Implications of Income Property Stock Data for Real Estate Investment Portfolio Location

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How should a typical institutional investor diversify its real estate portfolio across different geographic locations? A logical starting point is to assign market value weights to each region. This interpretation is consistent with one common reading of standard capital market pricing (CAPM) theory that suggests each investor should hold (appropriately leveraged) all risky assets in proportion to their outstanding market values. (See, for example, Sharpe [1964], Lintner [1965], and Mossin [1966].) Other approaches to the portfolio selection problem recognize different investor tax situations, constraints, and heterogenous expectations; but in general these also suggest the market portfolio as a logical starting point (see Black [1972], Mayers [1972], and Lintner [1969]).

In this article we have expended some effort to determine the relative market weights that should be given to real estate in eight independent geographic areas in the U.S. Perpetual inventory methods are used to construct the stock of income-producing real estate for each of 295 metropolitan statistical areas (MSA) within eight major geographic regions. We then compare the actual real estate investments of private institutional investors (NCREIF) and real estate investment trusts (REITs) to the market value portfolio of investible real estate, as represented by these stock estimates. In practice, neither private pension fund investors nor REITs hold balanced market-value real estate portfolios. We will show later they tend to hold real estate portfolios that are heavily concentrated in high-quality locations. The bias toward quality is especially pronounced for institutional investors.

SIZE OF THE U.S. REAL ESTATE MARKET PORTFOLIO

To construct the ideal portfolio weights that would be given to real estate if an investor were to buy the market and hold, is conceptually quite simple. The critical element is to construct a reliable measure of the income property stock. Our method for estimating the value of the income property stock is described in the Appendix. The method draws heavily on the 1982 Census of government data to establish baseline estimates of the stock of real estate in 1982 and on a perpetual inventory model to solve forward for the current value of the real estate.

A second feature of the analysis is to assign a relative market weight to each location or region. Here we use the classification system developed by Hartzell, Shulman, and Wurtzebach [1987] to break real estate investment into different regions. Most real estate portfolio diversification studies break real estate investment into different Census regions and examine various portfolio possibilities for diversifying holdings across these Census regions. Hartzell, Shulman, and Wurtzebach make the point that Census regions may not

accurately reflect the locational covariance of economic fundamentals and hence returns. Thus Hartzell, Shulman, and Wurtzebach divided the U.S. into eight regions that, according to their analysis, better reflected this locational covariance.[1] The eight regions are New England, the Mid-Atlantic Corridor (parts of the mid-Atlantic states close to the Eastern seaboard), the Industrial Midwest (including much of western Pennsylvania and New York, the Great Lakes Region, Minneapolis and St. Louis), the Old South (from Virginia, south to Florida, and west to Arkansas), the Farm Belt (roughly the Great Plains region), the Mineral Extraction Area (from Louisiana to Montana, including Alaska), Southern California (including southern Nevada and Hawaii), and Northern California (including northern Nevada, and the Pacific Northwest). The eight regions are displayed in Exhibit 1.

Generally, an analysis of the economic structure of these regions leads to few surprises. The Mid-Atlantic Corridor has the highest concentration of finance and other office employment. The concentration of oil, gas, and mining jobs is preeminent in the Mineral Extraction region. The highest rate of manufacturing jobs is found in the Industrial Midwest. It is initially surprising that the Northern and Southern California regions have higher proportions of their MSA labor force in agriculture than the Farm Belt. But note that we are limiting our examination to MSAs within these regions. Most of the two California regions are contained within MSAs, as is much of their agriculture. In the Farm Belt, most of the agriculture is outside of MSAs.

Exhibit 1 presents our first basic results, the approximate income property stock estimates for the top twenty MSAs in the U.S. The top five private markets are: Los Angeles with $249 billion in income properties; New York City, with $204 billion; Chicago with $173 billion; Houston, with $146 billion; and Dallas with $102 billion. Among these MSAs, there is a good correspondence between the size of the income property stock and the size of the MSA. The simple correlation coefficient is 0.4. But just as clearly, while larger MSAs clearly have larger income property stocks *ceteris paribus,* the size of the stock is not strictly proportional to population.

In the aggregate, we estimate the private metropolitan income property stock at approximately $3.8 trillion.

EXHIBIT 1

Income Property Capital Stock for the Top 20 MSAs

MSA	Income Property Capital Stock 1998 $Million	MSA's Share of the Capital Stock for 295 MSAs	Estimated Population 1998	MSA's Share of Population for 295 MSAs	Estimated Employment 1998	MSA's Share of Employment for 295 MSAs	Region
Los Angeles	249,318	6.6%	9,719,493	4.6%	5,039,256	4.0%	Southern California
New York	203,853	5.4%	8,677,391	4.1%	4,594,414	3.7%	Mid Atlantic
Chicago	173,417	4.6%	7,792,386	3.7%	4,811,542	3.8%	Industrial Midwest
Houston	145,691	3.8%	3,848,591	1.8%	2,266,672	1.8%	Mineral Extraction
Dallas	101,776	2.7%	3,175,898	1.5%	2,161,574	1.7%	Mineral Extraction
Boston	90,383	2.4%	5,850,745	2.8%	3,527,766	2.8%	New England
Washington	86,416	2.3%	4,812,949	2.3%	3,383,137	2.7%	Mid Atlantic
San Diego	85,156	2.2%	2,922,767	1.4%	1,583,640	1.3%	Southern California
Phoenix	73,271	1.9%	2,794,075	1.3%	1,640,243	1.3%	Southern California
Oakland	71,197	1.9%	2,324,850	1.1%	1,274,348	1.0%	Northern California
Atlanta	64,624	1.7%	3,736,020	1.8%	2,443,759	2.0%	Old South
Riverside	58,809	1.6%	3,520,772	1.7%	1,276,225	1.0%	Southern California
Philadelphia	52,082	1.4%	5,012,788	2.4%	2,760,470	2.2%	Mid Atlantic
Seattle	51,513	1.4%	2,377,613	1.1%	1,701,654	1.4%	Northern California
Minneapolis	51,397	1.4%	2,856,706	1.3%	2,031,200	1.6%	Industrial Midwest
Miami	49,315	1.3%	2,143,283	1.0%	1,186,036	0.9%	Old South
Detroit	46,803	1.2%	4,316,438	2.0%	2,466,720	2.0%	Industrial Midwest
San Jose	43,332	1.1%	1,636,260	0.8%	1,070,615	0.9%	Northern California
Denver	40,032	1.1%	1,886,999	0.9%	1,278,266	1.0%	Mineral Extraction
Sacramento	39,926	1.1%	1,615,042	0.8%	895,435	0.7%	Northern California
Total, 295 MSAs	3,792,129	100.0%	211,948,635	100.0%	125,121,163	100.0%	

This estimate includes the value of multi-family housing as well as office, industrial, retail, and other miscellaneous property types. We have excluded the value of all single family housing (by far the largest component of the total real estate capital stock) and all government real estate. We have also excluded the value of all nonmetropolitan real estate and all real estate from about thirty small metropolitan areas. In Malpezzi, Shilling, and Yang we undertake a comparison to other estimates, and find that our estimate of the private metropolitan income property stock is roughly in line with other studies.

