New Zealand Consumers Price Index – an empirical analysis of the frequency and level of weight updates

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1. Abstract

The New Zealand consumers price index (CPI) is reweighted once every three years, at the most-detailed (or basket) level of about 700 goods and services. Some countries update CPI weights more frequently than others, with these updates occurring at different levels of the hierarchical classification structure.

Following the two most recent CPI reweights, Statistics New Zealand retrospectively estimated the impact of upper-level substitution by compiling analytical superlative index time series. This paper builds on and expands that work, by presenting analytical CPI time series involving reweighting at different frequencies and at different levels of the hierarchical index structure. The paper looks at the impact that the different reweighting options might have had on the New Zealand CPI.

Statistics New Zealand made this work available to the Australian Bureau of Statistics to help inform discussion in Australia about the frequency of weight updates.

2. Introduction

This paper was prepared to help inform discussion about the frequency of consumer price index (CPI) weight updates, an issue being considered by the 16th Series CPI Advisory Group as part of the Australian Bureau of Statistics' review of the Australian CPI.

The New Zealand CPI is reweighted once every three years, on average, to ensure that the expenditure weights allocated to the basket of representative goods and services continue to reflect the relative importance of goods and services acquired by households for consumption purposes.

The three most recent reweights, which were implemented in 2002, 2006, and 2008, were based on the 2000/01, 2003/04, and 2006/07 Household Economic Surveys (HES) and a number of other information sources.

The 2006 reweight was implemented one year later than usual because of a decision to delay (by one year) both the 2003/04 HES and the CPI Revision Advisory Committee review. The HES decision was subsequently reversed, but this was made too late to convene the CPI Revision Advisory Committee in 2003, as originally planned. The most recent HES was conducted from July 2009 to June 2010. The 2009/10 HES will be used to reweight the CPI in 2011.

The delayed reweight in 2006 meant that the updated weights implemented in 2002 were used for four years and the updated weights implemented in 2006 were used for two years. The 2008 weights will be used for the usual three years.

Once each new set of CPI expenditure weights has been calculated, it is possible to make use of the existing and new weights to compile a 'superlative' index time series on a retrospective basis. Such a series might provide an indication of the effect of commodity substitution on the fixed-weight CPI (which occurs when households react to changes in relative prices by choosing to reduce purchases of goods and services showing higher relative price change, and instead buy more of those showing lower relative price change). The resulting superlative index would also reflect changes and improvements in the methods and data sources used to derive the expenditure weights.

It is also possible to look at how the CPI might have tracked had a scheduled reweight not occurred.

This paper – which draws on and extends work published by Statistics NZ in 2007 and 2008 (Statistics NZ, 2007 & 2008) – presents results of Laspeyres-type index time series calculated for four scenarios and a retrospective superlative index time series between the June 2002, June 2006, and June 2008 quarter 'price reference' periods. Expenditure weights as at the June 2002 and June 2006 quarters were used to compile the superlative index series from the June 2002 quarter to the June 2006 quarter, and expenditure weights as at the June 2006 and June 2008 quarters were used to compile the superlative index series from the June 2006 quarter to the June 2008 quarter.

3. The scenarios

Time series were compiled for four scenarios that cover different combinations of the frequency of weight updates and the level in the hierarchical CPI structure of weight updates.

The hierarchical commodity classification used for the New Zealand CPI is based on the international standard Classification of Individual Consumption According to Purpose.

The New Zealand classification comprises groups, subgroups, classes, sections, subsections, items, and subitems. There are just over 100 classes and nearly 700 subitems. The New Zealand class level corresponds closely to the Australian CPI expenditure class level.

The New Zealand CPI weight updates are undertaken at the subitem level and generally held fixed between the three-yearly reviews.

Scenario 1: Frequent weight updates at subitem level and above
This scenario reflects the current situation in New Zealand, with subitem-level expenditure weight updates implemented at the June 2002, 2006, and 2008 quarters. In addition to the regular Laspeyres-type index, Paasche and Fisher time series have been calculated retrospectively.

Scenario 2: Frequent weight updates at class level and above; infrequent weight updates within class
This scenario models the situation where expenditure weights are updated as frequently as possible at the class level and above (ie 2002, 2006, and 2008), while the quantity shares below class level remain fixed (between 2002 and 2008). This scenario minimises the effect on the time series of shifts in the relative importance of classes. When compared with scenario 1, this scenario provides an indication of the effect on the time series of within-class commodity substitution not mitigated by updating quantity shares below the class level in 2006.

