Rising Interest Rates and the Future of U.S. Commercial Real Estate

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Abstract

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This study focuses on the impact of rising interest rate environments on the valuation of commercial real estate and investment returns from holding such assets. Linear regression analyses using historical data show a statistically significant *positive* correlation between the most recent change in interest rates, and the ensuing returns on commercial real estate. In particular, these results suggest that during the period of one-to-three years after a significant rate increase, real estate returns have historically been higher than their long-run average. At the time of writing, a rising interest rate environment in the U.S. had generated widespread concern that discount rates on investment properties would increase, eroding their value. However, our findings indicate that other factors such as income growth have prevailed historically in such times, offsetting the increased discount rates. This paper discusses possible reasons for these observations, drawing on anecdotal evidence from real estate investors and developers, and proposing further topics of study related to the microeconomic factors driving these trends.

I. Introduction and Background

On Wednesday September 26th, 2018, the U.S. Federal Reserve Chairman Jerome Powell announced the Fed's intention to raise short-term interest rates by 25 basis points, marking the third rate increase in 2018 and the eighth since the start of the global financial crisis. Powell also indicated that one additional rate increase was planned for the fourth quarter of 2018, and he expressed confidence in the United States' rapidly strengthening economy. However, despite the country's growing economy, nearly record-low unemployment levels, and a bull market that has lasted for nine years, many investors worry that the Fed's rate increases will have an adverse effect on their portfolios, particularly real estate holdings.

Real estate, which is often a highly-levered investment, can be heavily impacted by the mortgage market and overall costs of borrowing. In theory, as the cost of borrowing increases, this will create a drag on real estate investors' total investment returns, either in the form of greater interest expense or a decreased level of maximum leverage leading to a lower IRR.[1] Additionally, higher interest rates across the board should mean a higher opportunity cost of capital, and this would lead to higher capitalization rates in real estate transactions.[2] Capitalization rates and property values are inversely related, so in theory this would depress the value of many real estate holdings. In any case, both of the above factors would put downward pressure on real estate prices.

However, slightly diminishing the credibility of the above arguments is another possibility: If the Fed is confident enough in the economy to be tightening its monetary policy, shouldn't this

[1] "IRR" or "Internal Rate of Return" is a popular way to measure a fund's investment returns. IRR is defined as the annualized discount rate that makes the net present value of all cash flows from a particular investment equal to zero.

[2] "Capitalization rate" is defined as a property's annual net operating income or "NOI," divided by its current market value or purchase price.

translate to greater demand for real estate (both ownership and rentals), higher rents per square foot, and thus higher transaction prices? If these opposing forces prove equally strong, then the total returns from real estate investments might be little changed by rate increases. Also, neither of these arguments account for changes in the underwriting practices of banks and mortgage lenders, which often loosen during economic boom times. As the economy improves, loan default rates decrease, giving bankers the justification they need to relax debt service coverage ratios, loan-to-value, and other metrics, all of which make capital easier for investors to access, which drives up real estate values.[3,4]

Many forces drive the current real estate market, some of which directly oppose each other. The purpose of this paper is to analyze how those forces interact. In the following research, we aim to determine the effects of rising interest-rate environments on the U.S. real estate market, by examining historical data and searching for patterns in the relationship between the key variables. Our goal is to use the outcomes of several past real estate cycles to build a predictive model, which gives insight into the likely course of our current real estate environment during the next one-to-three years.

II. Data Sources

To explore the above questions, we obtained historical data from the National Council of Real Estate Investment Fiduciaries ("NCREIF"), the Federal Reserve Bank of St. Louis' "FRED" Database, and various public sources including Yahoo Finance. From NCREIF, we utilized the Council's National Property Index ("NPI") to determine historical income returns and capital

[3] "Debt Service Coverage Ratio" or "DSCR" is defined as an investment's cash flow available for debt servicing, divided by its total annual debt service amount (including interest and required principal payments).

[4] "Loan to Value" or "LTV" is defined as the loan size divided by the asset's value. LTV is commonly used by mortgage lenders and real estate investors when evaluating mortgage loans.

returns from holding a diversified portfolio of commercial real estate assets. The NPI is one of the oldest commonly-used commercial property price indexes, and dates back to the fourth quarter of 1977. The index is comprised of operating properties acquired, at least in part, on behalf of tax-exempt institutions and held in a fiduciary environment. Each property's contribution to the index is weighted by its estimated market value, estimated quarterly, and the resulting data is reported to NCREIF. Each quarter, the index's contributing members are required to submit a market value for each NPI qualifying property, using standard commercial real estate appraisal methodology. While these market value reports can be determined either internally or using an independent appraiser, NCREIF requires that each property in the index be independently appraised at minimum once every three years. As of Q4 2018, the market value of properties included in the index totaled approximately $611.6 billion.

The NPI's cumulative nominal return can be seen in Fig. 1 below, in the left chart. During the studied period from Q1 1978 to Q2 2018, the NPI grew at an average annualized rate of 9.26%, while the income return grew at 7.26% and the capital return grew at 1.91%. Furthermore, the NPI's returns can be decomposed into 1) income returns and 2) capital returns, both of which are also shown in Fig. 1, in the right chart.

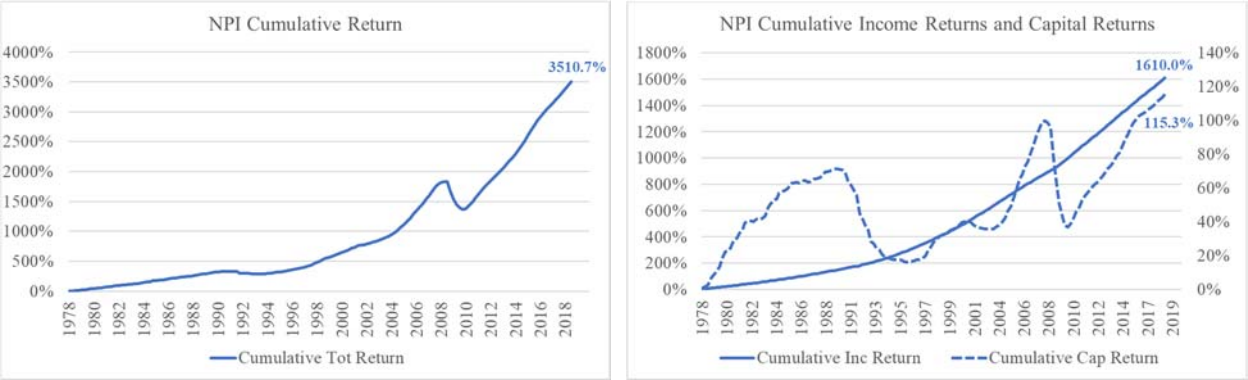

Fig. 1: NPI cumulative returns since inception

We can quickly observe that the NPI income return grows steadily over time, accounting for the majority of the long-term returns, while the capital return grows more slowly and fluctuates with broad economic conditions. Furthermore, below we show these two types of returns in comparison to aggregate U.S. inflation, as measured by the quarterly Consumer Price Index for all items.

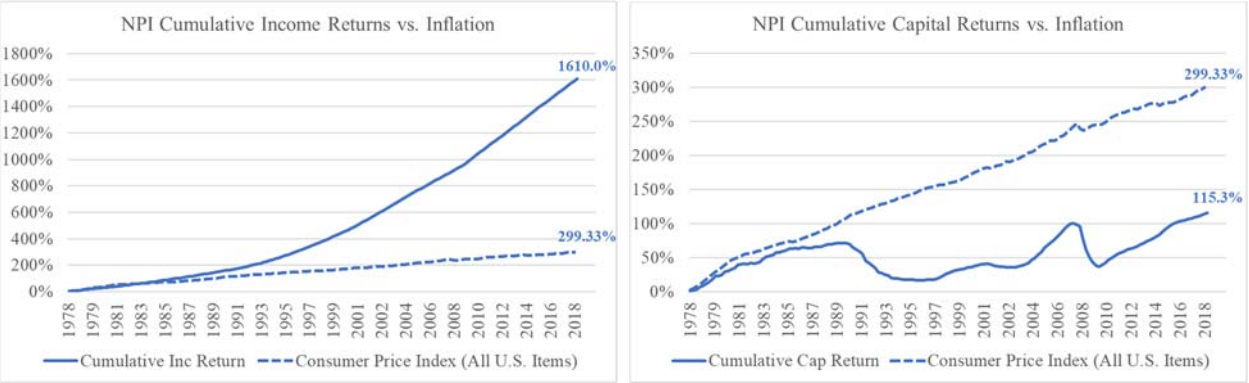

Fig 2: NPI cumulative income and capital returns vs. inflation

Over the time period studied, the CPI grew at an average annualized rate of 3.48%. As can be seen in Fig. 2, the aggregate income rose steadily over time and generated the majority of the investment returns, beating inflation by 1,310.65% over the studied period. The capital value fluctuated during recessions and recoveries, but grew much more slowly in the long run and ended up 183.98% below aggregate inflation.

The NPI includes some properties with leverage, but all returns are reported on an unleveraged basis. Property types include Apartment, Hotel, Industrial, Office and Retail properties, and sub-types within each type. Furthermore, the NPI includes “operating properties” only, defined as properties that are at least 60% occupied when entering the index. The properties can be wholly-

owned or in a joint-venture structure, and must be controlled by a tax-exempt institutional investor or its designated agent.[5]

From the Federal Reserve Bank of St. Louis, we obtained the Fed Funds Rate on a quarterly basis, dating back to Q2 1978. For comparison and analysis purposes, this data was aligned with the NCREIF NPI data for each respective period. The target for the Fed Funds Rate is set by the Federal Open Market Committee ("FOMC") and is one of the most influential interest rates in the U.S. economy. The Federal Reserve influences this key interest rate through open market purchases and sales of securities, and the result affects everything from home mortgage rates to credit card rates.

