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CMBS - US
Year-End Spotlight: NOI Index Performance: Riding the Recovery or Risking the Fall?

Executive Summary

In this report we examine net operating income (NOI) trends for key collateral types backing commercial mortgage-backed securities (CMBS) loans, encompassing Agency, Conduit/Fusion, Large Loan, and Single Asset/Single Borrower (SASB) deals. Spanning the period from 2000 to 2023, our NOI index series evaluates year-over-year changes in "same-store" property financials as reported by borrowers and processed by master servicers.

NOI trends are a pivotal metric for assessing credit drift, as they reflect changes in a borrower's ability to service debt independent of market value fluctuations. Operating leverage at the property level, captured through NOI, precedes financial leverage analysis. For example, a property with $100 rental income, $50 expenses, and $50 NOI would experience a 10% NOI decline if rental income fell by 5%, assuming expenses remained constant. This decrease would lower debt service coverage (DSCR), elevating the risk of term defaults. While CMBS-based NOI indices are subject to limitations, they provide critical insights into CMBS collateral earnings trends across asset classes, markets, and vintages.

The excel data supplement for the exhibits of this report can be found here.

Summary of findings:

» National Core Property Performance: By December 2023, the National Core Property Composite Index reflected sustained recovery, surpassing pre-financial crisis peaks with a cumulative 36.1% growth since inception. Following a 28.8% peak-to-trough decline during the financial crisis, NOI rebounded by 40.5%, showcasing market resilience. Over 15 years, NOI grew 34.7%, with a 13.6% rise over the past 5 years and 2.1% growth in 2023.

» Vintage Performance: Pre-crisis vintages (2007-2010) demonstrated robust recovery, with NOI levels 30-35% above initial levels by 2023. Post-crisis vintages (2019-2023) showed moderate growth of 5-15%, influenced by pandemic disruptions, with recovery visible for the 2020 vintage.

» NOI Distribution (2016-2023): Approximately two-thirds of loans-maintained income within a ±31.8% band around the starting NOI. 10% of properties saw declines exceeding 19.3%, while another 10% achieved growth above 61.1%. The asymmetric distribution, with a downside deviation of 18.3% versus an upside deviation of 23.5%, emphasizes heightened credit risk associated with NOI declines.

» Apartment vs. Commercial Property: Apartment NOI outperformed commercial NOI, exceeding pre-crisis levels by 53.4% as of 2023, compared to commercial properties 19.6% cumulative growth, underlining the apartment sector's resilience.

» Industrial Sector: Industrial properties led with 76.6% cumulative NOI growth since inception, rebounding 85.3% from trough levels during the financial crisis. In contrast, retail saw a 1.4% cumulative increase, and suburban office NOI remains 12.2% below inception, highlighting industrial's dominance.

» Hotel Sector Volatility: Hotel NOI remains the most volatile, with a 58.7% peak-to-trough decline during COVID-19. While recovery reached 134% from its trough, hotel NOI remains 3.4% below its pre-COVID peak and 2.3% below inception, reflecting ongoing recovery challenges.

National Indices

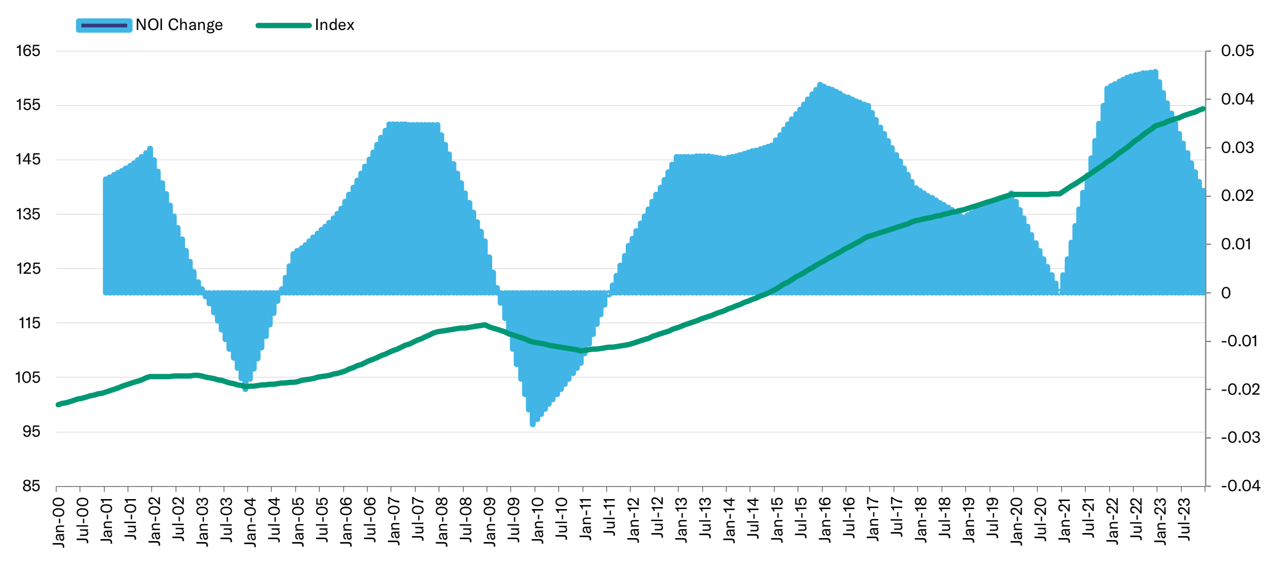
National Core Property Composite Index

As of December 2023, core commercial property prices have sustained a robust recovery, with the National Core Property Composite Index surpassing pre-financial crisis peaks. The index value stands at 154.4, reflecting a cumulative increase of 36.1% since its inception.

Exhibit 1 highlights that NOI (Net Operating Income) has rebounded significantly, rising 40.5% from the trough during the financial crisis. The peak-to-trough decline in NOI was 28.8%, emphasizing the magnitude of the market correction. However, the steady recovery since then underscores the resilience of the sector. Over the past 15 years, NOI has grown by 34.7%, including a 31.6% increase over the 10-year period and a 17.9% rise over the last 7 years. The recent momentum is evident, with NOI rising 13.6% over the past 5 years, 11.3% over the past 3 years, and 2.1% in the last year alone. This performance reflects a consistent upward trajectory in NOI, aligning with broader market recovery trends and reinforcing the strength of the national core property sector.

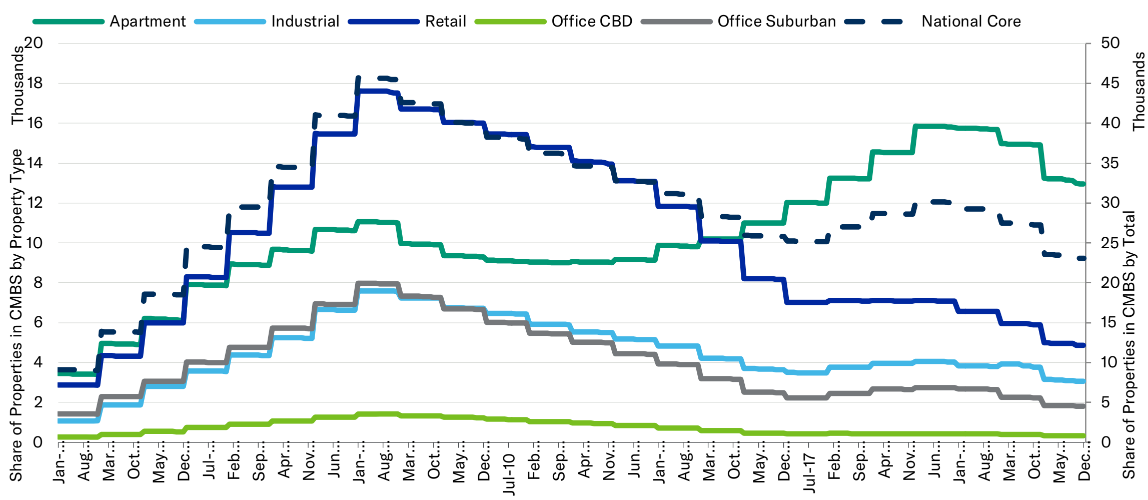
Exhibit 1

National Core Property Composite NOI Index



Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
National Core Property	2.1%	11.3%	13.6%	17.9%	31.6%	34.7%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
National Core Property	Dec-23	154.4	0.0%	40.5%	-28.8%	36.1%



Vintage Indices

Exhibit 2 illustrates the NOI growth trajectories for various vintages that comprise the national core composite series, encompassing all property types. The early pre-crisis vintages, such as 2007-2010, have exhibited robust long-term performance, achieving cumulative gains of approximately 30-35% above their initial levels by the end of 2023. The 2007 vintage experienced a significant decline during the financial crisis, briefly falling below its starting value, but has since demonstrated a remarkable recovery, now ranking among the top-performing vintages.

