

Introduction to Property Market Indexes

Produced by Dr. Amett Ametefe
Senior Lecturer in Property Investment and Finance
Department of Construction Economics and Management
University of Cape Town

Presented by Garth Wilson



Criticisms of Price Weighted Series

- The idea is similar to assuming an investment of one share per stock
- Places more weight on higher-priced stocks rather than those with higher market values
- Introduces a downward bias by reducing weight of growing companies whose stock splits
- Divisor changes frequently to account for stock splits and firms being replaced (divisor in 2025 has reduced to 0.1475 for the DJIA from the initial divisor of 30)

Value Weighted Index Series

- A value weighted index is generated by deriving the initial total market value (market capitalisation) of all stocks used in the series. This value is obtained as follows:

Market Value = Number of shares outstanding × Current market price

- The initial figure is typically established as the base and assigned an index value (the most popular beginning index is 100).
- Subsequently a new market value is computed for all securities in the index, and the current market value is compared to the initial 'base' value to determine the percentage change, which in turn is applied to the beginning value.

Value Weighted Series

- The rate of return of the index equals the rate of return that would be earned by an investor holding a portfolio of all firms in the index in proportion to their market values.
- The index does not reflect cash dividends paid by the firms.
- Most indexes today use a modified version of market-value weights.
- Rather than weighting by total market value, they may weight by the market value of free float, that is, by the value of shares that are freely tradable among investors, for example. This procedure does not count shares held by founding families or governments.

Value Weighted Series

$$Index_t = \frac{\sum P_t Q_t}{\sum P_b Q_b} \times \text{Beginning Index Value}$$

Where:

$Index_t$ = index value on day t

P_t = ending price for stocks on day t

Q_t = number of outstanding or freely floating shares on day t

P_b = ending price for stocks on base day

Q_b = number of outstanding or freely floating shares on base day

Example 1

- Construct a value-weighted index for a portfolio containing the two stocks ABC REIT and XYZ REIT. Set the initial index to 100.

Stock	Initial Price	Final Price	Shares (millions)
ABC	25	30	20
XYZ	100	90	1

Example 1 (Answer)

Stock	Initial Price	Final Price	Shares (millions)	Initial Value (millions)	Ending Value (millions)
ABC	25	30	20	500	600
XYZ	100	90	1	100	90
Total				600	690

- Assuming initial index value of 100 then,
- $$\text{New Index Value} = \frac{690,000,000}{600,000,000} * 100 = 115$$
- Unlike the price-weighted index, the value weighted index gives more weight to ABC.
- The value weighted index gives ABC (500m) five times the weight of given to XYZ (100m)
- Whereas the price-weighted index would have fallen because it was dominated by XYZ, the value weighted index rises because it gives more weight to ABC.

Example 2

- Calculate the one-year value weighted index given the following information:

REIT Name	Units (m)	Initial Price/Share	New Price/Share
Orange REIT	5	107	116
Macrotough REIT	7.75	55	62
Enout	4	75	91
Draintree	0.5	660	750
Smith	2.75	100	115

Example 2 (Answer)

- Beginning Value of Index

$$= (5 \times 107) + (7.75 \times 55) + (4 \times 75) + (0.5 \times 660) + (2.75 \times 100)$$

$$= 1,866.25$$

We can set divisor to make beginning Index Value 100:

$$\frac{1,866.25}{d} = 100$$

$$d = \frac{1,866.25}{100} = 18.6625$$

Beginning Value of index = 100.