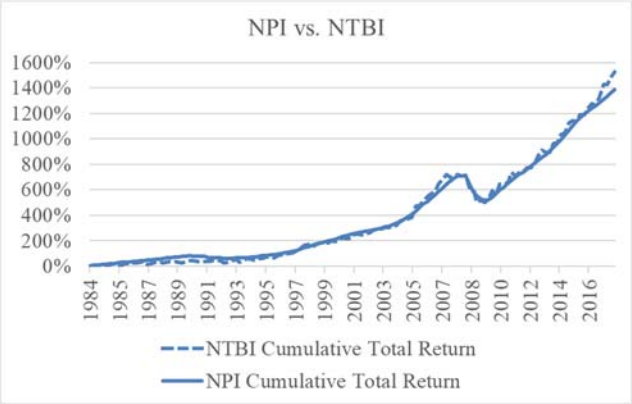

Fig. 3: NPI and NTBI cumulative returns

Furthermore, NCREIF also produces an equal-weighted transaction-based index known as the "NTBI," which incorporates actual transaction prices into the index's returns. In calculating the NTBI's returns, adjustments are made for the number of transactions observed in each quarter. The properties comprising the NTBI are weighted equally, because NCREIF views each property as equally representative of the universe of all commercial properties (i.e. the index itself is viewed as a statistical estimation). As can be seen in Fig. 3, the NTBI captures more short-term variations in property values, but tends to track the NPI over the longer-term.

[5] https://www.ncreif.org/data-products/property/

III. Methodology and Results

To analyze the relationship between interest rates and real estate returns, we first ran various regressions using the NPI "Total Return" as the response variable. For the predictor variable, we analyzed many different possible predictors of future return, including the current Fed Funds Rate and the most recent 1-year change in the Fed Funds Rate. The results of these regressions, commentary, and interpretations are as follows:

III.A – Current Quarter Return vs. Current Quarter Fed Funds Rate

First, we examined the possibility of a linear relationship between the current Fed Funds Rate and the NPI's current period return, the results of which are presented in Fig. 4 below.

Regression Statistics					
R Square	0.085				
Standard Error	0.020				
Observations	162				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.015	0.002	5.00E-09	0.010	0.020
Fed Funds Rate	0.160	0.041	1.65E-04	0.078	0.242

Fig. 4: Current Quarter Return vs. Fed Funds Rate regression outputs

This one-factor analysis revealed a positive correlation between the Fed Funds Rate and "Total Return," representing the investment return generated from holding the entire NPI basket of properties for a single calendar quarter. The analysis also revealed a slightly unexpected result: these two variables are positively correlated with statistical significance (P-value below 0.05), meaning when the Fed Funds Rate is higher, all else equal, that investment returns tend to be higher as well. Of course, the relatively low R-squared value of 0.085 means that the model's fit is far from exact.

Interestingly, this result appears in contrast to much of the popular wisdom that sparked the idea for this paper, which suggested that rising-rates are causing a fearful outlook for real estate investors. In June 2018, one such publication from TH Real Estate, a real estate investment manager with $115 Bn under management, stated that real estate investors currently "fear that higher rates could undermine property values and operating income by raising discount rates and slowing the economy. In particular, their concerns are rooted in the assumption that rising rates mean higher capitalization rates, or cap rates, which in turn can weaken property values and commercial real estate (CRE) investment performance."[6] TH Real Estate went on to note, however, that the relationship between interest rates and CRE returns is more complex, and involves a variety of factors including the health of the general economy and the spread between cap rates and benchmark interest rates. Our analysis above encouraged us to explore this relationship further, and investigate whether the Fed Funds Rate could be used to predict real estate returns over any reasonable length of time into the future.

III.B – Future Quarters' Return vs. Current Quarter Fed Funds Rate

Next, we explored the relationship between the current quarter's Fed Funds Rate and Total Return under different scenarios. In the first scenario, we used the next quarter's Total Return (one quarter *after* the current period) as the output variable, and the current quarter's Fed Funds Rate as the input variable. We note the results of this regression below in Fig. 5.

[6] TH Real Estate, A Nuveen Company, *Think US – The impact of rising interest rates on commercial real estate*. June 2018, pg. 3.

Regression Statistics					
R Square	0.055				
Standard Error	0.020				
Observations	162				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.017	0.002	4.77E-10	0.012	0.021
Fed Funds Rate	0.129	0.042	0.003	0.045	0.212

Fig. 5: Next Single-Quarter Return vs. Fed Funds Rate regression outputs

This model was significant at the 1% level, with a P-value of 0.003 and an R-squared of .055. In the second scenario, we used the next *two* quarters' Total Return as the output variable, keeping the current quarter's Fed Funds Rate as the input variable. We then extended this analysis out using an output variable of three quarters, four quarters, and so on, until the model lost its significance. Our goal was to see how far into the future we could reasonably rely on the Fed Funds Rate as a predictor. A summary of these models' significance is shown in Fig. 6:

# of Quarters' Return	P-Value	R Squared
1	0.003	0.055
2	0.004	0.050
3	0.011	0.040
4	0.032	0.029
5	0.081	0.019
6	0.165	0.012
7	0.285	0.007
8	0.440	0.004
9	0.619	0.002
10	0.785	0.000
11	0.932	0.000
12	0.944	0.000

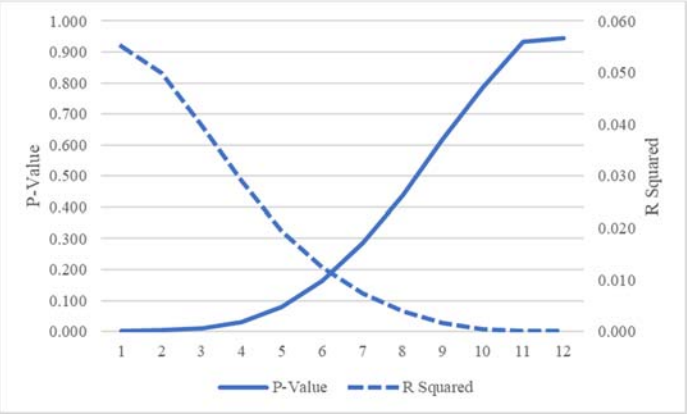

Fig. 6: Statistical summary of current Fed Funds Rate relationship to future NPI returns

The model became less and less statistically significant as we looked at NPI returns further into the future, dropping off sharply after approximately four quarters, or one full-year. Using four quarters as the output variable, the full regression output is shown below in Fig. 7.

Regression Statistics					
R Square	0.029				
Standard Error	0.074				
Observations	159				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.079	0.009	2.42E-14	0.060	0.097
Fed Funds Rate	0.339	0.156	0.032	0.030	0.648

Fig 7: Next 4 Qtr. Return vs. Fed Funds Rate regression outputs

From the above model output, we observed a weak positive correlation between four-quarter future returns and the Fed Funds Rate. However, this relationship appears to diminish in significance when looking beyond four quarters of future returns. Nevertheless, the apparent relationship discovered in the single-quarter model encouraged us to explore other possible linkages, including the *rate of change* of the Fed Funds Rate as a possible predictor.

III.C – Current Quarter Return vs. Last Four Quarters' Fed Funds Rate

Next, we calculated the change (measured in bps) of the Fed Funds Rate over the previous four quarters, measured from three quarters *before* the current period and inclusive of the change in the current period. We called this new variable "Last 4 Qtr. Change," and used it as our new input variable. Our reasoning was that recent *changes* in the Fed Funds Rate, rather than just the absolute value of the rate itself, might serve as a powerful indicator of economic conditions. In the regression below, the output variable is the current single-quarter NPI return, as before in Part III.A, but the input variable is Last 4 Qtr. Change.

Regression Statistics					
R Square	0.168				
Standard Error	0.019				
Observations	159				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.023	0.002	2.16E-32	0.020	0.026
Last 4 Qtr Change	0.560	0.099	7.71E-08	0.364	0.755

Fig. 8: Current Quarter Return vs. Last 4 Qtr. Change regression outputs

As can be seen in the regression outputs, the relationship between Last 4 Qtr. Change and the current period return is even stronger than the relationship examined in III.A. The statistical significance is high, and the R-squared value of 16.8% indicates a much better model fit. Interestingly, this result indicates that recent *changes* in the Fed Funds Rate, rather than simply the absolute value of the Fed Funds Rate, can serve as an important indicator. After interpreting this result, we then decided to test the relationship between our new variable, Last 4 Qtr. Change, and the NPI's return in future quarters. We hypothesized that this next analysis would give us insight into the predictive power of Last 4 Qtr. Change.

III.D – Future Returns vs. Last Four Quarters' Fed Funds Rate

To assess the future predictive power of Last 4 Qtr. Change, we first regressed this variable against the next quarter's NPI return, and then repeat the analysis for the NPI's next two-quarter, three-quarter, and four-quarter long run returns. We continued increasing the time duration of our response variable until Last 4 Qtr. Change lost its statistical significance. The results of the next single-quarter analysis are as follows:

Regression Statistics					
R Square	0.177				
Standard Error	0.019				
Observations	159				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.023	0.001	1.43E-32	0.020	0.026
Last 4 Qtr Change	0.568	0.098	3.28E-08	0.375	0.761

Fig. 9: Next Single-Quarter Return vs. Last 4 Qtr. Change regression outputs

We noted that the R-squared and P-values for this relationship, surprisingly, were slightly *better* than those of the analysis in III.C above. Next, we examined the relationship between the next two quarters' return and Last 4 Qtr. Change:

Regression Statistics					
R Square	0.216				
Standard Error	0.035				
Observations	158				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.046	0.003	2.76E-36	0.041	0.052
Fed Funds Rate	1.189	0.181	7.67E-10	0.831	1.547

Fig. 10: Next 2 Qtr. Return vs. Last 4 Qtr. Change regression outputs

This analysis resulted in the R-squared and P-value improving even more, and in fact the P-value improved by two orders of magnitude. To see if this trend would continue for a three-quarter forward-looking model, a four-quarter model, or greater, we repeated the above analysis until the model lost its significance. A complete summary of the P-Values and R-Squared statistics for the regressions performed is shown below in Fig. 11. From this chart, we see that Last 4 Qtr. Change remains very statistically significant up to the point of projecting forward ten quarters of NPI returns. After this point, Last 4 Qtr. Change begins to rapidly lose significance, but the model remains significant at the 5% level, for up to 13 quarters.

