LaSalle Investment Management®

Research & Strategy

Making Sense of Counterintuitive Results in NPI Data Analysis

Two Examples: Compositional Effects and Simpson's Paradox

Introduction

Custom analysis of the NCREIF property database can occasionally produce counter-intuitive results that are not the outcome of errors in the query or data, but statistical quirks. Below are two examples that may prove interesting to those tasked with querying, analyzing, and interpreting NCREIF property data. The first issue relates to the changing composition of the index over time. The second is a well-recognized statistical phenomenon, known as Simpson's Paradox, which can show up in NPI data. These are just two examples of how counter-intuitive results can sometimes be correct, and they serve as reminders of the care that must be taken when drawing conclusions from NCREIF data, particularly disaggregated data.

Example 1: Compositional Effects

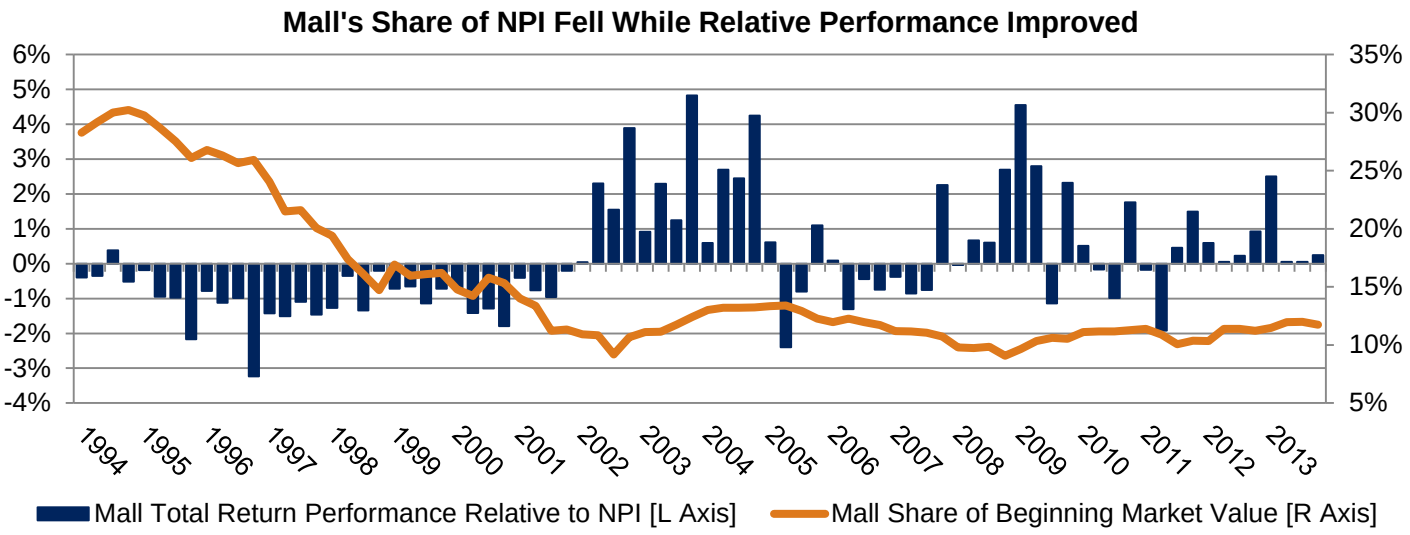
Malls, the combination of retail subtypes "Regional" and "Super regional," outperformed the NPI over the period from 1Q 1994 to 4Q 2013, a trailing 20-year return. As such, one would expect that excluding mall properties from the index would produce lower overall NPI returns. However, removing mall properties had the opposite effect: taking out this high-performing property subtype actually boosted the average annual return.

Annualized Total Returns, 1Q 1994 – 4Q 2013

Overall NPI	9.3%
Malls	10.0%
Overall NPI excl. Malls	9.5%

Excluding malls boosts NPI returns, even though malls outperformed.

