

7545018-priced-for-the-future-data-centers-in-institutional-real-estate-portfolios

SUMMARY: This article examines the rapid growth of data center investments within institutional real estate portfolios, particularly focusing on pension funds and other tax-exempt investors. The study uses NCREIF data to show that the data center segment has quadrupled in market value since 2024, with average capital expenditures of 10% of value per year, significantly higher than the all-property rate. Despite this growth, income from data centers has been below market, and appraised values have increased faster than capital invested. The article highlights that private real estate appraisals do not reflect the AI factor present in listed data center real estate investment trusts (REITs).

METHOD: The study uses NCREIF property-level data to analyze institutional tax-exempt investors' holdings of data centers. The data covers the period from the start of 2024 to mid-2026, documenting three key facts: the substantial growth in the data center segment, a shift in cash flow profile, and the selective lag in appraised values reflecting broad listed real estate information.

KEY FINDINGS:

- Institutional data center holdings grew from \$4.9 billion to \$19.1 billion in ten quarters.
- Since 2024, data center capital expenditures averaged 10% of value per year, seven times the all-property rate.
- Appraised values increased faster than capital invested in the properties.
- Private data center appraisals absorb broad real estate news with a lag but do not show positive AI exposure.
- Income net of capital expenditure was negative in nine of ten quarters from 2024 to 2026.

IMPLICATION FOR TRADING: The findings suggest that institutional investors, particularly those with tax-exempt status, are taking on AI-cycle risk within their real estate portfolios without fully reflecting this risk in their appraisal-based returns. This implies that data center investments may be overvalued or undervalued based on traditional real estate appraisal methods. Practitioners should consider the AI factor when valuing and managing data center investments within institutional portfolios, as traditional appraisal methods may not adequately capture the sector's unique dynamics.

Priced for the Future? Data Centers in Institutional Real Estate Portfolios Mariya

Letdin¹

Abstract

Pension funds and other institutional investors are building large data center positions inside private real estate portfolios. Using NCREIF data, I show that the segment has quadrupled in market value since 2024 while spending about a tenth of its value each year on capital improvements and earning below-market income. Appraised values have increased substantially during this brief period. An AI factor reflected in listed data-center REITs does not appear in private real estate data center returns. Institutional real estate is taking on AI-cycle risk that appraisal-based returns do not yet reflect.

Keywords: Data Centers, Artificial Intelligence, Institutional Real Estate, NCREIF, Private Real Estate

JEL codes: G11, G23, R33

Highlights

- Institutional data center holdings grew from \$4.9bn to \$19.1bn in ten quarters
- Since 2024, data center capex averages 10% of value a year, 7x the all-property rate
- Appraised values rose faster than the capital invested in the properties
- Privately held data center appraisals absorb real estate news with a lag but show no positive AI exposure
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1. Introduction

Pension funds and other institutional investors are rapidly acquiring the physical infrastructure of the artificial intelligence boom: data centers. These assets are unusual not only because of their capital intensity, but because sector demand is increasingly intertwined with supplier-supported financing. NVIDIA, for example, has guaranteed the land, power, and shell obligations of selected AI-cloud partners and, in August 2026, agreed to provide up to \$105 billion of credit support for a data center development leased to OpenAI (NVIDIA, 2026). Such arrangements resemble vendor finance, through which suppliers can support customer demand and facilitate external financing (Murfin and Pratt, 2019). Even properties outside these financing structures are exposed to these market drivers, since supplier support sustains sector-wide demand and could be reflected in valuations. This letter asks whether, as tax-exempt institutions increase their private real estate exposure to data centers, appraisal-based returns reflect the technology-cycle risk embedded in the sector. The evidence suggests they do not: private appraisals absorb broad listed-real-estate information with a lag but show no positive exposure to the AI factor that is priced in listed data-center REITs.

