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Tatauranga Aotearoa

Analytical retrospective superlative index based on New Zealand's CPI: 2017

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Stats NZ Tatauranga Aotearoa
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Contact
Stats NZ Information Centre: info@stats.govt.nz
Phone toll-free 0508 525 525
Phone international +64 4 931 4600

www.stats.govt.nz

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Summary of key points

This paper draws on and extends work previously published by Stats NZ (2007, 2008, 2011, and 2015) and presents the results of an analytical retrospective superlative index time series calculated between the June 2002 and September 2017 quarters. It also highlights the benefits of reweighting the CPI frequently:

- The published consumers price index (CPI), which is calculated using a fixed-weight Laspeyres-type formula, increased 35.9 percent between the June 2002 and September 2017 quarters, an average of 2.0 percent per year.
- The analytical superlative time series, which is calculated using a Fisher formula, increased 32.3 percent between the June 2002 and September 2017 quarters, an average of 1.9 percent per year.
- If no CPI reweights had happened after 2002, the CPI would have increased 42.8 percent between the June 2002 and September 2017 quarters, an average of 2.4 percent per year.
- If no CPI reweight had happened in 2014, the CPI would have increased 4.0 percent between the June 2014 and September 2017 quarters (an average of 1.2 percent per year), compared with an increase of 3.1 percent for the published CPI over the same period (an average of 0.9 percent per year).

Introduction to CPI reweighting

On average, the New Zealand CPI is reweighted once every three years. Once each new set of CPI expenditure weights is calculated, the previous and new weights can be used to calculate a superlative index on a retrospective basis. This shows the impact of commodity substitution on the fixed-weighted CPI. Commodity substitution occurs when households react to changes in relative prices by reducing purchases of goods and services that have increased in price and instead buying more goods and services that haven't increased as much.

Stats NZ implemented a review of the CPI in the December 2017 quarter covering the periods up to and including the September 2017 quarter. The new weightings have been used from December 2017. The review involved reselecting and reweighting the basket of representative goods and services to ensure it continued to reflect household spending patterns.

This paper also shows how the CPI might have tracked had no reweight, or only some reweights, occurred since 2002.

Retrospective superlative index

In this section we introduce the analytical retrospective superlative index, outline how it was constructed, and present the results in comparison with the published Laspeyres time series, and the tradables/non-tradables series.

Introduction to the superlative index

Under normal economic conditions, households tend to react to changes in relative prices by reducing purchases of goods and services that have increased in price and instead buying more goods and services that haven't increased as much. For example, if apple prices increased a lot, but pear prices only a little, consumers might buy more pears and fewer apples than before. Continuing to price the same quantities of apples and pears would overstate the actual price change faced by consumers. Under such circumstances, a base-weighted Laspeyres index will be greater than a current-weighted Paasche index. In other words, a Laspeyres index will overstate price change, whereas a Paasche index will understate price change.

In New Zealand, as in most countries, the CPI is calculated using a Laspeyres formula, where weights reflect expenditure shares in some historical period. The CPI is therefore subject to upper-level (or item) substitution bias, unlike indexes calculated using a superlative index formula such as the Fisher index formula (which is the geometric mean of the overstating Laspeyres index and understating Paasche index). For this reason, many national statistical organisations calculate superlative indexes to help show the level of upward bias that can result when CPIs are not regularly reviewed or reweighted.

International studies (eg Shoemaker, 2013, and Van Kints & Bishop, 2013) have found the long-term difference between superlative and Laspeyres CPI indexes to be about 0.2 of a percentage point a year. In other words, annual price changes would be around 0.2 of a percentage point lower if the CPIs accounted for commodity substitution. In another study (Clews, Sanderson, & Ralph, 2014) found that in the short term, the difference can be as high as half a percentage point a year.

How the superlative index was constructed

A superlative index is the geometric mean of a Laspeyres and a Paasche index. The formula used to calculate these three index types can be found in the appendix.

Stats NZ based the analytical retrospective superlative index from the June 2002 quarter to the September 2017 quarter. (This would normally be the June quarter, however, the most recent review was delayed one quarter following the 2016 Kaikoura earthquake.) There were six reweights in this period. (These indexes are expressed on a base where 2002=1000.)

We based the most recent CPI reweight, implemented in the December 2017 quarter, on expenditure information from the 2015/16 Household Economic Survey (HES) and other sources, price-updated to the September 2017 quarter.

At each reweight, we price-update the expenditure weights to the price reference period. The effect of price-updating, recommended for CPIs by the International Labour Organization (ILO) and common international practice, is to express the underlying quantities of the weight reference period (ie the HES period) in the prices of the price reference period. We also made volume adjustments in 2017 to reflect trend changes in quantities since the 2015/16 weight reference period.