Scenario 3: Infrequent weight updates at class level and above; frequent weight updates within class
This scenario models the situation where expenditure weights are updated infrequently at the class level and above (ie 2002 and 2008), while the quantity shares below class level are updated more frequently (ie 2002, 2006, and 2008). This scenario minimises the effect on the time series of commodity substitution within classes. When compared with scenario 1, this scenario provides an indication of the effect on the time series of shifts in the relative importance of classes not mitigated by updating quantity shares at the class level and above in 2006.

Of the four scenarios, scenario 3 most closely resembles the Australian situation, whereby expenditure class weights (and above) are updated six-yearly, and lower-level quantity shares are reviewed on an ongoing basis.

Scenario 4: Infrequent weight updates at all levels
This scenario models the situation where the CPI quantity shares remain fixed at all levels for six years (from 2002 to 2008). Comparing the scenario 1 and scenario 4 Laspeyres series provides an indication of the impact on the time series of updating the New Zealand CPI weights at six-yearly rather than three-yearly intervals.

4. Results

Table 1 shows the Laspeyres time series for June quarters from the June 2002 quarter to the June 2008 quarter for each of the four scenarios, and the scenario 1 Fisher time series. At the June 2008 quarter, the differences between the Laspeyres indexes under the four scenarios ranged from 0.4 of an index point to 0.9 of an index point.

Table 1

Consumers Price Index
Analytical all-groups – index numbers
Base: June 2002 quarter (=100.0)

Laspeyres	**Jun 02**	**Jun 03**	**Jun 04**	**Jun 05**	**Jun 06**	**Jun 07**	**Jun 08**
Scenario 1	100.0	101.3	103.4	106.1	110.3	112.4	117.0
Scenario 2	100.0	101.3	103.4	106.1	110.3	112.6	117.4
Scenario 3	100.0	101.3	103.4	106.1	110.3	112.8	117.5
Scenario 4	100.0	101.3	103.4	106.1	110.3	113.0	117.9
Fisher	**Jun 02**	**Jun 03**	**Jun 04**	**Jun 05**	**Jun 06**	**Jun 07**	**Jun 08**
Scenario 1	100.0	101.1	103.0	105.5	109.6	111.5	115.8

The scenario 1 Laspeyres series rose 17.0 percent from the June 2002 quarter to the June 2008 quarter, compared with 17.4, 17.5, and 17.9 percent respectively for scenarios 2, 3, and 4.

Over the two years that the Laspeyres indexes could potentially show differences, the scenario 1 Laspeyres series rose 6.1 percent from the June 2006 quarter to the June 2008 quarter, compared with 6.4, 6.5, and 6.9 percent respectively for scenarios 2, 3, and 4.

In terms of the frequency and level at which weight updates occur, the Fisher index calculated under scenario 1 might be considered the best approximation of how the 'true' time series might have tracked (as it makes fuller use of the available weighting information).

Figure 1 shows that the differences between the scenario 1 Fisher series and the Laspeyres series for each of the four scenarios grew over time.