In contrast, post-crisis vintages, particularly those from 2019 to 2023, reveal a more varied growth pattern. These vintages began at lower relative levels and have seen moderate growth, with gains ranging from 5-15% above their initial values. The 2020 vintage reflects the pronounced impact of the pandemic, showing an initial dip before recovering to post modest growth. As of December 2023, while all vintages are above their respective starting levels, the earlier pre-crisis vintages (2007-2010) have delivered the most substantial cumulative NOI growth. These trends underscore the influence of broader economic cycles and the timing of market entry on commercial property performance, highlighting the resilience of earlier vintages in achieving superior long-term growth.

Exhibit 2

Vintage Indices

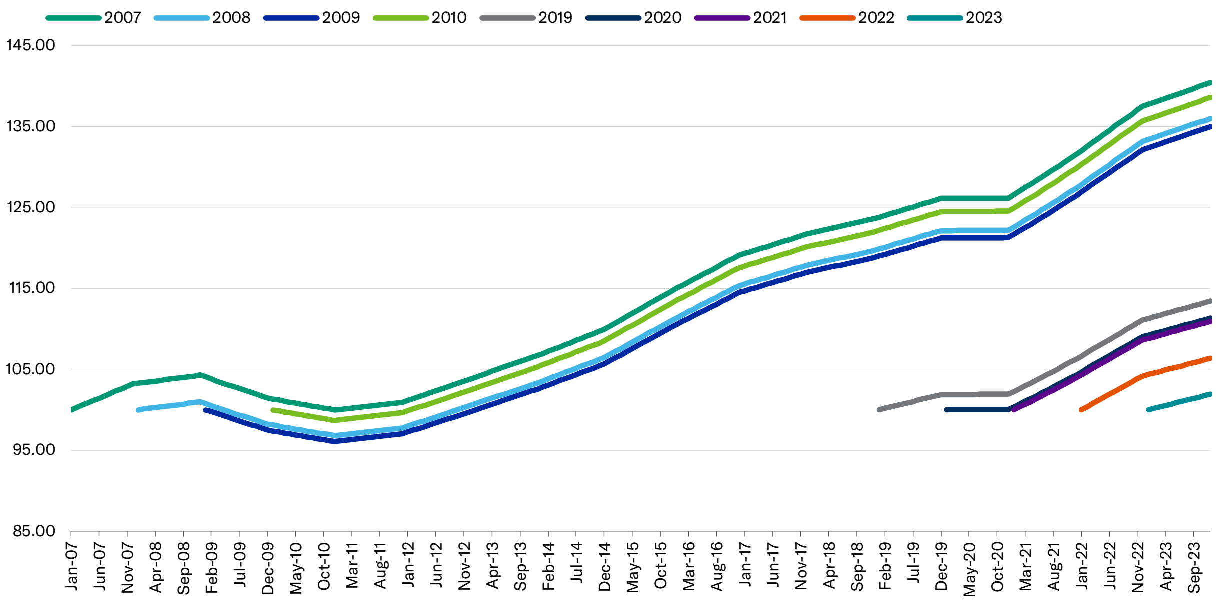
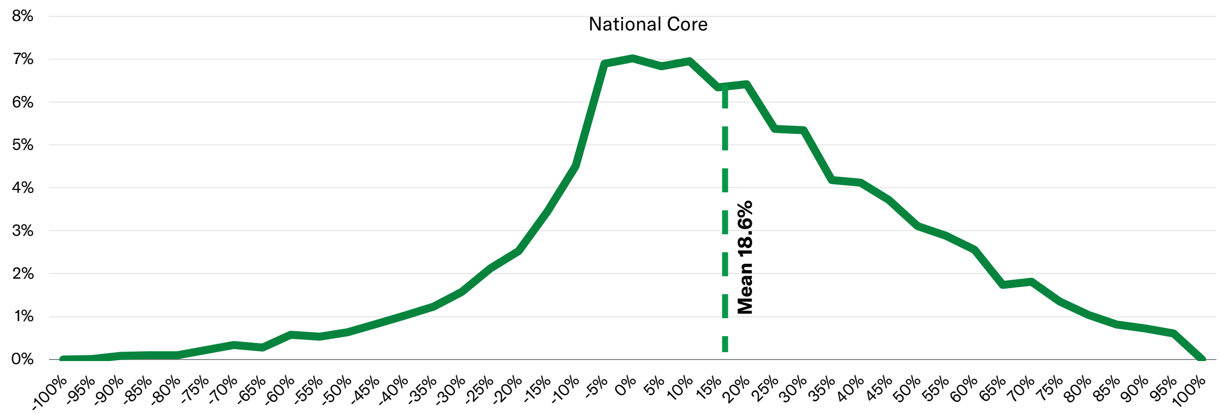


Exhibit 3 presents the distribution of NOI changes for loans reporting NOI performance between 2016 and 2023. The distribution highlights a slightly positive skew, with the mean NOI change at 18.6%. However, the implications for credit risk are asymmetrical. The left side of the distribution represents loans with declining NOI, often correlated with reduced debt service coverage, while the right side reflects loans with increasing NOI. Since upside returns in CMBS trusts are capped at the return of principal, the downside volatility poses more significant credit risk.

Approximately two-thirds of loans (within ± one standard deviation) experienced changes in NOI within a 63.6% band, ranging from -31.8% to +31.8%. At the tails, the 10th percentile represents a decline of 19.3% or more, while the 90th percentile reflects NOI growth of 61.1% or higher. The downside deviation, measuring the spread of negative NOI changes, is calculated at 18.3%, compared to an upside deviation of 23.5%. This indicates that while the overall distribution leans slightly toward positive outcomes, the credit implications of downside volatility remain more pronounced, underscoring the asymmetrical risk dynamics in CMBS performance.

Exhibit 3

National Core-Property Types 2016-23 NOI Change Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
National Core Property	31.8%	18.3%	23.5%	-19.3%	61.1%

Exhibit 4 provides a detailed breakdown of the negative side of the NOI distribution, categorizing the percentage of observations into distinct ranges of decline along with their cumulative shares. For instance, 28.8% of loans experienced m declines of 20% or less in NOI, while 19.8% (48.6% cumulative minus 28.8%) experienced declines exceeding 20%.

To contextualize, loans with a Debt Service Coverage Ratio (DSCR) of 1.30 can typically absorb an approximate 23% decline in NOI before falling to break-even levels for debt service. Similarly, loans with a DSCR of 1.60 can tolerate declines of up to 38% before reaching break-even. In this dataset, 28.8% of loans with NOI declines of 20% or less are likely able to continue servicing their debt obligations. In contrast, 19.8% of loans with NOI declines exceeding 20% are at a significantly elevated risk of default, emphasizing the importance of monitoring DSCR thresholds in assessing loan performance under stressed conditions.

Exhibit 4

National Core-Property Type Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Cohort Share	7.0%	6.9%	14.9%	8.1%	4.9%	3.1%	3.7%
Cumulative Share	7.0%	13.9%	28.8%	36.9%	41.8%	44.9%	48.6%

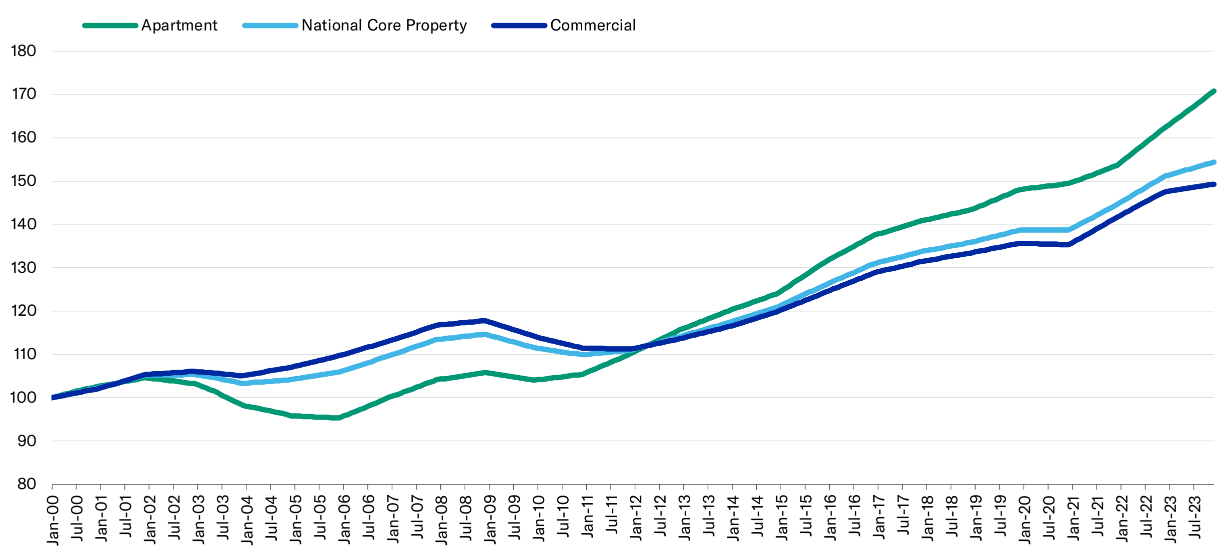
Apartment and Commercial (I,O,R) Sectors

Since 2008, apartment NOI has substantially outperformed commercial (I,O,R) NOI, mirroring the trend observed in their respective price trajectories. Apartment NOI experienced only a modest dip during the financial crisis and quickly recovered to surpass its pre-crisis peak by 61.5% as of December 2023.

