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**SESSION 3:
Quality adjustment in the Producers Price Index
In
New Zealand**

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1. Preview of the construction of the index:

Collection of prices:

Prices that are used in all the indexes in the BPI area are collected with the Commodity Price Survey. The prices (ACPs) then feed through the system to the respective outputs (Producers Price Index, Capital Goods Price Index, Farm Expenses Price Index and even the Overseas Trade Price Index). The survey covers prices of goods and services of the entire economy (including imports and exports). We currently survey approximately 3 000 respondents and collect approximately 13 000 prices. The survey is based on a purposive sample and therefore only covers a very small sample of products or services in each industry.

To enable us to establish whether a price movement is correct we ask for reasons for price changes on the questionnaire. These include:

- a. model or style change
- b. packaging or presentation
- c. components
- d. labour
- e. supplier's or manufacturer's price
- f. specialing
- g. exchange rates
- h. competition
- i. adjustments to profit margins
- j. new taxes
- k. change market share

The use of the same price in different areas makes quality adjustments complex. The structure of the different indexes where the prices are used will be discussed briefly.

Producers Price Index:

The PPI measures prices relating to the production sector of the economy and is divided into inputs and outputs indexes. The All PPI Inputs Indexes and All PPI Outputs Indexes are published by industry. The industries are classified according to the Australian and New Zealand Standard Industrial Classification of 1996 (ANZSIC96). The commodities are classified according to the Australian and New Zealand Standard Commodity Classification of 1996 (ANZSCC96).

Output Indexes

The output indexes measure changes in prices received by producers.

The output indexes cover the prices of:

- primary products
- manufactured goods
- revenue from renting and leasing
- the provision of services
- capital work undertaken by own employees
- margins on goods purchased for resale

Excluded from the output indexes are:

- interest and dividends
- royalties and patent fees
- receipts from insurance claims
- government cash grants and subsidies
- GST and other indirect taxes

These indexes are designed to measure price changes at a level corresponding to the price at the "factory door", before the addition of commodity taxes or deduction of subsidies (i.e. the price received by the producer).

Input Indexes

The input indexes measure price changes in costs of production excluding labour and depreciation costs.

The input indexes cover the prices of:

- materials
- fuels and electricity
- transport and communication
- commission and contract services
- rent and lease of land, buildings, vehicles and plant
- business services
- insurance premiums less claims

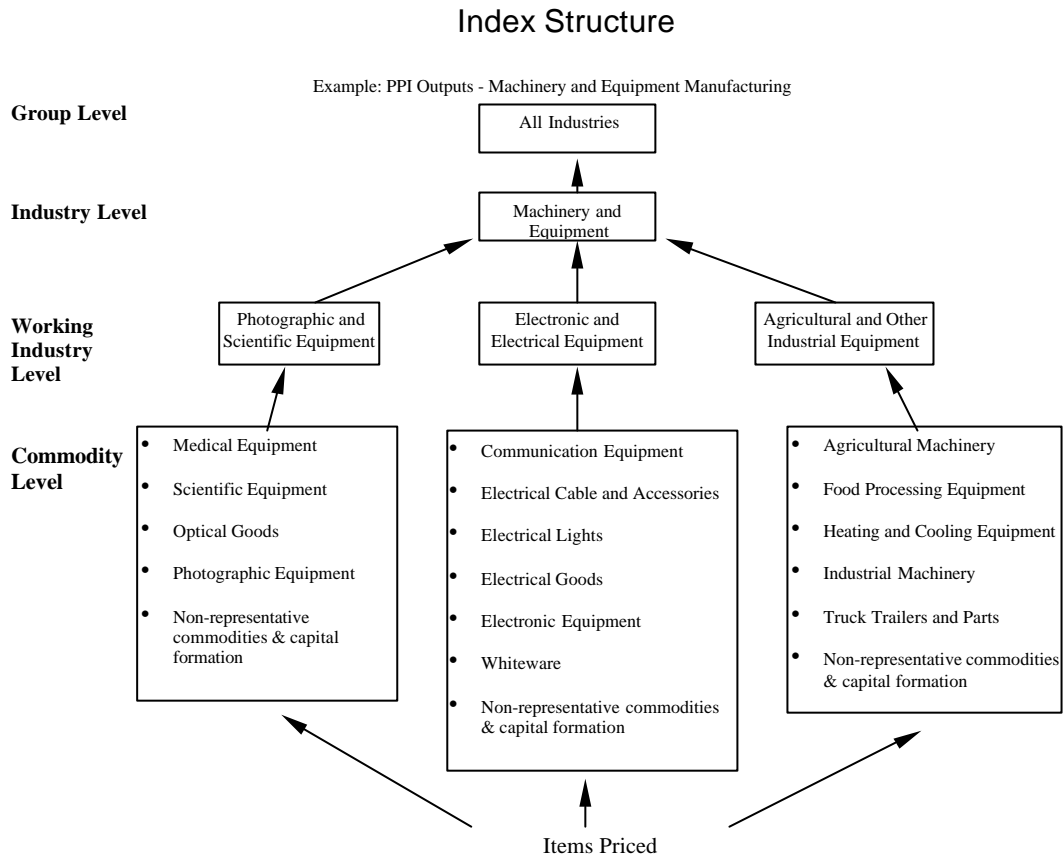
Excluded from the indexes are:

- wages and salaries (measured in the Labour Cost Index)
- capital expenditure (measured in the Capital Goods Price Index)
- ACC levies, land tax, government licence fees, road user charges
- rates
- royalties, patent fees
- bad debts and donations

GST is excluded when measuring input prices for 45 of the 47 industry input indexes. The assumption is made that those involved in activities in these industries are 'registered persons, or businesses' that provide 'taxable supply'. GST paid on intermediate consumption is recoverable under the GST credit offset system and therefore is effectively not part of the ultimate input price. Exceptions include the finance, and the ownership of owner-occupied dwellings indexes which include some 'GST exempt', and non-recoverable GST activities. Interest costs are excluded because they are regarded as a cost of capital and not as a payment for good or service. Government charges are excluded when they are used to raise tax revenue rather than the payment for a good or service purchased from the government. This is consistent with the System of National Accounts.

The indexes have a building block structure instead of a tree structure (like in the CPI). Therefore it is sometimes very difficult to determine which indexes a low level price (or

ACP) will influence and to what extent this price will influence indexes in the structure. For this reason it is also very difficult to decide whether it is a quality issue or not.



Theory indicates for example that when outputs indexes are compiled, the statistician often favour the resource cost approach when quality adjustment takes place whereas when inputs indexes are calculated, the user value approach to quality adjustment is often favoured. The former approach (resource cost approach) refers to the use of basic prices (supply prices) or the price that the purchaser gets (at the factory door), before the addition of transport or other costs and taxes, but after the addition of subsidies. The latter approach (user value approach) refers to the use of purchasers' prices, or what the producer pays for intermediate consumption or the value put on the item, and includes transport and other costs, margins and taxes and excludes subsidies. Values can differ from one purchaser to the next (eg wholesaler can value a product different than a retailer). It is clear from these definition differences that differences in the value of the product due to delivery, distribution or other factors will be excluded as quality differences from one index but should be included in another. Differences in value from a consumer's point of view can be quite different from the value that the producer of the product places on it. Prices often include delivery and other costs and should these costs change it could not be easily removed from the price. The PPI in SNZ is however

constructed in such a way that the same price is used for both inputs and outputs that will cause an adjustment in the price to affect both inputs and outputs in the same manner.

Capital Goods Price Index

The CGPI measures the changes in the price level for all physical capital assets purchased by producers of goods and services in the economy.

The indexes are broken down by asset type as follows:

Residential buildings
Non-residential buildings
Other construction
Land improvements
Transport equipment
Plant, machinery and equipment

Large value items (ie aircraft and ships) that are non-recurring and that are manufactured to customers' specifications are excluded from the survey. Second-hand equipment (such as cars) has also been excluded from the index (although this is debatable).

Farm Expenses Price Index

The Farm Expenses Price Index measures price changes of fixed inputs of goods and services to the farming industry. It does not fully measure changes in the production costs because these are also dependants on factors that affect productivity such as technological advances, management efficiencies and climate fluctuations.