Figure 1

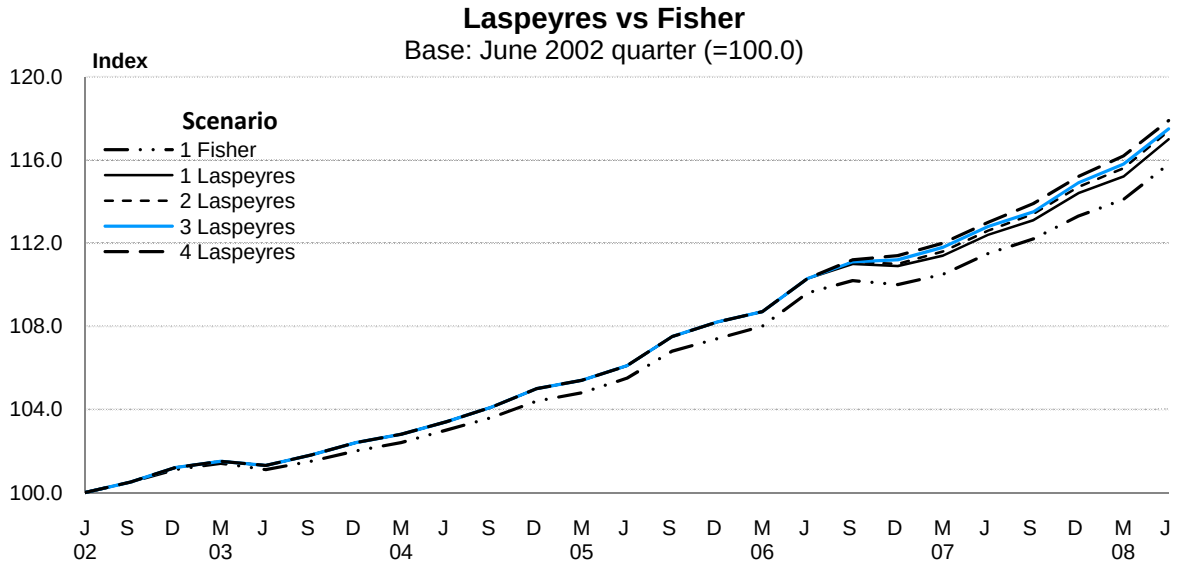


Table 2 and figure 2 show the differences between the Laspeyres series for each of the four scenarios and the scenario 1 Fisher series. As expected, the scenario 1 Laspeyres series was the closest to the scenario 1 Fisher series, being 1.2 index points higher at the June 2008 quarter. The scenario 4 Laspeyres series was the furthest from the scenario 1 Fisher series, being 2.1 index points higher at the June 2008 quarter. The Laspeyres series under scenarios 2 and 3 were 1.6 index points and 1.7 index points respectively higher than the Fisher series (scenario 1) at the June 2008 quarter.

Table 2

Consumers Price Index

Analytical all-groups – index numbers and index points difference

Base: June 2002 quarter (=100.0)

June quarter	Scenario 1 Fisher	Laspeyres 1 difference[(1)]	Laspeyres 2 difference[(1)]	Laspeyres 3 difference[(1)]	Laspeyres 4 difference[(1)]
2002	100.0	0.0	0.0	0.0	0.0
2003	101.1	0.2	0.2	0.2	0.2
2004	103.0	0.4	0.4	0.4	0.4
2005	105.5	0.6	0.6	0.6	0.6
2006	109.6	0.7	0.7	0.7	0.7
2007	111.5	0.9	1.1	1.3	1.5
2008	115.8	1.2	1.6	1.7	2.1