Example 2 (Answer)

- Ending Value of Index

$$= (5 \times 116) + (7.75 \times 62) + (4 \times 91) + (0.5 \times 750) + (2.75 \times 115)$$

$$= 2,115.75$$

Dividing by the denominator set:

$$= 2,115.75/18.6625 = 113.37$$

$$\text{Return} = \frac{2,115}{1,866.25} - 1 = 0.13337 \text{ OR}$$

$$\text{Return} = \frac{113.37}{100} - 1 = 0.13337$$

Example 2 (Answer)

REIT Name	Units (m)	Initial Price/Share	New Price per share	Initial Value	New Value
Orange	5	107	116	535	580
Macrotough	7.75	55	62	426.25	480.5
Enout	4	75	91	300	364
Draintree	0.5	660	750	330	375
Smith	2.75	100	115	275	316.25
Value of Index 1				1866.25	2115.75
Value of index 2				100	113.37
Divisor				18.66	18.66
Change in index value 1					13.37%
Change in index value 2					13.37%

Example 3

- An index is made up of two constituent securities – Stock A and Stock B.
- a) Calculate the value of the divisor that must be used to achieve a beginning index value of 1,000.
- b) Construct a Value Weighted Return Index using the data below:

	No. of shares (m)	Initial Price/Unit	New Price/Unit
Stock A	50	10	11
Stock B	30	100	24

***Stock B had a 5:1 forward stock split during the course of the year**

Example 3 (Answer)

- Variables after stock split:

	No. of shares (m) after split	Initial Price/Unit after split	New Price/Unit after split
Stock A	50	10	11
Stock B	150	20	24

- Note that you only need to adjust the initial price and number of shares to reflect the effect of the stock split. The New stock price is only known at the end of the period.

Example 3 (Answer)

- Index Value after Stock Split:

	No. of shares (m) after split	Initial Price/Unit after Split	New Price/Unit after split	Initial Value	New Value
Stock A	50	10	11	500	550
Stock B	150	20	24	3000	3600
Index Value				3500	4150
Divisor				3.5	3.5
Index value				1000	1185.714

Example 4 - Try

- Construct a value-weighted index using the information below for Stocks A, B and C. Set the base index to 100.

REIT	No. of Shares	Price (T)	Price (T+1) Scenario 1	Price (T+1) Scenario 2
A	1,000,000	10	12	10
B	6,000,000	15	15	15
C	5,000,000	20	20	24

Total Return Indexes

- A Total Return Index tracks the performance of a group of stocks by assuming that all cash distributions such as dividends are reinvested, in addition to tracking the price movements.

$$\textit{Total Return} = \textit{Portfolio Value} + \textit{Portfolio Income}$$

Example 1

- Construct a total return index for a portfolio containing the two stocks ABC and XYZ. Set the initial index to 100.

Stock	Initial Price (R)	Ending Price (R)	Shares (millions)	Dividend per share (R)
ABC	25	30	20	0.25
XYZ	100	90	1	2.4

Example 2 (Ans)

- Beginning Portfolio Value

$$= (25 \times 20) + (100 \times 1)$$

$$= 500 + 100 = 600$$

We can set a divisor to make the beginning Index Value 100:

$$\frac{600}{d} = 100$$

$$d = \frac{600}{100} = 6$$

Beginning Value of index = 100.

Example 2 (Ans)

- Ending Portfolio Value

$$= (30 \times 20) + (90 \times 1)$$

$$= 600 + 90 = 690$$

- Portfolio Income

$$= (0.25 \times 20) + (2.4 \times 1)$$

$$= 7.40$$

- Total Return = $690 + 7.40 = 697.40$

Dividing by denominator of 6

$$697.40/6 = 116.23$$

Example 1 (Answer)

Stock	Number of Shares	Beginning Price	Ending Price	Dividend per share	Initial Portfolio Value	Ending Portfolio Value	Portfolio Income	Ending Market Value
ABC	20	25	30	0.25	500	600	5	605
XYZ	1	100	90	2.4	100	90	2.4	92.4
Total					600	690	7.4	697.4
Divisor					6	6		6
Index					100	115.00		116.23
Value Weighted Price Return						15.00%		
Total Return								16.23%

Example 2

- Calculate the total return index given the following information:

REIT Name	Units (m)	Initial Price/Share	Ending Price/Share	Dividend
Orange	5	107	116	2.15
Macrotough	7.75	55	62	1.20
Enout	4	75	91	2.70
Draintree	0.5	660	750	0.00
Smith	2.75	100	115	3.00

Example 2 (Ans)

- Beginning Portfolio Value

$$= (5 \times 107) + (7.75 \times 55) + (4 \times 75) + (0.5 \times 660) + (2.75 \times 100)$$

$$= 1,866.25$$

We can set divisor to make beginning Index Value 100:

$$\frac{1,866.25}{d} = 100$$

$$d = \frac{1,866.25}{100} = 18.66$$

Beginning Value of index = 100.

