



A Comparison of NCREIF, INREV, and ANREV Open-End Core Fund Indices

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ABSTRACT

Cross-border investment in non-listed real estate is on the rise. This article aims to compare the U.S. NFI-ODCE index with the European INREV ODCE index and the recently released Asian ANREV ODCE index with the hope that this study will be helpful to cross-border investors in these major markets. From 2016 through 2020 (five years), we found that the NCREIF fund count remained relatively flat, but the INREV and ANREV fund count increase steadily. At the end of 2020, NCREIF's GAV was 270 billion dollars compared with INREVs 39 billion dollars and ANREV's 16 billion dollars, a considerable size difference between the U.S. and the other two. However, much smaller ANREV Gross Asset Value grew much faster. When we calculated the 12-month rolling returns for the respective regions, we found that ANREV realized a 12-month rolling total return of 7.59% compared with INREV at 5.52% and NCREIF at 5.28%. When looking at a longer time period of 4 1/2 years, we calculated a lower SHARP Ratio of 1.36 for ANREV compared to INREV at 2.28 and NCREIF at 2.32, demonstrating that INREV and NCREIF have similar and more favorable reward to risk ratios than ANREV. Further analysis found that the INREV and NCREIF ODCE indices are highly correlated, but we found that they were not cointegrated; therefore, we could not use one index to predict the values in the other. We encourage caution when generalizing these results since they are based on relatively short periods. It will be interesting to make these comparisons again when we have a long history of performance for the INREV and ANREV indices.

KEYWORDS

NCREIF; ODCE; indices; ANREV; INREV; benchmarks

Introduction

In the 1970s, it became apparent that an index was needed to compare the performance of real estate with other asset classes to start attracting institutional capital into the private real estate asset class. Without an index, there was no way to properly compare real estate's historical risk and return with other investment alternatives. Investors also wanted to be able to benchmark the performance of investment managers against an index. This desire led to creating the National Council of Real Estate Investment Fiduciaries (NCREIF) in 1982 to mitigate this challenge in the United States by collecting and aggregating data from member firms and creating the first indices to measure commercial real estate performance. In 2002 The European Association for Investors in Non-Listed Real Estate Vehicles (INREV) was established. The Asian Association for Investors in Non-

Listed Real Estate Vehicles (ANREV) was established in 2009 to provide the same products to the Asian non-listed real estate industry.

These three organizations provide valuable knowledge about private, unlisted real estate to institutional investors and tend to focus on producing performance indices with the data. In NCREIF's case, there is a suite of indices covering both asset-level and fund-level data, including the Open-End Diversified Core Equity index, called NFI-ODCE for short. INREV and ANREV recently released equivalent ODCE indices.

This article aims to better understand the open-end offerings in the U.S., Europe, and Asia by comparing the three ODCE indices. Cross-border investment in open-end funds¹ is on the increase, and the authors hope that this study will be helpful to cross-border investors and those with interest in these three major markets.

This article proceeds as follows. [Section 2](#) provides a brief institutional overview of the three organizations and the inclusion requirements of the ODCE indices, while [Section 3](#) summarizes the data. [Section 4](#) compares the three index values and returns, and [Section 5](#) provides further analysis by examining risk differences, serial correlation, and cointegration. Finally, [section 6](#) concludes the study.

Institutional Overview and Inclusion Requirements

The National Council of Real Estate Investment Fiduciaries (NCREIF) compiles quarterly property performance data on institutional-grade properties located in the United States. Member firms, comprised of investment managers and plan sponsors, contribute property performance data to NCREIF, which aggregates the data and then constructs and publishes the performance indices. According to their mission statement, "NCREIF is a member-driven, not-for-profit association that improves private real estate investment industry knowledge by providing transparent and consistent data, performance measurement, analytics, standards, and education."

Established in 1982, NCREIF released the first real estate index titled the NCREIF Property Index (NPI). The NPI has become widely recognized as one of the premier U.S. non-listed property-level performance indicators. Although initially conceived as a performance measure for the asset class, over time, it became a benchmark against which to compare the manager's performance and a basis for incentive fees if the manager beat the NPI. Although the NPI was used as a benchmark, it became apparent that the NPI was not an ideal benchmark for several reasons. It was not an "investable" index and not measuring the performance of the actual funds that invest in the NPI properties. Fund returns can differ from property returns for several reasons, including fund-level leverage, fund management fees, fund cash balances, joint ventures, and non-property investments held by the fund.

To address these issues, in 2005, NCREIF created its first fund level, strategy-based benchmark index titled NCREIF Fund Index – Open-end Diversified Core Equity (NFI-ODCE). The NFI-ODCE index started with 14 active funds but proliferated as managers created additional open-end core diversified funds. The NFI-ODCE index, unlike the NPI,² is an ownership level index and is therefore value-weighted,³ includes modest leverage,⁴ and is reported gross of fees; however, net of fees is also available.⁵

The European Association for Investors in Non-Listed Real Estate Vehicles (INREV) was founded in 2003 and is NCREIF's counterpart in Europe and is considered the leading provider of performance data for the European non-listed real estate industry. The majority of INREV indices measure the performance of European non-listed real estate funds. Some indices represent the performance of global strategies, while some represent the performance of funds.

In Europe, open-end funds diversified by sector are often single country funds (the U.K. has UK-only funds, Germany has Germany-only funds, and so on).⁶ These funds are often older and bigger than pan-European open-end funds, which are relatively new compared to the U.S. open-end

funds. In the real estate sector, Europe still works as a collection of individual national markets, which means separate tax regimes and separate legal rules to be applied in each country. This complexity, combined with investors' home bias, has historically hampered the creation of large pan-European open-end funds; however, recently, that has been changing.

ANREV is the Asian Association for Investors in non-listed real estate vehicles. ANREV is a not-for-profit organization driven by institutional investors in non-listed property funds. ANREV's agenda is driven by the members, particularly the investors, and focuses on improving transparency and accessibility of market information, promoting professionalism and best practices, sharing and spreading knowledge. In addition, fund managers, investment banks, lawyers, and other advisors provide support in addressing key issues facing the Asian non-listed private equity real estate fund markets. According to their mission statement, ANREV was established to serve as a platform for institutional investors and address key issues facing the Asian non-listed real estate funds industry.