Using NCREIF property-level data covering the universe of properties held by institutional tax-exempt investors, including but not restricted to pension funds, I document three facts. First, recent growth is substantial: the segment grew from 34 properties and \$4.9 billion of market value at the start of 2024 to 62 properties and \$19.1 billion by mid-2026, with the average property value doubling from \$145 million to \$308 million. Second, the growth coincides with a sharp change in the segment's cash flow profile. Through 2023, data centers earned an income return of 4.7% annually, above the index's 4.1%, with capital expenditure of 2.0% of value. From 2024Q1 through 2026Q2, income fell to 2.9% against 4.7% for the NCREIF Property Index, while capital expenditure rose to 10.2% of value per year, more than seven times the index rate and four times that of the next most capital-intensive major property type. Income net of capital expenditure was negative in nine of these ten quarters. Third, appraisals capitalize

the spending and more: appreciation, which NCREIF measures net of capital expenditure, averaged 5.2% annually over the same ten quarters, indicating that appraised values rose by roughly 15% per year against 10% of value invested. From 2020Q2 through 2026Q2 the segment's cumulative total return is 70%, against 25% for the index. Comparing the appraisal series with listed data-center REITs, I show that the appraisal lag is selective. Controlling for the listed REIT market, data-center REIT returns load on NVIDIA returns (a coefficient of 0.15, $t = 3.8$), while the appraisal series has no positive loading at any lag; appraisals do, however, absorb listed real estate returns with a delay.

The letter contributes to a small but rapidly growing literature on data centers as real estate and financial assets. Early work emphasizes the distinctive valuation challenges created by their specialized physical and technological characteristics, limited transaction evidence, and resulting appraisal uncertainty (McAllister and Loizou, 2009). As the sector institutionalized, Marzuki and Newell (2019) documented the risk-adjusted performance and diversification benefits of listed data center REITs, while Ling, Wang, and Zhou (2020) showed that data center REITs were relatively resilient during the early COVID-19 shock. More recently, Khaliq and Boufous (2026) document the sensitivity of listed data center REIT returns to electricity prices and broader financial conditions. A parallel literature examines the financing of the AI infrastructure buildout. Van Nieuwerburgh (2026) and Eren, Krohn, and Todorov (2026) document a shift toward leases, project finance, securitization, private credit, and special-purpose vehicles, transforming rather than eliminating the underlying risks. Gete and Mercader (2026) document related evidence on the debt side: originate-to-distribute lenders finance data center mortgages at higher leverage and with weaker underwriting standards.

This letter differs from that literature by observing the underlying private real estate directly. Using institutional property-level holdings rather than listed securities or mortgage contracts, I document the growth of data centers within private portfolios and the composition of realized returns between income, capital expenditure, and

appreciation. The distinction is economically important because private appraisal-based real estate reprices differently from listed markets (Ling and Naranjo, 2015; Letdin, 2026), particularly for a specialized property type whose value increasingly depends on technology-driven demand and external financing.

2. Data

The data are NCREIF Property Index (NPI) returns by property type, available quarterly for the data center subtype from 2018Q3 through 2026Q2. NCREIF collects market values, net operating income, capital expenditure, and partial sales for all operating properties held by its data-contributing members, which are investment managers and fiduciaries investing on behalf of tax-exempt institutions, predominantly pension funds (Fisher, 2005). For each property type and quarter I observe the property count, aggregate market value, capital improvements, and the market-value-weighted income, appreciation, and total returns. The income return is net operating income divided by NCREIF's return denominator; the appreciation return is the change in market value net of capital improvements and partial sales, so capital spending reduces appreciation rather than income. I measure capital expenditure as capital improvements divided by the same denominator. The all-property benchmark is the NPI total. For the listed comparison in Section 4, I construct an index of U.S. data-center REITs from CRSP monthly returns, weighted by lagged market capitalization and compounded to quarters through 2025Q4: Equinix, Digital Realty, and CoreSite and QTS Realty through their 2021 acquisitions.

The analysis window begins in 2020Q2, the first quarter with at least seventeen properties in the segment; earlier quarters contain as few as four properties and are shown only where exhibits display the full history. Three caveats apply throughout. Returns are appraisal-based, unleveraged, and gross of investment management fees. The segment is small in absolute terms: 62 properties and \$19.1 billion at 2026Q2, a fraction of the listed data center market. And with a cross-section this size, the evidence is descriptive; no asset pricing claims are made.

