January 2016

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Recommended Citation
Stoyu Ivanov. "Study of REIT ETF beta" *The Journal of Risk Finance* 17.3 (2016): 347-369.

Study of REIT ETF Beta

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Abstract

Purpose – In this study we examine REIT ETFs and test for the existence of the "asymmetric beta puzzle" phenomenon in these relatively new and gaining popularity financial instruments. The "asymmetric beta puzzle" phenomenon is used to identify the hedging and diversification benefits of a financial instrument. "Asymmetric beta puzzle" exists when betas in declining markets are higher than betas in advancing markets.

Design/methodology/approach – We study 14 REIT ETFs by using monthly and daily CRSP data. We use CAPM and Fama-French Three Factor models to estimate REIT ETFs betas and betas in advancing and declining markets. We use both the S&P 500 and the CRSP value weighted indices in the beta estimation. We define and test two hypotheses with regards to betas in advancing and declining markets to test for the existence of the "asymmetric beta puzzle" phenomenon.

Findings – We confirm the presence of the "asymmetric beta puzzle" in monthly REIT ETFs data as documented by Goldstein and Nelling (1999) and Chatrath, Liang and McIntosh (2000) for REITs; however, we do not find this phenomenon when using daily data, quite the opposite – we find that REIT ETF betas are higher in advancing markets than they are in declining markets.

Originality/value – Goldstein and Nelling (1999) and Chatrath, Liang and McIntosh (2000) identify the phenomenon of "the asymmetric REIT-beta puzzle" in monthly REITs returns. We revisit the phenomenon identified in their studies by using daily data and a relatively new real estate financial instrument - REIT ETFs. Therefore, this paper fills a void in the literature and would benefit both institutional and retail investors in their portfolio designs.

Keywords - Real Estate Investment Trusts, REITs, Exchange Traded Funds, ETFs, REIT ETFs, Asymmetric Beta Puzzle

Introduction

Exchange Traded Funds (ETFs) have exploded in popularity recently due to their tax efficiency and simplicity - typically ETFs are indexers and as such track a market index. The majority of ETFs are equity index based; however, to complete the investment opportunity set a lot of innovation has been done in the ETF universe with the introduction of alternative asset ETFs. One of these is the sub-category of Real Estate Investment Trusts (REITs) ETFs. With the introduction and addition of REIT ETFs to the existing set of real estate investment options, such as REITs and real estate mutual funds, the need to study this new investment alternative arises. The obvious and most important question is – does this new investment option provide an investment hedge during market downturns?

The oldest REIT ETF is the S&P 500 Equal Weight Real Estate ETF (ticker: IYR) which has been introduced on 6/12/2000. This ETF tracks the Dow Jones U.S. Real Estate Index (ticker: DJUSRET). The index and ETF consist of 122 REITs across the REIT spectrum. The largest investment is in Specialized REITs, approximately 25%, followed by Retail REITs, 19%, Residential REITs, 14% and lowest proportion of Industrial REITs, 3%. This REIT ETF also has smaller investments in Real Estate Operating Companies, Real Estate Development, Diversified Real Estate Activities and Cash. In terms of REITs, the largest investment is in the Simon Property Group REIT, approximately 6.87% and American Tower REIT, 4.93%. The smallest investment is in Northstar Realty Europe Corp, 0.08%.

Naturally, one might argue that because REIT ETFs are a mix of REITs and other real estate companies they should behave like REITs. It is well documented in the literature that REITs exhibit very low betas, even negative betas when compared to regular companies (Corgel and Djoganopoulos, 2000). Additionally, Goldstein and Nelling (1999) and Chatrath, Liang and McIntosh (2000) identify the phenomenon of "the asymmetric REIT-beta puzzle" in monthly REITs returns. The most recent financial crisis – the Great Recession, was a result of the bursting of a real estate bubble, thus one might expect that the hedging benefits of all real estate assets would have diminished at that time. Indeed, Sing, Tsai and Chen (2016) study the time-varying characteristics of REIT betas and find that in the 2000s equity REITs have experienced a steady increase in REIT betas with a peak during the Great Recession followed by a steep decline after the recession. Of course, all of these findings are with regards to REITs, not REIT ETFs. To the best of our knowledge this is the first study to examine the diversification benefits of REIT ETFs. The Great Recession provides us with an excellent laboratory to test whether REIT ETFs also experience the "the asymmetric beta puzzle" phenomenon. Therefore, this paper fills a void in the literature and would benefit both institutional and retail investors in their portfolio designs.

We find no evidence to suggest that this phenomenon exists in REIT ETFs when daily data are used. On the contrary we find evidence in support of the diversification benefits of REIT ETFs even in the most severe real estate caused market downturns. We document "asymmetric beta puzzle" phenomenon when monthly data are used, which suggests that REIT ETFs do not have diversification benefits.

Literature Review and Methodology

We have identified only a couple of studies examining REIT ETFs, since most studies focus on REITs. The reason is that REIT ETFs are a relatively new development. Boney and Sirmans (2008) study the effect of the introduction of the Dow Jones US Real Estate Index ETF (ticker: DJRE, domicile: Australia) on seven of the top REITs held by the REIT ETF that they hold by using daily data. The study finds a reduction of volatility of the top seven REIT holdings by the REIT ETF relative to a matched sample. They do not study beta and use only one REIT ETF. Ivanov (2012) studies the Vanguard REIT ETF (ticker: VNQ) and the iShares Dow Jones US Real Estate Index Fund (ticker: IYR) REIT ETFs and examine whether these ETFs disintegrate from their underlying indexes - the MSCI US REITs Index for the VNQ and the Dow Jones U.S. Real Estate Index for the IYR during the Great Recession by using daily data. The author finds that these ETFs do not disintegrate from their indexes during the crisis but that their tracking errors increase and become more volatile during the crisis relative to the before and after crisis periods. Neither, study examines the diversification benefits of REIT ETFs. To an individual or a professional investor obviously this is the most pressing question. Therefore, we attempt to fill the void in the literature with this study.

Again, most studies focus only on REITs. Corgel and Djoganopoulos (2000) document that REITs exhibit very low betas even negative betas when compared to regular companies. Goldstein and Nelling (1999) also study the diversification benefits of REITs by examining the behavior of both equity and mortgage REITs. Consistent with the findings in studies by Corgel and Djoganopoulos (2000) and Chiang, Lee and Wisen (2005), Goldstein and Nelling (1999) find that REITs exhibit low betas. Goldstein and Nelling (1999) also find that REITs monthly returns are more closely associated with small company stocks similar to the findings of McIntosh, Liang and Tompkins (1991), Khoo, Hartzell and Hoesli (1993) and Ghosh, Miles and Sirmans (1996). Clayton and MacKinnon (2001, 2003) document that across different periods REITs were more closely related to either large cap stocks or small cap stocks. Goldstein and Nelling (1999) document that REITs do not exhibit symmetric hedging properties in that REITs tend to be more correlated with stocks in declining markets than in advancing markets. There are several ways to identify declining and advancing markets in the literature. Sagalyn (1990) and Goldstein and Nelling (1999) identify declining and advancing markets based on the difference between the market and the risk free rates. Glascock (1991) uses the business cycle definitions of the National Bureau of Economic Research (NBER). In this study we use to a certain extent all of these methods.