Farm input costs are broken down by farm type (ie sheep and beef farms, dairy farms, horticultural farms, cropping and other farms) and include the following:

administration
animal health and breeding
electricity
feed, grazing, cultivation and harvesting
fertiliser, lime and seeds
freight
fuel
insurance premiums
rent and hire
repairs, maintenance, motor vehicle repairs
packaging costs
shearing
weed and pest control
livestock purchases
local and central government rates and fees
interest rates
wages and salaries

Goods and services tax (GST), capital expenditure and depreciation are excluded from the indexes.

2. What is quality adjustment:

Quality adjustment is the identification of quality (or quantity) differences of individual products and the technique of eliminating the effect of these differences on the calculation of price change. Different qualities of the same kind of product must be treated as separate goods or services in the National Accounts context (SNA93:382). Quality adjustment is also done to remove any differences between two homogenous items, if one item is replaced for another between two time periods. This is done to enable us to calculate price change between two periods when one item is replaced for another between these periods.

Various factors can have an influence on quality differences between products, other than changes in physical characteristics, which include:

- i. transport of the product to a location in which it is in greater demand, which gives the product a higher value in view of the more convenient location
- ii. different times of the day or even year, which has an influence on the utility of the product for the consumer and production costs for the producer. If there is a switch towards a product of a higher quality (eg higher grade apples) this should be recorded as a volume change and not a price change.
- iii. conditions of sale
- iv. circumstances or environment in which the product is delivered or produced, which include accessibility, delivery times, tailor made order, support and advice.

3. Why do we quality adjust?

Price indexes measure the extent to which the cost of an identical basket of goods or services changes over time, unaffected by changes in quality, quantity or terms of sale. The BPI indexes are mainly used to deflate the National Accounts and are calculated by using the Laspeyres Price Index formula. Deflation means that any price changes are removed from the Gross Domestic Product at Current Prices, to enable us to calculate real growth in the economy (or GDP at constant prices). Real growth is an indicator of productivity in the business sector.

According to the Laspeyres formula, the basket of items-to-price that is chosen to represent a commodity should remain constant from the base period. This is done to enable us to keep volumes constant in the base period so that we can only measure the real price change from period t to period $t+1$.

In the real world however, items-to-price tend to change from period t to period $t+1$ as a result of the appearance of new and technologically advanced products and services, the disappearance of old products and services and changes in the terms of sale.

We quality adjust to enable us to directly compare items in period t and $t+1$, if exactly the same product is not available in period $t+1$. This ensures that only “pure” price change is

measured and any changes in *volumes or productivity* are removed. Volume changes or productivity changes are removed from prices to enable National Accounts to show these changes in the real GDP. Volumes and quantities should not be mixed up. There can be a change in the volume without a change in the quantities.

An example will explain this situation:

Suppose two models of cars are produced and one is selling for twice the price of the other (\$10 000 and \$20 000 each). Although there are two models, there is only one product (motor cars) involved. Suppose that over two periods, *the price of each model stayed unchanged* and the total number of cars produced did not change (100 vehicles).

The proportion of higher priced cars has however increased from 50 to 80 per cent.

Total revenue in period 1 equals $(500\,000 + 1\,000\,000) = 1\,500\,000$.

Total revenue in period 2 equals $(200\,000 + 1\,600\,000) = 1\,800\,000$.

Therefore it is clear that real GDP has increased by 20% (a volume change took place).

4. How do we quality adjust?

When a decision has to be made about quality adjustment in the Commodity Price Survey, factors that should be taken into account are how the changes affect purchasers' utility and the cost of producing the item. The latter is often used as a guide since it is easier to establish. Quantitative characteristic changes are also more easily identifiable than qualitative characteristic changes of a good or service. An example is a box of chocolates that increases from \$3 to \$5 but also increases from 100gram to 125 gram. It is however more difficult to determine whether there is a decrease or increase in value to the purchaser if a car engine becomes more powerful that improves performance but also increase fuel consumption.

Style changes are not regarded as quality changes if the general quality of workmanship and function is unchanged, for example last year's bricks versus this year's bricks that differ in colour or texture. Therefore if the change does not change the function of the item, it is not regarded as a quality change. Similarly would a change in packaging that do not affect the contents of the package, not be a quality issue. If however the change in packaging affects the quality of the products (example the packaging of building materials while exported), it would be viewed as a quality difference.

When items change (become missing, new product emerges, compositional changes in the product) there are various methods available to quality adjust. These methods can be divided into explicit methods and implicit methods.