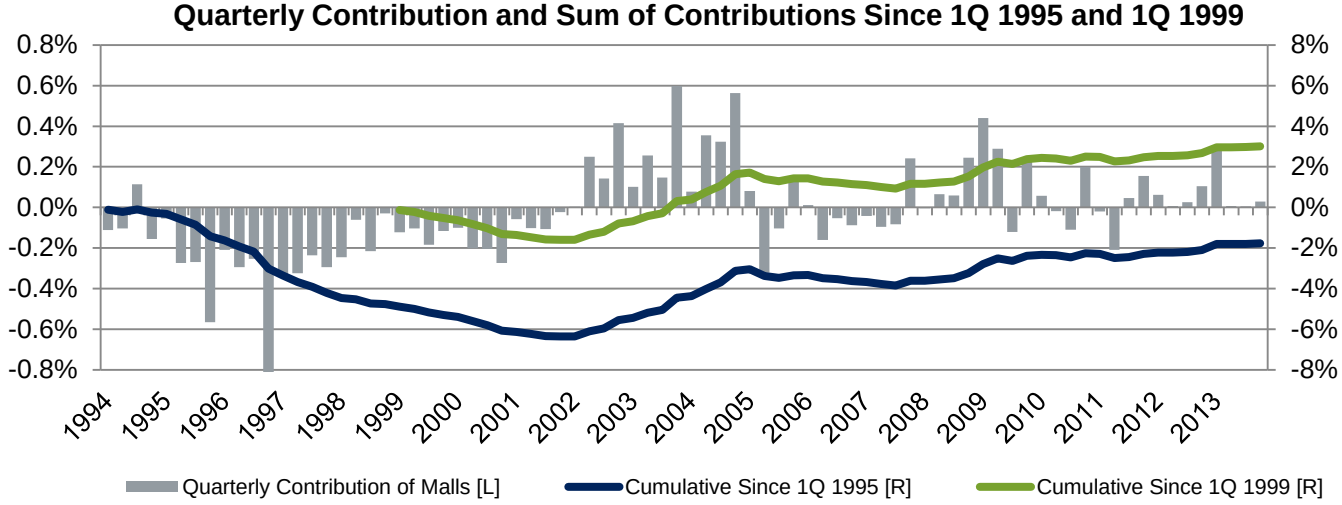
How could this be? This strange result is a due to the fact that the composition of the NPI changes every quarter, and so the weight of any given subset of properties, be it a property subtype or geography, also changes each quarter. This means that the impact of the out-/underperformance for a single property type (or any property subset) on overall NPI returns varies with time. In this case, malls have outperformed the NPI by about 70 basis points over the past 20 years. But looking at individual quarters' return relative to the broad index over the entire time frame reveals much greater variation. Malls underperformed the NPI in the late 1990s, and outperformed in most of the quarters since. However, since malls comprised 30% of the overall index in 1995 (more than office) and only 9-14% since 2001, their underperformance in the late 1990s had an outsized impact on the overall index during our reference period.



The impact of this change is illustrated by looking at the contribution to the index, which is simply the relative performance in a quarter multiplied by the share of NPI beginning market value. As shown in the table below, malls had a negative contribution of 84 bps to NPI total return in 4th quarter 1996 as they underperformed (-324 bps) and were over a quarter of the NPI. By contrast, in the first quarter of 2009 malls had a positive contribution of only 44 bps, even though they beat the index by a more significant 459 bps. This was because malls' share of the index had fallen to just 9.7%.

	Share of Beg. Market Value		Mall Total Return vs. NPI		Mall Contribution to NPI Total Return
1996 Q4	25.9%	x	**-3.24%**	=	-84 bps
2009 Q 1	9.7%	x	**4.56%**	=	44 bps

The cumulative contribution over the analysis period (shown in the chart below) illustrates the initial surprising result. And changing the start period from Q1 1994 to Q1 1999 (a trailing 15-year return) excludes quarters when negative impact from malls was greatest. The 15 year analysis yields the expected result, with the NPI getting a boost from mall



outperformance. The takeaway is that when trying to understand the relative performance of a subset of the NPI, it is important to examine both the absolute performance over the time period as well as contribution of that performance to the index, which is impacted by both performance and property type weight.