Chatrath, Liang and McIntosh (2000) also examine this topic and document evidence in support of the Sagalyn (1990) and Goldstein and Nelling (1999) findings. Chatrath, Liang and McIntosh (2000) call this phenomenon "the asymmetric REIT-beta puzzle" by examining the Equity REITs Index (NAREIT) monthly returns. In the conclusion of their study, Chatrath, Liang and McIntosh (2000) suggest that a study using finer data is needed to ensure robustness of the "asymmetric REIT-beta" phenomenon. Chatrath, Liang and McIntosh (2000) conclude that a study using finer data than monthly is needed to ensure robustness of the "asymmetric REIT-beta" phenomenon. We revisit this phenomenon by studying REIT ETFs. Chiang, Lee and Wisen (2004) suggest that "the asymmetric REIT-beta puzzle" might be due to decay in the REIT-stock market relation, dividend effects and small stock effects. They document lack of support of the

decay of REIT-stock relation or dividends but that the size factors might be able to help with the resolution of "the asymmetric REIT-beta puzzle." Chatrath, Liang and McIntosh (2000) document similarly to Peterson and Hsieh (1997) that the Fama-French three factor model explains entirely the "asymmetric REIT-beta" phenomenon. They also use monthly returns in their study.

Therefore our first null hypothesis tests if "asymmetric beta puzzle" phenomenon exists in REIT ETFs:

H0-1: REIT ETF Betas in declining markets are lower than REIT ETF Betas in advancing markets when daily and monthly data are used.

If H0-1 is rejected this would suggest that REIT ETF betas in declining markets are higher than REIT betas in advancing markets in both daily and monthly data. Thus, "the asymmetric beta puzzle" would exist in REIT ETFs and REIT ETFs would not be very beneficial hedging instrument for portfolio diversification purposes. However, if we fail to reject this null hypothesis the diversification benefits of REIT ETFs would exist. Considering that the REIT literature documents existence of the "asymmetric REIT-beta" puzzle we expect that REIT ETFs do not have diversification benefits since REIT ETFs are a mix of REITs.

Studies by Wang, Erickson, Gau and Chan (1995), Chan, Leung and Wang (1998), Ling and Naranjo (2003), Ott, Riddiough and Yi (2005), Bai, Chang and Glascock (2011), Kawaguchi, Sa-Aadu and Shilling (2012) and Sing, Tsai and Chen (2016) examine old versus new REITs in that the new REITs use more extensively leverage to grow bigger compared to the old REITs. The delineation is the year 1992 and since the data in this study start after 2000 the effects of the differential leverage would not have an impact on our analysis. The only major other factor which might impact our analysis would be the Great Recession period. Nevertheless, the Great Recession has been caused by real estate market correction it provides us with an interesting laboratory to directly test the hypothesis of REITs diversification benefits in the most difficult situations.

Therefore, our second working hypothesis is with regards to the existence of "asymmetric beta puzzle" for REIT ETFs during the Great Recession and the periods right before and after it. We identify the Great Recession period December 2007 to June 2009 based on the business cycle definitions of the NBER:

H0-2: REIT ETF Betas in declining markets during the Great Recession are lower than betas in advancing markets in that period.

If H0-2 is rejected this would imply that there is evidence to suggest that "the asymmetric beta puzzle" does exist in REIT ETFs and thus that the diversification benefits of REIT ETFs have been even lower during the Great Recession and as such REIT ETFs are not a good hedge even during the most severe market downturns that are caused by real estate corrections. Alternatively, if we fail to reject this hypothesis the diversification benefits of REIT ETFs would exist.

Sagalyn (1990) and Goldstein and Nelling (1999) identify declining and advancing markets based on the difference between the market and the risk free rates and this is the first methodology that we use to identify declining and advancing markets. Different studies use either one factor or three factor model specifications to estimate REIT ETF betas, others use both and so do we. We use both the S&P 500 and the CRSP value weighted indices and both daily and monthly returns for the estimation of beta as well. To the best of our knowledge all REIT beta studies focus on monthly data because monthly data are less noisy than daily data. Naturally, in order to be able to generalize the conclusions inferred from the monthly data other frequency than monthly needs to be examined.

Therefore, to test these two hypotheses we use the following model specifications to estimate betas – equations (1) and (3), and estimate asymmetric betas with equations (2) and (4) based on single factor - CAPM and multifactor-Fama-French Three Factor models, respectively. After we identify these betas we test for statistical difference across the different periods on these betas and model fits – based on the models' R-squared (RSQ):

$$r - r_f = \alpha_1 + \beta_0 (r_m - r_f) + \varepsilon_1 \quad (1)$$

$$r - r_f = \alpha_2 + \beta_1 (DP) + \beta_2 (DM) + \varepsilon_2 \quad (2)$$

$$r - r_f = \alpha_3 + \beta_3 (r_m - r_f) + \beta_4 (SMB) + \beta_5 (HML) + \varepsilon_3 \quad (3)$$

$$r - r_f = \alpha_3 + \beta_6 (DP) + \beta_7 (DM) + \beta_8 (SMB) + \beta_9 (HML) + \varepsilon_4 \quad (4)$$

$$\beta_i = \alpha_4 + \beta_{10} (B) + \beta_{11} (D) + \beta_{12} (A) + \beta_{13} (lMC) + \beta_{14} (l\sin ce) + \beta_{15} (er) + \beta_{16} (dy) + \varepsilon_5 \quad (5)$$

$$Rsq_i = \alpha_5 + \beta_{17} (B) + \beta_{18} (D) + \beta_{19} (A) + \beta_{20} (lMC) + \beta_{21} (l\sin ce) + \beta_{22} (er) + \beta_{23} (dy) + \varepsilon_6 \quad (6)$$

Where the alphas are the intercepts, betas are the risk measures and epsilons are the error terms. DP is a variable result of the multiplication of the market risk premium and a dummy variable with value of one if the market return is above the risk free rate and zero otherwise. DM is the product of the multiplication of the market risk premium and a dummy variable with values of one if the market return is less than the risk free rate and zero otherwise. DP and DM are modelled based on Chatrath, Liang and McIntosh (2000) study. SMB, HML, and Fama-French factor loadings, B, D and A are dummy variables with value of one in the Before, During and After periods of the Great Recession in the US and zero otherwise, Lmc is the log of the ETFs market capitalization on the last day of the Before, During and After periods, Lsince is the log of number of days since the ETF's inception, ER is expense ratio in 2015, DY is the 2015 Dividend Yield.