3. Results

3.1 Growth.

Exhibit 1 plots the property count and aggregate market value. The segment enters the NCREIF universe in 2018 with four properties and remains below \$2.3 billion of market value through 2021. Growth accelerates after 2023: from 2024Q1 to 2026Q2 the count rises from 34 to 62 while market value rises from \$4.9 billion to \$19.1 billion, and the average property value doubles from \$145 million to \$308 million. Institutional entry into data centers is concentrated in the ten quarters of the AI capital expenditure acceleration and reflects allocation to progressively larger assets.

3.2 Income and capital expenditure.

Exhibit 2 plots the annualized income return (Panel A) and capital expenditure (Panel B) for the data center segment and the NPI. Through 2023 the segment looks like conventional institutional real estate: its income return exceeds the index in all but one quarter, averaging 4.7% against 4.1%, and capital expenditure is modest after 2021. From 2024 the two series diverge. Income falls to an average of 2.9% annually over 2024Q1–2026Q2, below the index's 4.7%, while capital expenditure rises to 10.2% of value per year, peaking at an annualized 27% in 2025Q3 (Table 1, Panel B). None of the other major property types in Table 1 exceeds 2.5% over the same period. Income net of capital expenditure averages –7.3% annually and is negative in nine of ten quarters. The timing coincides with the entry of the large assets documented in Section 3.1, consistent with development, expansion, and fit-out spending on properties whose income has not yet stabilized. The marginal institutional dollar in this segment is buying a growth asset that is still absorbing capital.

3.3 Return composition.

Exhibit 3 reports cumulative return indices from 2020Q2. The data center segment compounds to a 70% total return through 2026Q2, against 25% for the NPI. Income alone compounds to 28% and appreciation alone to 34%. Because NCREIF appreciation is

measured net of capital expenditure, the appreciation component understates how far appraised values moved: over 2024Q1–2026Q2, appreciation of 5.2% annually added to capital expenditure of 10.2% implies appraised values rising roughly 15% per year, more than the capital invested. Table 1 places these figures against other property types. On total return and return composition, data centers are not an outlier: industrial earned more (10.6% annually against 8.7%) with a higher appreciation share (63% against 54%), and self storage matches the data center appreciation share. What distinguishes data centers is the combination of unusually high capital intensity and coupled with the appraisal process. As shown in Panel B, the segment has the smallest maximum drawdown of any property type (−1.8%) and a first-order autocorrelation of just 0.19, compared with 0.65 to 0.85 for most other sectors. Given the segment’s small and rapidly changing cross-section, this pattern is more likely to reflect composition effects than appraisal effects.

4. Discussion

Section 3 described a segment that absorbs capital, earns below-market income, and relies on appraisal gains for most of its return. This section considers what that implies for the institutions that hold it: how much their returns depend on appraisals (4.1), how those appraisals compare with listed prices for the same sector (4.2), and how diversified the underlying exposure is (4.3). Section 4.4 sets out what the data cannot establish.

4.1 Reliance on appraisal gains.

The segment has little current cash flow to absorb a decline in value. Since 2024, capital expenditures have exceeded net operating income in nine of ten quarters, meaning the properties have consumed rather than distributed cash. Since 2024, roughly two-thirds of the total return of data centers in private portfolios has come from appraisal gains. If investment in AI infrastructure slows, any decline in data-center values would reach institutional portfolios through appraisals, and the timing would depend on how quickly appraisers mark to market.

4.2 Appraisal-based and listed returns.

Table 2 shows how differently listed markets have priced the same sector. Over 2020Q2–2025Q4 the appraisal-based segment returned 65% cumulatively (9.1% annually) with volatility of 4.2% and a maximum drawdown of 1.8%; the value-weighted index of listed data-center REITs returned 38% (5.8% annually) with volatility of 19.6% and a maximum drawdown of 36%. Listed data-center REITs fell 36% over the first three quarters of 2022, as interest rates rose, and 15% in 2025Q1, a quarter that included the January 2025 sell-off in AI-related equities; the private portfolio appraisal series gained 7.1% and 2.2% over the same periods. A Geltner (1993) correction is not helpful in closing the gap, since the appraisal series has little autocorrelation to undo ($\phi = 0.19$), and correlations with lagged REIT returns show no consistent lead-lag pattern. Leverage and the operating businesses of listed data-center firms explain part of the volatility difference but not returns of opposite sign in the same quarters.