In contrast, core commercial property NOI, which closely tracked multifamily NOI up until the pre-crisis peak, has underperformed significantly in the years following the Covid-19 downturn. As of December 2023, cumulative core commercial NOI growth stands at approximately 26.7%, lagging behind apartment NOI by 34.8% on a cumulative basis. This gap underscores the strong resilience and growth in the apartment sector compared to the broader commercial property sector over the past decade and a half.

Exhibit 5

Apartment and Commercial Composite NOI Indices



Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
National Core Property	2.1%	11.3%	13.6%	17.9%	31.6%	34.7%
Apartment	5.1%	14.3%	19.1%	24.2%	42.3%	61.5%
Commercial	1.1%	10.3%	11.8%	15.9%	28.3%	26.7%

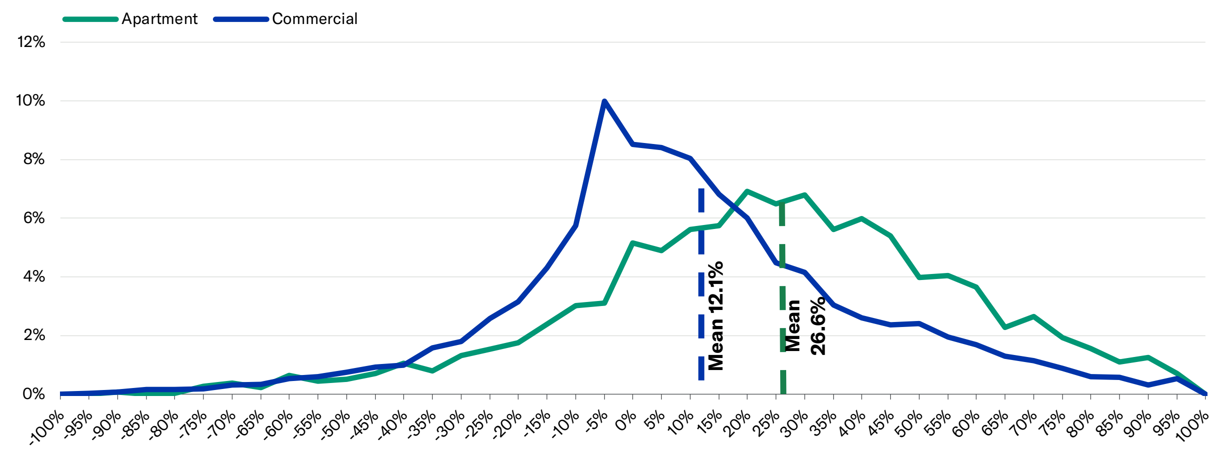
Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
National Core Property	Dec-23	154.4	0.0%	40.5%	-28.8%	36.1%
Apartment	Dec-23	170.8	0.0%	64.2%	-39.1%	64.0%
Commercial	Dec-23	149.3	0.0%	34.2%	-25.5%	27.9%

Exhibit 6 illustrates the distribution of changes in apartment and commercial NOI for properties reporting between 2016 and 2023. Apartment NOI shows a more pronounced skew towards positive growth compared to commercial NOI. The standard deviation for apartment NOI changes is higher at 32.5%, indicating greater variability, while commercial properties show slightly lower variability at 29.7%.

Additionally, apartment NOI exhibits a higher upside deviation of 23.5% compared to 22.4% for commercial, reflecting stronger upward movements in income. The downside deviations are close for both sectors at 19.1% and 17.7% respectively. In terms of the extremes, the 10th percentile for apartment NOI saw declines of around 14.3%, while commercial properties faced steeper declines, with the 10th percentile at -21.7%. At the other end of the distribution, the 90th percentile for apartment NOI growth reached 67.7%, compared to 52.9% for commercial properties with industrial contributing the most towards it.

Exhibit 6

Apartment and Commercial 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
Apartment	32.5%	19.1%	23.5%	-14.3%	67.7%
Commercial	29.7%	17.7%	22.4%	-21.7%	52.9%

Exhibit 7 highlights the differences in NOI decline distributions between the apartment and broader commercial property sectors from 2016 to 2023. Approximately 50.3% of commercial properties experienced NOI declines of 20% or more, compared to 32.0% of apartments, underscoring the relative resilience of the apartment sector. The apartment sector shows a notably lower incidence of significant income deterioration across all decline ranges. For instance, while 46.3% of commercial properties experienced declines of 40% or more, only 28.7% of apartments fell into this category. This disparity highlights the stability of apartments, which are less susceptible to severe income disruptions compared to the broader commercial property sector, particularly office properties, which likely contributed to the higher vulnerability in the commercial cohort. These findings emphasize the relative durability of the apartment sector during challenging market conditions, reflecting its ability to better withstand adverse economic cycles compared to the broader commercial sector.

Exhibit 7

Apartment and Commercial Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Apartment	5.2%	8.3%	16.8%	22.4%	26.1%	28.7%	32.0%
Commercial	8.5%	18.5%	31.7%	39.3%	43.6%	46.3%	50.3%

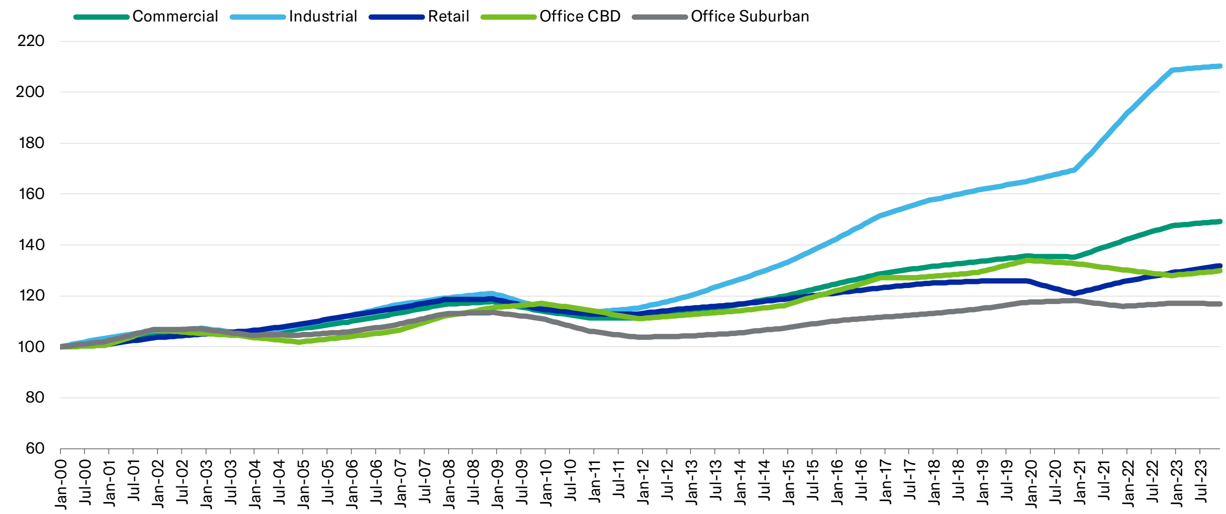
Commercial Sectors – Retail, Industrial and Office

Among the core commercial property sectors, industrial continues to outperform, demonstrating a cumulative NOI growth of 76.6% since inception. Industrial properties experienced a significant 46% peak-to-trough decline during the financial crisis but have rebounded, with an 85.3% trough-to-current recovery. This strong performance highlights the resilience and consistent upward trajectory of the industrial sector. The retail sector has shown more modest growth, with a cumulative NOI increase of 11.2% since inception. Retail properties experienced a relatively mild 14.4% peak-to-trough decline, reflecting more stability compared to other sectors. As of December 2023, the retail sector has fully recovered, with a 16.8% trough-to-current rebound.

The office sector continues to face challenges, with clear disparities between Central Business District (CBD) and suburban office properties. CBD office NOI has declined by 17.1% from its peak and remains 3% above inception levels, reflecting limited recovery. In contrast, suburban office NOI has declined by 12.2% since inception, with a 21.1% peak-to-trough decline, underscoring ongoing struggles in this sector. This highlights the industrial sector's dominance and recovery strength, while retail shows moderate resilience. Meanwhile, the office sector, particularly suburban properties, remains a laggard in NOI recovery, signaling continued headwinds for this asset class.