Table 1 summarizes the inclusion criteria for the NCREIF, INREV, and ANREV ODCE indices.⁷

For the most part, the inclusion criteria for NCREIF, INREV, and ANREV ODCE indices are the same; however, there are a few minor differences worth mentioning. INREV and ANREV specifically require that the funds have 50% institutional holding, have at least three (two for INREV) investors, and at least 90% (100% for ANREV) of the market value of real estate net assets invested in European/Asian markets. NCREIF requires that 95% of the market value of the real estate must be invested in U.S. markets. One significant difference between the construction of the NCREIF, INREV, and ANREV indices is the alternative valuation methods used across Europe and Asia, i.e., there is no single valuation standard.⁸

Data

Figure 1 provides a comparison of the fund count between the NCREIF, INREV, and ANREV, ODCE indices and shows that both INREV and ANREV fund count increased steadily from Q2 2016 through Q4 2020 (18 quarters), especially in the European market; however, the NCREIF count remained relatively flat. The chart illustrates quite dramatically the size difference, based on fund count, between the U.S., European, and Asian markets. In the fourth quarter of 2020, the number of U.S. funds in the NFI-ODCE index was 26 compared with the INREV ODCE index at 14 and the ANREV ODCE index at 7.

Figure 2 compares the Gross Asset Values (GAV) for the NCREIF, INREV, and ANREV ODCE indices. Again, the chart illustrates the relative size difference, and they are stark. For example, as of Q4 2020, NCREIF's GAV was 270 billion dollars compared with INREVs 39 billion dollars⁹ and ANREV's 16 billion dollars, a considerable size difference between the U.S. index and the other two. In addition, although INREVs and ANREVs total GAV is minuscule compared with NCREIFs, INREVs and ANREVs GAV have grown 316% and 314% respectively over the last 18 quarters compared with NCREIF's GAV, which has increased by 28%.

Although not shown, the difference between the GAV and NAV ranges from 20 to 27% for the NCREIF and INREV ODCE indices. In contrast, the difference for ANREV ODCE ranges from 30 to 37%, considerably higher and more volatile than the other two. **Figure 3** compares the average leverage as a percent of GAV for NCREIF, INREV, and ANREV, respectively. What is immediately noticeable is that from 2017 through 2020, the average for NCREIF and INREV are very similar, and the range stays within a narrow band from 20 to 23%; however, for ANREV, the range is much higher from 26 to 31%. This indicates that the spread between GAV and NAV is primarily due to leverage (gearing).

Table 2 provides the composition by the country for INREV and ANREV as of 4Q 2020. The tables show that Germany and France dominate the INREV allocation at 24.3% and 19.2%, respectively. The next nearest country is the Netherlands at 11.0%. In the ANREV ODCE, Australia and Japan

Table 1. ODCE index inclusion criteria.

NCREIF	INREV	ANREV
NCREIF requires that funds market themselves as open-end commingled funds, pursue a diversified core investment strategy, and primarily invest in private equity real estate.	INREV requires that funds have at least 50% in institutional holdings, be open end commingled funds with a core investment strategy with at least 2 investors.	ANREV requires that funds target at least 50% institutional holdings, be open-end funds with a core investment strategy with at least 3 investors.
The funds must also meet the following nine guidelines:		
1) At least 80% of the market value of net assets must be invested in real estate with no more than 20% invested in cash or equivalents.	Same for INREV	Same for ANREV
2) At least 80% of the market value of real estate net assets must be invested in private equity real estate properties [no more than 20% of such assets may be invested in, but not limited to, property debt, public company, equity/debt or private company (operating business) equity/debt].	Same for INREV	Same for ANREV
3) At least 95% of the market value of real estate net assets must be invested in US markets.	At least 90% of the market value of real estate net assets must be invested in European markets.	Target 100% of market value of real estate net assets in Asia Pacific.
4) At least 80% of the market value of real estate net assets must be invested in office, industrial, apartment and retail property types.	Same for INREV	Same for ANREV
5) At least 80% of market value of real estate net assets must be invested in operating properties [no more than 20% of such assets may be invested in, but not limited to, (pre)development/redevelopment or initial leasing/lease-up cycles].	Same for INREV	Same for ANREV
6) No more than 65% (\pm for market forces) of the market value of real estate net assets may be invested in one property type or one region as defined by the NPI.	No more than 65% of GAV in a single sector or a single country.	No more than 65% of market value of real estate net assets in one country and no more than 70% of market value of real estate net assets in one property type.
7) No more than 40% leverage. Leverage is defined as the ratio of total debt, grossed-up for ownership share of off-balance sheet debt, to the fund's total assets, also which are grossed-up for such off-balance sheet debt.	Same for INREV	Same for ANREV
8) The fund must comply with the NCREIF PREA Reporting Standards, including annual audits, quarterly valuations, and time-weighted returns.	Funds are audited annually. Funds are valued using the RICS, IVS or another mark-to-market valuation standard. Funds are valued externally at least quarterly	The funds must be audited annually, its properties should be revalued at least quarterly internally or externally, and at least once a year externally.
9) The fund must submit information in accordance with NCREIF.	The fund must submit information in accordance with INREV.	

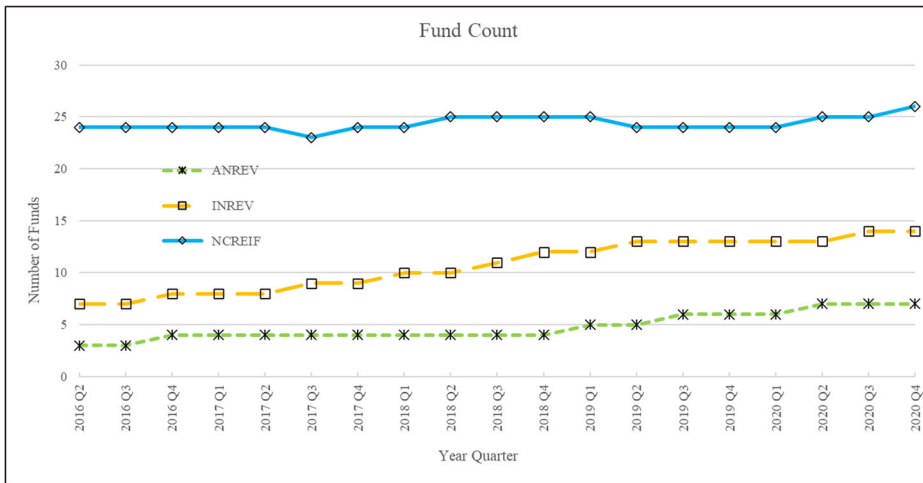


Figure 1. Comparison of active fund count.