Example 2: Simpson's Paradox

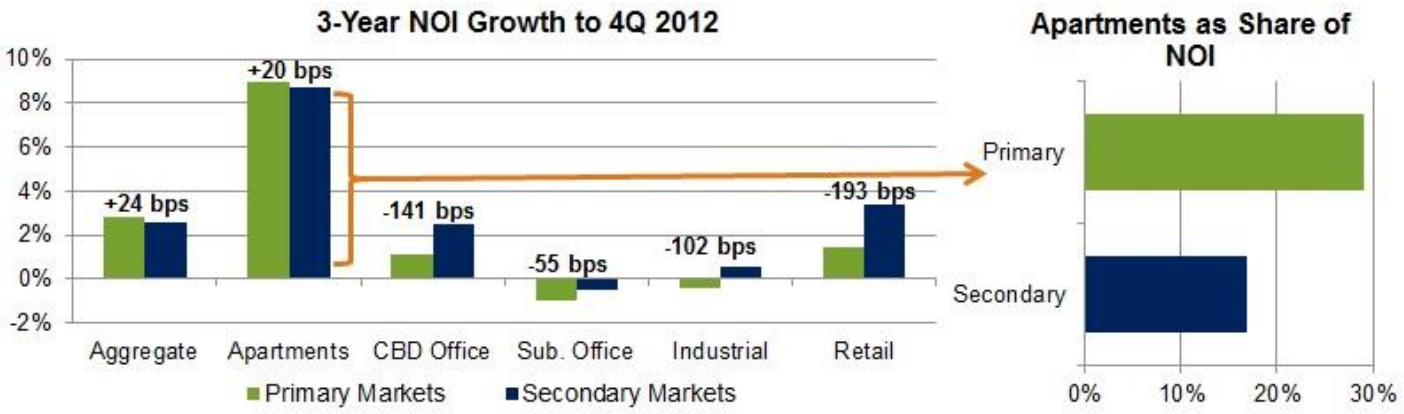
In another set of queries, we examined NOI growth across property and market types.[1] Secondary markets exhibited stronger NOI growth for every property type over the time frame with the exception of apartments, where primary markets had a slight (+20 bps) NOI growth premium.[2] For other property types, secondary market outperformance was significant, with CBD office, industrial, and retail all besting primary markets by more than 100 bps. Based on this, one would expect NOI growth for the aggregate of these property types to be stronger growth in secondary markets, but, to our surprise, the opposite was true. Primary markets outperformed secondary markets by 24 bps, even more than they had within apartments, the only property type working in primary markets' favor. This incongruous result turns out to be an example of Simpson's Paradox, a well-documented statistical phenomenon whereby a trend that appears in different subgroups disappears when those same subgroups are aggregated.

3-Year Trailing NOI Growth to 4Q 2012 in Primary and Secondary Markets

	Aggregate	Apartment	CBD Office	Sub. Office	Industrial	Retail
Primary Markets	2.8%	8.9%	1.1%	-1.0%	-0.4%	1.5%
Secondary Markets	2.6%	8.7%	2.5%	-0.5%	0.6%	3.4%
Difference	+24 bps	+20 bps	-141 bps	-55 bps	-102 bps	-193 bps

Although it was the only property type where primary markets outperformed, apartments were notable outperformers on NOI growth over this period and led the other property types by a significant margin. Annual NOI growth averaged 8.9% for apartment properties in primary markets and 8.7% for apartment properties in secondary markets. Retail was the sector with the next highest rate of NOI growth, at just 1.5% for primary markets and 3.4% for secondary markets.

[1] NOI growth as measured as a quarter-over-quarter change in same-store NOI, as provided by the "NOI Growth" drop-down query in the NCREIF Query tool.
[2] "Primary" and "secondary" are LaSalle's custom groupings of CBSA and Divisions and are specific to each property type.



Similar to Example 1, a closer look at the composition of the NPI data reveals the cause of this strange result. Because apartments so significantly outperformed the other property types over this period, they had larger positive impact on the aggregate return. As in our first example, the extent of this impact is also affected by the share of each property type in the primary and secondary buckets. Primary markets get a much larger share of their total NOI from apartments – 29% on average over than time frame – than secondary markets. Apartments accounted for just 17% of aggregate secondary market NOI over these three years. With a larger share of total NOI coming from the top performing property type, apartments, the aggregated growth rate looks better in primary markets than in secondary markets.

Final Comments

Both results discussed above are highly specific to the selected time frame. In the first example, looking at a 15 year period instead of 20 removes the years of weak performance and high relative value for malls and yields intuitive results. In the second example, the paradoxical effect disappeared over longer analysis periods. The relative performance and size of a given subset determine how that subset impacts the aggregate, and both of these factors vary over time – potentially helpful considerations when interpreting strange results in custom NCREIF queries. All of this is a reminder to be careful when doing deep analysis of the NCREIF property database as it is not a fixed set of properties, and understanding how that sample is changing can be important to the results and to reaching the correct conclusions from those results.

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