We now present market-value weightings by region. These weightings are formed by aggregating market-value weights over all MSAs within each region. The results appear in Exhibit 2. These portfolio weights are the ones considered to be perfectly diversified with a capital asset pricing model beta of 1.0.

Exhibit 2 shows that a market-value weighted real estate portfolio would have 27% of its investments in California — 11% in Northern California and 16% in Southern California. Of the remaining assets, 17% should be in Mineral Extraction states; 35% should be split evenly between the Industrial Midwest and the Old South; and 14% should be in the Mid Atlantic region. The Farm Belt and New England should have the smallest investments, 3% in the former and 4% in the latter.

Note that the market-value distribution of the income property stock is highly correlated with the distribution of population and employment, but not identical. The Industrial Midwest is significantly underweighted, relative to employment and population: it has almost a quarter of the latter, but only 18% of the income property stock. On the other hand, the Mid Atlantic region and the two California regions have more than their share of the income property stock. On all counts, the Farm Belt and New England are small relative to other regions.[2]

Finally, note that a weighted portfolio that puts exactly the same investment into each region is not consistent with a perfectly diversified market-value real estate portfolio.

SIZE OF ACTUAL PORTFOLIO WEIGHTS

At this point we would like to ask, how close do institutional investors come to holding a market-value weighted real estate portfolio? To answer this question, we have been able to obtain actual portfolio weights for institutional investment in real estate from NCREIF for the year-end 1998. We also have been able to obtain actual portfolio weights for REITs for 1998. These data are from Fidelity Management & Research Company, and are described in detail in Mahoney, McCarron, Miles, and Sirmans [1996].

We then follow Mahoney et al. and present the shares of investment in the MSAs with the largest investments for each investor type. We also present concentration ratios broadly similar to Mahoney et al. Because we have the advantage of our income property index, we also present concentration ratios based on the market value of the income property stock. Mahoney et al. were able to present some tabulations by property type, which we eschew because unfortunately our income property stock estimates are not available by property type. While we present a number of "top 10" and "top 20" lists, in addition to presenting more recent data, we also focus on regional tabulations.

EXHIBIT 2
Income Property Capital Stock by Region

Region	Number of MSAs	Income Property Capital Stock 1998 $Million	Percent	Estimated Population 1998	Percent	Estimated Employment 1998	Percent
Farm Belt	25	105,638	2.8%	6,630,000	3.1%	4,549,716	3.6%
Industrial Midwest	70	675,438	17.8%	48,243,800	22.8%	29,496,299	23.6%
Mid Atlantic	20	531,888	14.0%	33,707,600	15.9%	19,324,915	15.4%
Mineral Extraction	56	646,174	17.0%	28,528,300	13.5%	16,898,594	13.5%
New England	10	154,999	4.1%	11,065,600	5.2%	6,588,717	5.3%
Northern California	26	404,508	10.7%	17,709,400	8.4%	10,549,282	8.4%
Old South	75	656,690	17.3%	41,177,100	19.4%	24,993,937	20.0%
Southern California	13	616,794	16.3%	24,886,800	11.7%	12,719,702	10.2%
Total	295	3,792,129	100%	211,948,600	100%	125,121,163	100%

Exhibit 3 compares income property by region to estimates of the aggregate investment by institutional investors and REIT investors. As Exhibit 3 shows, we have data on $52 billion in institutional investment. This represents around 80% of total NCREIF properties. We are missing data on about thirty MSAs. Then there are some MSAs — those where there are fewer than twenty NCREIF properties and those with fewer than four NCREIF properties — where NCREIF either does not publish a sub-index or is precluded by "masking" requirements from constructing a custom-built MSA sub-index. These missing properties could skew the results, since a strong argument can be made that these properties are apt to be in regions of light NCREIF coverage. Also note that not all institutional investors are NCREIF members, so these data are a lower bound (although most large real estate managers for pension funds and similar investors belong).

The results in Exhibit 3 suggest that institutional investors invest less in the Farm Belt and the Mineral Extraction Region than market weights would suggest. The former region has almost 3% of the metropolitan income property stock and virtually no private investment, at least no private investment of sufficient size to be measured by NCREIF. The latter region has about 17% of the investible stock but only about 14% of investment. The most over-invested region is the Mid-Atlantic, although Northern California is also somewhat over-invested, according to these aggregates.

Our 295 metropolitan areas report $335 billion in stock of REIT investment in 1998. This is in line with SNL REIT Quarterly's 1998 estimate of $344 billion in total REIT capitalization for that year. This estimate of the stock of REIT investment includes the aggregate property market value of REIT total property assets.

Exhibit 3 further suggests that REITs depart from buying the market portfolio as well. The Farm Belt and Mineral Extraction region are only slightly under-invested by REITs (compared to the underinvestment by NCREIF investors), and the Mid-Atlantic region is no longer heavily over-invested. The largest divergences between REIT portfolio weights and market-value portfolio weights appear to be in the under-invested Southern California Region, and the heavily over-invested Old South. A formal analysis of variance test confirms that the differences observed in Exhibit 3 are significant.

DISTRIBUTION OF RELATIVE SHARES

Another way to examine the distribution of NCREIF direct equity investment and REIT portfolio investment, is to calculate relative shares for each metropolitan area and see if there are any strong regional patterns.

The previous study by Mahoney, McCarron, Miles, and Sirmans [1996] use population as a proxy for the size of the investible income property stock. Their "population-adjusted concentration ratio" is in effect a location quotient for investment; it is the ratio of two ratios. The numerator is each metropolitan area's share of total real estate investment by that investor type (public or private, in turn). The denominator is each metropolitan area's corresponding share of metropolitan population. Thus a location that has real estate investment of a given type proportionate to its population would have a population-adjusted concentration ratio of 1.