# of Quarters' Return	P-Value	R Squared
1	3.28E-08	0.177
2	7.67E-10	0.216
3	8.06E-10	0.217
4	5.43E-09	0.199
5	8.38E-08	0.172
6	7.39E-07	0.149
7	5.74E-06	0.128
8	4.22E-05	0.106
9	2.84E-04	0.085
10	0.001	0.069
11	0.004	0.054
12	0.015	0.040
13	0.044	0.028
14	0.091	0.020

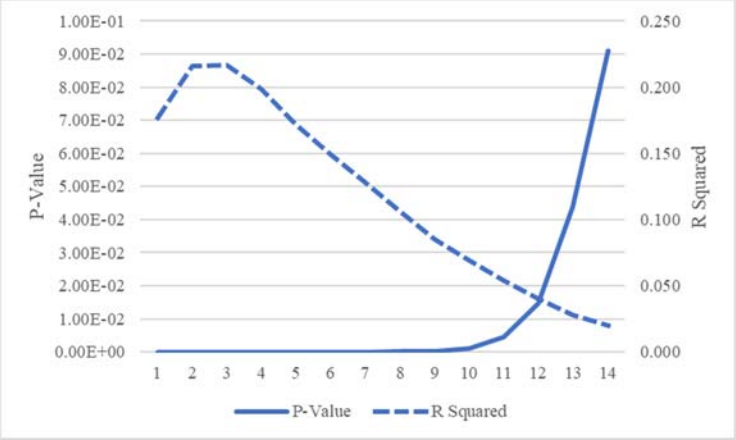

Fig. 11: Statistical summary of Last 4 Qtr. Change relationship to future NPI returns

For an illustration of how the model looks right on the cusp of its significance, we display the 13-quarter outputs below:

Regression Statistics					
R Square	0.028				
Standard Error	0.206				
Observations	147				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.333	0.017	2.22E-42	0.299	0.367
Last 4 Qtr Change	2.186	1.075	0.044	0.060	4.311

Fig. 12: Next 13 Quarters' Return vs. Last 4 Qtr. Change regression outputs

While the above model is far less significant or precise than models with a shorter time-horizon, we were nonetheless impressed with how relevant Last 4 Qtr. Change remained, even looking ahead as much as three years. From these results, we can begin to hypothesize how overall average commercial real estate investment returns will look over the next one-to-three years. Using our four-quarter forward looking model, for example, the coefficient of Last 4 Qtr. Change is 2.16. This implies that for a 1% increase in the Fed Funds Rate over the past year (the situation we are in currently in Q1 2019), real estate returns for the upcoming year (from Q1 2019 to Q1 2020) will be 2.16% higher than their long run average. In fact, using the 95% confidence interval, we can say with 95% confidence that the next year's average real estate return will be between 9.9% and

13.4%. Similarly, using our eight-quarter model, today's situation implies that annualized real estate returns will be approximately 10.7% over the next two years. Using our twelve-quarter model implies that annualized real estate returns will be approximately 10.0% over the next three years.

III.E – Future Returns vs. Last Four Quarters' Fed Funds Rate (Transaction-Based)

Given the above results, we felt it necessary to explore the possibility that the appraisal-based NPI index might cause too much smoothing in historical real estate returns, which would cast doubt on the meaningfulness of our prior analysis. After all, the NPI only captures two noticeable declines in property values: one from 1990-1993 and the other from 2008-2009, which limits the range of the output variables used in our regression analyses. Thus, we repeated the analyses from III.D, modeling the NTBI's current and future returns against Last 4 Qtr. Change, and obtained the below results:

# of Quarters' Return	P-Value	R Squared
1	0.174	0.014
2	0.004	0.062
3	7.80E-06	0.141
4	6.68E-07	0.172
5	1.15E-06	0.167
6	1.87E-05	0.133
7	6.90E-05	0.117
8	0.001	0.079
9	0.007	0.056
10	0.008	0.055
11	0.014	0.047
12	0.057	0.029
13	0.229	0.012
14	0.435	0.005

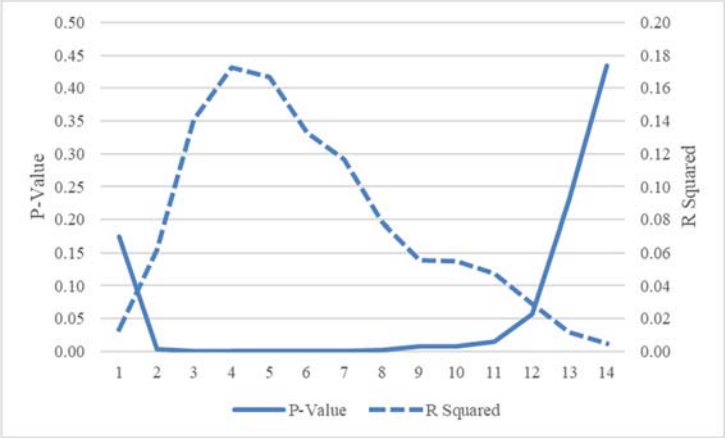

Fig. 13: Statistical summary of Last 4 Qtr. Change relationship to future NTBI returns

As can be seen in Fig. 13, the results are similar to our prior analysis from III.D, but the model's fit is less precise. The R-Squared value peaks at 17.2%, versus 21.7% for the model used in III.D. Additionally, the above model is still statistically significant but slightly less so than before, with the P-Value three orders of magnitude greater than that of our prior analysis. In addition, the model

loses its significance when the output variable is greater than 11 quarters in length, versus up to 13 quarters for the model used in III.D. However, the above results lead us to believe that Last 4 Qtr. Change is still quite significant, even when more short-term "noise" is introduced through the use of actual transaction prices, instead of just appraisal values.

III.F – Fed Funds Rate vs. Other Assets

As part of our analysis, we also examined the relationship between various broad indexes of assets and the Fed Funds Rate, to see if the relationships discovered in III.D and III.E were unique to real estate as an asset class, or whether these relationships applied more broadly to all assets in general. Interestingly, our results showed that the Last 4 Qtr. Change is a very weak predictor of future returns from *stocks*, in the S&P 500 for example, but is a relatively good predictor of future returns from real assets in general, as measured by the MSCI World Infrastructure Index.

In the case of the S&P 500, Last 4 Qtr. Change exhibited no statistical significance as a predictor. The best-fitting model we developed regressed Last 4 Qtr. Change against the next 16 quarters of S&P 500 returns, and resulted in a P-Value of 0.58 and an R-Squared value of 0.2%. The P-Value of this model continued to decrease as we looked at returns further into the future, however we imagine this is simply due to a continued reduction in the number of output data points, and thus degrees of freedom, that the model is based on.

By comparison, the MSCI World Infrastructure Index had a much stronger relationship with Last 4 Qtr. Change, which maintained its statistical significance as a predictor of as many as eight quarters of future returns. However, we question the overall significance of this result, since the

only data we had available for the infrastructure index extended from April 1999 to July 2015 (66 quarters in total). With such little historical data, there were only approximately eight non-overlapping periods of eight-quarter returns available. Further details on the MSCI World Infrastructure Index and its constituents can be found in Appendix II.

III.G – NPI Returns Decomposition (Income vs. Capital Return)

The NCREIF data we utilized had the advantage of separating the NPI's total returns for each quarter into "income returns," or returns from a property's net operating income ("NOI"), and "capital returns," representing returns from a property's appreciation or depreciation in value. Deciding to explore one step further, we decided to run the same regression analyses as in III.C and III.D but using these two separate types of returns as the output variables, instead of just "total return." By analyzing the NPI returns in this manner, we hoped to discover if our predictor Last 4 Qtr. Change had more of an effect on one type of returns than the other. This analysis allowed us to observe two important features, namely (1) that the current Fed Funds Rate had a strong and significant relationship with the NPI *income* returns, but a relatively weak relationship with the NPI *capital* returns, and (2) that the Last 4 Qtr. Change had a strong and significant relationship with the NPI *capital* returns, but a weak relationship with the NPI income returns. Further details can be found in Appendix III.

Our initial interpretation of (1) is that a property's income returns are strongly correlated with the risk-free rate, and perhaps interest rates in general, because most commercial property investments are levered using a mortgage. The mortgage rate an investor can obtain on their property likely has a strong effect on their decision to invest in the first place, and on the rental rates they attempt to

charge their tenants after the purchase. Especially at the institutional level, investors would attempt to raise rents if mortgage rates rise, just to cover their debt service payments, because these type of investors desire relatively stable, cash-flowing investments, and are not likely to fund an ongoing shortfall. In accordance with this hypothesis, the regression coefficients from our most significant regressions are all positive, indicating that higher Fed Funds Rates correspond to higher income returns from owning property. The slope of this regression is very small in magnitude, however, and a 1% higher Fed Funds Rate corresponds with approximately 62 bps of additional income return over the next 14 quarters, which when annualized would equal just 18 bps. Our interpretation of (2) is that rising interest rates are a positive sign for real estate owners, since rising-rate environments historically have allowed owners to increase rents by an amount that counteracts their increase cost of capital. We expand on this result in the "Discussion and Interpretation" section below, noting how it runs counter to most conventional thinking.

III.H – NPI Two-Factor Model

Having obtained the results from III.G, namely that the absolute value of the Fed Funds Rate and the recent change in the Fed Funds Rate each affect different components of the NPI returns, naturally our next step was to attempt a multi-factor analysis, to see if both input variables would be significant predictors. As our output variable for this analysis, we simply used the NPI's total returns, but ran regression with both the Fed Funds Rate and Last 4 Qtr. Change as inputs. The statistical summary was as follows.

# of Quarters' Return	Fed Funds Rate P-Value	Last 4 Qtr. Change P-Value	R Squared
1	0.051	3.53E-07	0.197
2	0.096	8.80E-09	0.230
3	0.200	7.05E-09	0.225
4	0.377	3.12E-08	0.203
5	0.629	2.93E-07	0.173
6	0.895	1.67E-06	0.149
7	0.885	9.06E-06	0.128
8	0.707	4.94E-05	0.107
9	0.562	2.60E-04	0.087
10	0.458	0.001	0.073
11	0.391	0.003	0.059
12	0.355	0.010	0.046
13	0.337	0.029	0.034
14	0.339	0.062	0.026
15	0.367	0.111	0.020
16	0.415	0.166	0.015

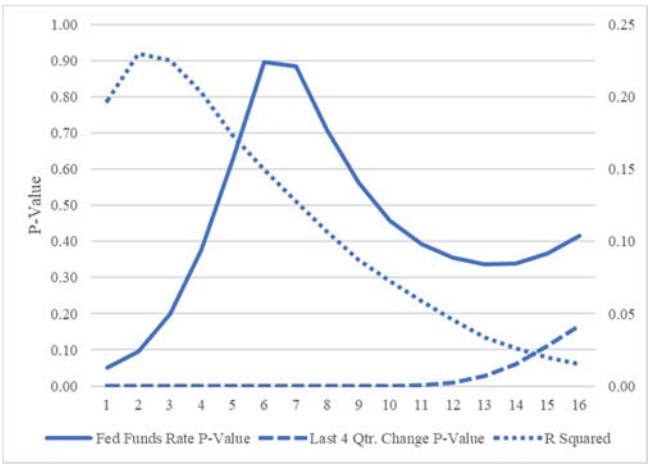

Fig. 20: Statistical summary of Fed Funds Rate and Last 4 Qtr. Change, multivariate relationship to future NPI total returns

In this series of regressions, we noticed that the Fed Funds Rate itself had very little significance, but the significance of Last 4 Qtr. Change persisted as before, for approximately 13 quarters. Furthermore, while the relationship between Last 4 Qtr. Change and future NPI returns remained positive, the relationship between Fed Funds Rate and future NPI returns started slightly positive, but then switched to negative after approximately seven quarters of NPI returns and continued to decrease thereafter. We did not read into this result too closely, due to the very weak relative significance of the Fed Funds Rate input.