Exhibit 8

Retail, Industrial and Office Composite NOI Indices



Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Commercial	1.1%	10.3%	11.8%	15.9%	28.3%	26.7%
Industrial	0.8%	24.1%	30.2%	38.6%	67.1%	73.8%
Retail	2.1%	9.0%	4.8%	7.0%	13.1%	11.0%
Office - CBD	1.4%	-2.2%	0.5%	2.1%	13.9%	12.6%
Office - Suburban	-0.2%	-1.1%	1.9%	4.8%	11.0%	3.0%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Commercial	Dec-23	149.3	0.0%	34.2%	-25.5%	27.9%
Industrial	Dec-23	210.3	0.0%	85.3%	-46.0%	76.6%
Retail	Dec-23	131.8	0.0%	16.8%	-14.4%	11.2%
Office - CBD	Dec-23	129.9	-3.0%	17.0%	-17.1%	15.8%
Office - Suburban	Dec-23	117.0	-1.1%	12.7%	-12.2%	3.6%

Among the core commercial segments, industrial NOI exhibited the highest volatility, with a standard deviation of 33.1%. Industrial properties experienced a 10th percentile decline of 13.1% and a 90th percentile gain of 71.6%, highlighting its strong upside potential and resilience.

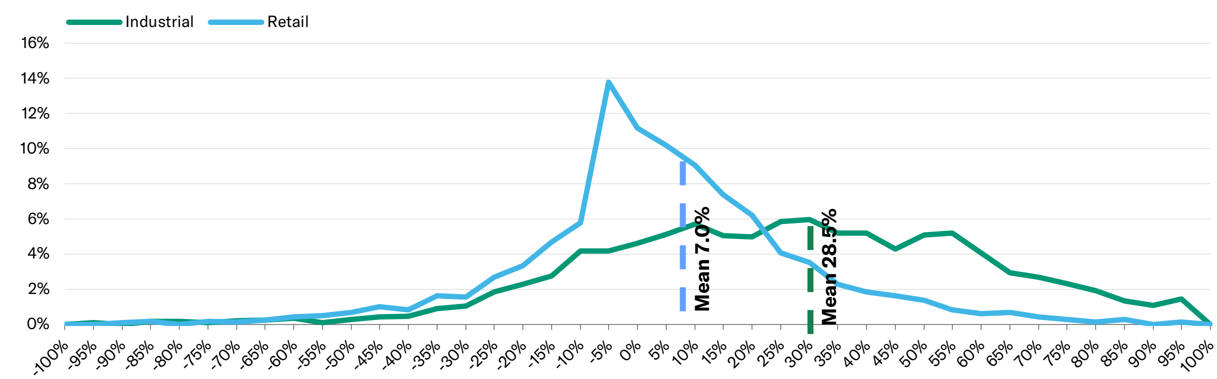
The retail sector showed relatively lower volatility, with a standard deviation of 24.0%, a downside deviation of 16.3%, and an upside deviation of 17.7%. At the extremes, retail NOIs declined by 20.2% or more at the 10th percentile, while the 90th percentile saw gains of 35.8%, reflecting its moderate performance across the distribution.

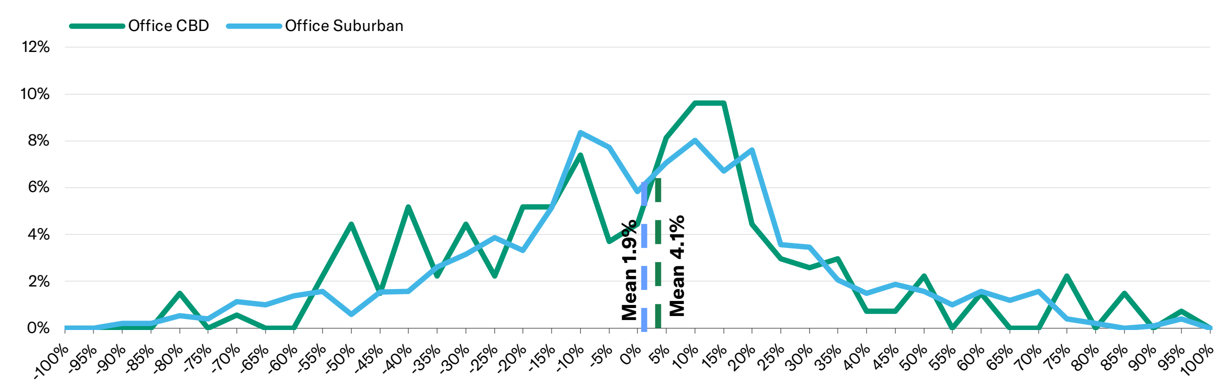
In the office sector, CBD office displayed a standard deviation of 33.2%, with a downside deviation of 18.4% and an upside deviation of 22.6%. At the 10th percentile, CBD office NOI declined by 41.7%, while the 90th percentile experienced gains of 39.1%. These figures underscore the heightened risk and reward dynamics within CBD office properties.

Suburban office, with a standard deviation of 31.6%, demonstrated a more balanced deviation profile. It exhibited a downside deviation of 20.5% and an upside deviation of 20.4%, with the 10th percentile showing NOI declines of 35.4% and the 90th percentile reporting gains of 44.6%.

Exhibit 9

Commercial Segments 20016-23 NOI Growth Rate Distribution





Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
Industrial	33.1%	17.9%	24.7%	-13.1%	71.6%
Retail	24.0%	16.3%	17.7%	-20.2%	35.8%
Office - CBD	33.2%	18.4%	22.6%	-41.7%	39.1%
Office - Suburban	31.6%	20.5%	20.4%	-35.4%	44.6%

Exhibit 10 highlights the varying degrees of stress experienced across commercial property segments from 2016 to 2023. The office sector faced the most significant challenges, with CBD office properties showing 70.8% of properties experiencing NOI declines greater than 20%, and a total of 81.9% of properties facing cumulative declines across all categories. Suburban office closely followed, with 71.0% of properties showing declines greater than 20% and a total of 76.2% experiencing declines across all ranges.

The retail sector exhibited moderate stress, with 56.4% of properties experiencing cumulative NOI declines of more than 20% and a total of 61.2% of properties showing declines across all categories. In contrast, the industrial sector demonstrated the highest resilience, with only 34.6% of properties experiencing NOI declines greater than 20%, and a total of 35.4% showing declines across all categories.

Exhibit 10

Commercial Segments Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Industrial	4.6%	8.8%	19.9%	26.8%	30.7%	32.5%	34.6%
Retail	11.2%	25.0%	38.8%	46.4%	50.4%	52.9%	56.4%
Office - CBD	4.4%	8.1%	25.9%	37.7%	49.5%	60.6%	70.8%
Office - Suburban	5.8%	13.5%	34.8%	47.1%	56.7%	62.5%	71.0%

CMBS Component NOI Indices

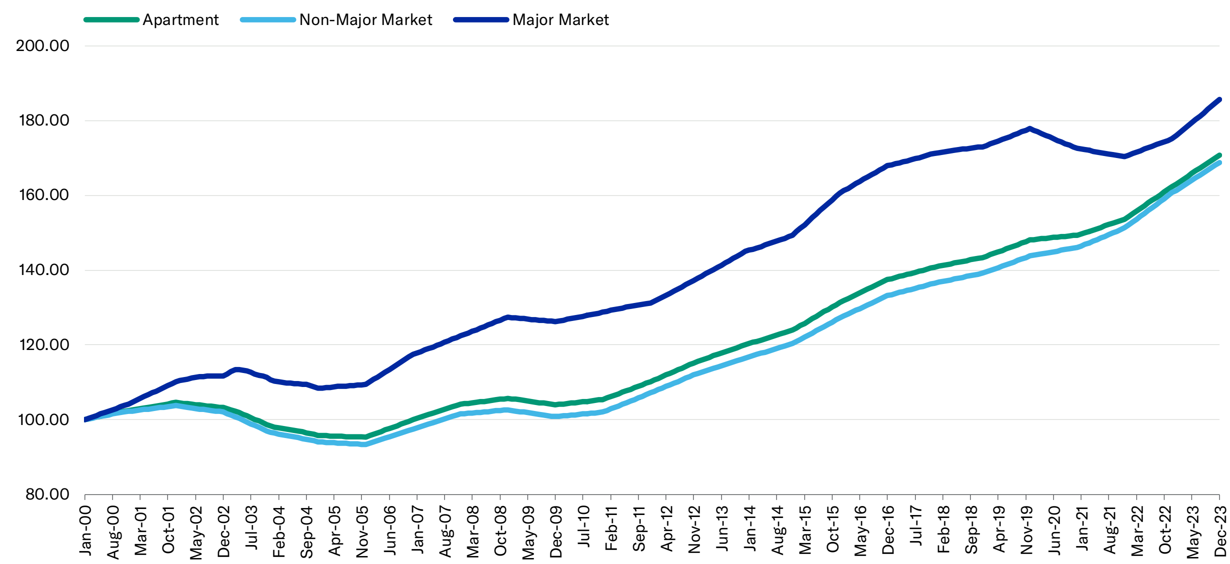
The following are count-weighted average indices used to construct the composite indices.