EXHIBIT 3

Public and Private Portfolio Investment by Region

				Private (NCREIF)			Public (REIT)		
Region	Number of MSAs	Income Property Capital Stock 1998 $Million	Percent	Metropolitan Real Estate Investment 1998 $Million	Region's Percent of MSA Private Investment	Private Investment / Income Property Stock	Metropolitan Real Estate Investment 1998 $Million	Region's Percent of MSA Public Investment	Public Investment / Income Property Stock
Farm Belt	25	105,638	2.8%	0	0.0%	0.0%	8,719	2.6%	8.3%
Industrial Midwest	70	675,438	17.8%	7,662	14.8%	1.1%	58,277	17.4%	8.6%
Mid Atlantic	20	531,888	14.0%	10,602	20.4%	2.0%	54,565	16.3%	10.3%
Mineral Extraction	56	646,174	17.0%	6,982	13.5%	1.1%	48,600	14.5%	7.5%
New England	10	154,999	4.1%	2,291	4.4%	1.5%	18,580	5.5%	12.0%
Northern California	26	404,508	10.7%	7,995	15.4%	2.0%	33,440	10.0%	8.3%
Old South	75	656,690	17.3%	8,014	15.4%	1.2%	77,220	23.1%	11.8%
Southern California	13	616,794	16.3%	8,359	16.1%	1.4%	35,525	10.6%	5.8%
Total	295	3,792,129	100.0%	51,905	100.0%	1.4%	334,926	100.0%	8.8%

In this article we extend the Mahoney, McCarron, Miles, and Sirmans analysis in several ways, most notably by using our income property stock estimates in the denominator of our concentration ratios. Once again, the numerator is each metropolitan area's share of total real estate investment by that investor type. But in our measure, the denominator is each metropolitan area's corresponding share of the income property stock. For comparison, some of the tables that follow will present both population-weighted concentration ratios as well as our preferred property value-weighted ratios.

Exhibit 4 presents the aggregate concentration ratios for investment at the regional level. That is, in the first three columns we compute the share of metropolitan public investment, private investment, and of all income property, using the sums presented in Exhibit 3. The last two columns present aggregate concentration ratios, or "location quotients," calculated by dividing each region's share of either public or private investment, by each region's share of income property. A concentration ratio of one indicates that the relevant investor type weights their investment in that region by the region's share of income real estate by value. If the concentration ratio is less than one, the investor is underweighted, in the sense of investing less in the region than it has of the nation's income property. If the concentration ratio exceeds one, proportionately investment exceeds the region's proportion of the nation's income property.

Several clear patterns emerge from Exhibit 5. First, the concentration ratio for private investors is zero in the Farm Belt. There are small institutional investments omitted from the location-specific NCREIF data base from which these data are taken, so we do not believe it likely that institutional investment in the Farm Belt is literally zero; but we are confident it is very low. At the other extreme, Mid Atlantic and New England regions are very popular with both public and private investors, with location quotients well over one all around. On the other hand, Northern California is particularly popular with private investors (1.46) while public investors invest about proportionately to the size of the market (a concentration ratio of 0.95). In the Old South, the situation is reversed, with a public investor weighting of 1.34 but a private weight of only 0.89.

Another way to examine regional differences is to compute the ratios separately for each metropolitan area and examine their distribution by region. Exhibit 5 presents summary statistics for these concentration ratios in each of our eight regions. If public and private investors bought the market portfolio, i.e., invested proportionately to the value of the income property stock, each region's concentration ratio would equal one. It follows trivially that the summary statistics presented (mean, median, first, and third quartiles) would also equal one.

We can see by immediate inspection that such is not the case. Consider the summary statistics for all regions. The mean concentration ratio for institutional investors is 0.22; and median, first and third quartiles are all zero, reflecting the fact that most MSAs within a specific region receive no measured private institutional investment. The distribution of concentration ratios for REITs — with a mean of 0.72, a median of 0.54, first quartile of 0.27, and third

EXHIBIT 4

Concentration Ratios, When Components Summed by Region

Region	Region's Percentage of Public Investment	Region's Percentage of Private Investment	Region's Percentage of Income Property	Regional Aggregate Concentration Ratio, Public Investment	Regional Aggregate Concentration Ratio, Private Investment
Farm Belt	2.6%	0.0%	2.9%	0.91	0.00
Industrial Midwest	17.4%	14.8%	18.4%	0.95	0.80
Mid Atlantic	16.3%	20.4%	13.5%	1.21	1.51
Mineral Extraction	14.5%	13.5%	17.1%	0.85	0.79
New England	5.5%	4.4%	3.4%	1.61	1.28
Northern California	10.0%	15.4%	10.6%	0.95	1.46
Old South	23.1%	15.4%	17.3%	1.34	0.89
Southern California	10.6%	16.1%	16.9%	0.63	0.95

EXHIBIT 5
Summary Statistics, MSA Concentration Ratios by Region

Region	Number of MSA Concentration Ratios		Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors	Concentration Ratios, Based on Population Private (NCREIF) Investors	Concentration Ratios, Based on Population Public (REIT) Investors
Farm Belt	25	Mean	0.00	0.59	0.00	0.57
		Median	0.00	0.51	0.00	0.45
		Q3	0.00	0.85	0.00	0.78
		Q1	0.00	0.21	0.00	0.23
Industrial Midwest	70	Mean	0.15	0.63	0.14	0.42
		Median	0.00	0.48	0.00	0.32
		Q3	0.00	0.79	0.00	0.46
		Q1	0.00	0.27	0.00	0.17
Mid Atlantic	20	Mean	0.46	1.19	0.43	0.84
		Median	0.00	1.32	0.00	0.92
		Q3	0.00	1.68	0.00	1.04
		Q1	0.00	0.45	0.00	0.44
Mineral Extraction	56	Mean	0.16	0.62	0.23	0.57
		Median	0.00	0.41	0.00	0.41
		Q3	0.00	0.84	0.00	0.76
		Q1	0.00	0.20	0.00	0.20
New England	10	Mean	0.19	0.60	0.16	0.45
		Median	0.00	0.27	0.00	0.15
		Q3	0.00	1.16	0.00	0.96
		Q1	0.00	0.00	0.00	0.00
Northern California	26	Mean	0.52	0.66	0.70	0.84
		Median	0.00	0.51	0.00	0.62
		Q3	0.00	0.97	0.00	1.22
		Q1	0.00	0.27	0.00	0.29
Old South	75	Mean	0.23	0.85	0.27	0.72
		Median	0.00	0.74	0.00	0.61
		Q3	0.00	1.11	0.00	1.06
		Q1	0.00	0.47	0.00	0.30
Southern California	13	Mean	0.40	0.51	0.60	0.73
		Median	0.00	0.36	0.00	0.38
		Q3	0.96	0.72	1.34	0.97
		Q1	0.00	0.22	0.00	0.30
Total	295	Mean	0.22	0.72	0.27	0.61
		Median	0.00	0.54	0.00	0.44
		Q3	0.00	0.99	0.00	0.83
		Q1	0.00	0.27	0.00	0.22

quartile of 0.99 — is a much wider spread of investment, but still far from the idealized market portfolio.