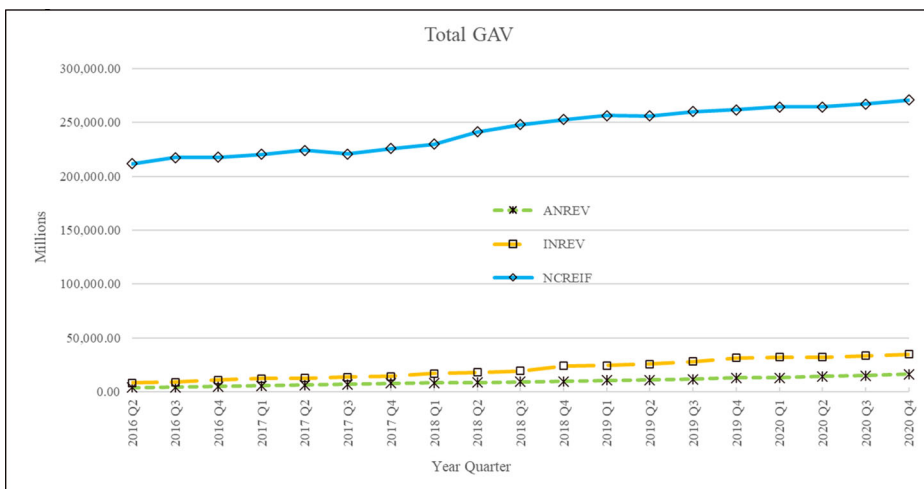


Figure 2. Comparison of GAV.

dominate the allocation at 31.21% and 29.39%, respectively. The next nearest country is Singapore, at 16.57%. Also shown in this exhibit is the sector allocation as a percent of GAV by index.

Office properties comprise the largest allocation for all three organizations at 30.80% for NCREIF, 43.3% for INREV, and 41.66% for ANREV. There is a greater disparity in the allocation to residential properties, with NCREIF at 26.1%, INREV at 6.5%, and ANREV at 11.7%. As for industrial/logistic property allocations, the range is 22% for both NCREIF and INREV and 28.91% for ANREV.

Comparison of Index Values and Returns

This section compares the intertemporal characteristics of ODCE index values and returns for NCREIF, INREV, and ANREV. We begin by discussing the total index values and returns. Figure 4A charts the normalized quarterly total index values (net of fees) from Q1 2016 through Q4 2020. Over the five years (20 quarters), the NCREIF and INREV total indices experienced a similar increase

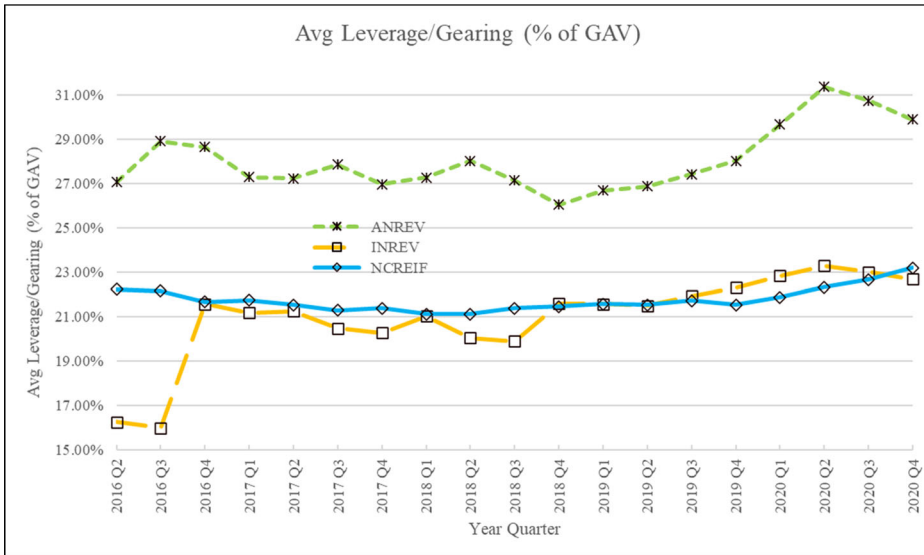


Figure 3. Comparison of average leverage (% of GAV).

of 26.82% and 27.46%, respectively, while the ANREV total index increased 52.46%, a significant outperformance of the NCREIF and INREV indices.

Figure 4B charts the quarterly total returns over the same period. The high volatility experienced with the ANREV returns stands in stark contrast to the relatively stable NCREIF, and INREV returns. Asia was the first geographic region to experience the COVID-19 pandemic, which shows the steep decline in returns during the first quarter of 2020. Europe and North America followed in the second quarter of 2020. All three regions over the subsequent quarters. Table 3 provides the descriptive statistics of returns for all three markets. As shown in the table, the mean and standard deviation of NCREIF and INREV quarterly total returns were very similar at 1.26% (1.29%) and 0.87% (0.91%), respectively. ANREV’s mean and standard deviation varied considerably at 2.29% and 3.17%, respectively.¹⁰

Figure 5A charts the appreciation index values and shows that ANREV ODCE indices experienced a much higher appreciation of 28% from 2016 through 2020. Much of this appreciation occurred during the last three quarters of 2020. NCREIF and INREV appreciation indices increased 8.86% and 11.79%, respectively, over the same five-year period. The charts show that NCREIF and INREV indices tracked quite closely during the first 3½ years, and then INREV widened the gap with a slight advantage over NCREIF during the last 1½ years. The chart shows that ANREV experienced a decline in appreciation during the first quarter of 2020 because of the pandemic, followed by three-quarters of strong appreciation. NCREIF and INREV appreciation dropped in the second quarter of 2020 and did not recover over the subsequent two quarters.