The retrospective superlative index between the June 2014 and September 2017 quarters is based on the underlying quantities for 2012/13 and 2015/16 (although in some cases adjustments were made to reflect quantity changes after both weight reference periods). We then linked the resulting three-year series to the June 2002 to June 2014 quarter series at the June 2014 quarter.

As part of a CPI review/reweight, we add and remove some goods and services from the basket. To calculate the Paasche index, we reallocate the expenditure weights of goods and services added to the basket across similar goods and services at each reweight year. The expenditures of goods and services removed from the basket are reallocated across similar, remaining goods and services. Table 1 gives a summary of the HES data time periods and number of items in the basket for each reweight.

Table 1

Summary of CPI baskets for last six reweights			
CPI reweight year	**Time period of HES data**	**No. of items in the basket**	**Superlative index published year**
2002	2000–01	672	
2006	2003–04	685	2007
2008	2006–07	694	2008
2011	2009–10	710	2011
2014	2012–13	709	2015
2017	2015–16	701	2018

Analytical retrospective superlative index results

CPI all groups

The analytical retrospective superlative index, calculated using a Fisher formula, increased 32.3 percent between the June 2002 and September 2017 quarters, while the published CPI all groups index, calculated using a fixed-weight Laspeyres-type formula, increased by 35.9 percent over the same period.

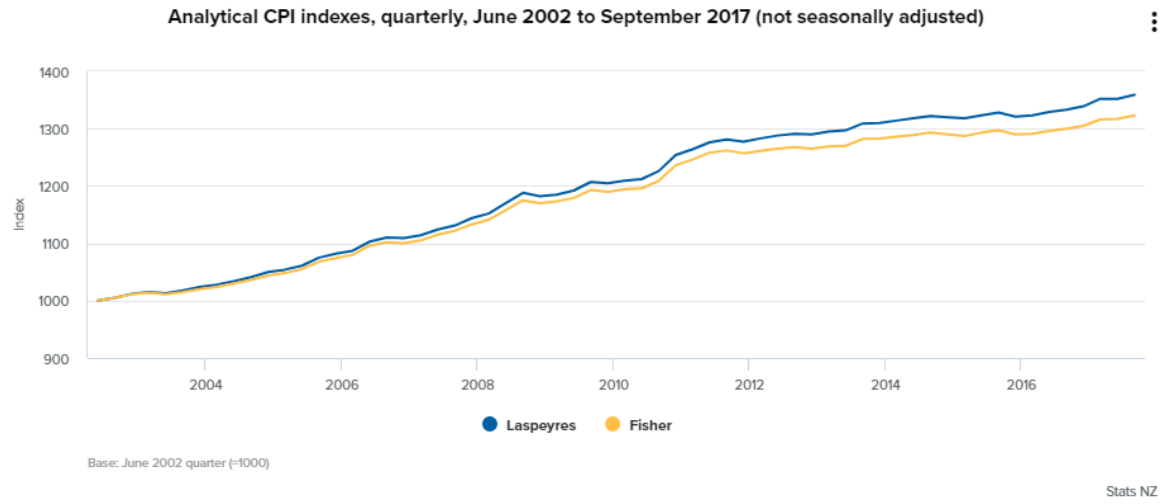
Between the June 2014 quarter and the September 2017 quarter, the analytical retrospective superlative index increased 2.6 percent, compared with a 3.1 percent increase for the Laspeyres-type index over the same period.

Table 2 below shows the superlative index time series from the June 2002 quarter to the September 2017 quarter. At the September 2017 quarter, the analytical Fisher all groups series was 1323, which was 36 index points lower than the Laspeyres-type index, at 1359.

Table 2

CPI analytical all groups index numbers			
June quarters	**Laspeyres**	**Fisher**	**Index points difference**
2002	1000	1000	0
2003	1013	1011	2
2004	1034	1030	4
2005	1061	1055	6
2006	1103	1096	7
2007	1124	1115	9
2008	1170	1158	12
2009	1192	1179	13
2010	1212	1196	16
2011	1276	1258	18
2012	1288	1265	23
2013	1297	1270	27
2014	1318	1289	29
2015	1323	1293	30
2016	1329	1296	33
2017	1352	1317	35
September quarter			
2017	1359	1323	36
Base: June 2002 quarter (=1000)			

Figure 1



From the June 2002 quarter to the September 2017 quarter, the Laspeyres-type index rose an average of 2.0 percent a year, compared with 1.9 percent for the Fisher index. (Note that alternative housing weights were used from the June 2002 to June 2006 quarters. More information about this can be found in the appendix.) Over the three years from the June 2014 quarter to the September 2017 quarter, the Laspeyres-type index rose an average of 0.9 percent a year, compared with 0.8 percent for the Fisher index.