Exhibit 5 confirms both the regional differences discussed earlier, and the more concentrated geographic investment patterns of private investors compared to public.[3] Private investors particularly favor the Mid-Atlantic region, and are particularly adverse to the Farm Belt. Public investors concentrate their investment in the Industrial Midwest, the Mid Atlantic Region, and the Old South. Some differences do exist between the patterns discerned from Exhibit 3 and Exhibit 5. That is to be expected, since Exhibit 3 in effect weights results by the size of each market, and in Exhibit 5, each MSA, large or small, has the same weight. Thus, when broad patterns emerge from both tables, such as heavy REIT investment in the South, we can be confident of the robustness of the result.

Notice, also, that the results in Exhibit 5 are qualitatively similar, whether concentration ratios are based on the income property stock or on population. Formal t-tests reject the hypothesis that they give numerically identical results but the general qualitative pattern, by region and by public/private investor, is quite robust. For this reason, we focus on our preferred income property concentration ratios for the rest of this article.

Exhibit 5 provides a useful breakdown of investor behavior, but it is still aggregated by region. Which specific MSAs attract the greatest proportionate investment by REITs and NCREIF institutional investors? Exhibits 6 and 7 present the top twenty MSAs using our concentration ratios to measure proportionate investment activity.[4] Exhibit 6 shows that there are about a dozen MSAs with NCREIF institutional investment roughly double or more than expected on the basis of market weights; San Francisco has over five times its expected investment! It is interesting to note that most of the MSAs with the highest concentration ratios are medium sized (1-2 million population). Washington, D.C. is the largest MSA to make the top ten; Boston and Philadelphia make the top twenty. The largest MSAs like Los Angeles, New York, and Chicago are conspicuous by their absence.

For comparison, Exhibit 6 also presents REIT concentration ratios for the top twenty private markets. In general, markets that attract more than proportionate NCREIF institutional investment also do well in attracting

EXHIBIT 6

Top 20 MSAs, Income Property Concentration Ratios, Private Investors

Rank	Largest City in MSA	Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Income Property Capital Stock 1998 $Million	Estimated Population 1998	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors	Region
1	San Francisco	5.30	35,281	1,690,698	1.57	Northern California
2	Washington	4.92	86,416	4,812,949	1.79	Mid Atlantic
3	Fort Lauderdale	2.57	31,873	1,501,550	1.11	Old South
4	Austin	2.52	23,195	1,098,247	1.43	Mineral Extraction
5	Charlotte	2.49	22,259	1,358,268	1.69	Old South
6	Raleigh	2.44	18,600	1,076,090	1.71	Old South
7	Denver	2.40	40,032	1,886,999	1.61	Mineral Extraction
8	Atlanta	2.34	64,624	3,736,020	2.60	Old South
9	Memphis	2.26	15,664	1,092,993	1.95	Old South
10	San Jose	2.23	43,332	1,636,260	1.51	Northern California
11	Seattle	2.19	51,513	2,377,613	1.38	Northern California
12	Minneapolis	2.15	51,397	2,856,706	0.79	Industrial Midwest
13	Boston	1.85	90,383	5,850,745	1.62	New England
14	Indianapolis	1.84	23,607	1,512,317	5.08	Industrial Midwest
15	Dallas	1.82	101,776	3,175,898	1.15	Mineral Extraction
16	Phoenix	1.75	73,271	2,794,075	1.21	Southern California
17	Philadelphia	1.72	52,082	5,012,788	1.70	Mid Atlantic
18	Columbus OH	1.72	24,183	1,493,501	1.22	Industrial Midwest
19	Baltimore	1.63	32,103	2,550,311	1.65	Mid Atlantic
20	West Palm Beach	1.59	35,491	1,092,581	0.69	Old South

REIT investment. Only West Palm Beach and Minneapolis in the private top twenty have public concentration ratios less than one.

Exhibit 7 presents the top twenty MSAs for REIT investment. The top ten MSAs have concentration ratios at or above two. Indianapolis has roughly five times its expected investment. There are many MSAs of modest size that make the top twenty of the REIT market, although Atlanta, Tampa and Washington all make the top twenty as well. Note that, in contradistinction to the pattern in Exhibit 6, many of the top twenty REIT markets have negligible measured NCREIF institutional investment. That is, taking Exhibit 6 and 7 together, MSAs that attract a lot of NCREIF institutional investment almost always also attract a high level of REIT investment; but the converse is not necessarily true.

WHAT EXPLAINS THE DIVERGENCE FROM MARKET-VALUE WEIGHTINGS?

What explains the remarkable divergence in concentration of investment activity between institutional and REIT investors? We believe an important determinant of the difference is the varying legal liability for different investors. In making real estate investments, private pension plan investors are guided by the Employee Retirement Income Security Act (ERISA), whereas public investors are not. It has been suggested that private pension plan investors are adverse to holding low-quality stocks and bonds because ERISA holds them personally liable for losses arising from any breach of their fiduciary duty (see Del Guercio [1996]). Elsewhere we have speculated that private investors tilt their real estate investments toward quality, too (see Malpezzi and Shilling [1997]).