Figure 5B illustrates the quarterly appreciation returns. Similar to the total returns, NCREIF and INREV appreciation returns tracked quite closely together during the five years. These indices were also quite stable until the second quarter of 2020 when the effects of the pandemic showed up in the data. The ANREV appreciation returns dropped sharply during the 1st quarter of 2020, followed by a sharp increase during the next three quarters. NCREIF and INREV appreciation returns experienced a material drop during the 2nd quarter of 2020 and then showed a strong recovery over the next two quarters. Table 3, which provides the descriptive statistics of returns for all three markets, shows the mean and standard deviation of NCREIF and INREV quarterly appreciation returns were very similar at 0.45% (0.59%) and 0.83% (0.95%), respectively. ANREV’s mean and standard

Table 2. Composition and allocation by county and index.

INREV	
Composition by country (% of GAV – 4Q 2020)	Percent
Germany	24.32%
France	19.25%
Netherlands	11.05%
United Kingdom	8.52%
Spain	5.88%
Italy	5.75%
Sweden	4.13%
Poland	3.81%
Luxembourg	2.11%
Finland	2.08%
Ireland	1.68%
Denmark	1.67%
Portugal	1.42%
Belgium	1.15%
Czech Republic	1.02%
Austria	0.45%
Norway	0.38%
Switzerland	0.00%
Not reported	0.97%
Cash	4.37%
Total	100.00%

ANREV	
Composition by Country (% of GAV – 4Q 2020)	Percent
Australia	30.21%
China	7.43%
Hong Kong	1.08%
Japan	29.39%
Korea	2.72%
New Zealand	7.99%
Singapore	16.57%
Cash	4.59%
Not reported	0.04%
Sector Total	100.00%

Sector allocation (% of GAV – 4Q 2020)	NCREIF Percent	INREV Percent	ANREV Percent
Office	30.80%	43.4%	41.66%
Retail	13.60%	18.1%	12.11%
Industrial/Logistics	22.00%	22.1%	28.91%
Residential	26.10%	6.5%	11.77%
Other	4.80%	4.5%	0.93%
Not reported	0.00%	1.0%	0.04%
Cash	2.70%	4.4%	4.59%
Total	100.00%	100.00%	100.00%

deviation varied considerably at 1.35% and 3.13%, respectively, capturing the higher return accompanied by much higher volatility.

Figure 6A illustrates a monotonic increase in quarterly income index values for all three indices. During 2016 the index values were virtually identical; however, in the later periods, INREV income values soften slightly compared to NCREIF, whereas ANREV increased somewhat compared with NCREIF. Overall, the NCREIF income index rose 16.61% over the five-year period, whereas INREV and ANREV increased 14.09% and 19.40%, respectively.

Figure 6B illustrates the quarterly income returns for NCREIF, INREV, and ANREV. The chart shows that the NCREIF income index declined steadily over the five years but exhibited very low volatility. ANREV experienced this same trend but with much higher volatility. INREV experienced a slightly increasing trend but high volatility similar to ANREV. As shown in the table of Table 3, NCREIF,

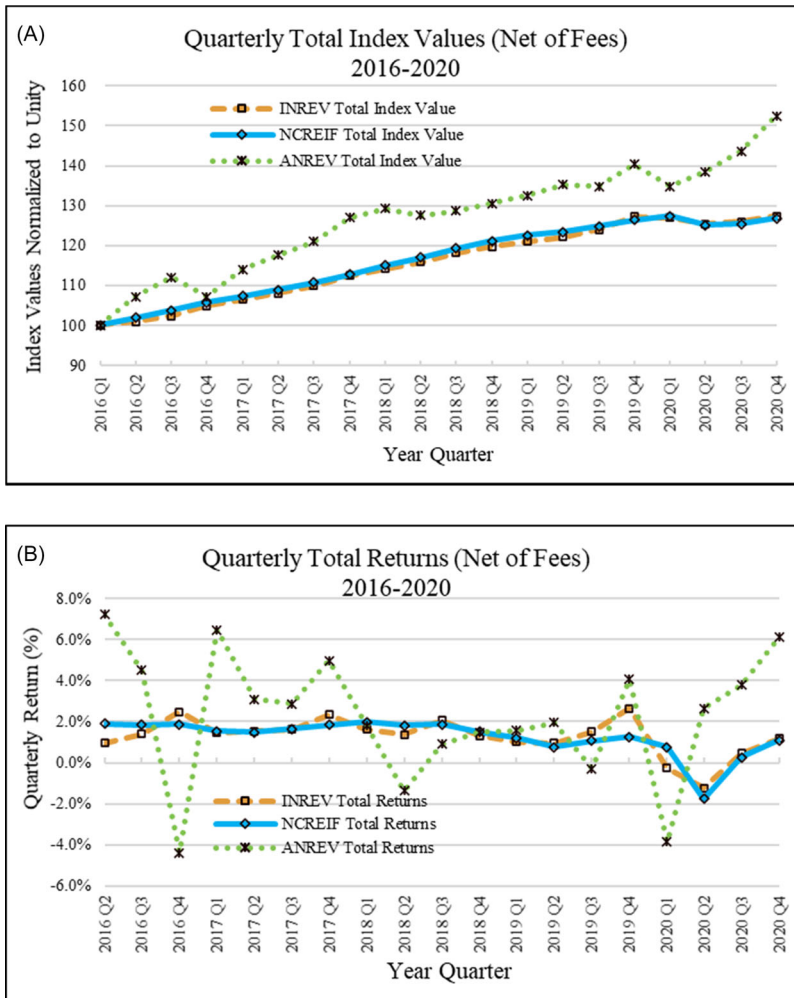


Figure 4. (A) Comparison of quarterly total index values (net of fees). (B) Comparison of quarterly total returns (net of fees).

INREV, and ANREV experienced mean and standard deviation income returns of 0.81% (s.d. 0.05%), 0.70% (s.d. 0.15%), and 0.94% (0.17%) respectively.

