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Removing Biases in Computed Returns: An Analysis of Bias in Equally-Weighted Return Indexes of REITs

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In this paper, we apply the method for removing the upward bias in returns in equally-weighted return indexes developed by Fisher, Weaver, and Webb (2010) to real estate investment trust (REIT) stocks in the US. While we find significant bias in this index, two trends are evident: first, there is less overall bias than in non-REIT stocks, and second, the bias of REIT stocks has declined over time. These trends are consistent with growing listings of REIT stocks on the New York Stock Exchange (NYSE), as well as with increasingly higher stock prices. They also support the hypothesis that there have been significant improvements in the market micro-structure environment of REIT stocks since the early 1970s. We further apply our methodology to REIT stocks listed in the two countries with the largest number of REITs outside the US: Germany and Australia. The results support the hypothesized relationship between index bias and market micro-structure environment.

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Keywords

Unbiased market index; Bias in computed returns; Index construction; REITs

1. Introduction

Many issues of critical importance in real estate finance require the use of a broad measure of returns as a benchmark for comparison. The fundamental question, for example, of whether investments in real estate securities as a whole outperform investments in non-real estate securities involves comparing broad indexes of each type. The question of whether real estate investments provide additional diversification opportunities involves comparing the risks, covariance, and returns of real estate and non-real estate securities. Questions that focus on optimal asset allocation require measures of performance on each asset under consideration. Still broader questions of investment opportunities internationally require indexes of the asset classes in several different countries. The uses of, and needs for, return indexes are so important that it is easy to take them for granted. Indeed, the concept of a broad market index is so intuitive that it is easy to overlook the many issues of data and methodology that are critical in forming empirical estimates of "the market."

These challenges are especially daunting in real estate. For one,unlike markets for common stocks, direct real estate transactions are not made on organized exchanges where the assets are standardized in at least some ways and prices are publicly available.[1] Geltner and Ling (2007) argue that, in the case of commercial real estate, an analyst may want to evaluate either a particular manager ("agent") or the success of an asset class for investment guidance. To evaluate an agent, an index must serve as a benchmark for comparison. To evaluate real estate as an asset class, the index must be appropriate for comparing market movements, volatility, and correlations of different assets across time. Geltner and Ling conclude that while no single index is ideal for both purposes, it is possible to characterize the ideal form of an index intended to serve for each one.[2]

[1] Lizieri and Ward (2000) provide a comprehensive survey of definitional and measurement issues in real estate, including transactions in both real property and financial securities.

[2] See also Geltner and Ling (2006) and Geltner (2007), especially for more comprehensive discussions of the optimal uses of appraisal versus actual transactions data, and other characteristics including frequency and coverage of different types of properties.

Our focus in this paper is on the methodology of constructing a market-wide index of publicly-traded REIT securities. As such an index is based on market prices and returns, it is free of the difficulties associated with measuring performance of direct real estate investments that Geltner and Ling have evaluated. However, even with this advantage, there are still difficult issues of data as well as of methodology.

In a related paper, Fisher, Weaver, and Webb (2010, henceforth FWW) develop a method for asymptotically removing the well-known upward bias in observed returns of equally-weighted portfolios. We show evidence of significant upward bias for stocks on all US markets, but the bias for Nasdaq stocks is substantially larger than for the New York Stock Exchange (NYSE) or American Stock Exchange (AMEX) stocks. However, FWW aggregate across all security classes, which leaves open the possibility of differential bias across asset classes.

Weaver (1991) shows that the amount of bias in stock returns is related to their microstructure. Wang et al. (1995) show that the microstructure of real estate investment trusts (REITs) differs from that of non-REITs. Taken together, these papers suggest a differential degree of bias for REITs as compared to non-REITs. It is entirely possible that the well-known anomalous behavior of REIT stocks may be an artifact of differential microstructure leading to bias-induced returns.

In this paper, we take the first step toward examining this possibility by comparing the bias of REIT and non-REIT returns for US and non-US exchanges. REITs constitute a class of assets of increasing interest to financial investors because they involve the (indirect) securitization of real estate, a major but relatively illiquid asset class. REIT securities are common stocks, but have unique dividend payout procedures due to special tax status. A firm that elects REIT status is exempt from federal taxation, but required to pay out at least 90% of its net income each year.[3]

Our application of the method for reducing bias enables us to measure the extent of bias in estimates of REIT portfolio performance. These estimates are critical in accurately comparing the risks and returns of different major classes of assets. Such comparisons are used in evaluating risk-return trade-offs, comparative advantages, and potential diversification benefits of major asset classes relative to one another. By focusing on REITs, we also extend the application of the FWW technique and are able to evaluate its applicability to a specific market sector with unique characteristics. This application reveals new insights about changes in the market microstructure environment of the REIT sector.

[3] Several additional requirements that REITs must follow to retain their special tax exemption in the United States are listed in Chan et al. (2003), page 16.

We first calculate indexes for REIT stocks in the US using both our method and the traditional method. Our estimate of bias is based on a comparison of these two indexes. We find economically and statistically significant bias in the traditionally calculated index for REIT stocks. Over the period of February 1973 to December 2006, we find that the average bias in REIT stocks is 9.38 basis points (b. p.) per month. The bias is cumulative and dramatically increases over time. The traditional index constructed from observed monthly REIT returns is almost 50% larger than an unbiased index by the year 2006.

We calculate the unbiased and traditional indexes for non-REIT US stocks over the same period, and also find significant bias in them. The average bias is 12.67 b. p. per month, slightly higher than that for the US REITs. As we discuss in greater detail below, we find that the bias tends to decline during our sample period for both REIT and non-REIT stocks, and that the decline is larger for the REIT stocks.

We examine several characteristics of US REIT stocks that we hypothesize are associated with bias, and find two trends consistent with a declining bias: since 1993, more REITs are traded on the NYSE than the Amex or Nasdaq; and many fewer REIT stocks have low prices of under $10.00 per share. On the other hand, we also find that more REIT stock prices are transaction prices than non-transaction prices estimated by the bid/ask average price quotation. As explained below, this factor works counter to the apparent decline in bias.

We extend the analysis internationally to Germany and Australia, which have the largest numbers of listed REITs outside of the US. We find significant bias in the standard equally-weighted index of German REITs, but not in the Australian REIT index. We attribute the lack of significant bias for the Australian REIT index to microstructure effects. In particular, while US and German closing prices are based on trades that occur in the continuous trading portion of the trading day, Australian closing prices are determined via a closing auction which effectively eliminates the bid-ask spread for closing prices. Since, as we show below, spreads are a major determinant of bias, eliminating the spread eliminates most of the bias in standard REIT indexes in Australia.