The quality of many investments is measured by ratings provided by agencies like Moody's, Standard & Poor's, and Fitch. Stocks, bonds, and countries are commonly rated. City governments are also rated, for the municipal bond market. But the fiscal position of cities is, in fact, different from the economic potential of metropolitan areas.[5] To our knowledge, there is little prior research on constructing an index of the quality of an area's economic fundamentals.[6]

EXHIBIT 7

Top 20 MSAs, Income Property Concentration Ratios, Public Investors

Rank	Largest City in MSA	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors	Income Property Capital Stock 1998 $Million	Estimated Population 1998	Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Region
1	Indianapolis	5.08	23,607	1,512,317	1.84	Industrial Midwest
2	Trenton	3.74	3,160	337,558	0.00	Mid Atlantic
3	El Paso	2.98	6,154	723,441	0.00	Mineral Extraction
4	Altoona	2.92	689	130,599	0.00	Industrial Midwest
5	Texarkana	2.70	1,459	124,682	0.00	Mineral Extraction
6	Atlanta	2.60	64,624	3,736,020	2.34	Old South
7	Montgomery	2.30	3,252	321,862	0.00	Old South
8	Lubbock	2.28	3,004	234,276	0.00	Mineral Extraction
9	Richmond	1.96	12,305	969,443	0.00	Old South
10	Memphis	1.95	15,664	1,092,993	2.26	Old South
11	Portland ME	1.92	3,255	259,290	0.00	New England
12	Augusta	1.92	4,046	477,094	0.00	Old South
13	Allentown	1.91	6,591	633,617	0.00	Mid Atlantic
14	Newark	1.85	16,950	1,921,888	0.00	Mid Atlantic
15	Washington	1.79	86,416	4,812,949	4.92	Mid Atlantic
16	Tampa	1.75	38,259	2,333,892	1.40	Old South
17	Kansas City MO	1.73	21,506	1,717,144	0.00	Farm Belt
18	Jacksonville FL	1.71	16,656	1,061,693	0.00	Old South
19	Raleigh	1.71	18,600	1,076,090	2.44	Old South
20	Salem OR	1.70	7,353	324,419	0.00	Northern California

For the purpose of this article, we measure MSA "quality" using the method of principal components. Each MSA is first categorized into one of two groups: high and low-quality locations. The differentiation is based on a univariate scale of market quality. The overall size of the market, economic growth, and the variance of growth (measured by employment and by real income per capita) are the main elements comprising the index. That is, investors are assumed to prefer larger markets, everything else equal; faster growing markets, everything else equal; and markets with steady growth are assumed preferred to volatile markets.

Malpezzi and Shilling [1997] formally model the locational decisions of public and private investors using this quality measure, and other variables reflecting the economic structure of metropolitan areas. Unsurprisingly, they find that the quality of the market is a powerful determinant of location decisions for both classes of investors as is economic structure. Also unsurprisingly, the effect of quality is much stronger for institutional investors, consistent with a stronger tilt to quality, also noted by Mahoney, McCarron, Miles, and Sirmans [1996], and also visible in our presentation in this article. Again, we argue that this is related to the fiduciary responsibilities that private institutional investors have.

To begin to address this issue, we present concentration ratios based on income property stock for those MSAs with the largest income property stock. See Exhibit 8. The NCREIF institutional real estate market is more concentrated in the twenty largest MSAs than the REIT market. Major differences include the large concentrations in Los Angeles, New York, Miami, Oakland, Riverside, and Sacramento for the institutional real estate market, but not for the REIT market. In contrast, wherever there is a large concentration in the REIT market, there also is a fairly sizeable concentration in the NCREIF institutional real estate market.

Our final exhibits, Exhibits 9 and 10, present data on investment levels and concentration ratios based on income property according to the "quality" of the market and geographic region. Exhibit 9 presents the key data for the top ten metropolitan areas, by quality, as well as the bottom ten.[7] While the top seven of the top ten are large metro areas, mainly with above average income and employment growth,[8] numbers eight through ten are

EXHIBIT 8

Concentration Ratios for MSAs with Largest Income Property Capital Stock

Rank	MSA	Income Property Capital Stock 1998 $Million	Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Private Investor Concentration Ratio Rank, Out of 295 MSAs	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors	Public Investor Concentration Ratio Rank, Out of 295 MSAs	Region
1	Los Angeles	249,318	1.32	26	0.51	156	Southern California
2	New York	203,853	1.02	32	0.50	160	Mid Atlantic
3	Chicago	173,417	1.56	21	0.98	75	Industrial Midwest
4	Houston	145,691	0.99	33	0.66	124	Mineral Extraction
5	Dallas	101,776	1.82	15	1.15	59	Mineral Extraction
6	Boston	90,383	1.85	13	1.62	27	New England
7	Washington	86,416	4.92	2	1.79	15	Mid Atlantic
8	San Diego	85,156	0.95	34	0.72	114	Southern California
9	Phoenix	73,271	1.75	16	1.21	50	Southern California
10	Oakland	71,197	1.27	28	0.49	163	Northern California
11	Atlanta	64,624	2.34	8	2.60	6	Old South
12	Riverside	58,809	1.21	29	0.53	152	Southern California
13	Philadelphia	52,082	1.72	17	1.70	21	Mid Atlantic
14	Seattle	51,513	2.19	11	1.38	41	Northern California
15	Minneapolis	51,397	2.15	12	0.79	102	Industrial Midwest
16	Miami	49,315	1.40	24	0.62	132	Old South
17	Detroit	46,803	0.00	121	0.74	111	Industrial Midwest
18	San Jose	43,332	2.23	10	1.51	32	Northern California
19	Denver	40,032	2.40	7	1.61	28	Mineral Extraction
20	Sacramento	39,926	1.20	30	0.40	187	Northern California