Example 2 (Ans)

- Ending Portfolio Value

$$= (5 \times 116) + (7.75 \times 62) + (4 \times 91) + (0.5 \times 750) + (2.75 \times 115)$$

$$= 580 + 480.5 + 364 + 375 + 316.25 = 2115.75$$

- Portfolio Income

$$= (5 \times 2.15) + (7.75 \times 1.20) + (4 \times 2.70) + (0.5 \times 0) + (2.75 \times 3)$$

$$= 10.75 + 9.30 + 10.80 + 0 + 8.24 = 39.09$$

- Total Return = $2,115.75 + 39.09 = 2,154.84$

Dividing by denominator of 18.6625

- $2,154.84/18.6625 = 115.46$

Example 2 (Ans)

REIT Name	Initial Value	New Value	Total Dividend	New Value + Total Dividend
Orange	535	580	10.75	590.75
Macrotough	426.25	480.5	9.3	489.8
Enout	300	364	10.8	374.8
Draintree	330	375	0	375
Smith	275	316.25	8.25	324.5
Total	1866.25	2115.75		2154.85
Divisor	18.6625	18.6625		18.6625
Index	100	113.37		115.46
Value Weighted Price Return		13.37%		
Total Return				15.46%

Example 3

- Construct a Total Return Index using the data below:

REIT Name	Price (2002)	Price (2003)	Dividend	No. of Shares
Lyttleton REIT	3.5	4.3	0.15	200
Whakatane REIT	6	5.9	1.1	50
Raglan Construction Limited	5.3	5.4	1.25	15
Greymouth Property Investment	19	20	3	12
Gore Developers	22	22	2	23

Example 3 (Answer)

REIT Name	Value (2002)	Value (2003)	Total Dividend	Value (2003) + Dividend
Lyttleton REIT	700	860	30	890
Whakatane REIT	300	295	55	350
Raglan Construction Limited	79.5	81	18.75	99.75
Greymouth Property Investment	228	240	36	276
Gore Developers	506	506	46	552
Value	1813.5	1982		2167.75
Divisor	1.8135	1.8135		1.8135
Value Weighted Price Return Index	1000	1092.91		
Total Return Index				1195.34
Value Weighted Price Return		9.29%		
Total Return				26 19.53%



Computing Price Returns from Price Indexes

- The return on a price index is the percentage change in the index from one period to the other.
- Given a Price Index, the Price Return can be calculated as follows:

$$\text{Price Return}(PR_t) = \frac{PI_t}{PI_{t-1}} - 1$$

Where:

PR_t = Price return for current period

PI_t = Current price index

PI_{t-1} = Previous price index

Computing Total Returns from Total Return Indexes

- Similarly, given a Total Return Index, the Total Return Can be calculated as follows:

$$\text{Total Return}(TR_t) = \frac{TRI_t}{TRI_{t-1}} - 1$$

Where:

TR_t = Total return for current period

TI_t = Current total return index

TI_{t-1} = Previous total return index

Compiling Price Indexes from Price Return Data

- To compile a price index from a price return series, do the following:
 1. Select a convenient starting index value such as 100. This is the beginning index. You need to also decide on the base year.
 2. For subsequent periods, use the following formula to compute the index value:

$$PI_t = PI_{t-1}(1 + PR_t)$$

where:

PI_t = Current price index

PI_{t-1} = Previous price index

PR_t = Price return for current period

- Remember to convert the price returns to decimal form before adding to 1.