The key contribution of our analysis is the development of improved measures of market returns for real estate securities, an increasingly important class of assets across the globe. A related contribution is to underscore the importance to researchers and market participants of understanding the implications of the particular micro-structure of the securities markets in any studies that compare market performance of financial securities in different countries.

The rest of this paper is organized as follows: in the next section, we explain the nature of the bias in equally-weighted indexes and outline our approach to

removing it. Next, we describe our US REIT index, based on data available in the Center for Research in Securities Prices (CRSP). In Section 3, we present our results on estimating the indexes and the extent of the bias in US REITs. We extend this analysis internationally to Germany and Australia in Section 4. Section 5 concludes.

2. Biases in Equally-Weighted Indexes and FWW's Approach

It is well known that observed returns of individual securities are upward biased and that the bias is caused by errors in quoted prices.[4]Equally-weighted indexes (or portfolios) are especially prone to the bias due to this source. Conrad and Kaul (1993), and Blume and Stambaugh (1983) show that the biases of value-weighted indexes (e.g. Standard & Poor's Index of 500 Stocks) and price-weighted indexes (e.g. Dow Jones Industrial Average) are much smaller than those of equally-weighted indexes. However, equal weighting is the preferred method of forming an index when the market capitalization weights among representative stocks are disproportionate, and is therefore used in many event studies.[5,6]

Previously suggested methods for reducing or removing the bias either do not allow for frequent rebalancing or have other undesirable properties.[7] FWW's method for asymptotically removing the bias in observed equally-weighted portfolio returns does allow for frequent rebalancing. The complete derivation is presented in FWW (2010).

The intuition behind our methodology is straightforward and similar to that for deriving implied future single-period spot rates in a two-period rate (assuming the liquidity premium is zero). The implied future spot rate for time *t*-1 to *t* is estimated by dividing the square of one plus the spot rate from *t*-2 to t by one plus the spot rate from *t*-2 to *t*-1. In a similar manner, dividing a two-period average portfolio price relative (one plus the observed return) ending at

[4] See Macaulay (1938) and Fisher (1966), among others.
[5] A notable exception is Fama et al. (1969) who use continuously compounded returns.
[6] For example,the explanation of the weighting method for the Dow Jones Turkey Equal Weighted 15 Index from the company's web site : (http://www.djindexes.com/mdsidx/?event=showTurkey15) is that "The index includes the largest stocks traded on the Istanbul Stock Exchange, and is equal weighted to limit the influence of the biggest companies on overall index performance." Also in 2005, NASDAQ began constructing an equally weighted version of several of their indexes including the NASDAQ 100.
[7] For example Blume and Stambaugh (1983) recommend using long-period buy-and-hold portfolios, and Bessembinder and Kalcheva (2007) assert that while estimates of continuous compounded rates of return contain no bias, they also possess certain properties that limit their usefulness in many tests.

time *t*, by a one-period average portfolio price relative that ends at time *t*-1 results in an unbiased estimate of the true one-period price relative (hence return) ending at time *t*, as long as errors in the prices at times *t*, *t*-1, and *t*-2 are independent.

The average bias inherent in observed returns is due to pricing errors at the beginning of the holding period. By invoking the law of large numbers, the expected bias in observed prices at time *t* is zero, leaving only the bias in observed prices at the beginning of the period. Our method removes the remaining bias due to *any* random transient errors (not limited to bid-ask bounce as in previous studies). The only assumptions needed are that: (1) transient errors in successive observed prices are independent, and (2) all observed prices are finite and greater than zero. In our method, as both the numerator and denominator start at the same time, the bias cancels out, leaving asymptotically unbiased estimates of true returns. Formally:

$$E\left[\frac{1+{}_2\hat{R}_t}{1+\hat{R}_{t-1}}\right]=\frac{\left[1+E({}_2R_t)\right]*\left[1+\sigma^2(e_{i,t-2})\right]}{\left[1+E(R_{t-1})\right]*\left[1+\sigma^2(e_{i,t-2})\right]}=\frac{1+E({}_2R_t)}{1+E(R_{t-1})}=1+E(R_t) \quad (1)$$

where:

${}_2R_t$ = two-period return on an equally-weighted portfolio ending at time *t*
R_{t-1} = one-period return on an equally-weighted portfolio ending at time *t*-1
$e_{i,\,t-2}$ = bias in the observed return at time *t*-2.

Carets indicate observed returns while the absence of a caret indicates a "true" (unbiased) value.

Our unbiased index of returns for N stocks is calculated as follows:

$$1+E(R_t)=\frac{\sum_1^N\left(1+{}_2\hat{R}_t\right)}{\sum_1^N\left(1+\hat{R}_{t-1}\right)} \quad (2)$$

It can be compared to the traditional (biased) index calculation:

$$1+E\left(\hat{R}_t\right)=1+\frac{\sum_1^N\hat{R}_t}{N} \quad (3)$$

3. Our US REIT Sample and Index

To form our equally-weighted REIT index of US stocks, we use the CRSP file with data through December 31, 2006. We include stocks that meet any one of these criteria: the Standard Industrial Classification (SIC) code is 6798 or 6799, or the CRSP share code ("SHRCD") has a second digit of "8." We include the returns for these stocks only in the time periods for which they meet one (or more) of these criteria. We also form a non-REIT index. This index only

includes stocks that never have SIC code 6798 or 6799 and never have a share code ending in the digit "8."[8]

We begin our data with December 1972, which marks the beginning of the Nasdaq data in CRSP. Our actual index values begin in February 1973, in order to allow for required lags in the data.

The CRSP data on REITS are known to be problematic. Chan, Erickson, and Wang (2003, henceforth CEW) explain that many REITs are not correctly designated as such in CRSP, and therefore are not included in our REIT index. Alternatively, some stocks that are designated as REITs by CRSP are in fact not REITs. CEW form an index of REIT stocks based on additional research in which they independently verify the REIT status of each included stock. Their time period is 1962-2000.

In our overlapping time periods of 1973 through 2000, there are significant differences between our REIT index and that of CEW. One of the most notable is in the number of stocks included. In December 1989, for example, there are 215 REITs in our CRSP-based index, and 119 in the CEW index, for a difference of 96 stocks. Outside of the years 1987-1991, the differences are much smaller. In 1973-1979, the CEW index typically has 7 to 16 more stocks than ours, and in the years 1992 to 2000, it has about 30 stocks fewer. Despite these differences, the correlations between the monthly returns of the two indexes are very high. The pair-wise correlation between the CEW and the FWW unbiased index is 0.982, and between the CEW and our traditionally-formed (biased) index, 0.985.