EXHIBIT 9

Concentration Ratios for MSAs by MSA Quality Index

MSA	MSA Quality Index	Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Private Investor Concentration Ratio Rank, Out of 295 MSAs	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors	Public Investor Concentration Ratio Rank, Out of 295 MSAs	Income Property Capital Stock 1998 $Million	Population 1998	Region
Top 10 Quality Metro Areas								
1 New York	4.8	1.02	32	0.50	160	203,853	8,677,391	Mid Atlantic
2 Washington	3.6	4.92	2	1.79	15	86,416	4,812,949	Mid Atlantic
3 Chicago	3.6	1.56	21	0.98	75	173,417	7,792,386	Industrial Midwest
4 Philadelphia	3.4	1.72	17	1.70	21	52,082	5,012,788	Mid Atlantic
5 San Francisco	3.2	5.30	1	1.57	31	35,281	1,690,698	Northern California
6 Boston	3.0	1.85	13	1.62	27	90,383	5,850,745	New England
7 Los Angeles	2.7	1.32	26	0.51	156	249,318	9,719,493	Southern California
8 Newark	2.6	0.00	46	1.85	14	16,950	1,921,888	Mid Atlantic
9 Nassau	2.5	0.00	84	1.03	69	27,596	2,661,827	Mid Atlantic
10 Middlesex	2.4	0.00	57	1.45	36	13,471	1,130,667	Mid Atlantic
Lowest 10 Quality Metro Areas								
295 Elkhart	-4.5	0.00	244	0.19	244	2,773	173,700	Industrial Midwest
294 Flint	-3.6	0.00	107	0.84	94	3,060	430,252	Industrial Midwest
293 Kokomo	-3.3	0.00	237	0.21	237	1,959	98,075	Industrial Midwest
292 Yuma	-3.2	0.00	198	0.36	198	2,215	143,492	Southern California
291 Richland	-2.7	0.00	56	1.45	35	3,946	177,425	Northern California
290 Lafayette LA	-2.7	0.00	217	0.28	217	3,873	361,321	Mineral Extraction
289 Merced	-2.5	0.00	284	0.04	284	4,747	218,777	Northern California
288 Kenosha	-2.4	0.00	147	0.58	142	1,574	143,223	Industrial Midwest
287 Fort Smith	-2.3	0.00	92	0.91	79	2,945	192,406	Old South
286 Melbourne	-2.3	0.00	134	0.63	128	7,467	506,911	Old South

EXHIBIT 10

Income Property, and Investment, by Region and MSA Quality Category

Region	MSA Quality Category	Number of MSAs	Income Property Capital Stock 1998 $Million	Population 1998	Private (NCREIF) Metropolitan Real Estate Investment 1998 $Million	Public (REIT) Metropolitan Real Estate Investment 1998 $Million	Concentration Ratios, Based on Income Property Stock, Private (NCREIF) Investors	Concentration Ratios, Based on Income Property Stock, Public (REIT) Investors
Farm Belt	High	13	69,015	4,832,300	0	6,638	0.00	0.61
Farm Belt	Low	12	36,623	1,797,700	0	2,080	0.00	0.58
Industrial Midwest	High	29	495,978	32,595,600	7,662	47,689	0.35	0.71
Industrial Midwest	Low	41	179,459	15,648,200	0	10,588	0.00	0.58
Mid Atlantic	High	19	529,067	33,575,300	10,602	54,464	0.49	1.24
Mid Atlantic	Low	1	2,821	132,200	0	101	0.00	0.38
Mineral Extraction	High	22	312,844	15,520,700	5,006	32,249	0.35	0.84
Mineral Extraction	Low	34	333,330	13,007,500	1,976	16,351	0.03	0.48
New England	High	9	153,574	10,959,800	2,291	18,580	0.21	0.67
New England	Low	1	1,425	105,700	0	0	0.00	0.00
Northern California	High	10	310,438	13,051,300	7,995	28,206	1.35	0.83
Northern California	Low	16	94,071	4,658,200	0	5,234	0.00	0.56
Old South	High	41	405,331	26,864,900	5,436	56,531	0.31	0.98
Old South	Low	34	251,358	14,312,200	2,578	20,689	0.15	0.69
Southern California	High	4	367,195	13,958,900	5,632	18,378	0.57	0.40
Southern California	Low	9	249,599	10,927,900	2,727	17,147	0.33	0.56
Total	High	147	2,643,442	151,359,000	44,620	262,735	0.39	0.86
Total	Low	148	1,148,688	60,589,600	7,280	72,191	0.06	0.57
Total	All	295	3,792,130	211,948,600	51,900	334,926	0.225	0.716

perhaps somewhat surprising. Newark, Nassau, and Middlesex are all in the eastern seaboard; near New York City; all three are of some size, between 1–3 million inhabitants; and all have generally strong income growth and fairly strong employment growth over the 1969-1994 period used to construct the quality index. At least, their inclusion in the top ten is a surprise to institutional investors, since the NCREIF data do not show any private investment there, at least sufficient to be reported; while the top seven all have concentration ratios above one. New York is near one, but all the rest are well above one, especially Washington (4.92) and San Francisco (5.30). Public investors are more sanguine about Newark, Nassau, and Middlesex, since the concentration ratios are above 1 for each of these three. On the other hand the public concentration ratio for New York and Los Angeles are surprisingly low, about 0.5.

The bottom ten metropolitan areas are all small in population, and generally have employment and income growth that lag the national average. Some have reasonable growth rates but above average volatility. In any event, none of the bottom ten has attracted institutional investment, at least sufficient to be measured in our index. On the other hand, all have some public investment, although Merced and Elkhart are particularly low. Richland, on the other hand, has a public concentration ratio well above one.

Exhibit 10 presents a more systematic look at the data by high and low quality (above and below the median quality index), by region. The results indicate that NCREIF institutional real estate holdings, by and large, are mostly confined to the high-quality locations in each geographic area. This is true whether looking at the aggregate investment in each cell, or the average concentration ratios in the last two columns. REIT real estate holdings, by contrast, are less concentrated in high-quality locations than private but they still tilt to quality.

CONCLUSIONS

We conclude that a broad-based index fund for real estate would have its largest concentration in California; its second largest concentration would be split evenly across the Industrial Midwest and the Old South; and its next largest concentration would be in the Mineral Extraction and Mid Atlantic regions. After that, it would have modest holdings in the Farm Belt and in New England. These are the allocations that would be optimal if investors generally were unable to predict asset prices well enough to outperform a buy-the-market-and-hold policy.

As indicated, however, no NCREIF institutional investor or REIT actually holds a market-value weighted real estate portfolio. In part this may due to asset selection based on superior forecasting. Conceivably, if NCREIF institutional investors or REIT investors have superior forecasting abilities, then they will combine risky assets in different proportions. Additionally, each NCREIF institutional or REIT investor has its own information costs and time horizons. Such differences may cause an investor to hold a more concentrated real estate portfolio. Think of the knowledge acquisition costs associated with real estate. These costs are largely fixed and upfront; once they have been incurred, real estate investment in a particular market can be expanded at very little cost. Or, alternatively, think of the transaction costs association with real estate. Because these costs can quickly become prohibitive, diversifying one's real estate portfolio efficiently is hard. Moreover, the search for good real estate investments can take up a lot of time.