Apartment Major and Non-Major Market Component Indices

Apartment NOI growth in major markets consistently outpaced growth in non-major markets over the 10-year period. Major market apartment NOI weathered the financial crisis better, opening a gap of more than 15 percentage points over non-major market apartments relative to their 2004 levels. However, as of December 2023, this gap has narrowed to about 10 percentage points, with non-major markets showing a stronger recovery in recent years.

Exhibit 11

Apartment Major and Non-Major Markets



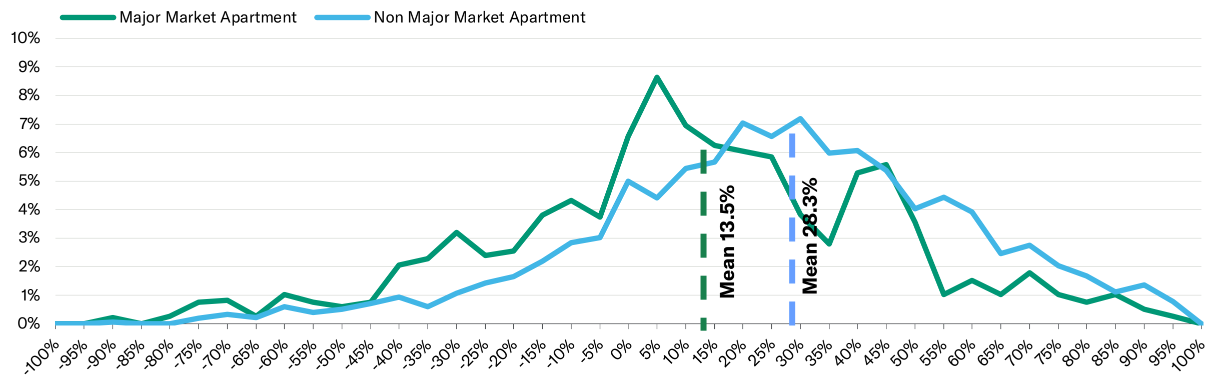
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Apartment	5.1%	14.3%	19.1%	24.2%	42.3%	61.5%
Apt - Major	6.0%	7.6%	7.3%	10.6%	28.1%	45.7%
Apt – NonMajor	5.0%	15.6%	21.3%	26.7%	44.9%	64.4%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Apartment	Dec-23	170.8	0.0%	64.2%	-39.1%	64.0%
Apt - Major	Dec-23	185.7	0.0%	51.7%	-34.1%	51.7%
Apt – NonMajor	Dec-23	168.8	0.0%	67.4%	-40.3%	66.2%

Major and non-major market apartment NOI changes exhibited similar standard deviations between 2016 and 2023, with major markets at 33.4% and non-major markets at 32%. Major market apartments demonstrated more favorable performance at the tails of the distribution, with a less severe decline at the 10th percentile (-28.9%) but a weaker gain at the 90th percentile (53.7%) compared to non-major markets, which saw a 10th percentile decline of -12.3% and a 90th percentile gain of 69.2%.

Exhibit 12

Major and Non-Major Market Apartment 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
Apt - Major	33.4%	19.9%	22.5%	-28.9%	53.7%
Apt - NonMajor	32.0%	18.9%	23.5%	-12.3%	69.2%

Major market apartments exhibited larger NOI declines than did non-major market apartments.

Exhibit 13

Major and Non-Major Apartment Summary of 2016-23 NOI Declines

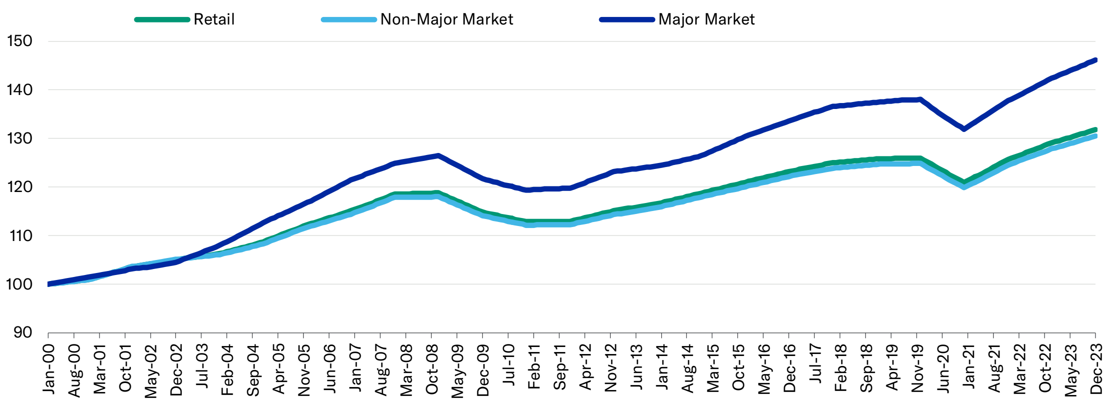
	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Apt - Major	6.6%	10.3%	22.2%	30.9%	38.8%	43.9%	49.3%
Apt - NonMajor	5.0%	8.0%	14.7%	18.8%	21.4%	23.6%	26.6%

Retail Major and Non-Major Market Component Indices

Retail property NOI in major markets consistently outpaced retail property NOI in non-major markets. On a 20-year cumulative basis, major market NOI growth outpaced that of non-major market NOI growth by seven percentage points.

Exhibit 14

Retail Major and Non-Major Markets



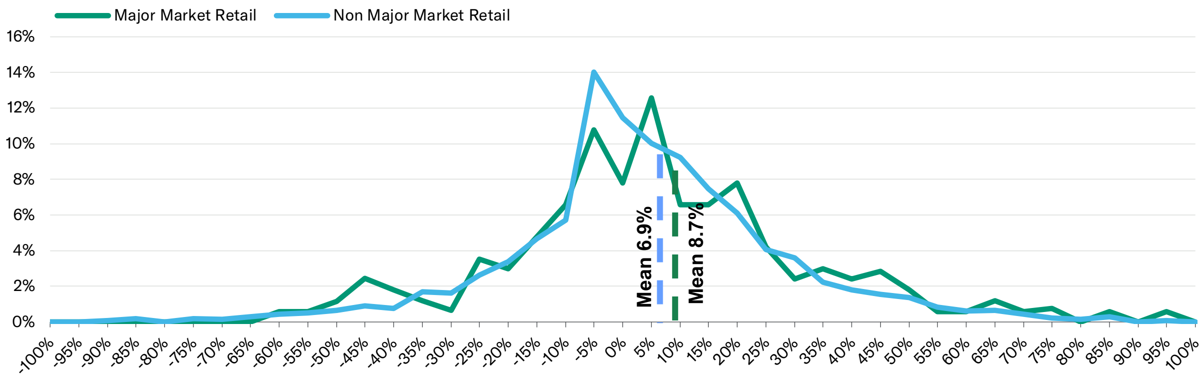
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Retail	2.1%	9.0%	4.8%	7.0%	13.1%	11.0%
Ret - Major	2.7%	10.8%	6.4%	9.4%	17.5%	15.6%
Ret – NonMajor	2.1%	8.9%	4.7%	6.8%	12.7%	10.6%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Retail	Dec-23	131.8	0.0%	16.8%	-14.4%	11.2%
Ret - Major	Dec-23	146.2	0.0%	22.5%	-18.3%	17.1%
Ret – NonMajor	Dec-23	130.5	0.0%	16.4%	-14.1%	10.7%

Major market retail NOI showed larger downturns and more volatility at the 10th percentile compared to non-major markets but demonstrated greater positive performance at the 90th percentile.

Exhibit 15

Major and Non-Major Market Retail 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
Ret - Major	26.8%	15.2%	20.4%	-22.9%	43.9%
Ret – NonMajor	23.8%	16.3%	17.4%	-20.1%	35.3%

Retail NOI in major markets saw more declines compared to non-major market retail as expected.