Although our use of the CRSP data is subject to qualifications, the CRSP data are available to many researchers, and are therefore often used for this purpose. For example, Hardin et al. (2005) form a REIT index based on all REITS in the CRSP file with SIC code 6798 or share codes of 18 or 48. Hartzell et al. (2007) form a sample including all CRSP securities with the second share class digit of 8. We proceed on the assumption that the REIT information in CRSP is meaningful. Indeed, the types of errors documented by CEW would tend to reduce differences between REIT and non-REIT stocks rather than to increase them.

[8] In the case of non-REITs, we omit returns for stocks that are REITs in some time periods and are not REITs in other periods. The omitted returns are those when they do not have REIT status. Damodaran, John, and Liu (1997) document that REITs that change their status to non-REIT corporations tend to do so in times of distress, and corporations that elect to switch from a corporate organization to a REIT form are firms usually that have substantial free cash flow. We exclude such firms even outside of their non-REIT periods in order to distinguish as fully as possible between the REIT and non-REIT samples.

4. Estimates of Bias in the Equally-Weighted REIT Index for US Stocks

We compute monthly returns and resulting index levels (with base December 1973 = 100) using our unbiased methodology as well as with the traditional approach. Observed returns are upward biased, and the indexes are cumulative with respect to the bias. Comparing our unbiased equally-weighted indexes for REITs and non-REITs to the traditionally formed indexes reveals the extent of this cumulative effect for each asset class. Our results are presented in Table 1.

Over the 33 years from 1973 to 2006, we find that the ending level of the traditional index is 46% higher than that of our unbiased REIT index (5,478.42 vs. 3,740.19). The indexes for the non-REITs for the same period show slightly larger cumulative bias of 64%. The comparative data in Column (8) show that the cumulative bias of REITs exceeds that of non-REITs in the 1975-1990 period. The comparison is reversed afterward, with cumulative bias in non-REITs higher than for the REITs. This split roughly divides our sample period in half. Since Weaver (1991) shows that the bias is related to microstructure, these findings suggest that the microstructure of US REITs has changed over our sample period.

It is very significant that the comparative performance of REITs and non-REITs is affected by the bias. In the 1990-2006 period, the regular (biased) index shows that the annual average return of non-REIT stocks is 16.84%, higher than the 16.33% average return of REIT stocks. After the bias is eliminated, the comparison reverses: the average return of the non-REITs is 15.25%, lower than the figure for the REITs of 15.61%.[9]

In Table 2, we show the average size of the bias in monthly returns for five-year time periods, as well as other periods, for the REITs and non-REITs. The overall bias for the REITs is 9.38 b.p., slightly lower than that for the non-REITs, which averaged 12.67 b.p. in the same 33-year period. The picture revealed by the sub-periods is that the bias in the REITs is higher than that for the non-REITs in the 1970s, but lower in all of the subsequent five-year periods. These comparisons further support the notion that the microstructure of REITs has changed over time.

[9] Effects on performance rankings are not unique to the case of REITs. FWW find that rankings of stock performance of Nasdaq versus NYSE stocks are also affected by the bias. An equally-weighted index of Nasdaq stocks outperforms NYSE stocks in the usual market comparison in 1973-2006. However, when the micro-structure bias is eliminated, stocks in the two markets perform about the same.

Table 1 Index Levels of the Unbiased and Conventional Biased Indexes

This table shows end-of-year index levels for REITs and non-Reits. REITs are defined as stocks in the CRSP file with SIC codes of 6798 or 6799, or CRSP sharecode indicating that the stock is a REIT. Stocks are included as REITS only for dates on which one or more of these requirements applies. Non-REITs are defined as all stocks in the CRSP file which at no point have SIC code 6798 or 6799 and are never classified as a REIT.
The index value of December 1973 = 100

Year End	REITs			Non-REITs			Ratio: REIT Bias vs. Non-REIT Bias
	Unbiased Index	Conventional Biased Index	Ratio: Conventional vs. Unbiased	Unbiased Index	Conventional Biased Index	Ratio: Conventional vs. Unbiased	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1973	100.00	100.00	1.0000	100.00	100.00	1.0000	1.0000
1974	34.37	34.81	1.0128	73.05	75.28	1.0305	0.9828
1975	37.42	42.07	1.1243	115.92	124.37	1.0729	1.0479
1976	54.71	63.42	1.1592	169.87	185.20	1.0902	1.0632
1977	72.36	86.15	1.1906	207.54	228.58	1.1014	1.0810
1978	82.99	100.36	1.2093	258.43	289.65	1.1208	1.0790
1979	118.81	146.80	1.2356	360.95	409.14	1.1335	1.0901
1980	161.99	202.34	1.2491	515.03	586.06	1.1379	1.0977
1981	169.34	211.77	1.2506	508.61	584.33	1.1489	1.0885
1982	222.96	286.61	1.2855	625.01	728.97	1.1663	1.1022
1983	302.81	393.77	1.3004	841.69	999.16	1.1871	1.0954
1984	334.29	436.56	1.3059	733.57	881.19	1.2012	1.0872
1985	372.41	488.77	1.3125	911.17	1,107.89	1.2159	1.0794

(*Continued*…)

(***Table 1 Continued***)

1986	410.86	545.77	1.3284	972.00	1,193.86	1.2283	1.0815
1987	358.82	473.84	1.3206	879.47	1,092.51	1.2422	1.0630
1988	389.66	516.41	1.3253	1,025.49	1,301.85	1.2695	1.0439
1989	423.85	556.18	1.3122	1,140.30	1,458.09	1.2787	1.0262
1990	317.69	418.88	1.3185	880.77	1,145.21	1.3002	1.0141
1991	395.25	517.73	1.3099	1,309.57	1,750.10	1.3364	0.9802
1992	430.15	568.40	1.3214	1,630.67	2,227.45	1.3660	0.9674
1993	593.74	805.83	1.3572	2,030.49	2,817.43	1.3876	0.9781
1994	602.75	824.86	1.3685	1,900.10	2,668.58	1.4044	0.9744
1995	718.34	991.47	1.3802	2,451.51	3,482.88	1.4207	0.9715
1996	970.44	1,346.33	1.3873	2,854.80	4,088.74	1.4322	0.9687
1997	1,192.14	1,660.07	1.3925	3,387.61	4,905.94	1.4482	0.9615
1998	1,006.37	1,409.50	1.4006	3,180.65	4,779.10	1.5026	0.9321
1999	983.31	1,404.71	1.4286	4,297.59	6,453.88	1.5017	0.9513
2000	1,131.54	1,613.02	1.4255	3,851.68	5,684.13	1.4758	0.9660
2001	1,453.76	2,080.60	1.4312	4,355.95	6,922.76	1.5893	0.9005
2002	1,579.11	2,278.29	1.4428	3,768.06	6,124.14	1.6253	0.8877
2003	2,256.07	3,288.29	1.4575	6,549.70	10,626.79	1.6225	0.8983
2004	2,825.78	4,143.54	1.4663	7,904.93	12,902.80	1.6322	0.8984
2005	2,951.59	4,325.51	1.4655	8,323.14	13,623.64	1.6368	0.8953
2006	3,740.19	5,478.42	1.4647	9,836.23	16,152.27	1.6421	0.8920

In Table 3, we show bias by calendar month. Although the bias in January returns is larger than other months for both REITs and non-REITs, almost all of the calendar months have substantial upward bias in observed returns. Thus, the bias is not concentrated in January and cannot be attributed to the existence of the January effect.