Data

The REIT ETFs descriptive statistics information is from the ETF Database, whereas all the daily and monthly return data on REITs, REIT ETFs and indexes are from the Center for Research in Security Prices (CRSP). The risk free rate, market rate of return and factor loadings are from Prof. Kenneth R. French's website.

As of time of accessing the data, September 2, 2015 there were 17 REIT ETFs in the US; however, after checking for data availability on CRSP only 14 REIT ETFs remained. The three

REIT ETFs that we excluded did not have data on CRSP, most likely because they were just created (i.e. their inception dates are in 2015). The ETFs that we excluded are the MSCI Real Estate Index ETF (ticker: FREL), the SuperDividend REIT ETF (ticker: SRET) and the S&P 500 Equal Weight Real Estate ETF (ticker: EWRE). We remove all REIT ETFs with less than three years of data. All 14 ETFs have at least three years of data. A description of the REIT ETFs characteristics used in this study is provided in Table 1, Panel A.

Only four of the 14 ETFs have market cap of more than $2 billion which is the market consensus for identifying small cap stocks. This suggests that even the REIT ETFs most likely would exhibit small cap stock return behavior. The largest in terms of assets under management ETF is the Vanguard REIT ETF (ticker: VNQ) with total assets of approximately $24.3 billion, inception date of 9/23/2004, 148 REIT holdings and 0.12% expense ratio. The smallest ETF is the Wilshire US REIT ETF (ticker: WREI), inception date of 3/9/2010, 116 REIT holdings and 0.33% expense ratio. All ETFs had Long Term Capital Gains Rate of 35% and Short Term Capital Gains Rate of 15%. All ETFs paid dividends with the iShares Mortgage Real Estate Capped ETF (ticker: REM) having the highest last annual dividend yield of 14.44% and the Active U.S. Real Estate Fund (ticker: PSR) having the lowest last annual dividend yield of 1.59%. Of course, this is the lowest paying ETF if we exclude the S&P 500 Equal Weight Real Estate ETF (ticker: EWRE) which has not paid a dividend yet since it has been just introduced. The newest REIT ETF is the S&P 500 Equal Weight Real Estate ETF (ticker: EWRE) which was introduced on 8/13/2015 and the oldest REIT ETF is the S&P 500 Equal Weight Real Estate ETF (ticker: IYR) which has been introduced on 6/12/2000.

Since the first REIT ETF was introduced in the early 2000s the leverage effects as identified by Wang, Erickson, Gau and Chan (1995), Chan, Leung and Wang (1998), Ling and Naranjo (2003), Ott, Riddiough and Yi (2005), Bai, Chang and Glascock (2011), Kawaguchi, Sa-Aadu and Shilling (2012) and Sing, Tsai and Chen (2016 would not be a factor in the analysis.

In Table 1, Panel B provides REIT ETFs excess returns. We use these returns to assess, similar to Glascock (2011) and other related studies, if real estate firms such as the newly introduced REIT ETFs, manage to earn abnormal returns. In aggregate, REIT ETFs over the examined period have managed to earn a higher return than the risk free rate, an average of 0.0552% daily or approximately 0.9446% monthly. Surprisingly, in the Before the Great Recession period the average REIT ETF returns have been negative, not so much for the During the Great Recession period. The reason is most likely the introduction of five new REIT ETFs who all have experienced major losses in the Before period, whereas the three oldest ETFs have earned positive returns. All ETFs not surprisingly have experienced losses during the Great Recession and all have experienced major gains in the After period. The average gains in the after period are about 0.0772% daily and 1.5555% monthly. Considering the causes of the Great Recession the major losses of REIT ETFs are not surprising. The question is however – does an "asymmetric beta puzzle" exist in REIT ETFs?

Table 1. Descriptive Statistics of REIT ETFs used in the study.
Panel A. ETF characteristics.

Permno	Symbol	Name	Price	Market Cap*	Assets*	Avg Vol	Inception	ER	Dividend Date	Dividend	Annual Dividend Yield %	# of Holdings
90350	VNQ	Vanguard REIT ETF	$72.62	27,110.94	24,299.10	4,290,020	9/23/2004	0.12%	6/26/2015	$0.76	4.11%	148
88294	IYR	iShares U.S. Real Estate ETF	$69.14	6,024.26	4,319.81	10,036,209	6/12/2000	0.43%	6/24/2015	$0.66	3.91%	116
88894	ICF	iShares Cohen & Steers REIT ETF	$88.14	3,394.24	2,989.51	323,808	1/29/2001	0.35%	6/24/2015	$0.76	3.39%	31
88961	RWR	SPDR DJ Wilshire REIT ETF	$82.46	3,047.97	2,807.39	336,530	4/23/2001	0.25%	6/19/2015	$0.70	3.35%	93
12536	SCHH	U.S. REIT ETF	$35.50	1,209.40	1,509.54	325,100	1/13/2011	0.07%	6/22/2015	$0.20	2.41%	94
92061	REM	iShares Mortgage Real Estate Capped ETF	$10.38	1,216.08	1,019.85	930,605	5/1/2007	0.48%	6/24/2015	$0.31	14.44%	39
92064	REZ	iShares Residential Real Estate Capped ETF	$56.03	285.71	253.61	35,411	5/1/2007	0.48%	6/24/2015	$0.51	3.39%	39
91992	FRI	S&P REIT Index Fund	$20.01	339.62	196.76	94,336	5/8/2007	0.50%	6/24/2015	$0.16	2.65%	155
12953	MORT	Market Vector Mortgage REIT Income ETF	$20.97	116.13	111.09	42,109	8/17/2011	0.41%	7/1/2015	$0.50	8.90%	25
12462	KBWY	KBW Premium Yield Equity REIT Portfolio	$28.67	118.93	103.94	22,164	12/2/2010	0.35%	8/14/2015	$0.14	5.73%	30
12868	ROOF	IQ US Real Estate Small Cap ETF	$23.50	81.08	86.33	18,297	6/14/2011	0.69%	6/24/2015	$0.33	5.55%	70
92060	FTY	iShares Real Estate 50 ETF	$42.64	82.72	76.06	6,265	5/1/2007	0.48%	6/24/2015	$0.40	3.67%	51
92839	PSR	Active U.S. Real Estate Fund	$66.72	48.38	47.19	1,750	11/20/2008	0.80%	6/19/2015	$0.26	1.59%	50
	FREL	MSCI Real Estate Index ETF	$20.77		26.50	15,174	2/2/2015	0.12%	6/19/2015	$0.23	1.92%	195
93275	WREI	Wilshire US REIT ETF	$41.31	18.53	14.72	2,802	3/9/2010	0.33%	6/24/2015	$0.39	3.18%	116
	SRET	SuperDividend REIT ETF	$12.85		2.62	2,988	3/16/2015	0.58%	8/3/2015	$0.10	2.38%	33
	EWRE	S&P 500 Equal Weight Real Estate ETF	$23.57		2.35	N/A	8/13/2015	0.40%	N/A	N/A	N/A	N/A

Source: http://etfdb.com/etfdb-category/real-estate/ retrieved on Sept. 2, 2015
* Market Cap and Assets in millions of U.S. Dollars. Market Cap, Assets, Average Volume as of 2015-09-02 00:14:04 UTC

Panel B. Excess Returns (%).