IV. Conclusions

Based on the empirical evidence we have collected, various conclusions can be supported. These conclusions follow in the sections below.

IV.A – Fed Funds Rate as a Predictor of Current and Near-Term Real Estate Returns

The Fed Funds Rate appears to be a likely predictor of future total returns from real estate assets, with higher Fed Funds Rates signaling higher future returns. This observation, which stands in contrast to the thinking of many present-day real estate investors, might be explained by the fact that the FOMC generally raises interest rates as a mechanism to moderate or dampen broad surges in economic activity. The Federal Reserve's "dual mandate" to 1) maximize sustainable employment and 2) stabilize prices often requires the Fed to employ a contractionary policy when the economy is growing most quickly, in order to prevent asset bubbles and market crashes that threaten long-term growth. Because of this, we find it reasonable to believe that the Fed will adjust interest rates higher during times of economic prosperity, and employ higher-than-average rates at the precise moments when real estate returns are elevated as well. The reverse should be true as well, on average, whereby the Federal Reserve only lowers rates when the economy is entering a recession and requires extra support from monetary policy.

IV.B – Change in Fed Funds Rate as a Predictor of Longer-Term Real Estate Returns

When examining recent *changes* in the Fed Funds Rate, instead of just the absolute rate, the Fed's actions appear to become an even stronger predictor of future real estate returns, and we found that this predictor maintains its significance for as many as three years into the future. This result can be explained in a similar fashion to the argument in IV.A. The Fed would usually not raise interest

rates unless the economy is already doing very well, and unless the Fed expects growth to continue. The Fed should want to adhere to its mandate and prevent prices from increasing too rapidly, but it certainly would not want to be the *cause* of a recession or even a major reduction in returns. The latter situation would go against the Fed's mandate, and would further undermine their credibility in the public view. If we accept the Fed's policies as generally well-reasoned and grounded in rigorous analysis, then we should expect recent changes in policy to serve as a strong indicator of future economic conditions, and particularly real estate.

It would be interesting to test this hypothesis during the current economic cycle, and attempt to predict the NPI's total return over the next one, two, and three years, then look backward in 2022 and see how close our predictions came to reality. From what we noted earlier in III.D, we already know that our indicator Last 4 Qtr. Change predicts that annual real estate returns will be approximately 11.7% over the next year, 10.7% over the next two years, and 10.0% over the next three years. These figures are, respectively, 2.16%, 1.31%, and 0.69% higher than their long run averages over the period we examined from 1978 to 2018. From here, the question becomes: Is 2.16% a big enough spread to trade on? Is 1.31%? 0.69%? Certainly for institutional investors managing multi-billion dollar portfolios, these findings would be useful.

Many investors have become bearish on real estate during the tail end of the recent bull market, including esteemed investors like Sam Zell, current chairman of Equity Residential (NYSE: EQR), who reportedly sold $8.5 billion of properties in 2015.[7] But for owners of real estate, with some appetite for risk, our findings suggest that it would be optimal to wait until the Fed begins to slow

[7] https://therealdeal.com/2018/11/16/sam-zell-is-reducing-his-exposure-to-real-estate/

its pace of rate increases, as it has since the start of 2019. In January of the new year, Fed Chairman Jerome Powell began to emphasize a greater level of "patience" than he had previously, and signaled that he anticipated two additional rate hikes in 2019, down from the total four hikes the market had anticipated until that point.[8] At this point, we will have to wait and see if Powell puts that plan into action, but it is clear from our analysis that 2019 may be a very important year for the economy, as it relates to commercial real estate. Investors may view today as the time to begin selling assets, especially because real estate can take many months to sell successfully, but if rates continue rising as quickly as they have, real estate investors should view this as a positive signal that their assets still have room to run.

IV.C – Federal Reserve Policy as a Lagging Indicator of Current Economic Conditions

One possible explanation, for the results obtained in Part III, is that the Fed's actions are not only forward-looking but backward-looking as well. When the economy enters a recession, it is very often sparked by a swift and unforeseen event, and we hypothesize that these situations force the Fed to scramble just as much as other market participants. Furthermore, during the recovery after a recession, the Fed is often careful not to raise interest rates again too quickly, and so their rate increases "lag" the general market. This can be seen graphically in Appendix I, particularly in the stock market crashes of 1987 (Fig. A1), 1990 (Fig. A3), and 1998 (Fig. A4), in which the Fed Funds Rate did not begin to decrease until well after the market downturn had occurred. Similarly, during the recoveries of the Dot Com bubble (Fig. A6) and the Great Recession (Fig. A8), the Fed waited to begin raising rates until the recovery had already progressed for one full year. What this means for investors is that by the time the Federal Reserve changes its policy, the economy has

[8] https://www.bankrate.com/banking/federal-reserve/fomc-recap/

probably already moved by an appreciable amount. In our current bull-market of 2009-2018, this is even more apparent, since the Fed waited until as late as 2016 to begin raising interest rates.

IV.IV – Rent and NOI Increases Offset Cap Rate Increases

Conventional wisdom in the real estate investment community tells us that higher interest rates are generally bad for property values, but we discovered through our analysis in III.G that this may not be true. For one thing, the relationship between the Fed Funds Rate and capital returns is very weak, and does not allow us to draw any definitive conclusions. However, we also discovered in III.G that the Fed Funds Rate *does* correspond with slightly higher *income* returns, even when projected relatively far into the future. We reason that this relationship exists because higher interest rates increase real estate investors' cost of capital (through, for example, higher mortgage rates) and *force* the investors to increase rents proportionately to avoid operating their property at an ongoing loss. While the relationship is not exactly one-to-one, we discovered that real estate investors on average are able to increase their income returns, on an unlevered basis, by 18 bps for every 100 bps increase in the Fed Funds Rate, offering somewhat of a cushion to the increased cost of capital.

In addition to the above effect, we also discovered through our analyses in III.D, III.E, and III.G that *changes* in the Fed Funds Rate actually have a positive effect on real estate, particularly through increased capital returns. We reason that this occurs because increased rental rates in the medium-term (eight to 12 quarters) cause investment properties to generate a higher NOI, and that this higher NOI more than offsets the capital depreciation caused by higher cap rates. To draw an analogy to how this might work in the real world, imagine interest rates are rising and landlords,

citing the burden of increased expenses, increase their asking rent. Then the landlords actually make *more* profit from this increase. This scenario could be likely if renters of commercial real estate are relatively price inelastic.

IV.E – Price Inelasticity of Real Estate Tenants

Building further on the point raised in IV.D, it is highly likely that renters of commercial real estate exhibit relative price inelasticity, especially in the short run during periods of rising interest rates.[9] Since constructing new buildings is a time and capital intensive process, the real estate market can become quite constrained on the supply side during times of strong demand. We reason that this demand occurs most frequently during the growth phase of the business cycle, and during those times when the Fed is most likely to raise interest rates (hence the correlation). Especially in notoriously supply-constrained cities like New York and San Francisco, where real estate tenants have limited options to begin with, an environment which causes all landlords to raise their rents simultaneously would have a pronounced effect. In those situations tenants simply would have no other place to go. If an office tenant finds themselves renewing a commercial lease during this time, at the current "market" rent, the tenant may feel relatively stuck with their current space, electing to pay the higher rent instead of going through the inconvenience of moving.

[9] https://www.aeaweb.org/conference/2017/preliminary/paper/9F9aaffA

V. Suggestions for Future Research

As a follow up to the above hypotheses, we suggest the following topics for future research, which would more deeply explore the linkages between our empirical results and the psychology of real estate market participants.

V.A – Adjust Statistical Results for Data Overlap

In performing the regression analyses in section III, we utilized many output variables that included overlapping observations.[10] For example, the Next 4 Quarter Return variable measured from Q1 2000 to Q4 2000 would include three quarters of returns in common with the same variable measured from Q2 2000 to Q1 2001. Prior research has indicated that the overlapping of observations causes the error term of such regressions to exhibit autocorrelation (Harri and Brorsen, 2009). A number of solutions have been proposed to correct for this effect, including using Hansen-Hodrick estimators to calculate the P-Values of each predictor variable, and/or separating the output variables into non-overlapping periods. We strongly suggest that future studies make use of these methods, to increase the precision and certainty of any conclusions.

V.B – Study Link Between Fed Funds Rate and Mortgage Rates

One area we did not explore in this study, but which would help validate our findings, is the link between the Fed Funds Rate and prevailing mortgage rates in the U.S. In theory the two should move more or less in lockstep, with any increase in the Fed Funds Rate being passed on to real estate owners in the form of higher debt service costs. However, if empirical data tells a different story, then we might discover a relationship between the Fed Funds Rate and mortgage rates that is not exactly one-to-one. If mortgage rates do not increase as quickly as the Fed Funds Rate, for

[10] https://pdfs.semanticscholar.org/3d59/d8106ae0ff9310ce5ac95e19f4e9ab6d505a.pdf

example due to the prevalence of 10-year fixed-rate mortgages used for commercial buildings, then this would allow property owners greater flexibility in preserving the value of their investments, and would further support our findings from this study.

V.C – Study Behavior of Renters and Property Owners in Rising Interest Rate Environments

As noted above in IV.D, we hypothesize that the correlation between rising interest rates and increases in property values may be linked to the rent vs. buy decision that users of commercial real estate must make. For example, it could be that rising interest rate environments encourage more users to rent rather than purchase, or that such environments generally give existing property owners the upper hand in the rental market. It would be interesting to examine historical trends in the behavior of such real estate users, to see if empirical findings confirm or refute these predictions.