Our main results show that cumulative returns in US REIT stocks are upward biased, as expected. However, the extent of the bias is higher than for the non-REIT stocks before 1990 and lower afterward. In our earlier paper, we show that the bias is larger for Nasdaq than NYSE stocks. In addition, Weaver (1991) shows that the bias is directly related to spread width and volatility, which historically have been higher on Nasdaq than on the NYSE.

We now consider several factors that may account for the observed decline in the bias of US REIT stock return indexes. Shown in Table 4 is the distribution of US REIT stocks by exchange. Through 1992, more than half of the REITs in our US sample were traded in the Amex or on Nasdaq. Since 1993, over half are NYSE-listed stocks. The lower bias in the second half of our sample period coincides with greater representation on the NYSE.

Another factor potentially related to bias is the incidence of low stock prices. The link here is that low stock prices tend to be associated with higher bid/ask spreads, and therefore with greater potential bias. In Table 5, we summarize data on REITs by end-of-year stock price. Throughout 1993, over half of the REIT stock prices were $10.00 or lower. The higher average prices after that are consistent with the lower degree of bias in REITs in the second half of our sample period.

If a stock has no closing price (due to no trading), CRSP assigns the closing price as the average of the closing bid/ask prices. As shown by Blume and Stambaugh (1983), bias is largely caused by observed prices being either at the bid or at the ask. FWW show that using the mid-point of the spread will reduce, but not eliminate, the bias in observed returns. CEW report that REITs have lower turnover than non-REITS, which may in turn, lead to a higher incidence of no trading – hence the closing price is the mid-point of the quoted spread. This would lead to lower bias in REITs.

Table 2 Estimates of the Bias for Selected Periods

This table shows the average bias in the monthly returns on the traditionally formed equally-weighted index. Bias is defined as the ratio of the traditional index relative to the unbiased index. Biases are expressed in basis points (1 b.p. = 0.0001, or 0.01%). Standard errors are expressed as percentages.

For each period and class, we show the number of observations included, and the mean bias, standard error, and t-statistic. Panel A shows the results for REITS, and Panel B shows them for the non-REIT stocks.

Period	Number of Observations	Mean Bias	Standard Error	t-Statistic	s_E of Transient Errors
Panel A: REITS					
197304 - 197512	33	35.82	11.60	3.09	5.99
197601 - 198012	60	17.03	5.08	3.35	4.13
198101 - 198512	60	8.25	2.72	3.04	2.87
198601 - 199012	60	0.71	2.71	0.26	0.84
199101 - 199512	60	7.73	5.99	1.29	2.78
199601 - 200012	60	5.35	2.17	2.46	2.31
200101 - 200612	72	3.78	1.77	2.14	1.94
197302 - 200612	405	9.38	1.71	5.48	3.06
Panel B: Non-REITS					
197304 - 197512	33	25.49	5.18	4.92	5.05
197601 - 198012	60	9.74	1.97	4.94	3.12
198101 - 198512	60	11.11	1.59	6.99	3.33
198601 - 199012	60	11.22	2.21	5.07	3.35
199101 - 199512	60	14.75	2.71	5.45	3.84
199601 - 200012	60	6.56	8.25	0.80	2.56
200101 - 200612	72	15.09	7.56	2.00	3.88
197302 - 200612	405	12.67	1.97	6.42	3.56

Table 3 Estimates of the Bias for Selected Months

This table shows average bias in the monthly returns in the traditionally formed equally-weighted index. Bias is defined as the ratio of the traditional index to the unbiased index. Biases are expressed in basis points (1 b.p. = 0.0001, or 0.01%). Standard errors are expressed as percentages.
For each period and class, we show the number of observations included, and the mean bias, standard error, and t-statistic. Panel A shows the results for REITS, and Panel B shows them for the non-REIT stocks.

Period	Number of Observations	Mean Bias	Standard Error	t-Statistic	s_E of Transient Errors
Panel A: REITS					
January	33	32.41	10.96	2.96	5.69
February	33	6.71	7.45	0.90	2.59
March	33	10.99	9.53	1.15	3.32
April	34	15.33	4.25	3.61	3.91
May	34	4.82	3.19	1.51	2.20
June	34	6.31	2.80	2.26	2.51
July	34	11.83	4.46	2.65	3.44
August	34	1.87	3.03	0.62	1.37
September	34	10.62	5.66	1.87	3.26
October	34	1.12	2.53	0.44	1.06
November	34	6.18	5.72	1.08	2.49
December	34	5.01	4.22	1.19	2.24
Panel B: Non-REITS					
January	33	50.14	13.15	3.81	7.08
February	33	13.46	10.78	1.25	3.67
March	33	15.38	8.47	1.82	3.92
April	34	9.91	4.03	2.46	3.15
May	34	3.72	4.32	0.86	1.93
June	34	7.48	3.49	2.15	2.73
July	34	11.66	3.24	3.60	3.41
August	34	9.57	2.60	3.69	3.09
September	34	8.16	3.24	2.52	2.86
October	34	13.19	5.24	2.52	3.63
November	34	3.12	4.70	0.66	1.77
December	34	7.43	7.33	1.01	2.73

Table 4 Trading Location of REIT Stocks in the CRSP File

This table shows the distribution of trading locations of the REIT stocks in the CRSP file as of the end of each year. Stocks are included when they have SIC 6798 or 6799, or the second digit of their CRSP sharecode (SHRCD) is "8".

Year End	NYSE	Amex	Nasdaq	Total	Percent NYSE
1972	33	35	39	107	30.8
1973	47	37	36	120	39.2
1974	48	32	36	116	41.4
1975	40	30	34	104	38.5
1976	36	27	37	100	36.0
1977	34	27	38	99	34.3
1978	34	27	38	99	34.3
1979	31	26	41	98	31.6
1980	33	27	46	106	31.1
1981	31	26	41	98	31.6
1982	32	26	42	100	32.0
1983	30	23	41	94	31.9
1984	29	24	44	97	29.9
1985	34	30	54	118	28.8
1986	42	31	34	107	39.3
1987	45	112	34	191	23.6
1988	49	116	29	194	25.3
1989	53	117	26	196	27.0
1990	53	119	22	194	27.3
1991	54	121	21	196	27.6
1992	60	55	14	129	46.5
1993	97	61	15	173	56.1
1994	130	59	20	209	62.2
1995	135	57	20	212	63.7
1996	146	41	14	201	72.6
1997	163	37	14	214	76.2
1998	173	41	12	226	76.5
1999	167	42	11	220	75.9
2000	158	40	10	208	76.0
2001	145	42	9	196	74.0
2002	144	41	9	194	74.2
2003	147	38	9	194	75.8
2004	168	26	8	202	83.2
2005	172	28	9	209	82.3
2006	162	30	8	200	81.0

Table 5 Distribution of End-of-Year Prices of REITs in the CRSP File

This table shows the distribution of end-of-year prices of the REIT stocks in the CRSP file as of the end of the year. Stocks are included when they have SIC 6798 or 6799, or the second digit of their CRSP sharecode (SHRCD) is "8".