Daily	All		Before		During		After	
	N	rp	N	rp	N	rp	N	mBAS
N	14	14	8	8	9	9	14	14
Mean	1958	0.0552	849	-0.0473	352	-0.0092	1247	0.0772
Median	1928	0.0582	494	-0.0059	377	-0.0565	1386	0.0872
StDev	990	0.0273	795	0.1161	75	0.1522	209	0.0189
Min	849	-0.0107	163	-0.2571	152	-0.1070	849	0.0451
Max	3658	0.1216	1895	0.0534	377	0.3915	1386	0.0947
Monthly	All		Before		During		After	
	N	rp	N	rp	N	rp	N	rp
N	14	14	8	8	9	9	14	14
Mean	95	0.9446	42	-1.3879	17	-2.0882	60	1.5555
Median	93	1.0159	25	-0.8538	18	-2.4238	66	1.7620
StDev	47	0.4936	38	2.7609	3	1.1372	9	0.3848
Min	42	-0.4154	9	-6.2040	9	-3.0468	42	0.9162
Max	176	1.7715	92	1.1330	18	0.8261	66	1.9139

Analysis

Before we address the issue of the "asymmetric beta puzzle" however let's first look at REIT ETFs' betas. Table 2 provides REIT ETF beta estimates using equation (1) with entire sample estimates provided in Panel A, and periods around the Great Recession in Panel B for daily data and Panel C for monthly data. These results are based on the CRSP NYSE/AMEX/NASDAQ Value-Weighted Market Index as market proxy. Table 2, Panel A shows that the average REIT ETF beta using daily data is 1.04 and when monthly data are used the beta is 1.06. This suggests that REIT ETFs on average pretty much behave as the overall market which is contrary to the findings of Corgel and Djoganopoulos (2000), Chiang, Lee and Wisen (2005) and Goldstein and Nelling (1999) that REITs exhibit very low betas. Naturally, some REIT ETFs have higher betas such as the VNQ, Vanguard REIT ETF, with permno 90350 which has a beta of 1.3953 and the MORT, Market Vector Mortgage REIT Income ETF with permno 12953, with the lowest daily beta of 0.5779.

Table 2, Panels B and C show results for the Before, During and After the Great Recession periods and indicate an increase in REIT ETF betas during the Great Recession period, which is not surprising considering that the Great Recession had real estate causes and also that during a crisis all financial assets correlations increase. The REIT ETF betas and R-squareds increase from 0.8587 and 0.3251, respectively in the Before period to 1.4794 and 0.5899, respectively, in the During period and back down to 0.9524 and 0.5484, respectively in the After period.

Table 2. REIT ETFs Beta Estimates.
The regression is estimated based on equation (1): $r - r_f = \alpha_1 + \beta_0 (r_m - r_f) + \varepsilon_1$.
DF is degrees of freedom and RSQ is R-squared.

Panel A. Entire samples.

	Daily			Monthly		
	DF	mrp	RSQ	DF	mrp	RSQ
N	14	14	14	14	14	14
Mean	1955	1.0433	0.4981	91	1.0631	0.4890
Median	1925	1.1130	0.5238	89	1.0840	0.4940
StDev	990	0.2092	0.0938	47	0.2057	0.1193
Min	846	0.5779	0.2846	38	0.6415	0.2362
Max	3655	1.3953	0.6396	172	1.3726	0.6404

Panel B. Before, During and After Great Recession, Daily.

	Before			During			After		
	DF	mrp	RSQ	DF	mrp	RSQ	DF	mrp	RSQ
N	8	8	8	9	9	9	14	14	14
Mean	757	0.8587	0.3251	350	1.4794	0.5899	1245	0.9524	0.5484
Median	491	0.7947	0.3276	375	1.6023	0.6252	1384	0.9765	0.5659
StDev	676	0.2846	0.1509	75	0.2343	0.1228	210	0.1726	0.1036
Min	160	0.5652	0.0394	149	1.1327	0.3772	846	0.5779	0.2846
Max	1529	1.3077	0.5425	375	1.7599	0.7126	1384	1.1427	0.6538

Panel C. Before, During and After Great Recession, Monthly.

	Before			During			After		
	DF	mrp	RSQ	DF	mrp	RSQ	DF	mrp	RSQ
N	8	8	8	9	9	9	14	14	14
Mean	34	1.3756	0.3673	15	1.5535	0.6502	57	0.9430	0.4950
Median	21	1.4729	0.2110	16	1.6543	0.6914	64	0.9824	0.5369
StDev	33	0.7296	0.2755	4	0.3304	0.1164	10	0.1490	0.1044
Min	5	0.5775	0.1285	5	0.7332	0.3460	38	0.6415	0.2362
Max	72	2.6065	0.8199	16	1.7935	0.7146	64	1.1518	0.6234

The results are similar when the Fama-French Three Factor model is used to estimate market risk around the Great Recession when daily data are used but no such pattern is detected when monthly data are used as presented in Table 3, Panels B and C. Consistently the models' R-squared increases During the Great Recession across model specifications and data frequencies. All of these findings suggest that indeed the diversification benefits of REIT ETFs have diminished during the most severe capital market correction since the Great Depression, but that is true for all financial assets during a downturn.

Table 3. Fama-French Three Factor Model Beta Estimation For Each ETF Based On Equation (3): $r - r_f = \alpha_3 + \beta_3(r_m - r_f) + \beta_4(SMB) + \beta_5(HML) + \varepsilon_3$.

DF is degrees of freedom and RSQ is R-squared.

Panel A. Entire Samples.

	Daily					Monthly				
	DF	mrp	SMB	HML	RSQ	DF	mrp	SMB	HML	RSQ
N	14	14	14	14	14	14	14	14	14	14
Mean	1953	0.8875	0.5349	0.6190	0.5617	89	0.8520	0.2987	0.4362	0.5569
Median	1923	0.9070	0.6006	0.7122	0.5844	87	0.8203	0.3877	0.5722	0.5635
StDev	990	0.1629	0.1829	0.3203	0.1120	47	0.1214	0.1984	0.3041	0.1361
Min	844	0.5222	0.2278	0.1504	0.2979	36	0.6949	-0.0746	-0.3268	0.2526
Max	3653	1.1618	0.7638	1.0551	0.7072	170	1.0085	0.5235	0.7288	0.7323

Panel B. Fama-French Regression Estimations Before, During and After Great Recession, Daily.