Table 3 summarizes the descriptive statistics of the returns for NCREIF, INREV, and ANREV. A side-by-side comparison shows that in all cases, the standard deviation of the ANREV returns exceeded those of NCREIF and INREV. This finding suggests that the Asian ODEC indices are more volatile compared with the Europe and North American ODEC indices. The range of quarterly returns is also much greater. As expected, the quarterly returns are higher for the ANREV indices to account for the greater volatility.

Also, the table provides the 12-month rolling returns for the respective regions. The data shows that over the five years, ANREV properties appreciated annually at a greater rate on average (3.72%) compared with INREV (2.70%) and NCREIF (1.94%). In addition, ANREV’s average annual income returns (3.76%) also outperformed INREV (2.77%) and NCREIF (3.30%). Overall, ANREV generated an average 12-month total return of 7.59% compared with INREV at 5.52% and NCREIF at 5.28%.

Table 3. Descriptive statistics of returns.

	Quarterly Returns				12 Month Rolling Returns			
	Min.	Max.	Avg.	Std. Dev.	Min.	Max.	Avg.	Std. Dev.
NCREIF (1Q 2016 to 4Q 2020)								
Total Returns	-1.75%	1.97%	1.26%	0.87%	0.34%	7.71%	5.28%	2.54%
Appreciation Returns	-2.46%	1.16%	0.45%	0.83%	-2.58%	4.28%	1.94%	2.36%
Income Returns	0.71%	0.89%	0.81%	0.05%	2.99%	3.50%	3.30%	0.14%
Note: U.S. currency net of fees								
INREV (1Q 2016 to 4Q 2020)								
Total Returns	-1.22%	2.66%	1.29%	0.91%	0.14%	7.60%	5.52%	2.22%
Appreciation Returns	-2.22%	1.91%	0.59%	0.95%	-2.79%	4.87%	2.70%	2.29%
Income Returns	0.46%	1.01%	0.70%	0.15%	2.57%	2.99%	2.77%	0.15%
Note: Local currency net of fees								
ANREV (1Q 2016 to 4Q 2020)								
Total Returns	-4.39%	7.22%	2.29%	3.17%	1.72%	18.52%	7.59%	4.64%
Appreciation Returns	-5.38%	6.24%	1.35%	3.13%	-1.60%	14.14%	3.72%	4.36%
Income Returns	0.66%	1.39%	0.94%	0.17%	3.12%	4.56%	3.76%	0.42%

Note. Local currency net of fees

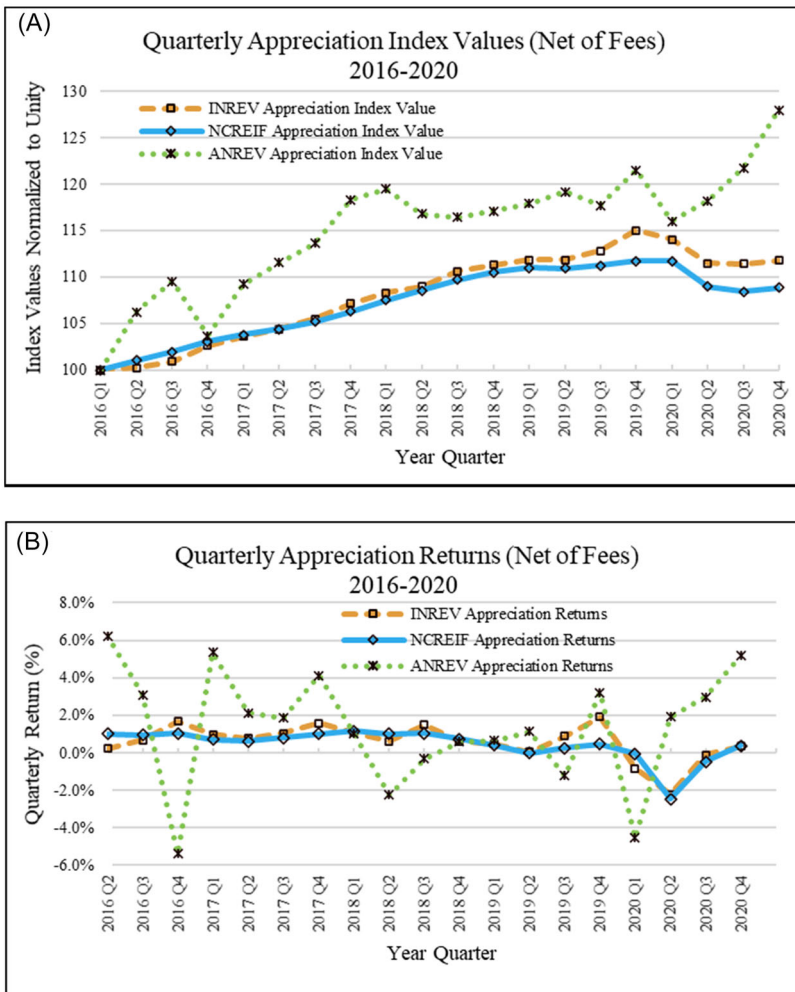


Figure 5. (A) Comparison of quarterly appreciation index values (net of fees). (B) Comparison of quarterly appreciation returns (net of fees).