Exhibit 16

Major and Non-Major Retail Summary of 2016-23 NOI Declines

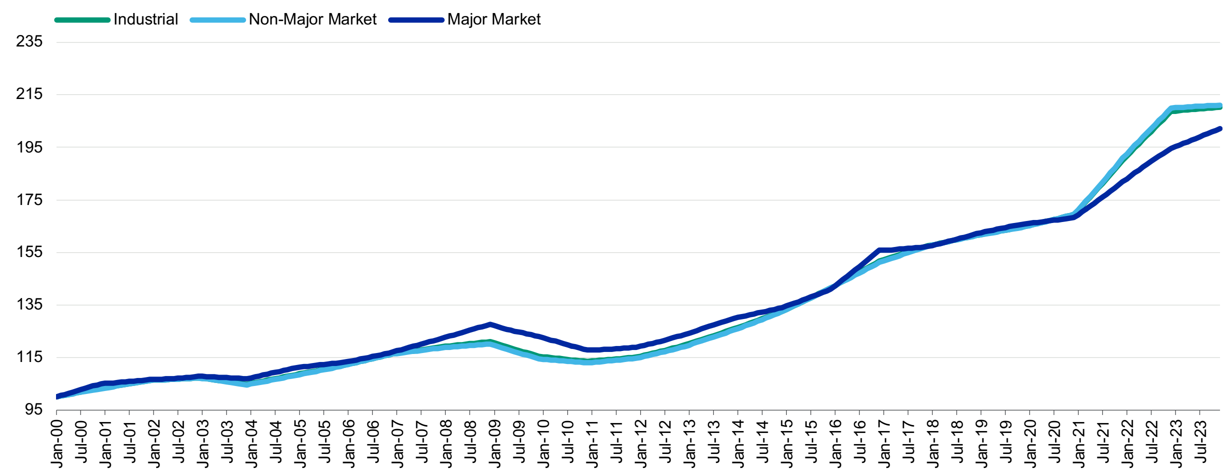
	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Ret - Major	7.8%	18.6%	40.7%	52.0%	57.4%	62.9%	67.7%
Ret – NonMajor	11.5%	25.5%	39.2%	46.9%	50.9%	53.2%	56.6%

Industrial Major and Non-Major Market Component Indices

Industrial property performance across major and non-major markets shows limited differentiation over the long term, with notable trends emerging only in recent years post-2021. This contrasts with other sectors where significant performance gaps between major and non-major markets are more pronounced. Over the 15-year cumulative period, non-major industrial markets outperformed major markets with an NOI growth of 77.8%, compared to 65.4% in major markets, reflecting a 12.4 percentage point advantage. Similarly, over the 10-year period, NOI in non-major markets grew by 68.4%, surpassing the 55.6% growth observed in major markets.

Exhibit 17

Industrial Major and Non-Major Markets



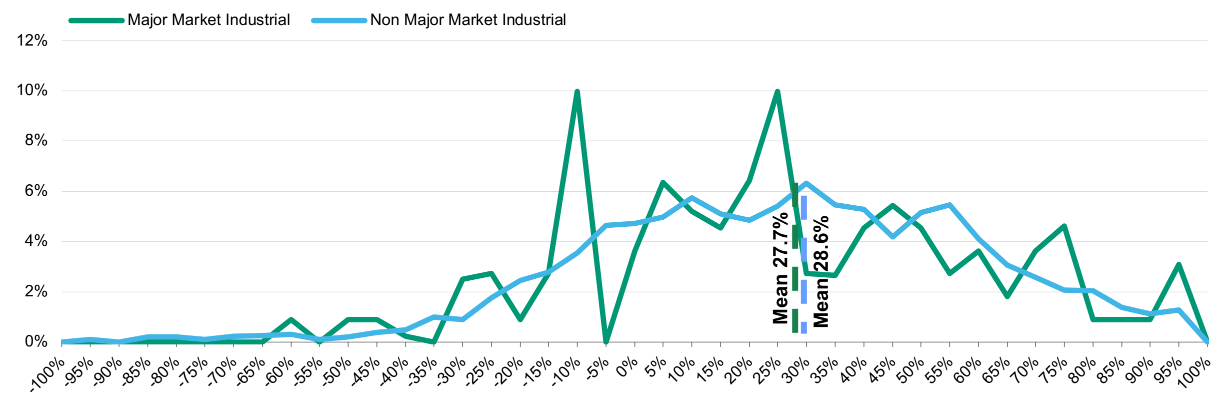
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Industrial	0.8%	24.1%	30.2%	38.6%	67.1%	73.8%
Ind - Major	3.9%	20.2%	24.6%	29.7%	55.6%	58.4%
Ind – NonMajor	0.5%	24.5%	30.8%	39.6%	68.4%	75.7%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Industrial	Dec-23	210.3	0.0%	85.3%	-46.0%	76.6%
Ind - Major	Dec-23	202.2	0.0%	71.6%	-41.7%	65.4%
Ind – NonMajor	Dec-23	211.1	0.0%	86.9%	-46.5%	77.8%

While both major and non-major market industrial properties performed similarly at the 90th percentile (70.7% vs. 76.9%), major market industrial had lesser downside deviation (-13.4% vs. -18.3%).

Exhibit 18

Major and Non-Major Market Industrial 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
Ind - Major	34.3%	13.4%	26.4%	-13.6%	76.9%
Ind – NonMajor	32.9%	18.3%	24.5%	-13.1%	70.7%

Exhibit 19 reveals the distribution of NOI declines for major and non-major industrial properties from 2016 to 2023. Major market industrial properties had a slightly lower share of properties with NOI declines up to the 30% level, accounting for 22.7% compared to 23.2% for non-major markets, reflecting a 0.5 percentage point difference. In contrast, major market properties had a marginally higher share of properties experiencing more substantial declines, with 31.7% of properties seeing declines greater than 30%, compared to 28.8% for non-major markets—a difference of 2.9 percentage points.

Exhibit 19

Major and Non-Major Industrial Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
Ind - Major	3.6%	3.6%	16.3%	22.7%	27.9%	29.0%	31.7%
Ind – NonMajor	4.7%	9.4%	18.1%	23.2%	25.6%	26.7%	28.8%

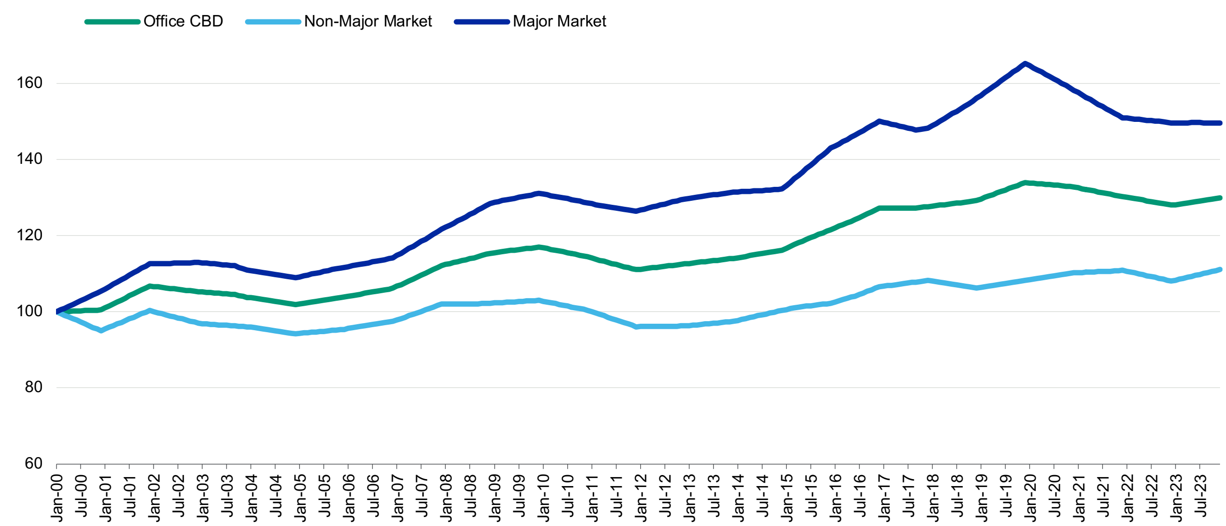
CBD Office Major and Non-Major Market Component Indices

NOI performance from CBD office properties in major markets exhibits a distinct pattern compared to those in non-major markets. Major market CBD office NOI is currently 9.4% below its peak, showing some recovery with a 23.0% increase from its trough. This recovery reflects the long-term lease structures often found in major markets, which can stabilize performance over time. Overall, NOI in major markets remains 16.5% above its inception level, underscoring its relative resilience.

In contrast, non-major market CBD office NOI has struggled significantly, with NOI at 13.6% below its peak. The recovery has been weaker, with a 15.7% increase from its trough, leaving NOI only 8.9% above its inception level. This performance highlights the challenges faced by non-major market CBD office properties, which have shown slower recovery and more prolonged impacts compared to their major market counterparts.