One might also argue that institutional investment in real estate is influenced by non-risk factors. For example, one issue regarding real estate is whether or not institutional investors can make forecasts of expected return, of the variation of returns, and of the covariance of real estate returns with the returns from other investments that are sufficiently reliable for making an investment judgment. Others argue that there is a tendency for pension fund trustees to tilt their portfolios toward high-quality assets that are easy to defend in court in order to protect themselves from personal liability.

The evidence presented in this article clearly would suggest that both NCREIF institutional investors and REITs appear to hold real estate portfolios that are heavily concentrated in high-quality locations. The tilt toward quality is especially pronounced for NCREIF institutional investors. Of course, an argument could also be made that REIT investors should not necessarily hold a broad-based market portfolio, particularly if REIT shareholders can diversify on their own account. Instead, individual REIT investors may be better off allocating their capital where they can get the most operating scale economies and synergies with existing properties, or where their superior information tells them timing opportunities are best.

As a final point, it is worth noting that a market-value weighted real estate portfolio is the "ultimate" passive investment fund. Inasmuch as it provides a fairly simple way for ranking real estate portfolios in relation to each other. For example, if there are two real estate portfolios, A and B, we not only would like to know whether A is better (in some sense) than B but also whether A and

B are good or bad relative to some absolute standard. A market-value weighted real estate portfolio is, in theory, excellent for this latter purpose. This is because, in the end, deviations from market-value portfolio weights need to be justified based on such factors as fear that a particular market may be overdone or a belief that prospects are simply better elsewhere. A tilt towards quality may also explain significant deviations from market-value portfolio weights.

APPENDIX
Method of Estimating Relative Market Weights

OVERVIEW

The Bureau of Economic Analysis (BEA) constructs estimates of the value of the capital stock over time, including the stock of real estate (see Young and Musgrave [1980]). Unfortunately, the BEA data, and alternative series such as those constructed by Hulten and Wykoff [1980], are not disaggregated geographically. Hartzell, Pittman, and Downs [1994] estimate the real estate capital stock by county (and hence by metropolitan area) in 1989. Unfortunately due to computer problems their results are not readily available at the county or metropolitan area level for reanalysis. For this and other reasons detailed in Malpezzi, Shilling, and Yang [1998], we undertook the construction of income property stock estimates at the metropolitan level. We use 1982 Census of Government data on assessed values and market-value-to-assessed-value ratios as a baseline. With permit value data from the Census, and depreciation estimates from Young and Musgrave [1980], we then solve forward to the 1994 income property stock, using a variant of the Census' perpetual inventory valuation method. Unfortunately, due to budget cutbacks, 1994 is the last date Census provides the data required for constructing these income property stock estimates directly. We therefore extrapolate the data forward several years using MSA-specific growth rates.

More specifically, from 1989 to 1994 for each of 242 MSAs with usable data, we solved forward:

$$K_{it+1} = K_{it} + C_{it+1} - \Delta K_{it} \qquad \text{(A-1)}$$

where

K_{it} = stock of income-producing real estate for metropolitan area i in time period t;
C_{it+1} = construction in metropolitan area i during period t + 1; and
Δ = the average annual rate of economic depreciation (taken from Young and Musgrave [1980]).

and with $K_{i0} = \gamma_{i0}A_{i0}$, where γ_{i0} is the market-value-to-assessed-value ratio from the 1982 Census of Governments for metropolitan area i in the base period, and A_{i0} is the assessed value of all income-producing real estate in metropolitan area i in the base period.

To estimate capital stock contemporaneous with our other data, we then computed:

$$K_{i98} = K_{i94}(1 + \alpha_i)^4 \qquad \text{(A-2)}$$

where K_{i94} is computed as described above and α_i is the MSA-specific annual growth rate of K between 1989 and 1994.

Reliable data are available for 242 MSAs, but there are over 300 MSAs in the United States. In Malpezzi, Shilling, and Yang [1998] we then model MSA income property stock per capita as a function of economic fundamentals, including employment growth and structure, as well as supply-side constraints such as local geography and regulation. Using these results we are able to estimate the income property stock for an additional fifty-three MSAs. These 295 MSAs for which we have data comprise over 97% of the U.S. metropolitan population, and 78% of the total population of the nation.

A detailed description of the methodology, including the predictive models, can be found in Malpezzi, Shilling, and Yang [1998]. In that article we also undertake a detailed comparison of our income property stock estimates to those from other studies.

This is a good place to note some differences between our work and the previous work by Hartzell, Pittman, and Downs [1994]. Hartzell, Pittman, and Downs have data that permits them to disaggregate their capital stock measures by type of property, i.e., apartment, industrial, office, and retail. Unfortunately, our capital stock data does not permit us to disaggregate different commercial property types. We can, however, construct capital stock measures for all private real estate, single family housing, and the difference — the latter comprising multi-family housing as well as office, industrial, retail, and other miscellaneous property types. We lump all these latter types together under the rubric "income property."

Another difference between our work and the Hartzell, Pittman, and Downs study is the geographic scope of our primary data. We have primary data for 247 MSAs, and forecasts for another fifty-three. The Hartzell, Pittman, and Downs study, by contrast, has actual data on only twenty-six counties. Consequently, Hartzell, Pittman, and Downs are forced to rely on regression forecasts for the other 3,115 counties. Finally, the Hartzell, Pittman, and Downs data are for 1989. Our data are more recent.

Details of the Constructed Weights

While the basic procedure we use to construct relative market weights is conceptually quite simple, there are many specific issues concerning the actual calculations that need to be discussed.

Actual Direct Investment in Real Estate. For the capital stock estimation, we use value of permits data as a proxy for actual direct investment. We would prefer construction put-in-place,

but that is not available for geographically disaggregated areas. We examine this issue with aggregate (national) data and find, as expected, that permits and construction data are highly correlated. Especially for income property, permitted projects usually get built. Even the lags involved between permitting and construction do not make too much difference when considering annual data (lags are quite visible with monthly data).

Rate of Economic Depreciation. Errors can arise in our estimation procedure during periods where there are a large number of removals from the stock, i.e., when economic depreciation is higher than the Young-Musgrave estimate. Malpezzi, Ozanne, and Thibodeau [1987] show that depreciation rates for residential real estate vary significantly by MSA. There are no similar MSA-specific estimates for income property that we are aware of. There is a pattern for older MSAs (proxied by the share of the housing stock built pre-World War II) to have higher rates of growth of the income property stock. This is consistent with a greater need for replacement real estate in older MSAs; but since we assume constant depreciation across MSAs, this could bias our 1998 estimates of the income property stock upwards in older MSAs, and downward in newer MSAs. Thus, as we discuss in detail in Malpezzi, Shilling, and Yang, future research on MSA-specific depreciation rates for income property could yield even better estimates of the income property stock.