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Appendix I: Graphical Analysis of Past Stock Market Crashes

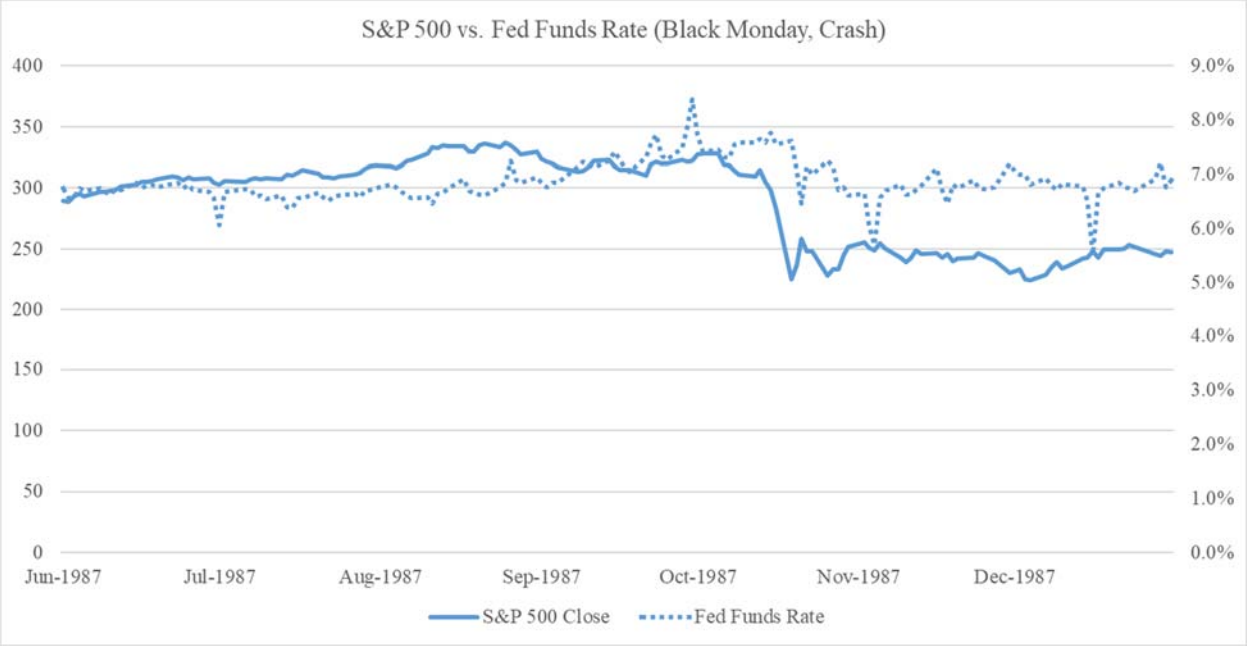

Fig. A1: Black Monday, Crash

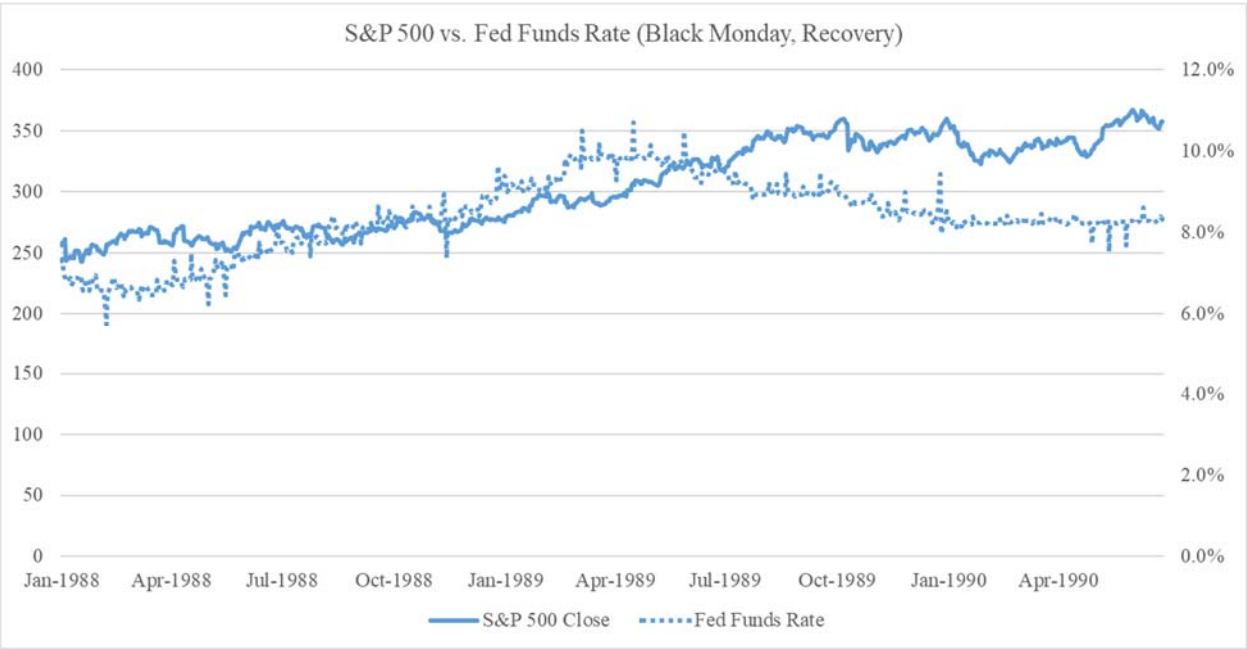

Fig. A2: Black Monday, Recovery

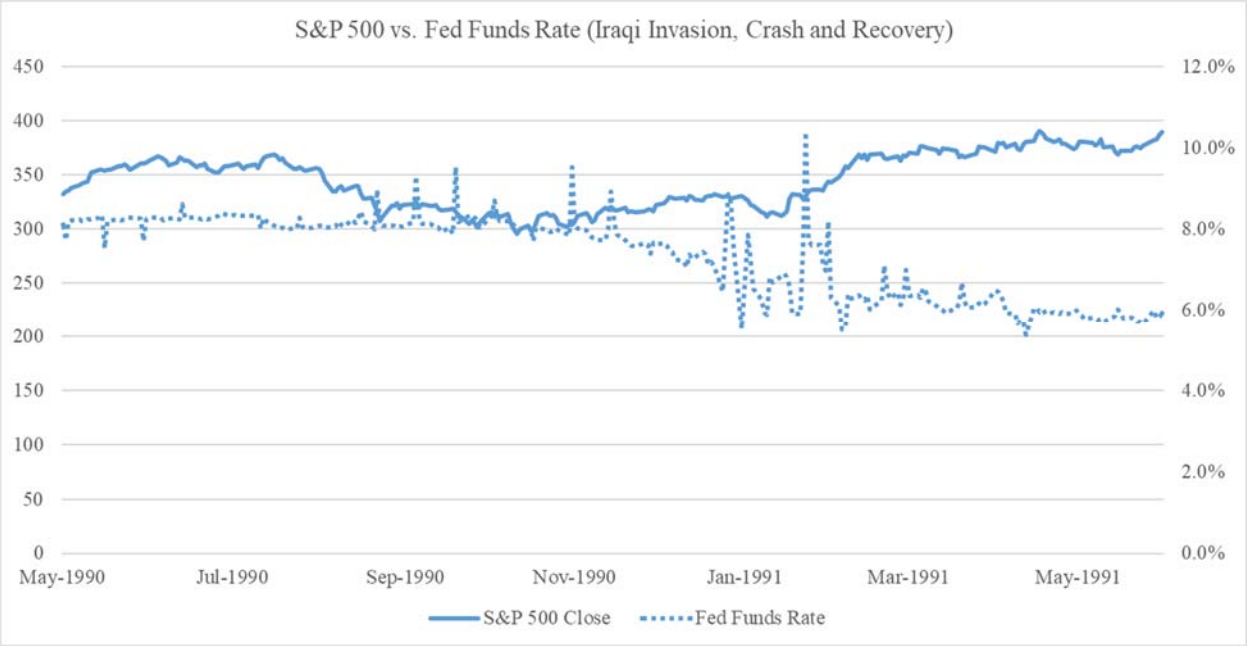

Fig. A3: Iraqi Invasion, Crash and Recovery

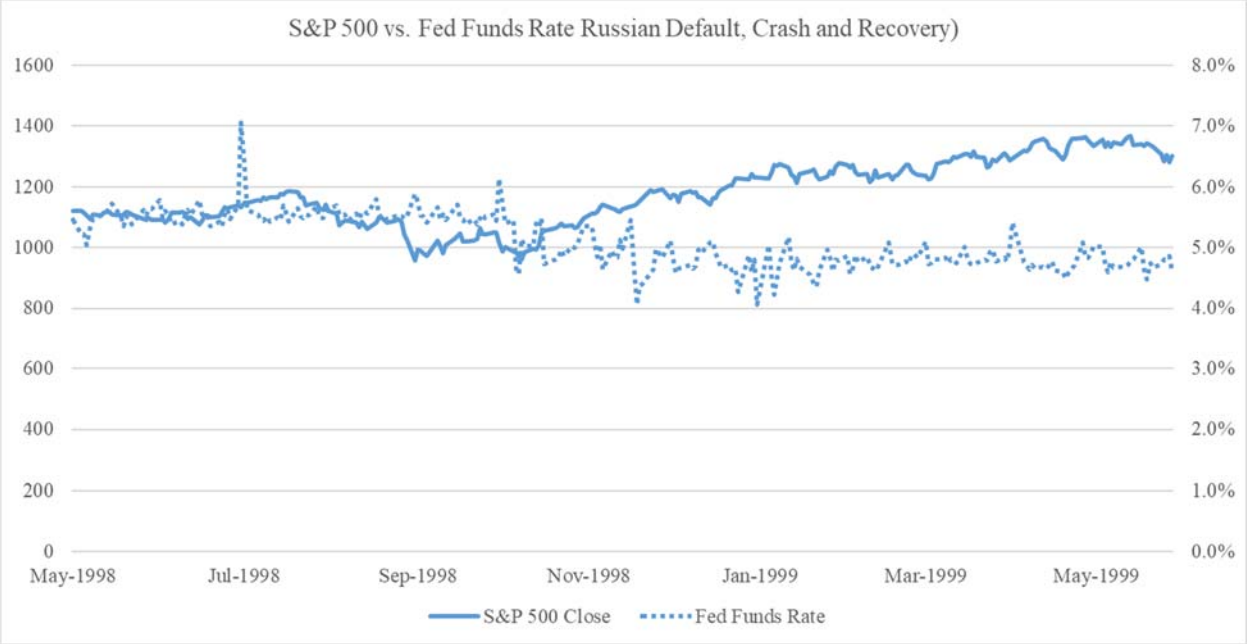

Fig. A4: Russian Default, Crash and Recovery

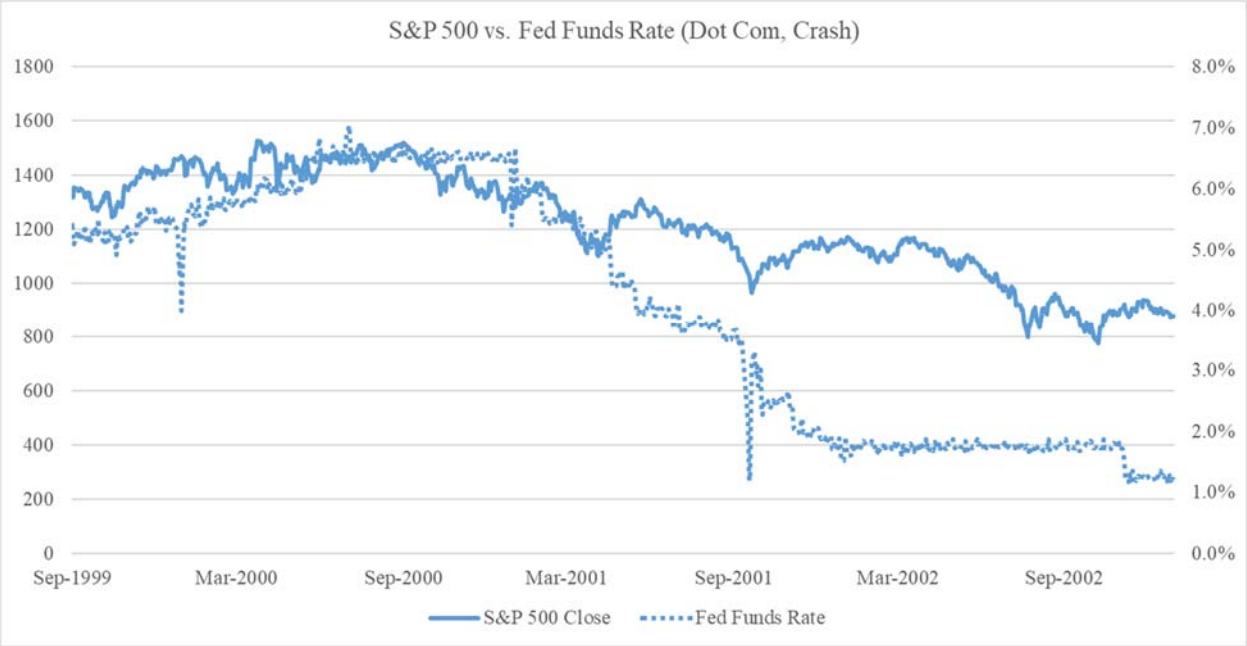

Fig. A5: Dot Com, Crash

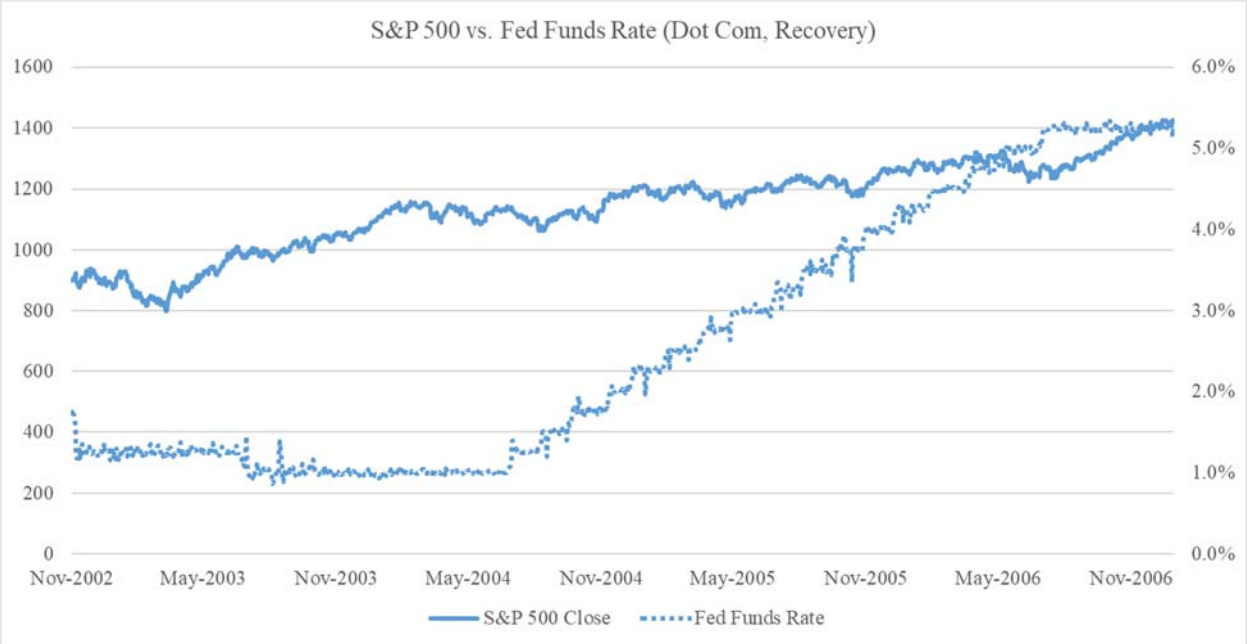

Fig. A6: Dot Com, Recovery

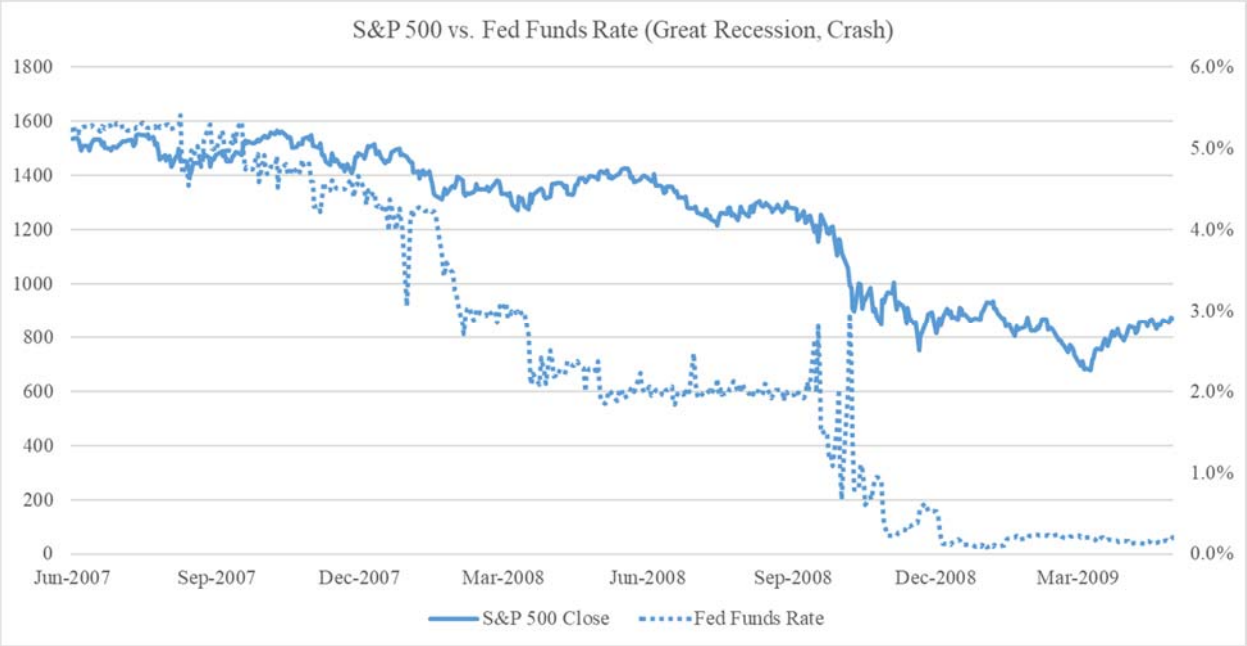

Fig. A7: Great Recession, Crash

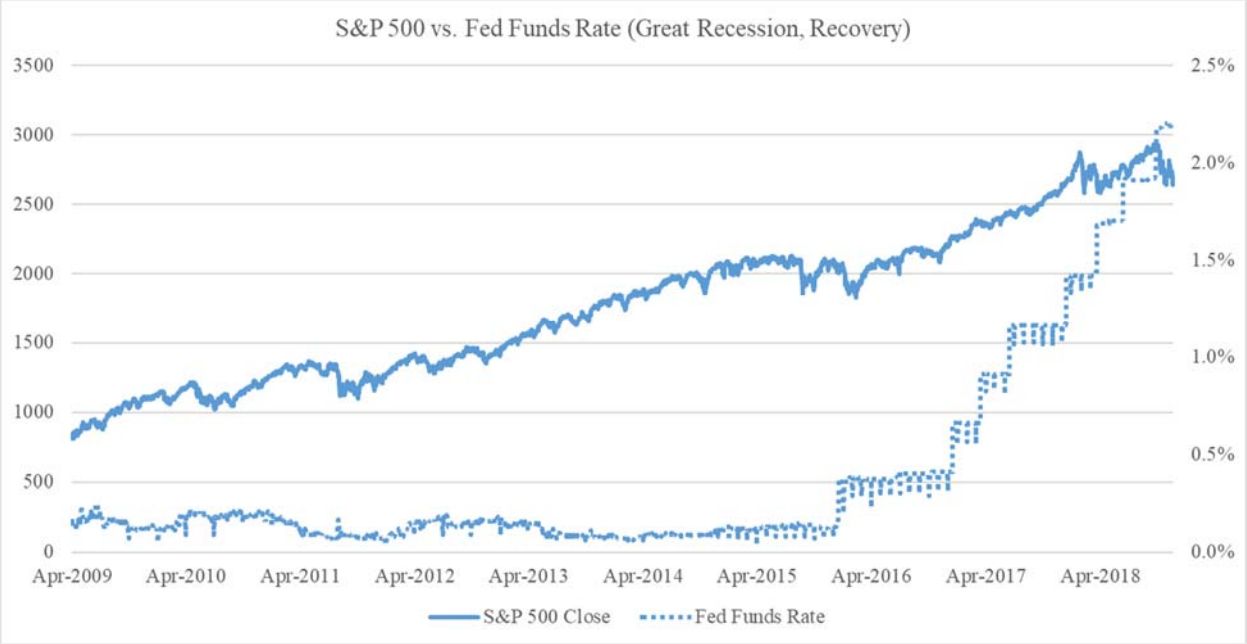

Fig. A8: Great Recession, Recovery

Appendix II: Benchmarking the NPI against Other Assets

Another useful comparison to make is between the NPI and other assets in general, to note if the phenomena we discovered in section III are unique to commercial real estate or if they apply more broadly to other real assets. In particular, we examined the NPI's movements relative to other broad indexes such as the S&P 500 Index and the MSCI World Infrastructure Index. We performed a similar analysis to those in section III, using the