To assess whether listed markets and private real estate appraisals price data centers' exposure to AI demand, I examine sensitivity of both to NVIDIA returns, which serve as a proxy for AI-related news. Panel C of Table 2 reports regressions of quarterly returns on the listed REIT market (VNQ) and NVIDIA returns. Holding the REIT market fixed, a 10% NVIDIA return is associated with a 1.5 percentage point higher data-center REIT return (coefficient 0.15, $t = 3.8$). The REIT market alone explains 39% of the variation in data-center REIT returns; adding NVIDIA raises this to 63%. This relation survives controlling for the aggregate stock market, holds at monthly frequency (0.18, $t = 4.6$, 69 months), and is present for Digital Realty alone (0.18, $t = 3.0$). The finding is specific to data centers: returns on the broad REIT market are not related to NVIDIA returns.

The private real estate data-center appraisal series behaves differently. NCREIF data-center returns show no positive relation to NVIDIA returns, either in the same quarter or over the following four quarters. Appraisals do respond to the REIT market with a delay: a 10% REIT market return is associated with NCREIF data-center returns about 3 percentage points higher over that quarter and the next two (summed coefficient 0.31, t

= 4.9). Data-center appraisals are also no more sensitive to NVIDIA than industrial appraisals.

4.3 Diversification

Vendor support can weaken the usual separation between tenant risk and real estate risk. When equipment suppliers provide equity, revenue support, or other credit backstops to compute providers, that support can strengthen tenant credit and facilitate financing of the underlying infrastructure. In turn, the value of the real estate becomes more dependent on the same technology cycle that supports the tenant and its equipment supplier. A slowdown in AI investment could therefore transmit simultaneously through tenant demand, financing capacity, and property appraisal. The landlord may remain senior in the contractual capital structure, but the underlying economic exposures are less diversified than traditional real estate investments.

4.4 Limitations.

What the data cannot distinguish is rational growth pricing from overpayment. Near-zero current yield is consistent with assets in development or lease-up whose stabilized income will justify today's marks, and equally consistent with acquisition at prices that capitalize demand that may not materialize. Separating the two requires lease-level detail on term, credit, escalations, and power arrangements, and the eventual realization of forward net operating income. Nor can segment-level data separate weaker income at existing properties from the entry of new properties that have yet to stabilize; the decline in income after 2024 coincides with the addition of large assets and may largely reflect composition. Each of these questions is a natural extension as the segment seasons.

5. Conclusion

Institutional investors, including pension funds, are absorbing the physical layer of the artificial intelligence boom into private real estate portfolios at a pace that quadrupled the segment's market value in ten quarters. The assets they are buying earn below-market

current income while absorbing capital expenditure of about a tenth of their value each year, and appraisers have marked them up by more than the capital invested. Listed markets priced the same sector with nearly five times the volatility and repriced it twice, on interest-rate news in 2022 and AI-related news in early 2025; appraisals absorbed the real estate component of those moves with a lag but show no positive exposure to AI. Whether this reflects mispricing or rational option value on AI demand, the segment changes the economic character of the allocation: an asset class valued in part for income stability now carries, at its fastest-growing margin, concentrated exposure to a single technology cycle.

Declaration of generative AI and AI-assisted technologies

During the preparation of this work, the author used Claude (Anthropic) for data analysis support and language editing. The author(s) reviewed and edited the output as needed and take full responsibility for the content of the published article.

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Exhibits

Exhibit 1. Institutionally held data centers: property count and aggregate market value, 2018Q3-2026Q2. Source: NCREIF Property Index.