ENDNOTES

[1]Hartzell, Shulman, and Wurtzebach credited the well known study by Garreau [1981], but developed their own classification.

[2]The differences between regional shares of income property and shares of population are perfectly understandable. For example, Malpezzi, Shilling, and Yang [1992] model the determinants of income property per capita using the metro area as the unit of observation. They find, inter alia, that markets with higher growth rates of employment have more income property stock, as do markets with higher income levels, and markets with lower fractions of employment in manufacturing (hence higher fractions in other activities that use more real estate per employee). Each of these relationships is perfectly sensible. Now, among the regions, the Industrial Midwest has a very low employment growth rate over the study period; the regional median is about half the national median. The Midwest also has a high fraction of employment in manufacturing. On the other hand, the two California regions have employment growth rates half again the national median, and low percentages of employment in manufacturing, so they have larger income property stocks per capita. The Mid Atlantic region's employment growth rate and percentage in manufacturing is near the national norm; but median income is by far the highest of the eight regions, and this seems to drive their above-normal income property stock.

[3]This and all other qualitative statements regarding differences in table cells have been formally tested using ANOVA techniques. All reported differences are statistically significant at conventional levels.

[4]For discussion of the concentration of the dollar amount of activity in specific counties, see Shilton, Stanley, and Tandy [1996].

[5]In preliminary work, we examined the role municipal bond ratings could play in measuring the economic potential of the area. In fact, municipal bond ratings added little information to the economic fundamentals we settled on for our index, described below.

[6]Of course there is a large literature on metropolitan "quality of life" indexes, such as Roback [1982] and Gyourko and Tracy [1991]; but these are at best indirectly related to an index of the economic development potential of an area.

[7]The "bottom 10" are the last of 295 metropolitan areas for which we had data. There are some 330 metropolitan areas, so roughly 35 metropolitan areas are omitted. We believe that the great majority of these omitted areas would be ranked "low quality" if we had the data to rank them. Thus, our list of the top 10 is probably complete, but our list of the bottom 10 probably omits a number of metro areas that would be ranked lower than those listed if they were ranked.

[8]Remember that our analysis is for metropolitan areas, not central cities. Despite the general correlation of central city and suburban economic health in recent years, some U.S. central cities, such as Philadelphia, have experienced ups and downs while their overall metropolitan area has prospered. See Voith [1992].

REFERENCES

Black, F. "Capital Market Equilibrium with Restricted Borrowing." *Journal of Business*, July 1972, pp. 444-455.

Del Guercio, Diane. "The Distorting Effect of the Prudent-Man Laws on Institutional Equity Investments." *Journal of Financial Economics*, 40 (1996), pp. 31-62.

Garreau, Joel. *The Nine Nations of North America*. Houghton Mifflin, 1981.

Gyourko, Joseph, and Joseph Tracy. "The Structure of Local Public Finance and the Quality of Life." *Journal of Political Economy*, 99 (4), August 1991, pp. 774-806.

Hartzell, David J., David Shulman, and Charles Wurtzebach. "Refining the Analysis of Regional Diversification for Income-Producing Real Estate." *Journal of Real Estate Research*, 2 (2), Winter 1987, pp. 85-95.

Hartzell, David J., Robert J. Pittman, and David H. Downs. "An Updated Look at the Size of the U.S. Real Estate Market Portfolio." *The Journal of Real Estate Research*, 9 (2), Spring 1994, pp. 197-212.

Hulten, Charles R., and Frank C. Wykoff. "Economic Depreciation and the Taxation of Structures in United States Manufacturing Industries: An Empirical Analysis." In Dan Usher, ed., *The Measurement of Capital*. University of Chicago Press for NBER, 1980.

Lintner, John. "The Aggregation of Investor's Diverse Judgments and Preferences in Purely Competitive Security Markets." *Journal of Financial and Quantitative Analysis*, December 1969, pp. 347-400.

Lintner, John. "The Valuation of Risky Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets." *Review of Economics and Statistics*, 47 (1), February 1965, pp. 13-37.

Mahoney, Joseph, Shelley McCarron, Mike Miles, and C.F. Sirmans. "Location Differences in Private and Public Real Estate Investment." *Real Estate Finance*, Summer 1996, pp. 52-64.

Malpezzi, Stephen, Larry Ozanne, and Thomas Thibodeau. "Microeconomic Estimates of Housing Depreciation." *Land Economics*, 63 (4) (November 1987), pp. 373-85.

Malpezzi, Stephen, and James D. Shilling. "Institutional Investors Tilt Their Real Estate Holdings Towards Quality, Too." University of Wisconsin, Center for Urban Land Economics Research Working paper, 1997.

Malpezzi, Stephen, James D. Shilling, and Yu-Yun Yang. "The Stock of Private Real Estate Capital inn U.S. Metropolitan Areas: Measurement and Determinants." University of Wisconsin, Center for Urban Land Economics Research, 1998.

Mayers, D. "Non-Marketable Assets and the Capital Market Equilibrium under Uncertainty." Reprinted in M.C. Jensen, ed., *Studies in the Theory of Capital Markets*. New York: Praeger, 1972.

Mossin, Jan. "Equilibrium in a Capital Asset Market." *Econometrica*, 34 (4) (October 1966), pp. 768-783.

Roback, Jennifer. "Wages, Rents and the Quality of Life." *Journal of Political Economy*, 90 (December 1982), pp. 1257-1278.

Sharpe, William F. "Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk." *Journal of Finance*, 19 (3) September 1964, pp. 425-442.

Shilton, Leon, Craig Stanley, and Janet Tandy. "The Top Thirty Counties of Institutionally Owned Real Estate." *Real Estate Review*, Winter 1996, pp. 54-59.

Voith, Richard. "City and Suburban Growth: Substitutes or Complements?" *Federal Reserve Bank of Philadelphia Business Review*, September/October 1992, pp. 21-31.

Young, Allan H., and John C. Musgrave. "Estimation of Capital Stock in the United States." In Dan Usher, ed., *The Measurement of Capital*. University of Chicago Press for NBER, 1980.