Tradables and non-tradables

The tradables and non-tradables components of the CPI divide CPI goods and services into two categories – one contains goods and services that are imported or in competition with foreign goods, either in domestic or foreign markets (tradables); and the other contains goods and services that do not face foreign competition (non-tradables). Movements in the tradables category (tradable inflation) demonstrate how international price movements and exchange rates affect movements in consumer prices. The non-tradables category shows how domestic demand and supply conditions affect consumer prices.

Table 3 below shows the Laspeyres and analytical Fisher index time series for tradables and non-tradables. At the September 2017 quarter, the difference for the tradables component was 39 index points, while the difference for the non-tradables component was only 15 index points.

Table 3

CPI analytical all groups index numbers – tradables and non-tradables						
June quarters	Tradables			Non-tradables		
	Laspeyres	Fisher	Index points difference	Laspeyres	Fisher	Index points difference
2002	1000	1000	0	1000	1000	0
2003	988	986	2	1034	1034	0
2004	982	979	3	1078	1077	1
2005	990	984	6	1122	1120	2
2006	1027	1019	8	1167	1165	2
2007	1022	1011	11	1214	1213	1
2008	1071	1056	15	1256	1253	3
2009	1073	1055	18	1298	1295	3
2010	1083	1062	21	1327	1323	4
2011	1143	1118	25	1396	1390	6
2012	1130	1101	29	1430	1421	9
2013	1112	1081	31	1466	1454	12
2014	1113	1080	33	1506	1492	14
2015	1093	1060	33	1537	1522	15
2016	1077	1041	36	1566	1551	15
2017	1087	1048	39	1602	1587	15
September quarter						
2017	1088	1049	39	1614	1599	15
Base: June 2002 quarter (=1000)						

From the June 2002 quarter to the September 2017 quarter, the published tradables Laspeyres-type index rose an average of 0.6 percent a year, compared with 0.3 percent for the analytical Fisher index. Over the same period, the published non-tradables Laspeyres-type index rose an average of 3.2 percent a year, compared with 3.1 percent for the analytical Fisher Index.

The reason for the difference between the tradables and non-tradables is partly because the former experiences large price decreases and associated large quantity and quality increases (eg the audio-visual equipment class, and the telecommunication equipment subgroup), while the latter does not.

Impact of reweighting the CPI basket

This section examines how the CPI would have tracked under the following four scenarios:

- **Scenario 1** – CPI reweights in 2006, 2008, 2011, and 2014. This time series is identical to the published CPI.
- **Scenario 2** – no CPI reweights between 2002 and 2017. Shows the situation where the CPI is not reweighted at all.
- **Scenario 3** – CPI reweights in 2006, 2008, and 2011, but not 2014. Shows the short-term effect of not reweighting for one review period.
- **Scenario 4** – CPI reweights in 2008, 2011, and 2014, but not 2006. Shows the long-term effect of not reweighting for one review period.

Table 4 below shows the Laspeyres-type index time series from the June 2002 quarter to the September 2017 quarter for each scenario. At the September 2017 quarter, the difference between the scenario 1 and scenario 2 indexes is 69 index points.

Table 4

CPI analytical all groups index numbers				
June quarters	**Published CPI (scenario 1)**	**No reweight (scenario 2)**	**No reweight in 2014 (scenario 3)**	**No reweight in 2006 (scenario 4)**
2002	1000	1000	1000	1000
2003	1013	1013	1013	1013
2004	1034	1034	1034	1034
2005	1061	1061	1061	1061
2006	1103	1103	1103	1103
2007	1124	1129	1124	1129
2008	1170	1179	1170	1179
2009	1192	1206	1192	1201
2010	1212	1233	1212	1221
2011	1276	1302	1276	1286
2012	1288	1326	1288	1297
2013	1297	1347	1297	1307
2014	1318	1375	1318	1328
2015	1323	1383	1327	1333
2016	1329	1393	1336	1339
2017	1352	1422	1365	1362
September quarter				
2017	1359	1428	1371	1369
Base: June 2002 quarter (=1000)				