	Before					During					After				
	DF	mrp	SMB	HML	RSQ	DF	mrp	SMB	HML	RSQ	DF	mrp	SMB	HML	RSQ
N	8	8	8	8	8	9	9	9	9	9	14	14	14	14	14
Mean	755	0.8403	0.7177	0.5404	0.3910	348	1.2454	1.3187	0.6717	0.6891	1243	0.8202	0.3223	0.4356	0.5826
Median	489	0.7494	0.5407	0.5157	0.4106	373	1.1778	1.3334	0.6417	0.7249	1382	0.8568	0.2921	0.4527	0.6030
StDev	676	0.2075	0.4759	0.3058	0.1619	75	0.2184	0.2091	0.1703	0.1312	210	0.1414	0.0943	0.1703	0.1116
Min	158	0.6409	0.1685	0.1295	0.0429	147	0.9948	1.0352	0.4225	0.4312	844	0.5222	0.2278	0.1504	0.2979
Max	1527	1.1706	1.7351	1.1103	0.5902	373	1.5291	1.6111	1.0339	0.8128	1382	0.9812	0.5901	0.6331	0.6941

Panel C. Before, During and After Great Recession, Monthly.

	Before					During					After				
	DF	mrp	SMB	HML	RSQ	DF	mrp	SMB	HML	RSQ	DF	mrp	SMB	HML	RSQ
N	8	8	8	8	8	9	9	9	9	9	14	14	14	14	14
Mean	32	1.3771	0.8475	1.4817	0.5072	13	0.9454	1.1500	0.4854	0.8046	55	0.8456	0.1569	0.2943	0.5179
Median	19	1.4473	0.4939	0.3770	0.4020	14	0.9930	1.2906	0.5510	0.8452	62	0.8756	0.1458	0.3992	0.5673
StDev	33	0.8191	2.3541	3.0206	0.2806	4	0.1461	0.8913	0.2434	0.1538	10	0.1064	0.1008	0.2226	0.1089
Min	3	0.4599	-1.2091	0.0957	0.2314	3	0.6292	-0.5954	-0.0852	0.4034	36	0.6293	-0.0294	-0.3268	0.2526
Max	70	2.6230	6.4072	8.8887	0.8687	14	1.0973	2.6266	0.7671	0.9339	62	1.0085	0.4050	0.4925	0.6478

Now that we have examined the overall beta behavior we can delve into examining the "asymmetric beta puzzle" phenomenon, which is of greater importance to portfolio managers. Table 4, Panel A presents results for CAPM beta asymmetry in the REIT ETF sample but such pattern cannot be discerned in the daily data. When daily data are used the average REIT ETF beta of advancing markets is 1.0534, whereas the beta in declining markets is slightly lower but not statistically significantly to 1.0346; compare these betas to betas estimated using monthly data with beta in advancing markets of 0.9121 and in declining markets higher of 1.1887, a

simple test on the differences of the betas in declining and advancing markets rejects equality to zero of the differences in monthly data but not in the daily data. Please, note that the statistical significance exists despite the small number of observations, which indicates strength of the assessment. This is an initial evidence suggesting failure to reject H0-1 for daily data but rejection of H0-1 in monthly data.

Table 4. REIT ETFs Asymmetric Beta.
Panel A. Regressions estimated for each ETF based on equation (2):
$r - r_f = \alpha_2 + \beta_1(DP) + \beta_2(DM) + \varepsilon_2$**, entire samples.**
DF is degrees of freedom and RSQ is R-squared.

	Daily					Monthly				
	DF	dp	dm	diff	RSQ	DF	dp	dm	diff	RSQ
N	14	14	14	14	15	14	14	14	14	14
Mean	1954	1.0534	1.0346	-0.0188	0.4987	90	0.9121	1.1887	0.2766	0.4952
Median	1924	1.1014	1.0767	-0.0216	0.5238	88	0.9458	1.3060	0.3721	0.4955
StDev	990	0.2399	0.1853	0.0923	0.0928	47	0.1370	0.3395	0.3237	0.1191
Min	845	0.4700	0.6875	-0.2077	0.2896	37	0.7182	0.4438	-0.3315	0.2423
Max	3654	1.4505	1.3441	0.2176	0.6401	171	1.1078	1.5807	0.6505	0.6502
p-value				0.22946					p < .0001	

Panel B. Regressions estimated for each ETF based on equation (2): $r - r_f = \alpha_2 + \beta_1(DP) + \beta_2(DM) + \varepsilon_2$ **Before, During and After Great Recession, daily.**

	Before					During					After				
	DF	dp	dm	diff	RSQ	DF	dp	dm	diff	RSQ	DF	dp	dm	diff	RSQ
N	8	8	8	8	8	9	9	9	9	9	14	14	14	14	14
Mean	756	0.8721	0.8512	-0.0209	0.3272	349	1.4880	1.4734	-0.0146	0.5909	1244	0.9743	0.9326	-0.0417	0.5492
Median	490	0.7165	0.8683	-0.0053	0.3285	374	1.5116	1.5555	-0.0500	0.6252	1383	1.0206	0.9356	-0.0686	0.5669
StDev	676	0.4207	0.1954	0.2977	0.1517	75	0.2676	0.2370	0.1843	0.1223	210	0.2135	0.1358	0.0903	0.1027
Min	159	0.4879	0.6216	-0.4291	0.0412	148	1.0985	1.1181	-0.3095	0.3782	845	0.4700	0.6875	-0.1229	0.2896
Max	1528	1.5425	1.1134	0.4920	0.5486	374	1.7854	1.7777	0.2661	0.7130	1383	1.2009	1.0957	0.2176	0.6542
Diff p-value				0.42282					0.40764					0.05385	

Panel C. Regressions estimated for each ETF based on equation (2): $r - r_f = \alpha_2 + \beta_1(DP) + \beta_2(DM) + \varepsilon_2$ **Before, During and After Great Recession, monthly.**

	Before					During					After				
	DF	dp	dm	diff	RSQ	DF	dp	dm	diff	RSQ	DF	dp	dm	diff	RSQ
N	8	7	7	8	8	9	9	9	9	9	14	14	14	14	14
Mean	33	1.3852	1.8302	0.3894	0.3883	14	1.1666	1.7668	0.6003	0.6617	56	0.9702	0.9040	-0.0663	0.4981
Median	21	0.5416	0.9855	0.3890	0.2160	15	1.2668	1.9304	0.6372	0.7018	63	1.0048	0.9656	-0.0412	0.5371
StDev	33	1.2028	1.6247	2.4631	0.2813	3	0.2366	0.4193	0.3246	0.1206	10	0.0886	0.2615	0.2132	0.1016
Min	4	0.3264	0.8018	-2.8735	0.1586	5	0.7799	0.6791	-0.1663	0.3475	37	0.7752	0.3189	-0.6150	0.2423
Max	71	2.8735	5.1792	5.1792	0.8285	15	1.4012	2.0030	0.9862	0.7371	63	1.0808	1.3430	0.3381	0.6285