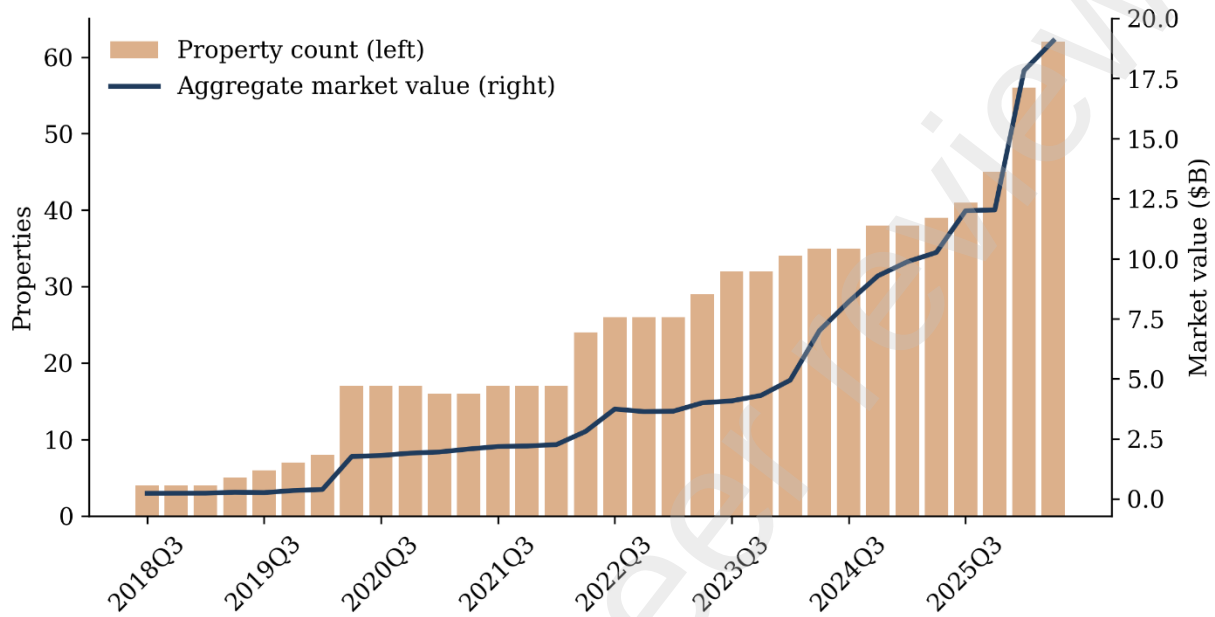


Exhibit 2. Annualized income return (Panel A) and capital expenditure (Panel B): data center segment and all property types (NCREIF Property Index), 2020Q2-2026Q2. Income return is net operating income and capital expenditure is capital improvements, each divided by the NCREIF return denominator and multiplied by four. Source: NCREIF Property Index.