Year End	Less than $1.00	$1.00-$4.99	$5.00-$9.99	$10.00 - $19.99	$20.00 - $49.99	$50.00 and Higher	Total	Percent under $10.00
1972	39	3	5	20	38	2	107	43.9
1973	38	5	18	43	17	0	121	50.4
1974	48	51	14	7	0	0	120	94.2
1975	51	38	14	12	0	0	115	89.6
1976	53	32	10	15	3	0	113	84.1
1977	52	25	12	15	5	0	109	81.7
1978	49	24	16	17	1	0	107	83.2
1979	50	16	17	15	8	0	106	78.3
1980	54	14	14	13	18	0	113	72.6
1981	47	14	12	18	11	0	102	71.6
1982	45	10	12	20	15	0	102	65.7
1983	42	7	10	16	21	0	96	61.5
1984	41	5	15	21	17	0	99	61.6
1985	34	9	17	42	17	0	119	50.4
1986	15	8	17	42	25	1	108	37.0
1987	43	14	43	56	21	14	191	52.4
1988	47	15	57	48	19	8	194	61.3
1989	33	28	48	42	33	12	196	55.6
1990	43	50	38	26	27	11	195	67.2
1991	54	34	36	27	28	18	197	62.9
1992	18	35	29	27	21	0	130	63.1
1993	8	35	29	54	48	0	174	41.4
1994	16	30	35	81	48	0	210	38.6
1995	13	27	29	74	69	1	213	32.4
1996	7	18	21	54	97	4	201	22.9
1997	7	12	18	62	113	3	215	17.2
1998	5	24	40	70	85	2	226	30.5
1999	5	26	59	72	57	1	220	40.9
2000	9	30	50	49	65	5	208	42.8
2001	10	17	34	57	77	1	196	31.1
2002	11	16	31	52	77	7	194	29.9
2003	10	12	22	50	91	9	194	22.7
2004	3	5	19	62	91	22	202	13.4
2005	5	4	34	53	96	17	209	20.6
2006	3	8	22	48	81	38	200	16.5

We consider this possibility by examining the incidence of transaction prices, as opposed to average bid/ask prices reported in the CRSP. Table 6 shows the percent of end-of-year prices for US REITs that are actual transaction prices. The percent of prices represented by average bid/ask prices has significantly declined over our sample period. It was over 30% in the earliest years, and as high as 47.8% in 1980. Since 1986, it has been under 30%, declining to as low as 1.5% in 2006. Since we expect that the substitution of average bid/ask prices is associated with lower bias, the trend toward transaction prices should tend to be associated with more rather than less bias. Thus, this factor does not contribute to an explanation of the lower bias in the second half of our sample period.

Overall, there appears to be a significant difference in trading location, price levels, and transaction/non-transaction prices before and after the early 1990s. This break roughly coincides with the passage of the Omnibus Budget Reconciliation Act of 1993, which made it easier for pension and other institutional investors to invest in the stocks of REITs. This generally led to increased interest, investment, and trading in REIT stocks afterward.[10]

Finally, we test for the significance of these three factors jointly with a regression analysis. The dependent variable is the relative bias, calculated as the ratio of the biased to the unbiased REIT monthly return index. The unbiased index is based on the FWW methodology. The biased index is based on the standard method for calculating an equally-weighted market return index. We include all months from February 1972 through December 2006. The independent variables are the proportion of REITs in our sample that are traded on the NYSE/Amex; the proportion of REIT stock prices over $10.00/ share; and the proportion of stock prices that represent actual transaction prices as opposed to the average of bid/ask prices. The regression is estimated with ordinary least squares, and the results are summarized in Table 7.

The regression is highly significant, with an F ratio of 498.7 and a p-value less than 0.0001. The coefficient on the proportion of REITs traded on the NYSE/ Amex is -0.2832, significant at a high level of confidence. This confirms that the higher proportion of REITs traded on the NYSE or the Amex over our sample period is associated with less bias. The coefficient on the proportion of REIT stock prices higher than $10.00 per share is -0.0417, significant at the 0.0108 level of confidence. This also confirms that the generally higher REIT stock prices are also associated with reduced levels of bias. Finally, the proportion of REIT stock prices represented by actual transaction prices as opposed to average bid/ask spread, is not significant. Overall, the regression analysis indicates that the lower bias in the REIT index we observe over time

[10] See CEW, page 30, for more detailed information on the rule changes and the overall effects on the REIT industry.

from 1973 through 2006 is associated with both increasing representation of trading on the NYSE/Amex and higher stock prices in general.

Table 6 Distribution of End-of-Year Prices of REIT Stocks in the CRSP File by Their Transaction Status

This table shows the distribution of end-of-year prices of the REIT stocks in the CRSP file according to their transaction status. Actual transaction prices are coded with positive numbers in the CRSP file. In the absence of an actual transaction price, CRSP substitutes an estimate based on the average of the closing bid and ask prices. These are coded as negative numbers.

Year End	Actual Transaction Price	Average of Bid/Ask Price	Total	Average Bid/Ask Prices as Percent of the Total
1972	68	39	107	36.4
1973	83	38	121	31.4
1974	79	41	120	34.2
1975	70	45	115	39.1
1976	61	52	113	46.0
1977	58	51	109	46.8
1978	58	49	107	45.8
1979	57	49	106	46.2
1980	59	54	113	47.8
1981	56	46	102	45.1
1982	57	45	102	44.1
1983	55	41	96	42.7
1984	59	40	99	40.4
1985	85	34	119	28.6
1986	93	15	108	13.9
1987	152	39	191	20.4
1988	149	45	194	23.2
1989	166	30	196	15.3
1990	162	33	195	16.9
1991	162	35	197	17.8
1992	122	8	130	6.2
1993	168	6	174	3.4
1994	201	9	210	4.3
1995	204	9	213	4.2
1996	197	4	201	2.0

(*Continued*…)

(*Table 6 Continued*)

1997	208	7	215	3.3
1998	222	4	226	1.8
1999	216	4	220	1.8
2000	204	4	208	1.9
2001	193	3	196	1.5
2002	189	5	194	2.6
2003	188	6	194	3.1
2004	200	2	202	1.0
2005	205	4	209	1.9
2006	197	3	200	1.5

Table 7 Time-Series Regression Analysis of the Bias, 1973-2006

This table reports the results of a regression analysis of the relative bias, based on the ratio of the biased to the unbiased market return index. The unbiased index is based on the FWW methodology. The "biased" index is based on the standard method for calculating an equally-weighted market return index. The dependent variable is the ratio of the biased to the unbiased return index for all months from February 1972 through December 2006. The independent variables are the proportion of REIT stock prices over $10.00/share, the proportion of REITs in our sample that are traded on the NYSE/Amex, and the proportion of stock prices that represent actual transaction prices as opposed to average of bid/ask prices. The regression is estimated with ordinary least squares.