Diff p-value				0.33105					p < .01					0.13279	

Panel D. Fama-French Regressions estimated for each ETF based on equation (4):
$r - r_f = \alpha_3 + \beta_6(DP) + \beta_7(DM) + \beta_8(SMB) + \beta_9(HML) + \varepsilon_4$ **, entire samples.**

	Daily							Monthly						
	DF	dp	dm	diff	SMB	HML	RSQ	DF	dp	dm	diff	SMB	HML	RSQ
N	14	14	14	14	14	14	14	14	14	14	14	14	14	14
Mean	1952	0.9244	0.8520	-0.0723	0.5373	0.6226	0.5627	88	0.6437	1.0124	0.1367	0.3099	0.4466	0.5667
Median	1922	0.9319	0.8635	-0.0608	0.6031	0.7123	0.5845	86	0.6166	1.0492	0.1697	0.4078	0.5918	0.5748
StDev	990	0.2107	0.1221	0.1113	0.1848	0.3234	0.1113	47	0.2252	0.2368	0.1903	0.2105	0.3124	0.1399
Min	843	0.4157	0.6308	-0.2740	0.2275	0.1478	0.3028	35	0.2424	0.5503	-0.2686	-0.0778	-0.3070	0.2569
Max	3652	1.2532	1.0725	0.2151	0.7715	1.0625	0.7087	169	0.9421	1.2893	0.3621	0.5411	0.7665	0.7469
Diff p-value				<0.01							<0.01			

Panel E. Fama-French Regressions estimated for each ETF based on equation (4):
$r - r_f = \alpha_3 + \beta_6(DP) + \beta_7(DM) + \beta_8(SMB) + \beta_9(HML) + \varepsilon_4$ **, daily.**

	Before							During							After						
	DF	dp	dm	diff	SMB	HML	RSQ	DF	dp	dm	diff	SMB	HML	RSQ	DF	dp	dm	diff	SMB	HML	RSQ
N	8	8	8	8	8	8	8	9	9	9	9	9	9	9	14	14	14	14	14	14	14
Mean	843	0.8863	0.7840	-0.1024	0.7065	0.5562	0.3875	347	1.3404	1.1467	-0.1937	1.3312	0.6864	0.6916	1242	0.8448	0.7979	-0.0469	0.3222	0.4360	0.5834
Median	488	0.7384	0.7886	-0.0574	0.5117	0.5096	0.3993	372	1.4209	1.2515	-0.2495	1.3499	0.6654	0.7265	1381	0.9174	0.7982	-0.0738	0.2920	0.4535	0.6041
StDev	795	0.3538	0.1413	0.2907	0.4794	0.3125	0.1641	75	0.2823	0.1879	0.2032	0.2130	0.1679	0.1321	210	0.1829	0.1049	0.0914	0.0943	0.1709	0.1108
Min	157	0.5166	0.6219	-0.5454	0.1713	0.1468	0.0442	146	0.9886	0.9086	-0.5123	1.0344	0.4338	0.4315	843	0.4157	0.6228	-0.1278	0.2275	0.1478	0.3028
Max	1889	1.4693	0.9298	0.4132	1.7317	1.2008	0.5974	372	1.6811	1.4017	0.1399	1.5997	1.0361	0.8156	1381	1.0428	0.9234	0.2151	0.5902	0.6338	0.6945
Diff p-value				0.16864							<0.0001							0.03854			

Panel F. Fama-French Regressions estimated for each ETF based on equation (4):
$r - r_f = \alpha_3 + \beta_6(DP) + \beta_7(DM) + \beta_8(SMB) + \beta_9(HML) + \varepsilon_4$ **, monthly.**

	Before							During							After						
	DF	dp	dm	diff	SMB	HML	RSQ	DF	dp	dm	diff	SMB	HML	RSQ	DF	dp	dm	diff	SMB	HML	RSQ
N	8	8	8	8	8	8	8	9	9	9	9	9	9	9	14	14	14	14	14	14	14
Mean	35	3.6967	-0.8487	-4.5454	2.7488	1.1443	0.5563	12	-0.1922	1.3061	1.4983	0.9652	0.7604	0.8449	54	0.8855	0.7882	-0.0973	0.1570	0.2969	0.5211
Median	18	0.2298	0.5635	0.3724	0.3617	0.2901	0.4773	13	-0.1079	1.3614	1.4940	1.1524	0.7691	0.8832	61	0.8978	0.8192	-0.0907	0.1457	0.4014	0.5680
StDev	38	7.6184	6.3560	13.8843	7.6814	2.1243	0.3242	4	0.3885	0.2362	0.5598	0.7888	0.1697	0.1681	10	0.0578	0.2208	0.2120	0.1070	0.2195	0.1062
Min	2	-1.3561	-13.5672	-33.5804	-3.6835	-0.0536	0.2274	2	-0.8996	0.6937	0.2459	-0.6181	0.4130	0.4057	35	0.7244	0.2621	-0.6276	-0.0480	-0.3070	0.2569
Max	85	20.0132	4.9168	6.2349	19.7638	6.3352	0.9352	13	0.4478	1.4857	2.2997	2.0697	1.0544	0.9810	61	0.9436	1.2189	0.3671	0.4234	0.4965	0.6536
Diff p-value				0.18566							<0.0001							0.05477			

Table 4, Panel B presents results for CAPM beta asymmetry over the Before, During and After periods of the Great Recession for daily data. Betas in advancing markets seem to be higher than declining market betas but again not statistically significantly in the Before and During periods, which again suggests failure to reject H0-1 in all three periods. What is important to point out is that in the After period the betas in up markets are statistically higher, at the 10% level, than in down markets. This is the case for the Before and After periods of the monthly data as well but not for the during period which means presence of "asymmetric beta puzzle" for REIT ETFs during the Great Recession when monthly data are used. The up market average beta is 1.1666 whereas the down market beta is 1.7668, it is important to point out the small number of monthly observations used in the estimation of these betas so these results need to be interpreted carefully.

Table 4 Panels D, E and F provide results for the "asymmetric beta puzzle" using the ideas developed by Peterson and Hsieh (1997) who suggest that using the Fama-French three factor model helps explain this phenomenon. Table 4 Panel D presents results for estimation of asymmetric betas using Fama-French models and again the monthly results indicate rejection of H0-1 and presence of "asymmetric beta puzzle" phenomenon in REIT ETFs. The daily data again suggests lack of "asymmetric beta puzzle" and again that REIT ETFs are a good hedge by having average advancing market betas of 0.9244 which are statically higher than the declining market betas of 0.8520.