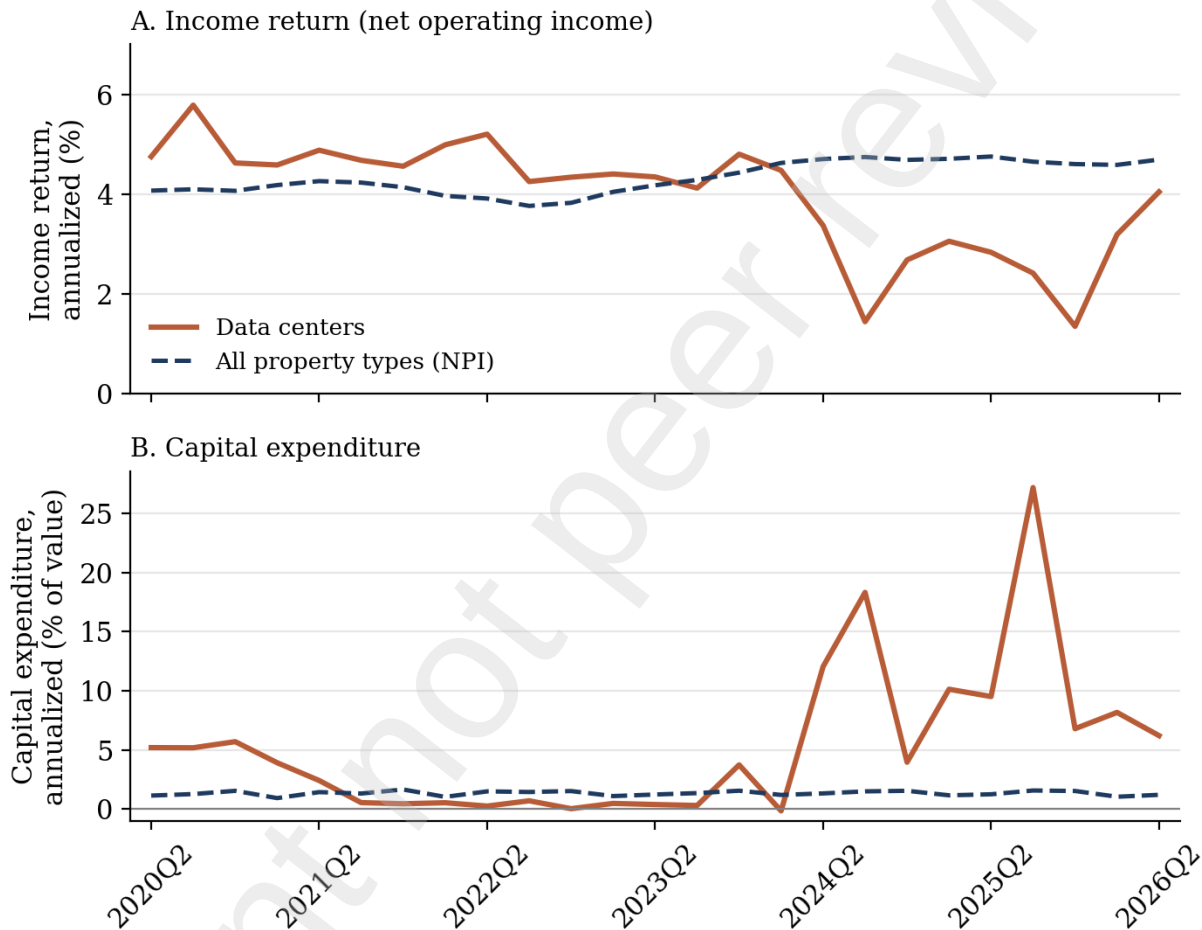


Exhibit 3. Cumulative return indices (start of 2020Q2 = 100): data center total, appreciation-only, and income-only components, and the NCREIF Property Index total. Appreciation is net of capital expenditure. Source: NCREIF Property Index.

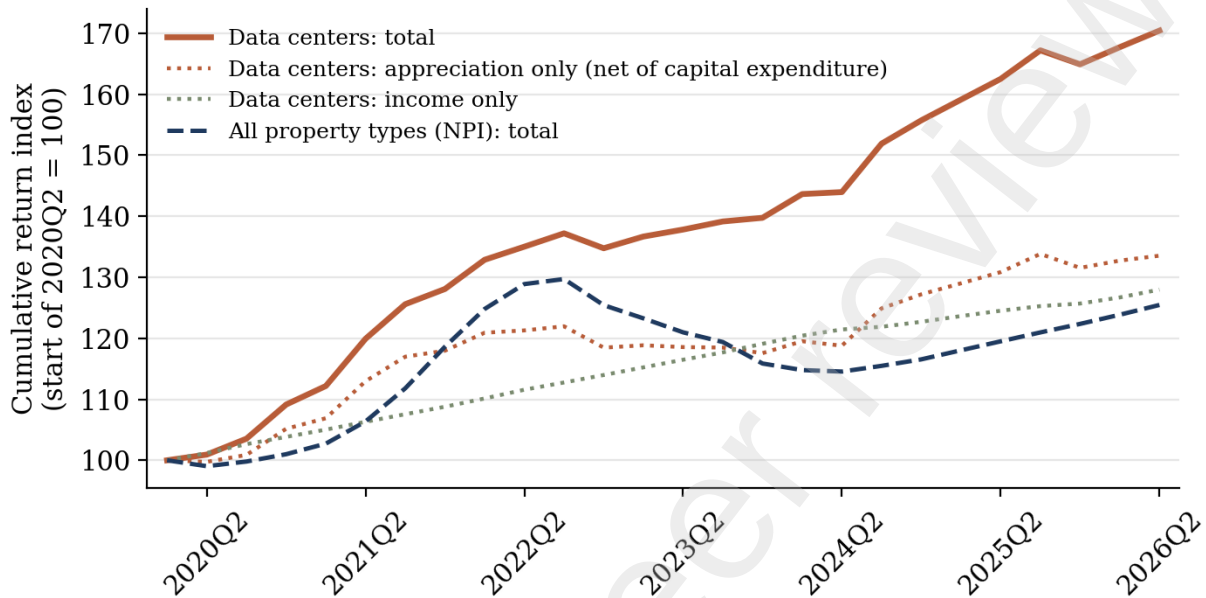


Table 1

Data centers and other NCREIF property sectors: returns, capital expenditure, and risk