	Coefficient Estimate	**Standard Error**	**t Statistic**	**P-value**
Intercept	1.2727	0.0087	146.2075	0.0000
Proportion of REITs Traded on the NYSE/Amex	-0.2832	0.0300	-9.4554	0.0000
Proportion of REIT Prices > $10	-0.0417	0.0163	-2.5606	0.0108
Proportion of REIT Prices Represented by Actual Transaction Prices	-0.0359	0.0374	-0.9593	0.3380
Regression Summary Statistics				
R Squared	0.7878			
Adjusted R Squared	0.7862			
Standard Error	0.0324			
F ratio	498.7			
p-value of F ratio	< 0.0001			
Number of Observations	407			

5. An International Comparison

In this section, we extend our analysis to evaluate evidence of bias in equally-weighted indexes in markets outside of the US.

Using DataStream, we identify all securities that are denoted as REITs or their local equivalent. The global distribution of REITs is summarized in Table 8. As of July 2009, there were 1,010 REIT securities shown as active, and another 637 shown as inactive, or delisted, for a worldwide total of 1,647 REITs. The single most heavily represented country is the US, with 539 REITs. The second is Germany, with 434 REITs,[11] and the third is Australia, with 187. Together, these three countries account for 70 percent of the REITs in the table. Fully half of the REITs in this table are listed in 2004 or later. Excluding the US, 63% of the REITs are listed in 2004 or later.

These characterizations are generally consistent with data on the international universe of REITs presented by Serrano and Hoesli (2008) in an analysis of four major indexes of global real estate securities: the FTSE EPRA/NAREIT; two indexes from the Global Property Research (the GPR General and the GPR 250); and the S&P/Citigroup Global Property index. As of the end of 2007, the number of stocks in the FTSE EPRA/NAREIT index is 313,[12] and the number in the GPR General is 405. All four of the indexes impose minimum size requirements, and three impose additional requirements on free float and liquidity. As described by the FTSE, the free float requirement reflects the actual availability of stock in the market for public investment.[13] The liquidity screen is based on turnover, and so refers to actual trading volume. These requirements are intended to assure that each FTSE constituent stock is actually available for investment. It is apparent that the number of active REITS we find in Datastream includes many that do not meet these requirements of trading volume and free float. Also, as shown in Serrano and Hoesli, the inception date of the FTSE EPRA/NAREIT index is December 29, 1989, and the inception date of the S&P/Citigroup index is July 30, 1989 -- both relatively recent in terms of financial research.

[11] Four different German exchanges are shown in the table: Berlin, Deutsche Börse, Munich, and Stuttgart.

[12] The number of constituents in the FTSE EPRA/NAREIT index as of July 24, 2009 is 329, from the FTSE website, http://www.ftse.com/objects/csv_to_table.jsp?infoCode=encv&theseFilters=&csvAll=&theseColumns=MCwxLDIsNSwxMSwxNywyMg==&theseTitles=&tableTitle=FTSE%20EPRA/NAREIT%20Global%20Indices%20Values&dl=&p_encoded=1.

[13] From: http://www.ftse.com/Indices/FTSE_Index_Standards/Free_Float.jsp.

Table 8 International Distribution of Exchange-Traded REITs

This table reports the numbers of REITs listed on exchanges around the world, grouped by geographic region. The source of the data is DataStream. The listing date is the base date as reported in Datastream. Preference stock, preferred stock, and warrants are excluded. The equities of each exchange are partitioned into current (active) listings or dead (delisted) ones. Equities are further partitioned according to the year of initial listing.

		Status as of July, 2009		Year of Listing						
Region Exchange	**Total**	**Active**	**Delisted**	**2003 and Before**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009 (1st 6 Months)**
Africa										
Cairo	1	0	1	1	0	0	0	0	0	0
Johannesburg	11	8	3	8	0	2	0	0	0	1
Nigeria	1	1	0	0	0	0	0	0	1	0
Asia										
Bangkok	22	22	0	2	0	6	4	4	5	1
Hong Kong	8	7	1	0	0	3	3	2	0	0
KOSDAQ	1	1	0	1	0	0	0	0	0	0
Kazakhstan	1	1	0	0	0	0	0	0	0	1
Korea Stock Exchange	11	5	6	5	1	2	1	1	1	0
Kuala Lumpur	16	13	3	4	0	4	4	4	0	0
Kuala Lumpur 2nd Board	1	0	1	0	1	0	0	0	0	0
Singapore	38	23	15	7	4	4	11	6	5	1
Singapore OTC	1	0	1	1	0	0	0	0	0	0
Taiwan	7	7	0	0	0	0	6	1	0	0
Taiwan OTC	1	1	0	0	0	0	1	0	0	0
Tel Aviv	1	1	0	0	0	0	1	0	0	0
Tokyo Stock Exchange	41	40	1	10	5	12	12	2	0	0
Pacific										
Australia	187	67	120	92	23	29	16	20	6	1
New Zealand	27	7	20	19	3	2	1	2	0	0
North America										

(*Continued*…)

(***Table 8 Continued***)