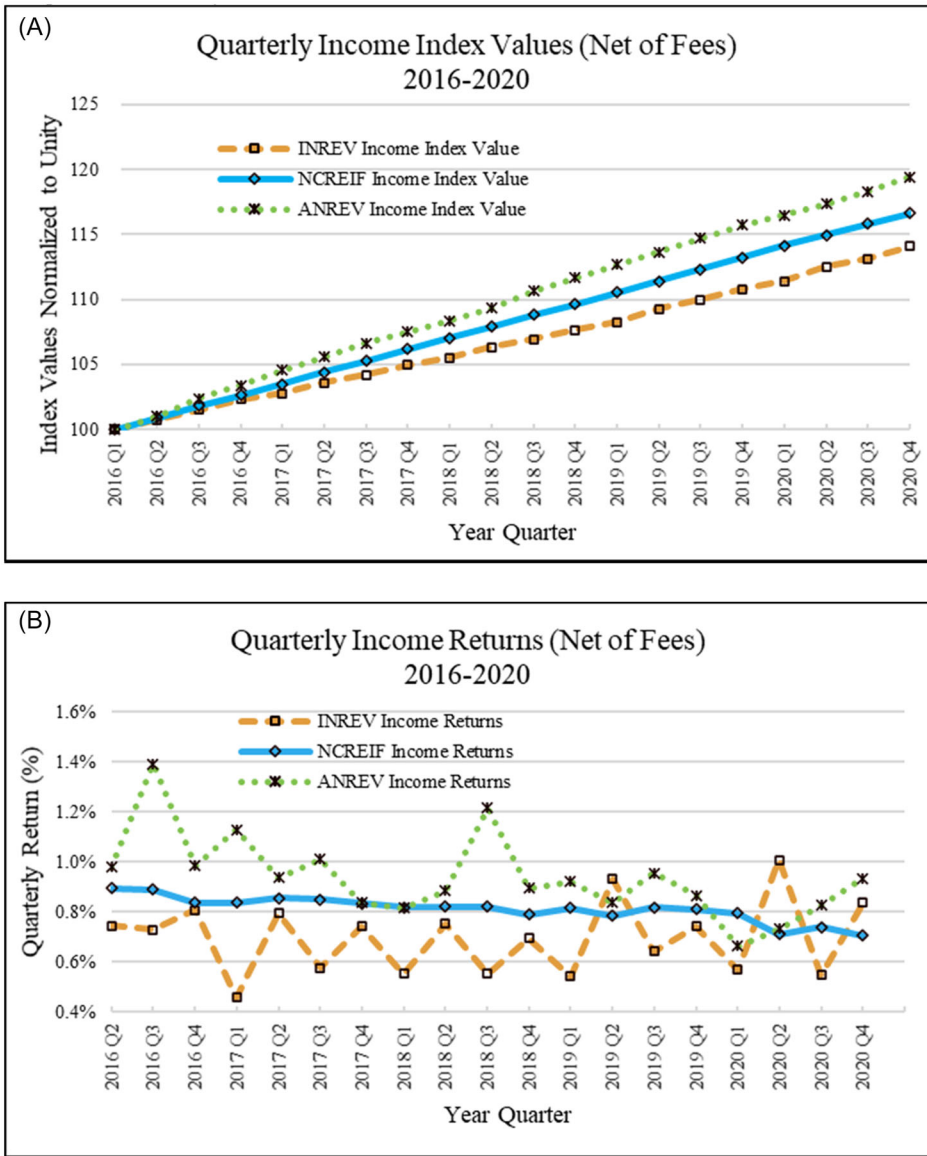


Figure 6. (A) Comparison of quarterly income index values (net of fees). (B) Comparison of quarterly income returns (net of fees).

Further Analysis of the ODCE Indices

Table 4 shows the calculation inputs for the Sharpe Ratio for NCREIF, INREV, and ANREV total returns. This allows us to examine additional risk differences in the returns. A cursory look at the table shows that the NCREIF and INREV numbers are very similar; however, the ANREV numbers are strikingly different. The Sharpe ratio is the average excess return over the risk-free rate (US 3 month T-Bill). The denominator is the standard deviation of the excess return. Notice that compared with NCREIF and INREV, the average excess return for ANREV is 8% or twice the size. Also, notice that the standard deviation of the excess return for ANREV is more than three times that of NCREIF and INREV. This finding confirms that the ANREV higher average excess returns are accompanied with much higher volatility.¹¹

Table 4. Risk measures.

	NCREIF	INREV	ANREV
Sharpe numerator	3.88%	3.99%	8.00%
Sharpe denominator	1.67%	1.75%	6.34%
Sharpe ratio	2.32	2.28	1.26

Notes. Data range: 2 Q 2016 – 4 Q 2020. Risk free rate: US 3 month T-rate.

Because private real estate returns depend on appraised values, there tends to be a correlation between the return in each quarter and the return from prior quarters. [Figure 7](#) shows that NCREIF has more serial correlation – especially between the return for the current quarter and the return lagged one quarter. This relation shows up with INREV as well but is less pronounced. The serial correlation for ANREV lagged one quarter is negative, which is unexpected.

A visual examination of the total, appreciation, and income index values shown in [Figures 4A, 5A, and 6A](#) suggests possible intertemporal similarities or trends among the indices. Cointegration (or co-movement) occurs when two or more time series have a common stochastic trend (Granger & Weiss, 1983). Put another way, cointegration occurs when the indices tend to move together long-run, even when experiencing short-run deviations. If two indices are cointegrated, an Error Correction Model can be used to predict the movement of one index based on the movement of the other. So knowledge about cointegration between two economic or financial indices could be important to investors and policymakers.

There are generally two approaches for determining if there is cointegration between two-time series. The first approach involves plotting the difference or spread between two variables and examining the trend. If the spread or difference hovers around zero, then the two variables would appear to be cointegrated. The second approach involves formal statistical tests for cointegration. The first step to this approach requires that we determine the order of integration of each variable by performing unit root tests. A necessary condition for cointegration is that the series are nonstationary in levels but stationary in first differences. The Augmented Dickey-Fuller (ADF) test (Dickey & Fuller, 1979) and the Phillips-Perron (P.P.) test (Phillips & Perron, 1988) are generally considered the most common methods for performing the unit root tests. The null hypothesis in both tests is a unit root.

We first start with the visual comparisons of the differences between the two series. [Figure 8A](#) shows the difference between the series for the total index values. Notice that the absolute difference between the NCREIF and ANREV values and the INREV and ANREV values vary considerably over time; however, the absolute difference between the NCREIF and INREV values are very low in comparison.

The total index values are comprised of the appreciation and income index values. [Figure 8B,C](#) show the differences between the three regions' appreciation and income index values, respectively. [Figure 8B](#) shows that appreciation index values varied considerably between NCREIF and ANREV and between INREV and ANREV. Both of these findings are similar to the differences in the total index values. The differences between the NCREIF and INREV appreciation index values, however, tell a different story. In the first four years of the series, the differences were minor; however, beginning in the fourth quarter of 2019, the differences increased to about 2% and maintained the spread over the next four quarters of 2020. [Figure 5A](#) provides a different perspective of this spread. In particular, the charts show that in the fourth quarter of 2019, INREV appreciation jumped about 2% compared with NCREIF. Although both indices declined over the next four quarters and the pandemic took hold, the spread between the two indices never closed.

