fluctuations in the wake of 9/11. Working Paper, Maastricht University.
- Taylor, L., Goebel, T., 2001. CLI: WTC impact is short-lived. *Deutsche Bank Alex Brown Inc.*, November 9, 2001.
- Veronesi, P., 1999. Stock market overreaction to bad news in good times: a rational expectations equilibrium model. *Review of Financial Studies* 12, 975–1007.

- Wang, A., 1998. Strategic trading, asymmetric information and heterogeneous prior beliefs. *Journal of Financial Markets* 1, 321–352.
- Whyte, G., 2001. Mack-Cali Realty: CLI; 2001 guided lower despite 2Q01 beat. Morgan Stanley, August 16, 2001.