TSX Venture	9	6	3	4	0	1	2	1	1	0
Toronto	58	27	31	44	4	2	5	2	1	0
US NYSE,Amex, Nasdaq	539	258	281	418	38	17	16	8	33	6
Europe										
Athens	2	2	0	0	0	1	1	0	0	0
Berlin*	212	148	64	70	58	32	36	12	4	0
Berne	1	1	0	1	0	0	0	0	0	0
Copenhagen Stock Exch.	1	1	0	0	0	0	0	1	0	0
Deutsche Bourse**	210	178	32	42	8	10	74	36	38	2
Euronext - Amsterdam	11	8	3	9	0	0	1	1	0	0
Euronext - Brussels	22	16	6	16	0	0	3	1	2	0
Euronext - Paris	65	49	16	36	4	4	14	2	4	1
Istanbul	18	18	0	11	1	1	0	5	0	0
Ljubljana	1	0	1	1	0	0	0	0	0	0
London	34	25	9	20	2	2	5	3	0	2
London OTC	5	5	0	0	3	2	0	0	0	0
Luxembourg	2	0	2	2	0	0	0	0	0	0
Munich	9	6	3	0	1	7	1	0	0	0
SIX Swiss Exchange***	10	2	8	10	0	0	0	0	0	0
Sofia	57	54	3	0	6	5	13	18	14	1
Stuttgart	3	1	2	1	0	0	2	0	0	0
Vienna Stock Exchange	1	0	1	0	0	0	0	0	1	0
Zagreb	1	1	0	0	0	0	0	0	1	0
Total Number of REITs	1,647	1,010	637	835	162	148	233	132	117	17

* The Berlin Stock Exchange only dual-lists companies that are listed outside of Germany.
** Listed in DataStream as two separate exchanges, Frankfurt and XETRA;
*** Listed in DataStream as two separate exchanges, SWX Europe and the Swiss Stock Exchange.

From Datastream, we obtain prices as of the first of the month, dividends, and ex-dividend dates for German and Australian REITS, which exclude preference stock, preferred stock, and warrants. We calculate monthly returns from these data, and then form the standard equally-weighted and FWW return indexes, and their cumulative forms.[14] As shown in Table 9, Panel A, the data for Germany begin on October 1, 1988. For both German and Australian REITs, we denote prices dated on the first of the month as prices for that month. The first column of data shows the number of REITs for which there are non-missing data. For December 1988, for example, there were just two REITs, and it was only in 1999 that the number rose to 12. Consistent with the data on the extent of recent interest in REITs, the great majority of REITs listed on the various German exchanges are relatively recent.

The base date of the cumulative indexes for German REITs is December 1988. The EW index is generally higher than the FWW index, as shown in the ratio being generally higher than 1.0. The ratio climbs over time, consistent with the expected cumulative bias in the EW index. As of the end of our sample period, the ratio was 1.1097, which represents a cumulative bias of 10.97%.

Although these data are formed from all REITS for which the returns are non-missing, a survey of the actual returns for the German and Australian REITs shows a relatively large number of zero returns. It is highly probable that many of these zero returns are due to the absence of any actual trades, or "non-trading." In the absence of trades, prices are unchanged, and the return is zero, by definition. However, the FWW method corrects for the bias in which errors in pricing are associated with the bid/ask spread and any other errors that may be present. When there are no trades, there are no pricing errors of this type because the recorded price is fixed. Thus, when there are significant numbers of zero returns due to non-trading, the EW and FWW indexes will be the same.

[14] We make one change in the empirical method in calculating the FWW indexes for Germany and Australia from our method in the US, and this deals with the way in which we treat missing returns. The problem is that to calculate the FWW return in a given month, we need returns in the current and preceding months. This differs from the equal weighted index, for which only the returns in the current month are required. In the US estimates, we construct the FWW index so that it has the same number of securities as the equal weighted index in each month. To do this, we use the equal weighted index as the basis for estimating (otherwise) missing returns in the FWW index. In the German and Australian indexes, our equal weighted index includes returns only for the same months as the FWW index.

Table 9 Biases in REITS of Germany and Australia

This table shows end-of-month biased and unbiased index levels for REITs and non-Reits in each country. REIT stocks are those identified as such (or the local equivalent) on the Datastream data base. Panel A lists the index levels for German REIT stocks while Panel B lists those for Australian REIT stocks. The left side of each panel contains stocks with non-missing returns, while the right side contains stocks with non-zero returns. For each partition, we list the number of included REITs, the biased index, unbiased FWW index, and ratio of the two. The first month of each series is assigned an index value of 100.

	All REITs for which the monthly returns data are non-missing				All REITs for which the monthly returns data are non-zero			
Month	**Number of REITs**	**Equal-weighted Index**	**FWW Index**	**Ratio, EW to FWW**	**Number of REITs**	**Equal-weighted Index**	**FWW Index**	**Ratio, EW to FWW**
Panel A: German REITs								
198812	2	100.00	100.00	1.0000	1	100.00	100.00	1.0000
198912	2	116.72	115.99	1.0063	2	119.68	119.20	1.0040
199012	2	94.92	92.74	1.0235	2	83.57	81.76	1.0221
199112	3	117.16	110.57	1.0597	3	114.84	110.55	1.0388
199212	3	112.33	104.98	1.0700	2	128.12	123.28	1.0393
199312	3	142.72	131.41	1.0860	2	178.16	168.98	1.0543
199412	3	163.41	150.27	1.0874	1	210.78	199.22	1.0580
199512	5	161.10	147.78	1.0901	4	198.25	187.08	1.0597
199612	5	138.61	125.56	1.1039	4	192.38	178.81	1.0759
199712	5	123.97	113.70	1.0903	4	157.92	149.23	1.0582
199812	9	120.83	108.86	1.1100	3	164.82	151.78	1.0859
199912	12	105.49	94.98	1.1106	7	141.90	131.38	1.0801
200012	17	141.39	147.10	0.9612	13	190.52	199.21	0.9564
200112	23	151.84	149.64	1.0147	13	188.78	184.59	1.0227
200212	32	157.71	151.57	1.0405	24	199.96	188.49	1.0608
200312	37	205.63	194.25	1.0586	25	290.54	266.98	1.0883
200412	43	261.45	239.73	1.0906	35	392.08	346.58	1.1313

(***Continued…***)

(***Table 9 Panel A Continued***)

	All REITs for which the monthly returns data are non-missing				All REITs for which the monthly returns data are non-zero			
Month	**Number of REITs**	**Equal-weighted Index**	**FWW Index**	**Ratio, EW to FWW**	**Number of REITs**	**Equal-weighted Index**	**FWW Index**	**Ratio, EW to FWW**
200512	51	343.06	309.88	1.1070	40	565.68	491.10	1.1519
200612	116	556.01	512.17	1.0856	99	1,005.51	890.11	1.1296
200712	140	622.58	603.18	1.0322	112	1,151.16	1,081.88	1.0640
200812	181	850.99	762.34	1.1163	131	1,721.64	1,449.01	1.1882
200907	184	1542.56	1390.01	1.1097	125	3991.09	3313.78	1.2044
Panel B: Australian REITs								
197312	1	100.00	100.00	1.0000	1	100.00	100.00	1.0000
197412	1	80.53	80.53	1.0000	1	70.06	70.06	1.0000
197512	2	116.76	116.35	1.0035	2	98.86	99.43	0.9943
197612	2	106.61	106.27	1.0031	2	79.29	80.23	0.9883
197712	2	110.07	110.34	0.9976	1	82.58	83.42	0.9899
197812	2	217.54	221.65	0.9814	2	147.04	150.40	0.9777
197912	2	319.80	323.92	0.9873	1	219.49	223.06	0.9840
198012	2	338.04	342.08	0.9882	2	225.20	228.86	0.9840
198112	2	585.30	594.87	0.9839	2	411.28	420.93	0.9771
198212	2	480.22	483.56	0.9931	1	359.95	368.67	0.9763
198312	3	721.81	720.38	1.0020	3	541.04	549.23	0.9851
198412	4	861.85	857.07	1.0056	2	714.31	721.24	0.9904
198512	4	1,217.02	1,227.49	0.9915	3	848.20	871.52	0.9732