	Data centers	Industrial	Apartment	Office	Retail	Self storage	Seniors housing	Hotel	NPI (all)
<i>Panel A: 2020Q2–2026Q2</i>									
Income return (ann., %)	3.97	3.87	4.02	4.98	5.00	4.41	4.25	4.45	4.33
Capital expenditure (ann., %)	5.28	0.98	0.89	2.12	1.14	0.72	0.74	3.41	1.34
Income less capital exp. (ann., %)	–1.31	2.89	3.13	2.86	3.85	3.69	3.52	1.04	2.99
Appreciation return (ann., %)	4.73	6.71	0.35	–7.56	–2.50	5.27	–0.40	–2.62	–0.57
Total return (ann., %)	8.70	10.58	4.37	–2.58	2.50	9.67	3.85	1.82	3.75
Cumulative total return (%)	70.42	88.25	30.20	–15.53	16.53	79.63	26.73	9.61	25.46
Appreciation share of total (%)	54.37	63.43	8.02	n.m.	n.m.	54.44	n.m.	n.m.	n.m.
Volatility of total return (ann., %)	4.00	8.53	5.20	4.73	2.95	6.47	3.11	8.20	4.78
Max drawdown (%)	–1.78	–7.51	–11.48	–26.87	–5.99	–4.31	–3.84	–23.92	–11.69
AR(1) of total return	0.19	0.85	0.82	0.85	0.65	0.82	0.80	0.73	0.82
<i>Panel B: 2024Q1–2026Q2</i>									
Income return (ann., %)	2.89	4.04	4.38	5.71	5.48	4.29	5.26	6.35	4.67
Capital expenditure (ann., %)	10.22	0.77	0.85	2.45	1.16	0.89	0.93	2.05	1.34
Income less capital exp. (ann., %)	–7.33	3.27	3.53	3.26	4.33	3.40	4.33	4.30	3.34
Appreciation return (ann., %)	5.19	–0.17	–1.05	–6.49	0.71	1.18	3.38	–2.21	–1.47
Total return (ann., %)	8.07	3.87	3.33	–0.78	6.19	5.47	8.64	4.14	3.21
<i>Panel C: Size of segment, 2020Q2–2026Q2</i>									
Average number of properties	30	5,130	2,145	1,853	1,198	1,006	195	65	12,051
Ending market value (\$bn)	19.1	313.9	255.3	161.9	117.4	25.3	16.0	2.1	943.1
Share of NPI market value (%)	2.0	33.3	27.1	17.2	12.4	2.7	1.7	0.2	100.0

Notes: Quarterly NCREIF Property Index (NPI) returns by property type. Panel A covers 2020Q2–2026Q2 (25 quarters), starting in the first quarter with more than seventeen data-center properties; Panel B covers 2024Q1–2026Q2 (10 quarters). Data centers are the NCREIF “Other: Data Center” subtype; Apartment is the “Residential: Apartment” subtype; other columns are NCREIF property types. Income return is net operating income divided by the NCREIF return denominator. Capital expenditure is capital improvements divided by the same denominator, in percent of value. NCREIF appreciation returns are net of capital expenditure, so capital spending lowers appreciation, not income. Income, capital expenditure, appreciation, and total returns are the average quarterly value multiplied by four. Cumulative total return compounds quarterly total returns. Appreciation share is the sum of quarterly appreciation returns divided by the sum of quarterly total returns; n.m. (not meaningful) where cumulative appreciation is negative. Volatility is the standard deviation of quarterly total returns multiplied by two. Maximum drawdown is the largest peak-to-trough decline in the cumulative total-return index. Returns are property-level, unlevered, and gross of fees. Market value is as of 2026Q2.