[Figure 8C](#) provides the differences between the income index values among the three regions. It shows that the differences between the three regions are material, suggesting that the indices are not cointegrated. The data indicates that beginning in 2019, the difference between the NCREIF and the INREV income indices average about 2%. This finding is supported by [Figure 6A](#) that shows that NCREIF income index values are greater than the INREV income index values of about 2%. So now the picture becomes clear as to why the total index values between NCREIF and INREV are so close, even

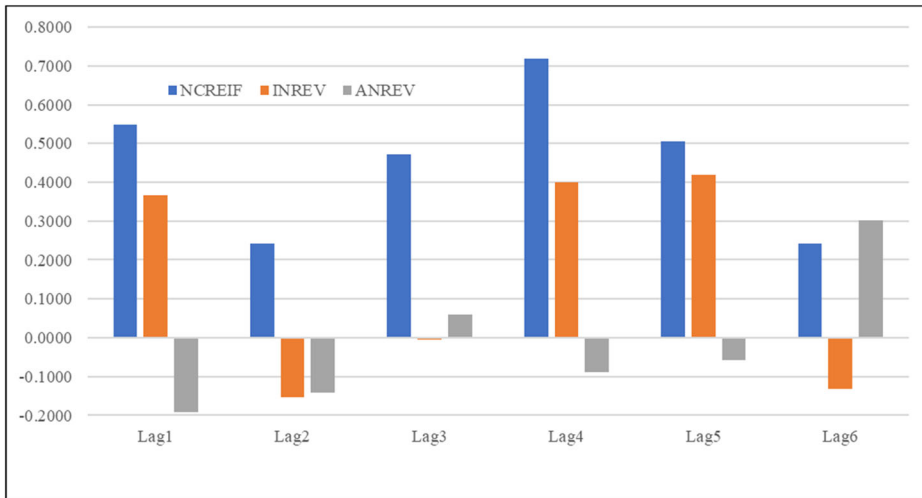


Figure 7. Serial correlation.

though the appreciation index values and the income index values are diverging. The declining income index values are offsetting the increasing appreciation of the INREV index values.

Because of the above findings, it's clear that the appreciation and income index values are not cointegrated. Also, it's clear from the visual analysis that the total income index values between NCREIF and ANREV and INREV and ANREV are not cointegrated. What is not clear is if the total index values between NCREIF and INREV are cointegrated. Therefore, we perform formal statistical tests for cointegration by first testing for a unit root in each series to answer this question. As shown in Table 5, the tests find that the null hypothesis of a unit root cannot be rejected (5% significance level), suggesting that the series in levels is nonstationary, a necessary condition for cointegration. Table 6 shows the results of the unit root tests for the time series in first differences. The panel shows that when using the ADF test, we fail to reject the null hypothesis of a unit root in both series; however, the P.P. test shows that we reject the null hypothesis for the INREV indices. Because we cannot conclude that the time series in first differences is nonstationary, a necessary condition, we conclude that the series are not cointegrated; therefore, we cannot use one index to predict the values in the other.

Please note that the results of these findings may be influenced by the relatively small number of observations, which in this case is 20 quarters. Perhaps in the future, as the time series increases, additional analysis of the data will shed more light on the indices' correlation.

Summary and Conclusion

Cross-border investment in non-listed real estate is on the rise. This article aims to compare the U.S. NFI-ODCE index with the European INREV ODCE index and the recently released Asian ANREV ODCE index with the hope that this study will be helpful to cross-border investors in these major markets. At the end of 2020, the number of U.S. funds in the NFI-ODCE index was 26 compared with the INREV ODCE index at 14 and the ANREV ODCE index at 7. From 2016 through 2020 (five years), we found that the NCREIF fund count remained relatively flat, but the INREV and ANREV fund count increase steadily. At the end of 2020, NCREIF's GAV was 270 billion dollars compared with INREVs 39 billion dollars and ANREV's 16 billion dollars, a considerable size difference between the U.S. index and the other two. Although much smaller than NCREIF, INREV and ANREV Gross Asset Value grew much faster than NCREIF.

The office sector accounted for the largest allocation in all three regions. Residential was the second largest sector in the U.S., followed by industrial/logistic properties. The industrial/logistics