Table 4 Panel E shows results for the Before, During and After the Great Recession periods using the Fama-French Three Factor model. The table's Panel E shows results when daily data are used whereas Panel F shows monthly results. Again, when using daily data and the Fama-French model estimations advancing market betas are higher than declining market betas thus failing to reject H0-1 and even statistically supporting H0-2 in the During the Great Recession period. When the monthly data sample is used H0-1 is rejected and so is H0-2 during the Great recession period. This again is evidence that "asymmetric beta puzzle" is detected in REIT ETFs during the Great Recession when monthly data are used but not when daily data are used. Surprisingly, in the After recession period with monthly data advancing market betas are higher than declining market betas supporting H0-1 and also providing evidence of the diversification benefits of REIT ETFs even in the most severe real estate cause market downturns.

Of course, the small number of observations in the monthly data is definitely having an impact on the estimations and the results need to be interpreted with caution.

Robustness Tests

As robustness, we also estimate beta using the S&P 500 index and the results are the same as when the Composite Index is used as the market proxy. These results however are not presented in the interest of brevity, but are available upon request.

To insure stability in the market risk estimates we also test for the statistical significance of the beta estimates by conducting multivariate analyses based on equations (5) and (6). These results are presented in Tables 5 and 6. Regressions of dependent variables Beta, DP, DM, SMB, HML

and R-squareds using daily data on independent variables - B, D and A are dummy variables with value of one in the Before, During and After periods and zero otherwise, Lmc is the log of the ETFs market capitalization on the last day of the Before, During and After periods, Lsince is the log of number of days since the ETF's inception, ER is expense ratio in 2015, DY is the 2015 Dividend Yield.

Table 5 provides results for cross-sectional regressions using CAPM beta estimates and provides evidence for a statistically higher betas during the recession period and smaller betas before and after the event. Table 6 provides results for cross-sectional regressions using CAPM advancing and declining market beta estimates and provides evidence for statistically elevated advanicng and declining market betas during the Great Recession period and smaller betas before and after the event.

Table 5.

The cross-sectional regressions are estimated based on equation (5)

$\beta_i = \alpha_4 + \beta_6(B) + \beta_7(D) + \beta_8(A) + \beta_9(lMC) + \beta_{10}(l\sin ce) + \beta_{11}(er) + \beta_{12}(dy) + \varepsilon_4$

and (6) $Rsq_i = \alpha_5 + \beta_{13}(B) + \beta_{14}(D) + \beta_{15}(A) + \beta_{16}(lMC) + \beta_{17}(l\sin ce) + \beta_{18}(er) + \beta_{19}(dy) + \varepsilon_5$

and equation (1) $r - r_f = \alpha_1 + \beta_0(r_m - r_f) + \varepsilon_1$ **coefficients and R-squareds as dependent variables for each firm, daily data.**

	Dependent Variable MRP						Dependent Variable R-Squared					
	Coef	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**
Inter	**1.5191**	**0.0091**	**1.3096**	**0.0087**	**2.0174**	**0.0005**	0.3824	0.1721	0.1862	0.4312	**0.4556**	**0.0839**
b	-0.2095	0.1254			**-0.7078**	**<.0001**	**-0.1963**	**0.0073**			**-0.2695**	**0.0002**
d	**0.4983**	**<.0001**	**0.7078**	**<.0001**			0.0732	0.1766	**0.2695**	**0.0002**		
a			0.2095	0.1254	**-0.4983**	**<.0001**			**0.1963**	**0.0073**	-0.0732	0.1766
lmc	0.0653	0.1257	0.0653	0.1257	0.0653	0.1257	0.0141	0.5068	0.0141	0.5068	0.0141	0.5068
lsince	-0.1741	0.1171	-0.1741	0.1171	-0.1741	0.1171	0.0072	0.8956	0.0072	0.8956	0.0072	0.8956
er	0.0544	0.8692	0.0544	0.8692	0.0544	0.8692	-0.1573	0.3521	-0.1573	0.3521	-0.1573	0.3521
dy	-0.0161	0.1972	-0.0161	0.1972	-0.0161	0.1972	-0.002	0.7503	-0.002	0.7503	-0.002	0.7503
N		31		31		31		31		31		31
R-sq		0.6578		0.6578		0.6578		0.6051		0.6051		0.6051

Note: In bold are the coefficients which are statistically significant at least at the 10% level.

Table 6.

The cross-sectional regressions are estimated based on equation (5):

$\beta_i = \alpha_4 + \beta_6(B) + \beta_7(D) + \beta_8(A) + \beta_9(lMC) + \beta_{10}(l\sin ce) + \beta_{11}(er) + \beta_{12}(dy) + \varepsilon_4$

and (6) $Rsq_i = \alpha_5 + \beta_{13}(B) + \beta_{14}(D) + \beta_{15}(A) + \beta_{16}(lMC) + \beta_{17}(l\sin ce) + \beta_{18}(er) + \beta_{19}(dy) + \varepsilon_5$

and equation (2): $r - r_f = \alpha_2 + \beta_1(DP) + \beta_2(DM) + \varepsilon_2$ **coefficients and R-squareds as dependent variables for each firm, daily data.**

	Dependent Variable DP						**Dependent Variable** DM						**Dependent Variable** R-sq					
	Coef	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**	**Coef**	**p-value**
Inter	**1.5346**	**0.0462**	**1.3197**	**0.0453**	**2.0238**	**0.0065**	**1.5153**	**0.0014**	**1.3121**	**0.0012**	**2.022**	**<.0001**	0.3871	0.1672	0.1917	0.4179	**0.4601**	**0.0812**
b	-0.2149	0.2439			**-0.7042**	**0.0003**	**-0.2032**	**0.0605**			**-0.7100**	**<.0001**	**-0.1954**	**0.0075**			**-0.2684**	**0.0002**
d	**0.4892**	**0.002**	**0.7042**	**0.0003**			**0.5068**	**<.0001**	**0.7100**	**<.0001**			0.073	0.1781	**0.2684**	**0.0002**		
a			0.2149	0.2439	**-0.4892**	**0.002**			**0.2032**	**0.0605**	**-0.5068**	**<.0001**			**0.1954**	**0.0075**	-0.073	0.1781
lmc	0.0622	0.2781	0.0622	0.2781	0.0622	0.2781	**0.0694**	**0.0412**	**0.0694**	**0.0412**	**0.0694**	**0.0412**	0.0137	0.5173	0.0137	0.5173	0.0137	0.5173
lsince	-0.1659	0.2673	-0.1659	0.2673	-0.1659	0.2673	**-0.1862**	**0.0359**	**-0.1862**	**0.0359**	**-0.1862**	**0.0359**	0.0073	0.8938	0.0073	0.8938	0.0073	0.8938
er	-0.0373	0.9341	-0.0373	0.9341	-0.0373	0.9341	0.1543	0.5515	0.1543	0.5515	0.1543	0.5515	-0.159	0.3473	-0.159	0.3473	-0.159	0.3473
dy	-0.0121	0.4715	-0.0121	0.4715	-0.0121	0.4715	**-0.0196**	**0.0506**	**-0.0196**	**0.0506**	**-0.0196**	**0.0506**	-0.0019	0.7577	-0.0019	0.7577	-0.0019	0.7577
N		31		31		31		31		31		31		31		31		31
R-sq		0.5007		0.5007		0.5007		0.7648		0.7648		0.7648		0.6022		0.6022		0.6022

Note: In bold are the coefficients which are statistically significant at least at the 10% level.