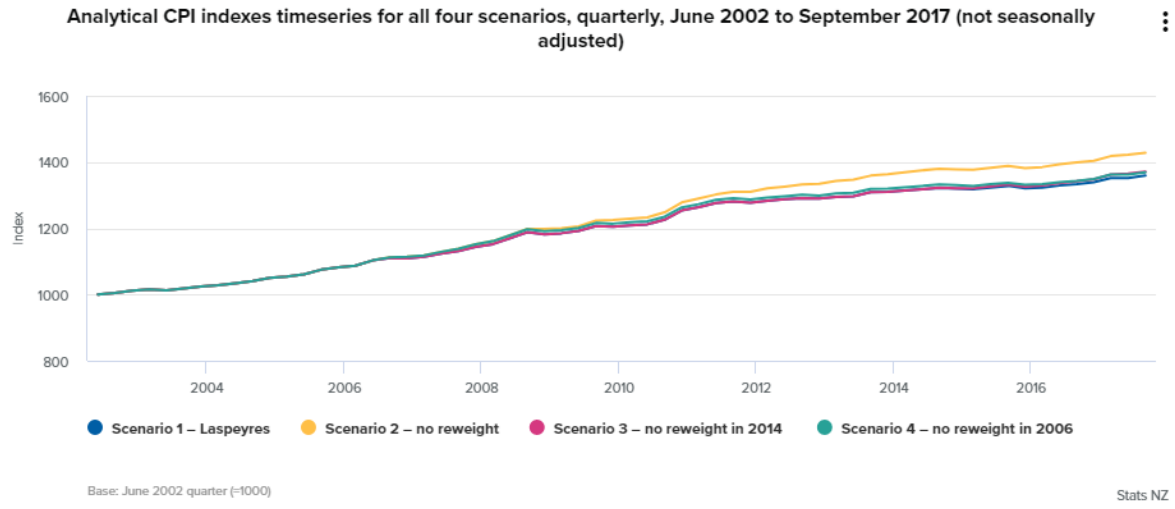
Note: The 2006 reweight was implemented four years after the previous reweight in 2002, a year later than usual. However, the 2008 reweight was implemented two years after the 2006 reweight, bringing the CPI back to a three-yearly review cycle.

Between the June 2002 and September 2017 quarters, the published CPI (scenario 1) increased 35.9 percent (2.0 percent per year).

Had reweights not taken place in 2006, 2008, 2011, or 2014 (scenario 2) the index would have increased 42.8 percent (2.4 percent per year).

This compares with 37.1 percent had the index been reweighted in 2006, 2008, and 2011, but not in 2014 (2.1 percent per year – scenario 3). Or 36.9 percent had the index been reweighted in 2008, 2011, and 2014, but not in 2006 (also 2.1 percent per year – scenario 4).

Figure 2



Conclusion

Stats NZ prepared the analytical superlative time series to assess the impact on the CPI of commodity substitution. The results shown in these time series are broadly in line with results from international studies.

These time series also show the potential effect of not reweighting the CPI, reweighting it less frequently, and the benefit of three-yearly reweights currently in place.

Stats NZ will compile a retrospective superlative index following the next reweight of the CPI basket, which is scheduled for 2020.

References

Akem, A (2018). Reference paper for the "Methodological issues in CPI compilation" [PDF, 19p]. Paper presented at United Nations Economic Commission for Europe, 7–9 May 2018, Geneva, Switzerland.

Clews, G, Sanderson, R, & Ralph, J (2014). Calculating a retrospective superlative consumer prices index for the UK [PDF, 41p]. Retrieved from Office for National Statistics, www.ons.gov.uk.

International Labour Organization (2003). Resolution concerning consumer price indices. Available from www.ilo.org.

Shoemaker, OJ (2013). 10 Years of comparative results: Chained C-CPI-U vs regular CPI-U [PDF, 13p]. Available from Bureau of Labor Statistics, www.bls.gov/.

Statistics New Zealand (2007). Consumers price index: Retrospective superlative index and impact of alternative housing weights – Information paper. Available from www.stats.govt.nz.

Statistics New Zealand (2008). Consumers price index retrospective superlative index, 2008. Available from www.stats.govt.nz.

Statistics New Zealand (2011). Analytical retrospective superlative index based on New Zealand's CPI: 2011. Available from www.stats.govt.nz.

Statistics New Zealand (2013). CPI Advisory Committee 2013. Available from www.stats.govt.nz.

Statistics New Zealand (2014). Analytical retrospective superlative index based on New Zealand's CPI: 2014. Available from www.stats.govt.nz.

Stats NZ (2017). Consumers price index review: 2017 (revised). Available from www.stats.govt.nz.

Van Kints, M & Bishop, G. (2013). Geometric indexes and substitution bias in the CPI [PDF, 26p]. Paper presented to the Ottawa Group. Available from www.ottawagroup.org/Ottawa/ottawagroup.nsf/home/Papers.

Appendix

The time series presented in this paper use housing weights for 2002 that are different from the housing weights used in the official CPI. We calculated the alternative housing weights to be consistent with the method used to calculate the 2006, 2008, 2011, 2014, and 2017 housing weights. These differences affect the time series from the June 2002 quarter to the June 2006 quarter. From the June 2006 quarter onwards, weights used match those in the official CPI. For more details on these alternative housing weights, see *Consumers price index: Retrospective superlative index and impact of alternative housing weights* (Statistics NZ, 2007).

Prices for fresh fruit and vegetables are not seasonally adjusted for the analytical retrospective time series, between the June 2002 and September 2017 quarters. In the official CPI, prices for fresh fruit and vegetables were seasonally adjusted between the June 2002 and June 2006 quarters but not after that.

Price index formulae

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
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