Compiling Total Return Indexes from Total Return Data

- To compile total return index from a total return series, do the following:
 1. Select a convenient starting index value such as 100. This is the beginning index. You need to also decide on the base year. Note that, in constructing return indexes, the base year can be set one period before the date that the first return data is available.
 2. For subsequent periods, use the following formula to compute the index value:

$$TRI_t = TRI_{t-1}(1 + TR_t)$$

where:

TR_t = Total return for current period

TI_t = Current total return index

TI_{t-1} = Previous total return index

Example 1

- Below is a sample quarterly price index series drawn from the South African Listed Property (SAPY) Index:

Exchange Date	Price Index
31-Dec-20	272.98
31-Mar-21	286.87
30-Jun-21	315.16
30-Sep-21	327.28
31-Dec-21	331.46

- Compute the quarterly price returns from the index series above.
- Rebase the index to a starting value of 100.
- Calculate the arithmetic mean and geometric mean returns for the series

Example 1a (Ans)

Exchange Date	Close	Price Returns
31-Dec-20	272.98	
31-Mar-21	286.87	5.088%
30-Jun-21	315.16	9.862%
30-Sep-21	327.28	3.846%
31-Dec-21	331.46	1.277%

Example 1a (Ans)

Exchange Date	Price Return	Rebased Index	Price Return (New)
31-Dec-20		100.00	
31-Mar-21	5.0883%	105.09	5.0883%
30-Jun-21	9.8616%	115.45	9.8616%
30-Sep-21	3.8457%	119.89	3.8457%
31-Dec-21	1.2772%	121.42	1.2772%

Example 1b (Ans)

	$\sum r_i =$	0.200728
	$n =$	4
Arithmetic mean =	$\sum r_i / n$	0.050182
Arithmetic Mean using excel =	= average(r_1, r_n)	0.050182
Product =	$\prod HPR$	1.214228
Geometric Mean =	$(\prod HPR)^{1/n-1}$	0.049724
Geometric Mean using excel =	=geomean(r_1, r_n)-1	0.049724

Example 2

- Below is a sample annual total returns for the South African Property (SAPY) Index:

Year	Total Return
2015	8.3823
2016	7.8901
2017	7.8017
2018	8.0355
2019	7.9573

- Construct an annual total return index from the returns given above, use a starting index of 100; base year should be set to 2014.
- Calculate the average total return using both the Arithmetic and Geometric Mean Approaches.

Example 2a - Answer

Year	Total Return	Index
2015	8.3823	1000
2016	7.8901	1078.90
2017	7.8017	1163.07
2018	8.0355	1256.53
2019	7.9573	1356.52

Example 2b - Answer

Year	Total Return	HPR
2015	8.3823	1.083823
2016	7.8901	1.078901
2017	7.8017	1.078017
2018	8.0355	1.080355
2019	7.9573	1.079573

Example 2b - Answer

Arithmetic Mean:	
Sum	40.0669
n	5
Arithmetic Average	8.0134
Arithmetic Average (Excel)	8.0134
Geometric Mean:	
Product	1.4702
n	5
Geometric mean	8.0132
Geometric Mean (Excel)	8.0132

Example 3

- The table below shows the annual total returns of the IPD SA All Property Index over the period 2014-2018:

Year	Total Return Index
2014	2004.98
2015	2073.76
2016	2265.46
2017	1905.44
2018	1855.04

- a) Compute the annual total returns from the index series above.
- b) Rebase the index to a starting value of 100. Base year should be set to 2014.
- c) Calculate the average total return using both the Arithmetic and Geometric Mean Approaches.

Example 3a (Ans)

Year	Total Return Index	Total Returns	Rebased Index	HPR
2014	2004.98		100.00	
2015	2073.76	0.034305	103.43	1.034305
2016	2265.46	0.092441	112.99	1.092441
2017	1905.44	-0.158917	95.04	0.841083
2018	1855.04	-0.026451	92.52	0.973549

Example 3b (Ans)

Arithmetic Mean	
Sum	-0.058622
n	4
Average	-0.014656
Average (Excel)	-0.014656
Geometric Mean:	
Product	0.925216
Geometric mean	-0.019244
Geometric Mean (Excel)	-0.019244

QUESTIONS

amett.ametefe@uct.ac.za