current quarter's S&P 500 return as the input variable and future quarters' NPI returns as the output variables. From the below summary, we can see that the relationship is quite strong when looking at NPI returns approximately four quarters into the future, and eventually loses its statistical significance beyond nine quarters into the future. However, the overall relationship is far weaker than the relationship explored earlier between Last 4 Qtr. Change and the future NPI returns.

# of Quarters' Return	P-Value	R Squared
1	0.002	0.056
2	0.002	0.061
3	0.000	0.075
4	0.000	0.082
5	0.001	0.073
6	0.002	0.059
7	0.005	0.049
8	0.015	0.039
9	0.031	0.030
10	0.053	0.025
11	0.087	0.020
12	0.113	0.017
13	0.152	0.014
14	0.207	0.011

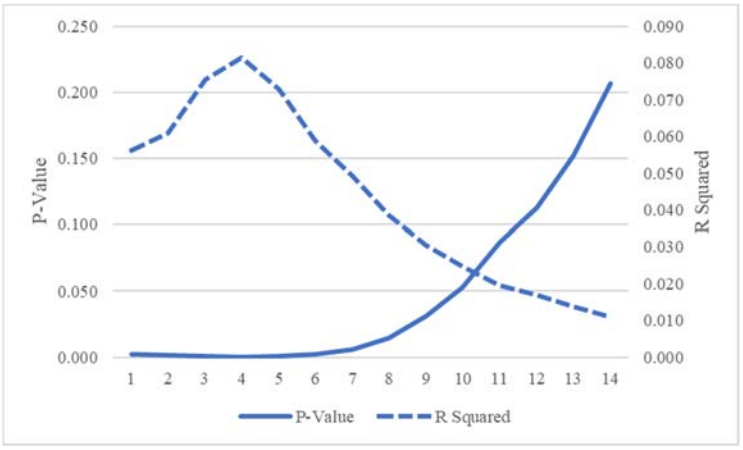

Fig. A9: Statistical summary of current quarter S&P 500 returns, relationship to future NPI returns

Shown below is the output from the four-quarter return model, which achieved the highest R-Squared value of 8.2%.

Regression Statistics					
R Square	0.082				
Standard Error	0.072				
Observations	158				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.086	0.006	5.74E-30	0.074	0.098
Last 4 Qtr Change	0.310	0.083	0.000	0.146	0.475