1. Laspeyres for relevant scenario minus scenario 1 Fisher.

Figure 2

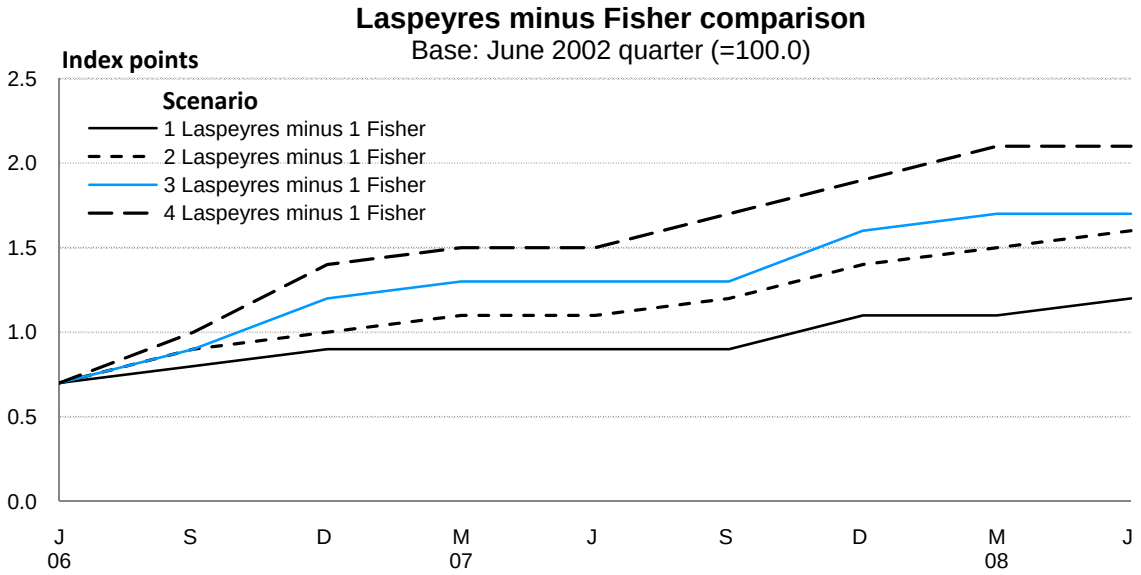
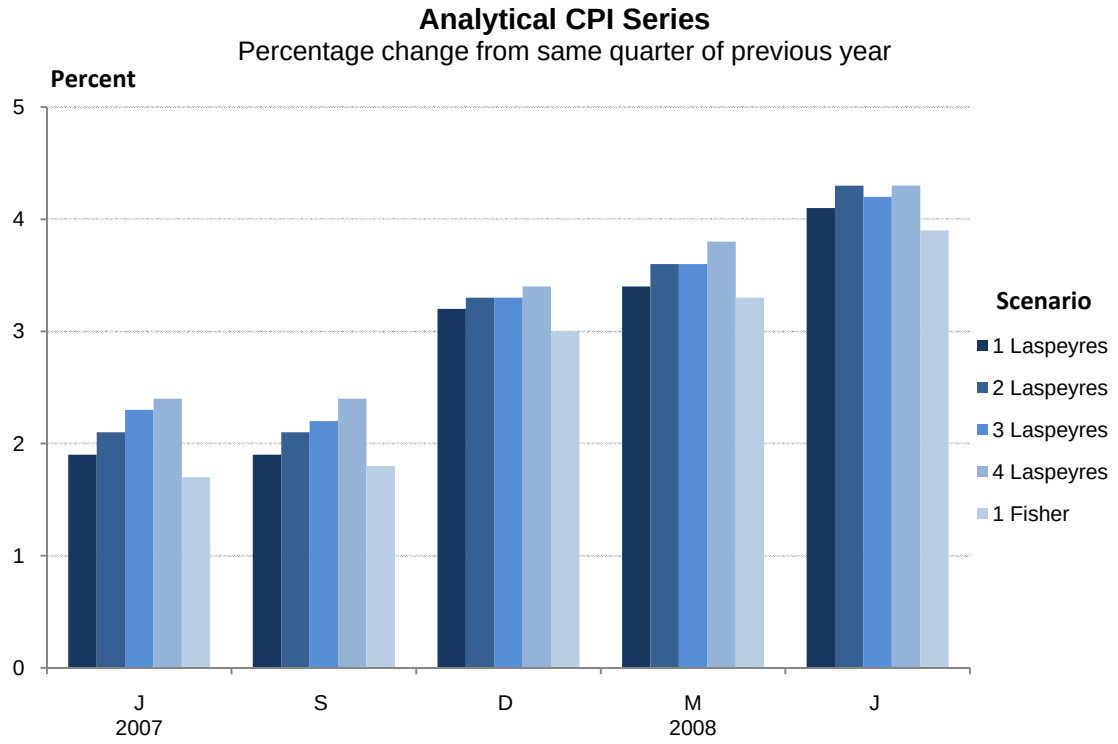


Figure 3 shows the annual percentage changes for the four Laspeyres series and the scenario 1 Fisher series. Compared with the scenario 1 Fisher series, the four Laspeyres series showed differences ranging from 0.1 of a percentage point higher to 0.7 of a percentage point higher.

Figure 3



The scenario 1 Laspeyres series rose by an annual average rate of 3.0 percent from the June 2006 quarter to the June 2008 quarter, compared with 2.8 percent for the scenario 1 Fisher analytical series, a difference of 0.2 of a percentage point per year. This result is broadly consistent with international studies.

Table 3 shows that the scenario 2 and 3 Laspeyres series each increased by an annual average of 3.2 percent over the two-year period.

The scenario 4 Laspeyres series showed an annual average increase of 3.4 percent over the two-year period.

Table 3

Analytical CPI Series

Annual average percentage change from June 2006 quarter to June 2008 quarter

Scenario	Percentage change
1 Laspeyres	3.0
2 Laspeyres	3.2
3 Laspeyres	3.2
4 Laspeyres	3.4
1 Fisher	2.8

All four of the Laspeyres series are identical between the June 2002 quarter and the June 2006 quarter. Differences appear after the June 2006 quarter, when different weight-update scenarios take effect. Table 4 shows the differences between the scenario 1 Laspeyres and the Laspeyres series for each of the three other scenarios.