Exhibit 20

CBD Office Major and Non-Major Markets



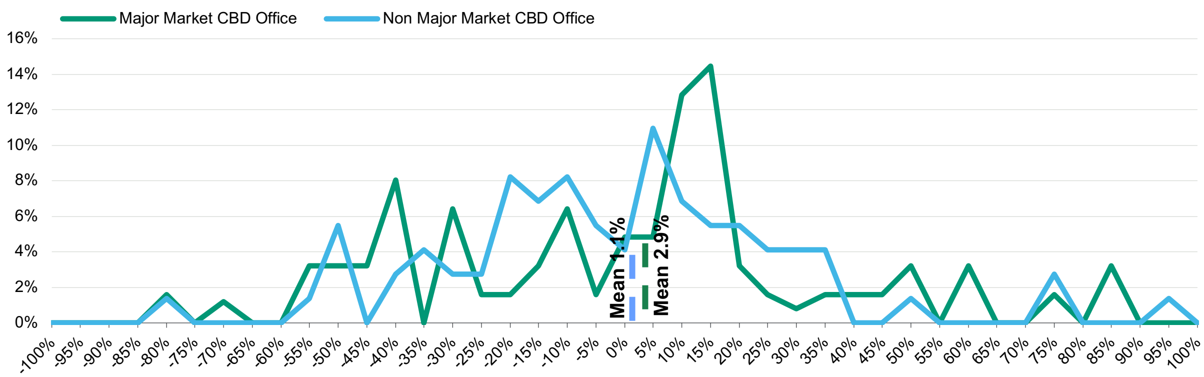
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Office CBD	1.4%	-2.2%	0.5%	2.1%	13.9%	12.6%
OffCBD - Major	0.0%	-5.4%	-4.1%	-0.3%	13.8%	16.5%
OffCBD – NonMajor	2.8%	0.8%	4.6%	4.3%	14.0%	8.7%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Office CBD	Dec-23	129.9	-3.0%	17.0%	-17.1%	15.8%
OffCBD - Major	Dec-23	149.7	-9.4%	23.0%	-26.4%	23.0%
OffCBD – NonMajor	Dec-23	111.2	0.0%	15.7%	-13.6%	8.9%

While the decline at the 10th percentile for major market CBD office was about 42%, the decline at the same percentile for non-major market CBD office was only six percentage points lower.

Exhibit 21

Major and Non-Major Market CBD Office 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
OffCBD - Major	36.1%	18.1%	23.3%	-42.1%	51.8%
OffCBD – NonMajor	30.5%	17.4%	21.8%	-36.7%	33.4%

While NOI in nearly 73% of non-major market CBD observations experienced a decline the share in major markets was nearly 18 percentage points less.

Exhibit 22

Major and Non-Major CBD Office Summary of 2016-23 NOI Declines

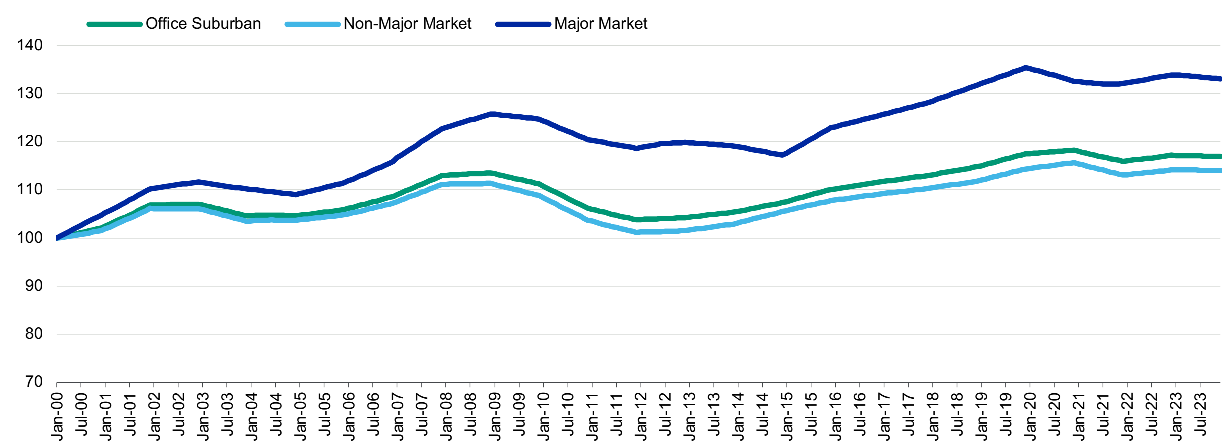
	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
OffCBD - Major	4.8%	6.4%	17.7%	24.1%	32.1%	43.4%	55.8%
OffCBD – NonMajor	4.1%	9.6%	32.9%	46.6%	56.2%	64.4%	72.6%

Suburban Office Major and Non-Major Market Component Indices

NOI from suburban office properties in major and non-major markets demonstrates broadly similar challenges, with both segments experiencing significant declines. Major market suburban office NOI is currently 1.7% below its peak, showing a modest 13.5% recovery from its trough, but remains 8.4% above its inception level. Non-major market suburban office NOI, in contrast, is 1.4% below its peak, with a 12.7% recovery from its trough, but shows weaker long-term performance, remaining only 2.6% above its inception level. Although major markets have shown slightly better recovery and long-term growth, both segments highlight the broader challenges facing suburban office properties in adapting to market conditions.

Exhibit 23

Suburban Office Major and Non-Major Markets



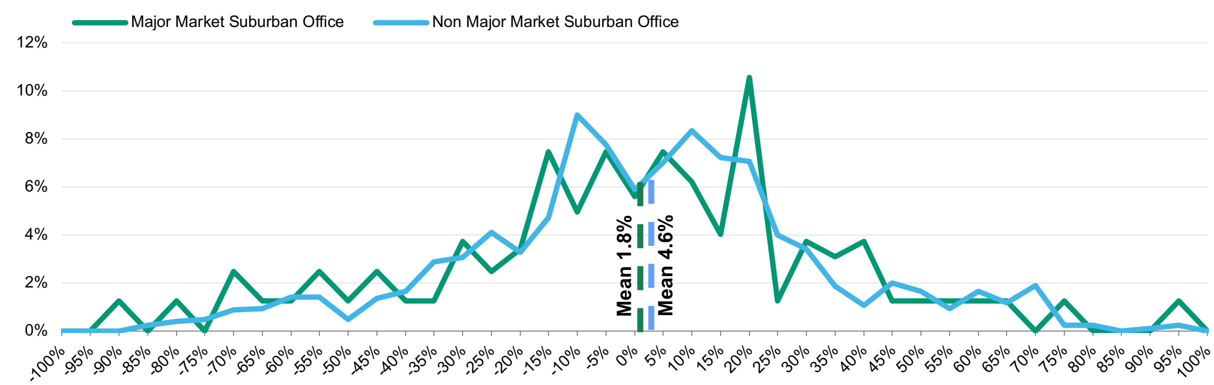
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
Office Suburban	-0.2%	-1.1%	1.9%	4.8%	11.0%	3.0%
OffSub- Major	-0.6%	0.4%	1.0%	6.0%	11.7%	5.8%
OffSub – NonMajor	-0.1%	-1.4%	2.0%	4.5%	10.9%	2.5%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
Office Suburban	Dec-23	117.0	-1.1%	12.7%	-12.2%	3.6%
OffSub- Major	Dec-23	133.1	-1.7%	13.5%	-13.4%	8.4%
OffSub – NonMajor	Dec-23	114.1	-1.4%	12.7%	-12.5%	2.6%

Suburban office in non-major markets showed less downside and more upside than it did in major markets at the 10th percentile and the 90th percentile respectively.

Exhibit 24

Major and Non-Major Market Suburban Office 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
OffSub- Major	35.1%	23.7%	21.1%	-50.0%	40.6%
OffSub – NonMajor	30.9%	19.7%	20.3%	-33.3%	45.3%

Exhibit 25

Major and Non-Major Suburban Office Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
OffSub- Major	5.6%	13.0%	32.9%	46.3%	53.7%	58.7%	72.4%
OffSub – NonMajor	5.9%	13.6%	30.6%	41.1%	48.7%	52.2%	59.7%