Fig. A11: Next 4 Quarters' Return vs. Current Quarter S&P 500 return regression outputs

As an additional benchmark for the NPI, we obtained returns data from the MSCI World Infrastructure Index, from the period beginning January 1, 1999 and ending December 31, 2015. We hypothesized that this broad index of securities backed by real infrastructure assets should have a similar return profile to real estate, as measured by the NPI and NTBI. The MSCI index's constituent companies own assets including railroads, highways, airports, telecommunications infrastructure, energy and electric infrastructure, and water infrastructure. As can be seen below in Fig. A12, A13, and A14, these assets' returns appear to move somewhat in tandem to the NPI, and are especially correlated with the NPI's Capital Return component.

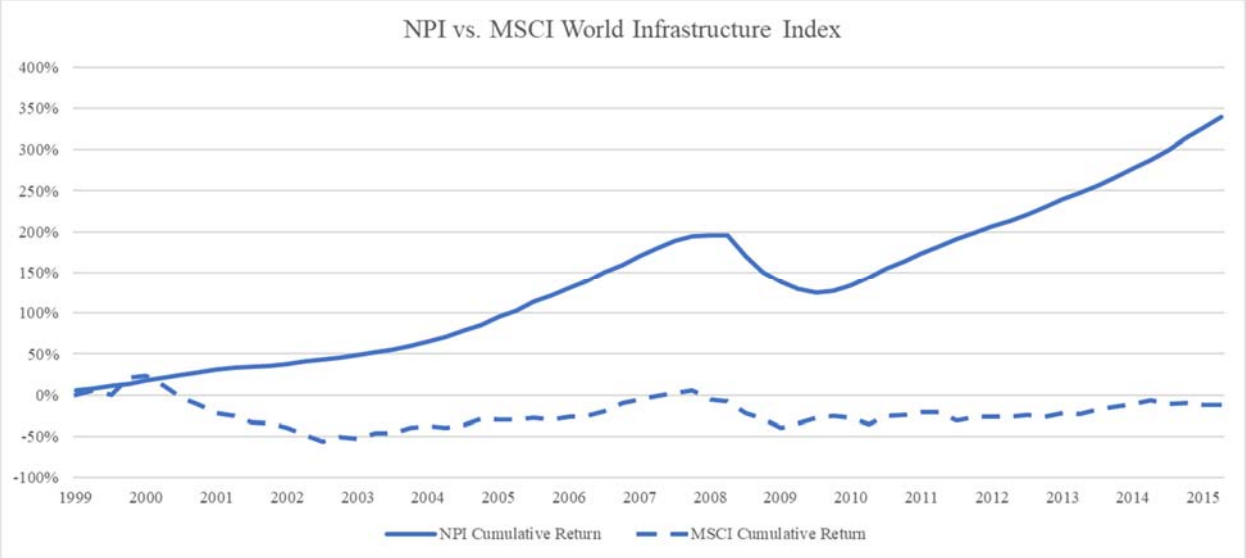

Fig. A12: NPI returns vs. MSCI World Infrastructure Index returns (16.1% correlation)

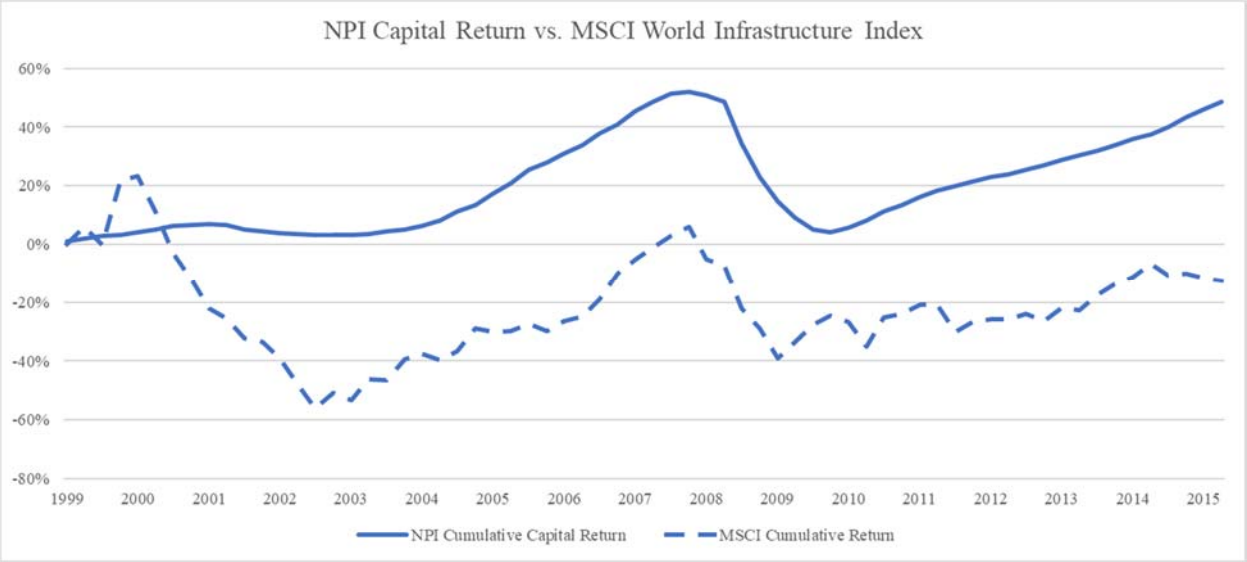

Fig. A13: NPI capital returns vs. MSCI World Infrastructure Index returns (37.4% correlation)

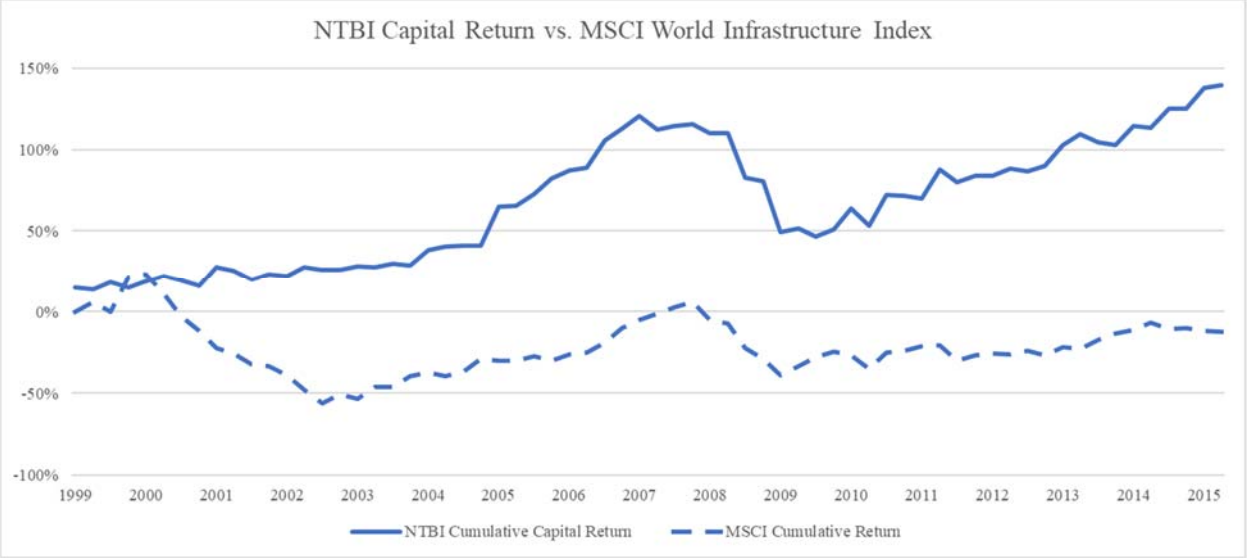

Fig. A14: NTBI capital returns vs. MSCI World Infrastructure Index returns (25.4% correlation)