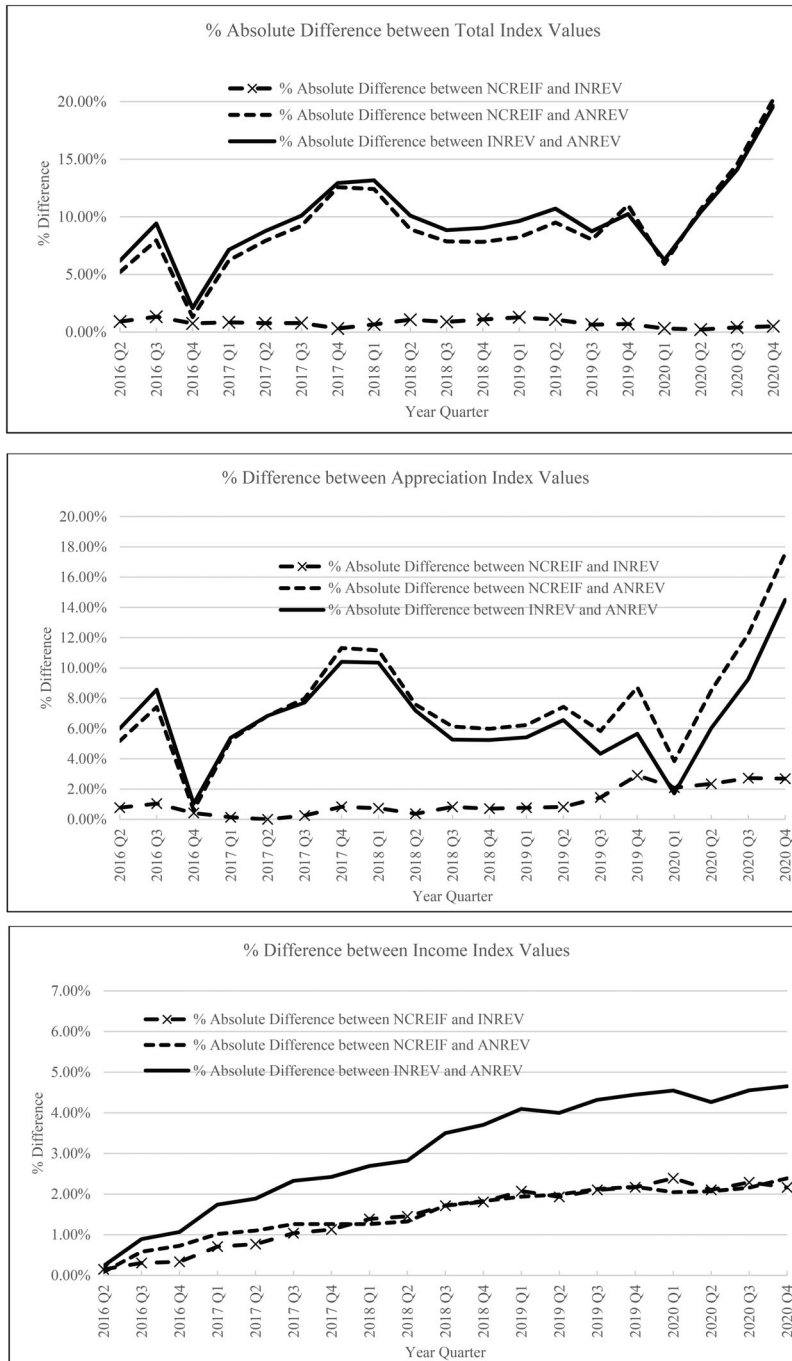


Figure 8. (A) Difference comparisons of total index values. (B) Difference comparison of appreciation index values. (C) Difference comparisons of income index values.

sector was the second largest sector in both Europe and Asia. ANREV total, appreciation, and income returns were higher than NCREIF and INREV but experienced much greater volatility. ANREV appreciation experienced an initial decrease at the beginning of the pandemic (first quarter

Table 5. Results of unit root tests (variables in level—NCREIF and INREV).

	ADF test	P.P. test
Total index values		
NCREIF total index	-0.6417 (1)	-0.0073
INREV total index	-1.4737 (0)	-0.7191

Notes. * Indicates that the result is significant at the 5% level. The numbers in parentheses for the ADF test are the optimal lag lengths as determined by the AIC. The test includes a constant term and time trend. The critical value of the ADF and the P.P. t-statistic at the 5% level is -3.41.

Table 6. Results of unit root tests (variables in first difference—NCREIF and INREV).

	ADF test	P.P. test
Total index values		
NCREIF total index	-3.0870 (0)	-3.1173
INREV total index	-2.0925 (2)	-3.3591*

Notes. * Indicates that the result is significant at the 5% level. The numbers in parentheses for the ADF test are the optimal lag lengths as determined by the AIC. For both tests, a constant term and time trend are included. The critical value of the ADF and the P.P. t-statistic at the 5% level is -3.41.

of 2020) but then increased in each subsequent quarter. NCREIF and INREV appreciation dropped in the second quarter of 2020 but did not recover over the next two quarters.

When we calculated the 12-month rolling returns for the respective regions, we found that ANREV properties appreciated at a greater rate on average (3.72%) compared with INREV (2.70%) and NCREIF (1.94%). The ANREV 12-month rolling average income returns of 3.76% outperformed INREV (2.77%) and NCREIF (3.30%). Overall, ANREV realized a 12-month rolling total return of 7.59% compared with INREV at 5.52% and NCREIF at 5.28%.

A comparison of the NCREIF, INREV, and ANREV indices found that the NCREIF and INREV indices were highly correlated, suggesting that the indices may be cointegrated; however, further analysis found they were not. So, we could not use one index to predict the values in the other. As noted earlier, we encourage caution when generalizing these results since they are based on relatively short periods. It will be interesting to make these comparisons again when we have a long history of the indices.

Notes

1. European and U.S. real estate investors often use different words to describe the same thing. Some of these include: gearing = leverage, and capital growth = appreciation, residential = apartment. For purposes of this paper the U.S. (latter) terms are used.
2. Source: ncreif.org, research corner Sept. 2012
3. All properties that the NFI-ODCE funds invest in are included, regardless if they qualify for the NPI.
4. The historical loan-to-value ratio is about 22%.
5. The main reasons the returns from NFI-ODCE do not match the income, appreciation, or total returns from the NPI include the following: 1. Not all NFI-ODCE properties and property types are in the NPI (seniors housing, self-storage, development, etc.) 2. Leverage is included in fund-level calculations but not in the NPI. 3. Joint venture properties in NFI-ODCE are reflected at economic ownership. In contrast, those properties are reported at 100% in the NPI. 4. Fund level expenses (accounting, legal, etc.) impact fund-level returns, but may not be allocated down to the property level in the NPI. 5. Cash balances at the fund level affect NFI-ODCE returns. In contrast, cash is not assumed to be held at the property level in the NPI. 6. Differences in property type allocations (e.g., NFI-ODCE has more office). 7. Differences in regional allocations (e.g., NFI-ODCE has more properties in the West). 8. The average building size in NFI-ODCE is larger than the average NPI property.
6. Historically, approximately 40% of funds are multi country funds.
7. NCREIF updated the inclusion criteria in 2019 to keep current with the contemporary market environment. The maximum leverage was reduced from 40% to 35%. Most of the tests were previously based on net assets, whereas the current test is based on a form of gross assets, depending on the test.
8. Alternative and inconsistent valuation methods could lead to greater volatility in the indices.
9. 35 billion euros at a 1.1 exchange rate.

10. As a point of clarification, ANREV index values are value weighted numbers so sample size should not be a significant contributing factor to the volatility.
11. Currency fluctuations could be a cause of some of the volatility because the cash flows are converted to US dollars before the return is calculated.

References

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