(***Continued…***)

(***Table 9 Panel B Continued***)

198612	4	2,463.27	2,551.21	0.9655	4	1,699.40	1,793.43	0.9476
198712	5	1,894.33	1,922.57	0.9853	5	1,283.27	1,325.04	0.9685
198812	6	1,982.21	1,997.84	0.9922	5	1,335.14	1,367.01	0.9767
198912	6	1,824.87	1,840.09	0.9917	5	1,190.96	1,220.90	0.9755
199012	6	1,451.40	1,479.51	0.9810	4	935.42	970.86	0.9635
199112	7	1,563.38	1,544.11	1.0125	6	1,109.26	1,115.45	0.9945
199212	13	1,269.45	1,261.59	1.0062	8	964.37	981.79	0.9823
199312	13	1,659.84	1,669.26	0.9944	9	1,316.04	1,364.82	0.9643
199412	19	2,697.28	2,614.48	1.0317	12	2,477.39	2,456.71	1.0084
199512	19	3,096.31	3,001.95	1.0314	9	3,074.08	3,049.46	1.0081
199612	22	3,613.54	3,431.39	1.0531	16	3,778.71	3,625.82	1.0422
199712	28	5,202.55	4,818.31	1.0797	18	4,556.26	4,248.73	1.0724
199812	30	5,230.04	4,811.45	1.0870	23	4,760.56	4,414.39	1.0784
199912	36	6,260.55	5,607.72	1.1164	23	5,272.22	4,690.81	1.1239
200012	35	7,184.32	6,933.97	1.0361	23	6,405.40	6,306.77	1.0156
200112	38	7,813.78	7,561.32	1.0334	29	7,263.92	7,177.43	1.0121
200212	50	9,064.47	8,992.19	1.0080	21	8,099.01	8,326.68	0.9727
200312	66	10,182.52	10,042.80	1.0139	37	9,649.15	9,803.63	0.9842
200412	79	12,138.89	11,944.85	1.0162	42	12,680.30	12,822.03	0.9889
200512	104	13,325.96	13,087.70	1.0182	56	14,623.24	14,713.15	0.9939
200612	113	15,591.13	15,277.48	1.0205	61	19,155.86	19,160.41	0.9998
200712	112	16,263.78	15,917.63	1.0217	59	20,348.25	20,292.44	1.0028
200812	112	7,897.06	8,135.83	0.9707	62	5,543.68	5,649.58	0.9813
200907	109	7,930.02	7,938.75	0.9989	55	5,297.84	5,091.75	1.0405

To determine how the zero returns may affect the comparison, we repeat the calculations for all returns that are non-zero. Although this excludes some valid returns that are zero in the presence of active trading, the great majority are most likely due to non-trading. The results are shown in the right-hand columns of Table 9. After the zero returns are excluded, the number of REITs with meaningful returns in July 2009 declines from 184 to just 125 REITs, a reduction of 32%. The cumulative bias in this case is 20.44%, nearly twice that of the other case.[15]

We repeat these analyses for Australian REITs, as summarized in Table 9, Panel B. Their data begin in 1973, but like the German REITs, the population has only become substantial in recent years. In the analysis based on all of the non-missing returns, the cumulative EW and FWW indexes track each other fairly closely, in contrast to the US and Germany. When we exclude the zero returns, we find that as many as half of the returns are excluded. The cumulative indexes in this case are fairly close to each other, which indicate lack of bias in the standard EW index in the case of Australia.

Earlier, we argued that different microstructures result in different spread widths and hence different levels of bias. The Australia Stock Exchange, where all of the Australian stocks in our sample are listed, conducts a daily closing call auction to determine closing prices. Call auctions eliminate spreads (by trading inside of it) so that we would expect bias to be largely removed. Our results for Australia are consistent with this expectation

Our analysis suggests that the bias in the standard equally-weighted indexes can be economically significant in a market other than the US. However, the microstructure of a particular market impacts the extent of the bias. This underscores the fact that researchers must be critically aware of the microstructure of the particular markets that they are studying when making comparisons of long-term stock returns internationally.

6. Summary and Conclusions

In this paper, we have applied the FWW method for removing upward bias in equally-weighted return indexes to the special case of REIT stocks. We first find that there is significant bias in REIT stocks, as in non-REIT stocks, in the US. The relative bias is larger for REITs in the 1970s and 1980s, but lower

[15] Excluding returns of zero may have a negative or positive effect on the equally-weighted return in a particular month. If the non-zero returns are on balance positive, then excluding the zero returns will result in an average index return that is higher.If the non-zero returns are on balance negative, then excluding the zero returns will result in an index return that is lower.

after that. We find that this trend reflects more listings of REIT stocks on the NYSE, as well as higher prices for the REIT stocks in general.

Reliable empirical estimates of the bias are essential in developing accurate assessments of asset returns over long periods of time. Errors that may appear to be quite small on a monthly basis significantly cumulate over long periods. Relative rankings of asset performance may be significantly affected by such errors. Indeed, we find that the comparative ranking of REIT versus non-REIT stock performance is different when the bias is eliminated. Such considerations cast considerable importance on defining and measuring these biases as accurately as possible.

We extend our analysis internationally to REITs listed in Germany and Australia. We find that significant bias exists in indexes constructed of non-US REIT stocks in Germany, but not in Australia. We conclude that the amount of bias depends on the particular microstructure of trading and exchange markets in the country. This serves to emphasize the importance of understanding the structure of market trading in analyses not only of bias of equally-weighted indexes, but more broadly of any comparison of returns or prices that may be affected by the way prices are determined in a particular market.

We identify several specific factors that help explain the existence of the bias for REITs, but leave certain further questions for future research. First, one could test the significance of additional microstructure factors that should contribute to the bias, especially stock volatility and turnover. Second, one could test whether firm continuity is related to the general downward trend in bias for the REITs. This would involve determining whether the REIT firms in more recent years are the same or different as those in the earlier years. This is significant because it may reveal information about the source of the decline: to what extent is it related to growth and development of REITs, to new firms, or to more general market-related changes?

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