The biggest difference overall was for the scenario 4 series, which was up to 1.0 index point higher than the scenario 1 series over the two-year period from the June 2006 quarter to the June 2008 quarter. In comparison, scenarios 2 and 3 were up to 0.4 and 0.6 index points higher respectively during the two-year period.

Table 4

Consumers Price Index

Analytical all-groups – index numbers and index points difference

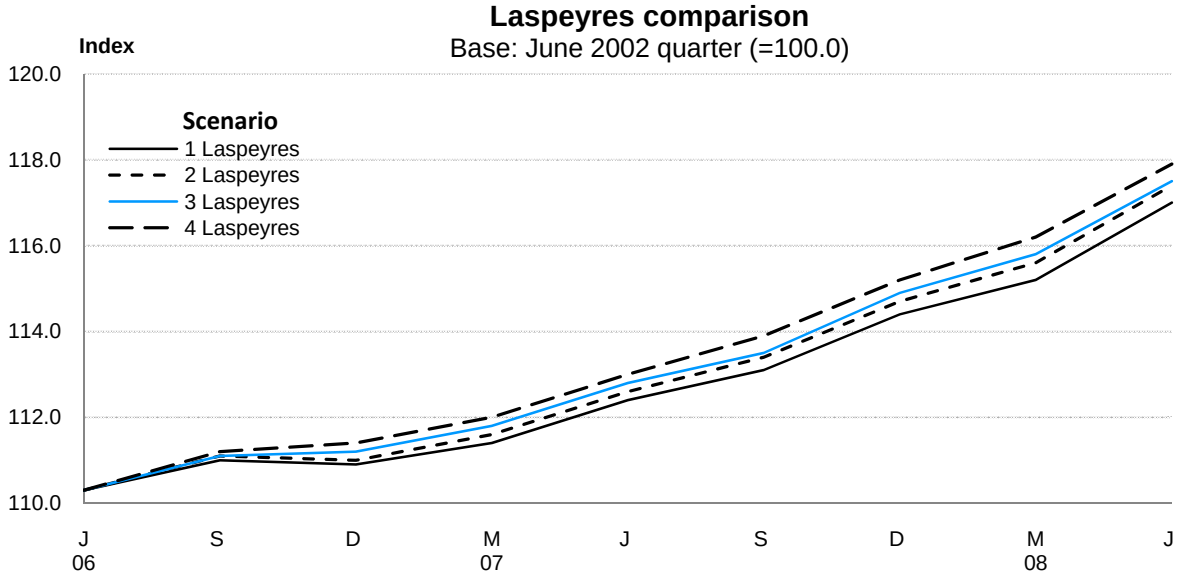
Base: June 2002 quarter (=100.0)

	Scenario 1	Scenario 2		Scenario 3		Scenario 4	
Quarter	Laspeyres	Laspeyres	Difference[1]	Laspeyres	Difference[1]	Laspeyres	Difference[1]
2006 Jun	110.3	110.3	0.0	110.3	0.0	110.3	0.0
Sep	111.0	111.1	0.1	111.1	0.1	111.2	0.2
Dec	110.9	111.0	0.1	111.2	0.3	111.4	0.5
2007 Mar	111.4	111.6	0.2	111.8	0.4	112.0	0.6
Jun	112.4	112.6	0.2	112.8	0.4	113.0	0.6
Sep	113.1	113.4	0.3	113.5	0.4	113.9	0.8
Dec	114.4	114.7	0.3	114.9	0.5	115.2	0.8
2008 Mar	115.2	115.6	0.4	115.8	0.6	116.2	1.0
Jun	117.0	117.4	0.4	117.5	0.5	117.9	0.9

1. Laspeyres for relevant scenario minus scenario 1 Laspeyres.

Figure 4 shows that, as expected, the gaps between the scenario 1 Laspeyres series and the three other Laspeyres series grew over time.

Figure 4



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Statistics NZ (2007). Consumers Price Index: Retrospective Superlative Index and Impact of Alternative Housing Weights. Retrieved 18 April 2011 from http://www stats.govt.nz.