Table 9. Betas Over Tech Bubble and Great Recession.
DF is degrees of freedom and RSQ is R-squared.

Panel A. CAPM beta estimates, daily.

	During Tech Bubble			After Tech Bubble			Before Great Recession			During Great Recession			After Great Recession		
PERMNO	DF	mrp	RSQ	DF	mrp	RSQ	DF	mrp	RSQ	DF	mrp	RSQ	DF	mrp	RSQ
88294	196	0.18	0.12	164	0.29	0.21	1529	0.61	0.32	375	1.60	0.71	1384	1.08	0.65
88894	34	0.22	0.20	164	0.21	0.12	1529	0.58	0.27	375	1.76	0.71	1384	1.14	0.62
				145	0.24	0.13	1529	0.57	0.27	375	1.70	0.69	1384	1.14	0.64
Mean	115	0.20	0.16	158	0.24	0.15	1529	0.58	0.28	375	1.69	0.70	1384	1.12	0.64

Panel B. Asymmetric beta estimates, daily.

	During Tech Bubble				After Tech Bubble				Before Great Recession				During Great Recession				After Great Recession			
PNO	DF	dp	dm	RSQ	DF	dp	dm	RSQ	DF	dp	dm	RSQ	DF	dp	dm	RSQ	EDF	dp	dm	RSQ
88294	195	0.18	0.18	0.12	163	0.17	0.41	0.23	1528	0.55	0.67	0.32	374	1.65	1.56	0.71	1383	1.12	1.05	0.65
88894	33	0.08	0.31	0.21	163	0.03	0.39	0.16	1528	0.54	0.62	0.27	374	1.79	1.74	0.71	1383	1.20	1.09	0.63
88961					144	0.03	0.42	0.16	1528	0.49	0.64	0.27	374	1.78	1.61	0.69	1383	1.19	1.09	0.64
Mean	114	0.13	0.25	0.16	157	0.08	0.41	0.18	1528	0.53	0.64	0.29	374	1.74	1.63	0.70	1383	1.17	1.08	0.64

We repeat the estimation of the same regressions using monthly data. The only consistency and similarity to the daily data results are the regression results on R-squared. The rest of the regressions using monthly data do not yield statistically significant, consistent and similar results on the daily data beta estimate regressions. These results however are not presented in the interest of brevity but are available upon request. The reason is the NBER identifies the Great Recession period as December 2007 to June 2009 which provides us with small sample sizes - 19 observations to run the regressions necessary for the estimation of the risk metrics. Also, in the Before sample period four of the examined eight ETFs have been just introduced, i.e. have three monthly observations which makes the sample sizes even smaller. Naturally, an argument could be made that the small sample sizes might be driving the monthly results. Therefore, as robustness we remove these small sample sizes ETFs from the analysis as robustness. Once removed, the resulting averages show statistically significant differences between declining and advancing market betas with the declining market betas being higher. This suggests rejection of H0-1 and presence of "asymmetric beta puzzle" in the before sample of ETFs.

Another interesting question that needs to be addressed which can help with the generalization of this article's results is with regards to the diversification benefits of REIT ETFs during the Tech Bubble recession which had no real estate causes. NBER defines the periods of the Tech Bubble as the period - March 2001 to November 2001. Unfortunately, only two REIT ETFs existed at that time – the REIT ETFs with ticker symbols IYR and ICF, with the introduction of a third one in the period after the Tech Bubble recession - the RWR.

Table 9 provides information on the ETFs which had data prior to the Great Recession and covers the period of both the Tech Bubble and the Great Recession. Panel A provides overall beta estimates and Panel B asymmetric beta estimates. Panel A clearly shows the upwards trend

in these REIT ETFs betas being in the low twenties in the early years with very low R-squareds as well and betas being above one after the Great Recession. These findings are consistent with the evidence documented in Corgel and Djoganopoulos (2000), Chiang, Lee and Wisen (2005) and Goldstein and Nelling (1999) for REITs, which suggests that the reason for the identification of low betas might be the periods used in the study. As Sing, Tsai and Chen (2016) document that betas tend to vary significantly over time and also show lower betas in their early samples and higher REIT betas and in the later samples.

Considering that these ETFs have been just introduced which is typically accompanied by a lot of uncertainty and volatility in the initial period of any new product this is surprising. However, one thing is clear these oldest ETFs exhibit great diversification benefits during the Great Recession but no diversification benefits during the Tech Bubble indicated by the higher betas in up markets than in down markets in Panel B. It seems that even though Real Estate based these ETFs have been well designed to provide diversification benefits even in the most severe real estate caused market corrections.

Conclusion

In this study we examine 14 REIT ETFs using daily and monthly data to estimate REIT ETFs betas and REIT ETFs betas in declining and advancing markets and test for the existence of the "asymmetric beta puzzle" phenomenon in REIT ETFs which has been documented in the prior literature for REITs. This phenomenon's existence is important because its existence suggests lack of diversification benefits and hedging abilities of an instrument during a market downturn. Studying REIT ETFs is important because ETFs have exploded in popularity recently due to their tax efficiency and simplicity - typically ETFs are indexers and as such track a market index but there are very few studies that examine REIT ETFs and none to the best of our knowledge who examine the diversification benefits of REIT ETFs.

We find no evidence to suggest that this phenomenon exists in REIT ETFs when daily data are used. On the contrary we find evidence in support of the diversification benefits of REIT ETFs even in the most severe real estate caused market downturns. We document "asymmetric beta puzzle" phenomenon when monthly data are used, which suggests that REIT ETFs do not have diversification benefits. However, these results need to be considered with a "grain of salt" since the NBER identifies the Great Recession period as December 2007 to June 2009 which provides us with small sample sizes - 19 observations to run the regressions necessary for the estimation of the risk metrics. Naturally, an argument could be made that the small sample sizes might be driving the monthly results. One thing is certain though the monthly results are in agreement with the findings of the "asymmetric REIT beta puzzle" studies by Chatrath, Liang and McIntosh (2000), Chiang, Lee and Wisen (2004) and Peterson and Hsieh (1997) since all of these studies use monthly data. Daily data does not have the same small sample sizes issues however, and in our opinion provides the more robust results.

An interesting extension to this study is the examination of the hedging and diversification benefits of REIT ETFs and REITs in general for that matter using intradaily data. The market microstructure issues surrounding these real estate financial instruments most likely differ from the market microstructure issues of the typically examined equity securities. Of course, without

further examination we cannot say if such benefits exist one way or the other. Such analysis would naturally be possible if such data become available.

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