Appendix III: NPI Returns Decomposition (Income vs. Capital Return)

As part of our analysis, we considered separately the relationship between the Fed Funds Rate and the NPI's "income returns" and "capital returns." In addition to being reported on a total return basis, the NPI dataset is bifurcated into these two return categories, allowing us to analyze each separately. Ultimately, we were able to determine that the current Fed Funds Rate had a strong and significant relationship with the NPI *income* returns, but a relatively weak relationship with the NPI *capital* returns, and also that the Last 4 Qtr. Change had a strong and significant relationship with the NPI *capital* returns, but a weak relationship with the NPI income returns.

The statistical summary graphs below illustrate these relationships in more detail.

# of Quarters' Return	P-Value	R Squared
1	2.9E-11	0.242
2	4.5E-11	0.240
3	8.6E-11	0.235
4	1.6E-10	0.230
5	2.6E-10	0.227
6	3.7E-10	0.224
7	5.4E-10	0.222
8	7.7E-10	0.220
9	1.1E-09	0.218
10	1.4E-09	0.216
11	1.7E-09	0.216
12	2.0E-09	0.215
13	2.5E-09	0.214
14	3.1E-09	0.213

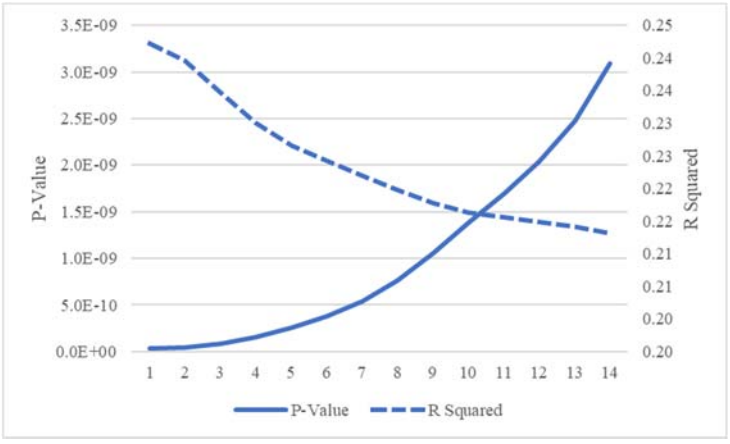

Fig. A15: Statistical summary of Fed Funds Rate relationship to future NPI income returns

# of Quarters' Return	P-Value	R Squared
1	0.044	0.025
2	0.072	0.020
3	0.149	0.013
4	0.303	0.007
5	0.551	0.002
6	0.842	0.000
7	0.873	0.000
8	0.617	0.002
9	0.414	0.004
10	0.278	0.008
11	0.189	0.011
12	0.130	0.015
13	0.094	0.019
14	0.075	0.021

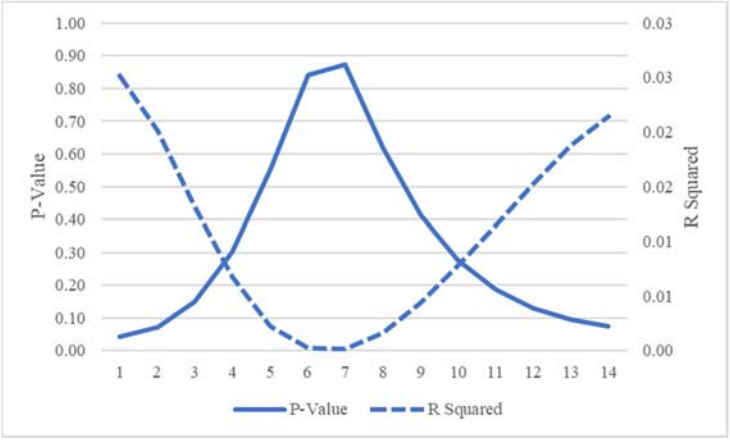

Fig. A16: Statistical summary of Fed Funds Rate relationship to future NPI capital returns

For illustrative purposes, the 14-quarter model output is shown below.

Regression Statistics					
R Square	0.213				
Standard Error	0.045				
Observations	149				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.247	0.006	7.66E-82	0.235	0.260
Fed Funds Rate	0.623	0.099	3.09E-09	0.428	0.818

Fig. A17: Next 14 Quarters' Income Return vs. Fed Funds Rate regression outputs

Above we note a significant positive, yet small, relationship. A 1% higher Fed Funds Rate corresponds with approximately 62 bps of additional income return over the next 14 quarters, which when annualized would equal just 18 bps. In contrast, the relationship of the Fed Funds Rate to the NPI's *capital* returns was of little significance. This model remains significant at the 5% level up to one quarter forward, and at the 10% level up to two quarters forward. The very small R-Squared values here (below 3%) are also indicative of a weak relationship that is of little interest.

However, the relationship of our predictor variable Last 4 Qtr. Change to the NPI's future capital returns was both positive and very significant. In these analyses, the results were flipped. Last 4 Qtr. Change appeared to be an excellent predictor of *capital* returns, but weakly related to *income* returns. The statistical summary of these analyses are as follows.

# of Quarters' Return	P-Value	R Squared
1	0.591	0.002
2	0.633	0.001
3	0.746	0.001
4	0.820	0.000
5	0.863	0.000
6	0.881	0.000
7	0.916	0.000
8	0.967	0.000
9	0.989	0.000
10	0.964	0.000
11	0.966	0.000
12	0.980	0.000
13	0.997	0.000
14	0.962	0.000

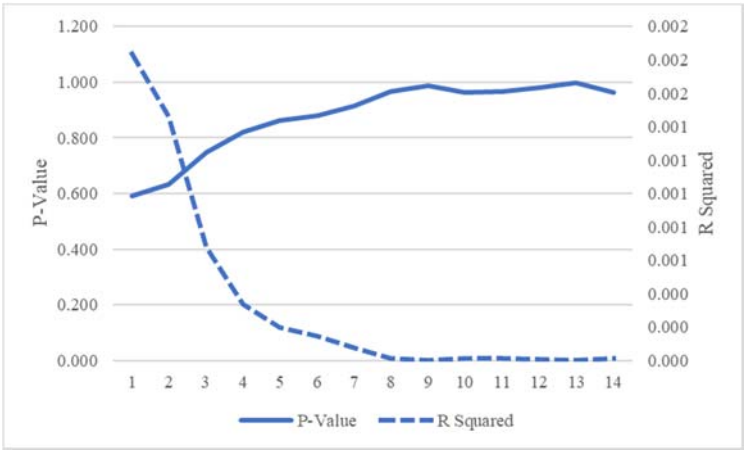

Fig. A18: Statistical summary of Last 4 Qtr. Change relationship to future NPI income returns

# of Quarters' Return	P-Value	R Squared
1	3.46E-08	0.177
2	7.45E-10	0.216
3	6.61E-10	0.219
4	4.29E-09	0.201
5	6.91E-08	0.174
6	6.53E-07	0.151
7	5.19E-06	0.129
8	3.83E-05	0.107
9	2.62E-04	0.086
10	0.001	0.070
11	0.004	0.054
12	0.016	0.039
13	0.048	0.027
14	0.104	0.018

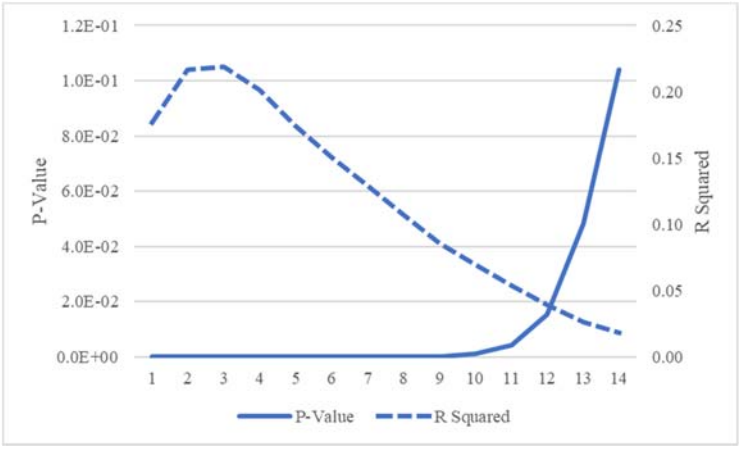

Fig. A19: Statistical summary of Last 4 Qtr. Change relationship to future NPI capital returns

Here we can see that Last 4 Qtr. Change remains significant until between the 12th and 13th quarters, like before in III.D. For illustrative purposes, below we have included the model output for the 4-quarter model of capital returns. This model is of reasonably high significance, with a P-Value of 4.29E-09 and an R-Squared of 20.1%, and it also captures a full year of future NPI returns.

Regression Statistics					
R Square	0.201				
Standard Error	0.063				
Observations	156				
	Coefficients	*Standard Error*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.022	0.005	2.47E-05	0.012	0.032
Fed Funds Rate	2.043	0.328	4.29E-09	1.395	2.690

Fig. A20: Next 4 Quarters' Capital Return vs. Last 4 Qtr. Change regression outputs

Our interpretation of the relationship between capital returns and Last 4 Qtr. Change is further detailed in the "Discussion and Interpretation" section. At first glance, we found the results interesting and slightly surprising: it appears that rising interest rates are a positive sign for real estate owners, since increases in interest rates, historically, have corresponded with higher future capital returns from holding real estate. This result runs counter to the conventional thinking, which is that rising rates lead to lower property values.