Appendix – further information

Weight-reference periods

The 'weight reference' periods for the 2002, 2006, and 2008 CPI reviews were the years to June 2001, 2004, and 2007, respectively, which coincide with the 2000/01, 2003/04, and 2006/07 Household Economic Surveys (although expenditure on some goods and services is collected in the HES on a recall basis, meaning that purchases can span a two-year period). When alternative sources were used to derive expenditure weights, information for the years to June 2001, 2004, and 2007 was used, where possible.

Volume adjustments

For the 2006 and 2008 CPI reviews, adjustments were made to the underlying quantities in selected cases where there was strong evidence of significant trend (rather than short-term) change in volumes since 2003/04 and 2006/07, respectively. The aim of making these adjustments was to improve the relevance of the expenditure weights during the period they would be used (from 2006 to 2008, and from 2008 to 2011).

Price updating

Expenditure information from the 2000/01, 2003/04, and 2006/07 Household Economic Surveys and other sources was 'price updated' to the 'price reference' periods of the June 2002, 2006, and 2008 quarters. The effect of price updating, recommended for CPIs by the International Labour Organization and common international practice, was to express the underlying 2000/01, 2003/04, and 2006/07 quantities in the prices of the June 2002, 2006, and 2008 quarter price-reference periods.

Basket of goods

There were 672 different goods and services in the 2002 CPI basket, 685 in the 2006 basket, and 694 in the 2008 basket. Some goods and services were removed from the basket and some were added at the time of each CPI review. The majority of goods and services are in all three CPI baskets (2002, 2006, and 2008). The scenario 2 and 4 Laspeyres series exclude the price movements of goods and services added to the basket at the 2006 CPI review, except for cases where the addition was a direct replacement.

Classes

There were 105 classes in the 2002 and 2006 CPI structures, and 107 in the 2008 CPI structure.

Alternative weights

The 2002 weights used to compile the series in this paper include 'alternative' weights for the purchase of new housing and for rentals for housing, which are lower than those used in the official CPI. The alternative 2002 housing weights, which were compiled using methods that are consistent with the 2006 and 2008 housing weights, better reflect falling home-ownership rates in New Zealand.

Seaonsal adjustment

At the 2006 reweight, the official all-groups index became fully seasonally unadjusted. Up until the June 2006 quarter, fresh fruit and vegetable prices used in calculating the all-groups index were seasonally adjusted. In the series compiled for this paper, the 2002 weights for fresh fruit and vegetables, and the fresh fruit and vegetable prices from 2002 to 2006 were not seasonally adjusted.

Calculation of Paasche series

The Paasche series (used to calculate the Fisher series in this paper) was calculated by retrospectively applying updated weights at the June 2006 and June 2008 quarters to price movements from earlier quarters to the June 2006 and June 2008 quarters, respectively.

Price index formulae

The Laspeyres, Paasche, and Fisher price index formulae used to calculate the analytical time series are given below. The series have been expressed on a base of the June 2002 quarter (=100.0).

Index numbers presented in this paper were rounded to one decimal place. Percentage changes were calculated from index numbers rounded to one decimal place and are presented to one decimal place. Any differences between the Laspeyres and Fisher series are based on comparisons of the index numbers rounded to one decimal place. Differences based on unrounded index numbers may be slightly smaller or larger.

The **Laspeyres** price index formula, expressed in terms of expenditure weights and price relatives is:

$$P_L = \frac{\sum_{i=1}^{n} w_{i0}\left(\frac{p_{i1}}{p_{i0}}\right)}{\sum_{i=1}^{n} w_{i0}}$$

The **Paasche** price index formula, expressed in terms of expenditure weights and price relatives is:

$$P_P = \frac{\sum_{i=1}^{n} w_{i1}}{\sum_{i=1}^{n} w_{i1}\left(\frac{p_{i0}}{p_{i1}}\right)}$$

The **Fisher** price index is the geometric mean of the Laspeyres and Paasche price indexes:

$$P_F = \sqrt{P_L \times P_P}$$

Where:
P_L = Laspeyres price index
P_P = Paasche price index
P_F = Fisher price index
w_{i0} = expenditure weight of the ith good or service for the base period 0
w_{i1} = expenditure weight of the ith good or service for the current period 1
s_{i0} = expenditure share of the ith good or service for the base period 0
s_{i1} = expenditure share of the ith good or service for the current period 1
p_{i0} = price or index number of the ith good or service for the base period 0
p_{i1} = price or index number of the ith good or service for the current period 1