Table 2
Appraisal-based and listed data-center returns

	NCREIF data centers (appraisal)	NCREIF data centers (unsmoothed)	Data-center REITs (VW)	Data-center REITs (EW)	Equinix	Digital Realty
<i>Panel A: Return and risk, 2020Q2–2025Q4</i>						
Cumulative total return (%)	64.90	62.89	38.06	51.38	36.53	35.78
Annualized return (%)	9.09	8.86	5.77	7.48	5.56	5.46
Volatility (ann., %)	4.16	5.07	19.59	20.68	20.40	24.18
Max drawdown (%)	–1.78	–2.58	–35.96	–37.13	–31.84	–42.25
AR(1) of total return	0.18	–0.06	–0.11	–0.17	–0.02	–0.17
	k = 0	k = 1	k = 2	k = 3	k = 4	
<i>Panel B: Correlation of the NCREIF return in quarter t with the REIT (VW) return in quarter t – k</i>						
NCREIF data centers (appraisal)	0.04	0.25	–0.08	0.50	–0.07	
NCREIF data centers (unsmoothed)	0.07	0.25	–0.12	0.51	–0.14	
	Listed REIT market (VNQ)	NVIDIA	R ²	N		
<i>Panel C: Factor loadings on the listed REIT market and NVIDIA returns</i>						
Data-center REITs (VW), lag 0	0.517 [4.04]	0.150 [3.77]	0.63	23		
Data-center REITs (VW), lags 0–2 summed	0.287 [1.54]	0.232 [4.36]	0.70	22		
NCREIF data centers, lag 0	0.066 [1.46]	–0.008 [–0.98]	0.08	23		
NCREIF data centers, lags 0–2 summed	0.312 [4.90]	–0.038 [–3.09]	0.45	22		
NCREIF industrial, lags 0–2 summed	0.661 [3.67]	–0.098 [–3.12]	0.50	22		

Notes: Sample 2020Q2–2025Q4 (23 quarters). NCREIF data centers are the NPI “Other: Data Center” subtype. The unsmoothed series applies a first-order Geltner (1993) correction, $r^*(t) = [r(t) - \phi r(t-1)] / (1 - \phi)$, with $\phi = 0.19$ estimated as the AR(1) coefficient of the appraisal series over 2020Q2–2026Q2. Data-center REITs are U.S. data-center REITs in CRSP (Equinix, Digital Realty, CoreSite, QTS Realty), weighted by lagged market capitalization (VW) or equally (EW); CoreSite and QTS are included until their 2021 acquisitions, with their final monthly returns reflecting the buyout. CyrusOne is not included. Monthly CRSP returns are compounded to quarters. Annualized return is the geometric average; volatility is the standard deviation of quarterly returns multiplied by two. REIT returns are levered equity returns; NCREIF returns are unlevered property returns. Panel C reports OLS regressions of quarterly returns on the quarterly return of the Vanguard Real Estate ETF (VNQ) and of NVIDIA stock, both from CRSP, over 2020Q2–2025Q4; lag specifications include each factor at lags 0, 1, and 2 and report the summed coefficient. t-statistics in brackets use Newey–West standard errors with two lags. The negative summed NVIDIA coefficient for the appraisal series also appears for NCREIF industrial, reflecting the 2022 period in which NVIDIA and listed real estate fell while appraisals continued to rise. Additional results cited in the text: with the CRSP value-weighted market return as a further control, the NVIDIA coefficient for data-center REITs is 0.155 ($t = 3.19$); in monthly data (April 2020–December 2025, 69 months, Newey–West with three lags) it is 0.177 ($t = 4.58$); for Digital Realty alone it is 0.184 ($t = 2.98$). In a regression of VNQ on the market return and NVIDIA, the NVIDIA coefficient is –0.076 ($t = -1.54$). For NCREIF data centers with lags 0–4, the summed NVIDIA coefficient is –0.016 ($t = -0.80$). In a regression of NCREIF data-center minus NCREIF industrial returns on VNQ and NVIDIA, the NVIDIA coefficient is 0.021 ($t = 1.61$).