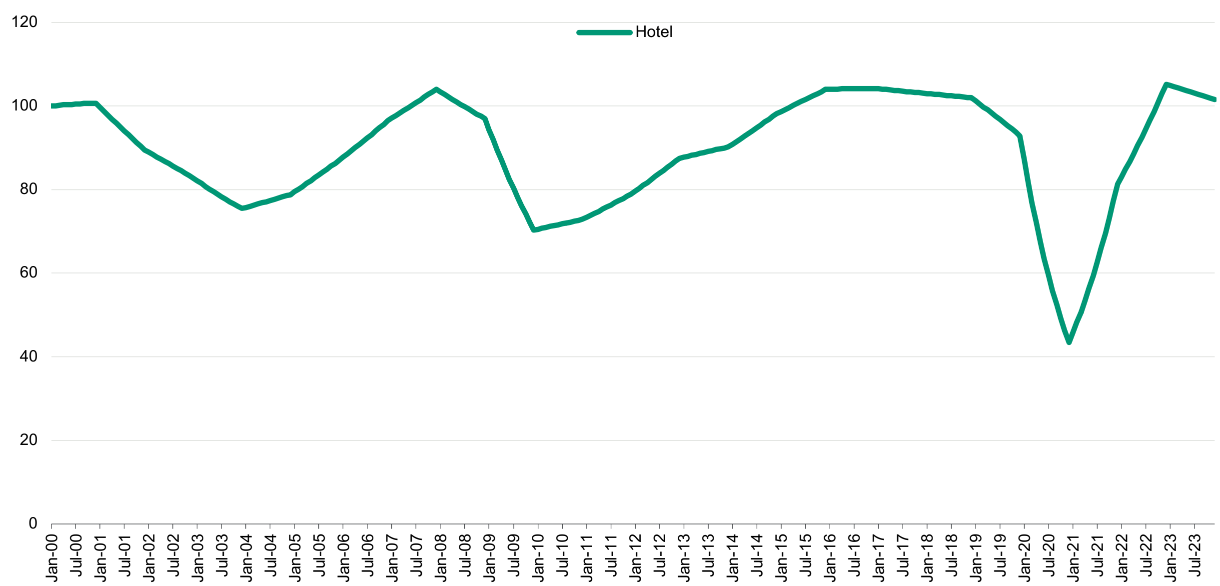
Conduit CMBS National Hotel NOI Index

Hotel was not included among the core commercial asset types rolled up into the composite due to its more operationally intensive nature. However, hotels represent a significant portion of collateral backing CMBS, consistently accounting for a double-digit share in recent quarters. Hotel NOI has been the most volatile among asset classes supporting CMBS loans, as room rates—and consequently NOI—are subject to frequent repricing, often daily. High operating expenses further amplify the impact of revenue changes on NOI, making the sector particularly sensitive to economic cycles.

During the financial crisis and especially during the COVID-19 pandemic, hotel NOI experienced extreme fluctuations, with a peak-to-trough decline of 58.7%, marking the steepest drop among asset classes. As of December 2023, hotel NOI has recovered 134% from its trough, but it remains 3.4% below its pre-COVID peak and 2.3% below its inception value. These figures highlight both the resilience and ongoing challenges faced by the hotel sector, as it continues to recover from the profound disruptions of the COVID-19 pandemic while contending with its inherent sensitivity to market conditions.

Exhibit 26

National Hotel NOI Index



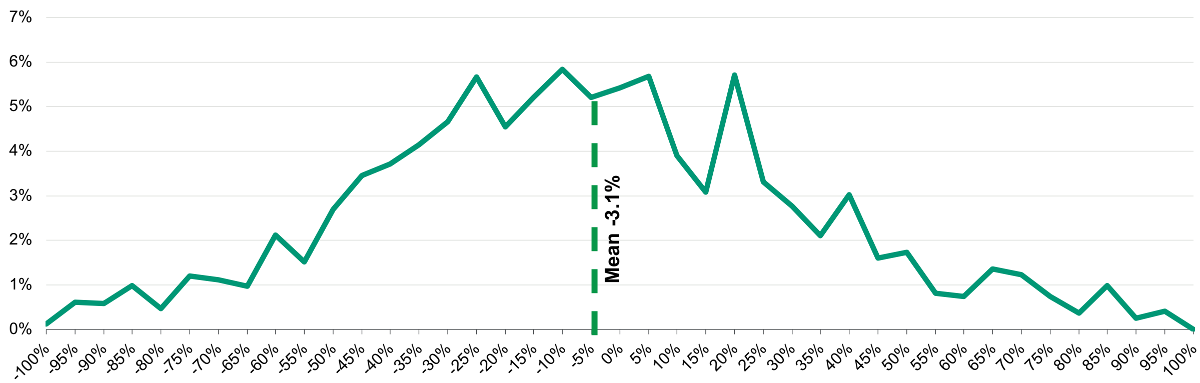
Index	Dec-22	Dec-20	Dec-18	Dec-16	Dec-13	Dec-08
	1-Year	3-Year	5-Year	7-Year	10-year	15-Year
National Hotel	-3.4%	134.0%	-0.4%	-2.5%	12.6%	4.8%

Index	Reference Month-Year	Reference Index Value	Peak-Current	Trough-Current	Peak-Trough	Inception-Current
National Hotel	Dec-23	101.6	-3.4%	134.0%	-58.7%	-2.3%

Hotel had a wide distribution of NOI changes between 2016 and 2023. While the weakest 10% of hotel performers saw NOI decline by 50% due to Covid-19, the strongest 10% of performers saw NOI increase by 46%.

Exhibit 27

National Hotel 2016-23 NOI Growth Rate Distribution



Index	Standard Deviation	Downside Deviation	Upside Deviation	10th Percentile	90th Percentile
National Hotel	37.8%	22.2%	23.8%	-49.7%	45.6%

Exhibit 28

National Hotel Summary of 2016-23 NOI Declines

	0 to -5%	-5 to -10%	-10 to -20%	-20 to -30%	-30 to -40%	-40 to -50%	< -50%
National Hotel	5.4%	10.6%	26.9%	42.3%	56.8%	68.1%	83.9%

Appendix 1: Calculating the NOI Series

The net operating income (NOI) performance of commercial real estate (CRE) plays crucial role in assessing the creditworthiness of collateral backing commercial mortgage-backed securities (CMBS). Historically, comprehensive CMBS-specific NOI data spanning multiple economic cycles was unavailable. Before the introduction of CMBS, most CRE financing occurred privately, and data on historical NOI performance was rarely disclosed. Some sources, such as the National Council of Real Estate Investment Fiduciaries, have provided over 30 years of NOI data, though these metrics predominantly represent institutional-grade assets and do not fully capture the performance of the middle-market properties often securing CMBS loans.

CMBS loan documents typically mandate borrowers to report property-level income and expenses to master servicers for credit monitoring. Approximately 90-95% of borrowers comply with this requirement annually, with some reporting quarterly. Over two decades' worth of NOI data, covering the financial crisis and subsequent recovery, has been gathered from a wide range of property types and geographic locations, resulting in robust CMBS conduit loan data representing more than $500 billion in debt.

While the NOI indices follow the reporting framework of Moody's. The NOI index covers CMBS collateral from various deal types, including Agency, Conduit/Fusion, Large Loan, and Single Asset/Single Borrower (SASB) deals, with many year-over-year observations from the same properties. To construct the NOI indices, we used NOI reported by CMBS borrowers that was processed by master servicers (typically to CREFC standards) and aggregated in our proprietary database. Our dataset includes NOI from loans securitized in CMBS deals between 2000-2023. As borrowers report NOI for the same property over the life of their CMBS loan, we can observe "same-store" nominal NOI growth (or decline) over the period between reported NOIs. To be clear, the first and subsequent observations in each series are changes in borrower-provided NOI statements; no issuer or underwritten NOIs were applied.

Our tests for a valid NOI change observation include that a loan maintains its collateral and performance profile from one reporting period to the next. In addition, to qualify for inclusion in the NOI series indices, a loan or property must meet the following criteria:

- Loan has not entered foreclosure or delinquency
- Loan is backed by the same number of properties (no releases)
- Loan has not defeased or partially defeased
- NOI must be calculated using the same methodology period-over-period such as annualized or trailing-12-months actual
- NOI values are within the 5th to 95th percentile range for their respective property type

The index is constructed using geometric growth rates, with the start period value as of 31 January 2000 benchmarked at 100. We've expanded our dataset to create a continuous monthly time series for each property, filling in missing months with the most recent available data. This allows us to capture NOI performance trends more granularly and consistently across different reporting frequencies.

To enable more nuanced analysis, we've categorized properties into broader types (Apartment, Industrial, Office, Retail, Hotel, and Other) and grouped loans by size. We've also added a core/non-core categorization, with Retail, Office, and Industrial properties classified as core, and Apartment and Hotel properties as non-core.

This comprehensive approach to data collection, processing, and categorization allows for a more detailed and accurate representation of NOI performance across various segments of the CMBS market, providing valuable insights for credit assessment and market analysis. For the purposes of this analysis, we define major markets as Boston, Chicago, Los Angeles, New York, San Francisco, and Washington.

To create composite indices, we employed a value-weighting methodology based on each component segment's long-term proportion of the total securitized loan balance. The component index returns are weighted accordingly, with potential annual rebalancing to reflect market changes. For instance, in our current dataset, retail properties in major markets represent 29% of the total retail loan balance, while those in non-major markets account for 71%. Consequently, when constructing the composite retail NOI index, we apply a 29% weight to the major market retail NOI index returns and a 71% weight to the non-major market returns. This weighting process is applied progressively to create higher-level composite indices, ultimately culminating in the national all-property NOI index.

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