Implicit methods:

i. Overlap method:

Overlap prices for the new and old items – the difference in prices are an indication of the difference in quality and both the items are available over the two quarters. A pre-requisite for the use of this method would be that both items are available side-by-side for some time and that both have sold in reasonable quantities. The technique of splicing the prices in full would be used, where the price movement of product B will be spliced on the price of product A. The time of splicing is important since in most cases the price of

the old product is dropped just prior to or after the release of the new item. The use of the lower price in the price would result in an unrepresentative price movement. If it is found that there is also an element of pure price change in the replacement item, a partial splice needs to be carried out and the pure price change needs to be shown.

Example:

Period	Old quality	New quality
0	$P_o = 10$	
t	$P_t = 12$	$P_{t*} = 15$
n		$P_{n*} = 18$

The ratio of P_t and P_{t*} can be used as a measure of the differences in quality. Therefore the price relative will be:

$$P_n * (P_t / P_{t*}) / P_o$$

$$18 * (12 / 15) / 10 = 1.44$$

$$\text{Index: } 1000 * 1.44 = 1440$$

ii. Overall mean/targeted mean imputation:

Imputation – this is based on an average price of other similar items whose price evolution is judged the same as the missing product if no immediate replacement is available.

iii. Class mean imputation – this is based on the average price of other items which are in the same class as the missing item.

iv. Comparable replacement:

Direct comparison - a replacement item is sought when the old product is not available any more, that has the same characteristics as the item that is no longer available. In this case it is assumed that the two items are of the same quality and the new item's price is spliced in. If they are not then the differences need to be valued and the value of the additional characteristics will have to be deducted (or added) from (or to) the value of the new item. The explicit method explained below will then be used.

v. Carried forward or show no change – this is done when the commodity or service is only temporarily unavailable and a new replacement will come onto the market in the near future.

Explicit methods:

i. Explicit adjustment – A non-comparable item is used but the components of the old and new items are valued to exclude those characteristics from the new item that are not found in the old item. This method can also be used for compositional changes in the same item.

ii. Hedonic regression techniques – this was discussed in a separate session.

iii. Expert judgement – this is often used in conjunction with another method. Product equivalence is based on the judgement of the commodity specialist and is a subjective view. This can have complications since the subjective view of two people can sometimes differ dramatically.

iv. Quantity adjustment – An adjustment is made purely based on quantity differences eg instead of a 100g bar of chocolate, it is now 110g (with no price change). Therefore the formula for the price relative is:

$$(P_1/P_0)*(Q_0/Q_1).$$

If we use this formula we don't know whether there is any difference in the production cost or margin of producing and selling any larger size product. If there is a cost differential, then we should not accept a price change that accompanied a change in size.

v. Production cost/Option cost – Example: Suppose the price of the new product is 15 per cent higher than the old, while it is estimated that it will cost 10 per cent more to produce the new product from period 0 to period t. The following formula can be used to calculate the price relative from period 0 to period t: $100+x/100+y$.

Therefore $100+15/100+10 = 115/110 = 1.0454545$

The Business Price Index area currently uses most of the methods above except hedonic regression. The choice of method is dictated by data availability.

5. What are the challenges/issues to be considered?

- i. Various problems can arise when matched items are used eg time of replacement, changes in volumes being sold, full splices may hide real price movements etc.
- ii. Old item is not comparable to any other item on the market, which may lead to difficulty in replacing the outgoing item. Item might be so obsolete that it can't be replaced with another item in the same product description (eg battery problem).
- iii. Representativeness of the replacement item in the market may change and weights are not in line with items sold.
- iv. Sampling issues: How relevant is the sample to what the market purchase.
- v. Where does it fit into the indexes (ultimate use of the price).
- vi. New products: Initial prices may be higher due to capacity limitations and market imperfections.
- vii. Weight of the item in the index: If the weight is too small to have any effect and the quality adjustment is complex, it might be best to assume no quality adjustment is needed.
- viii. Price discrimination (customer mixes). When different prices are charged to different customers (discounts for bulk buying), the question should be asked if the different price is charged because the product or service that is offered is of a different quality (eg at peak time). If it can not be established that the product is of different quality then the price differences are pure prices and should be included in the prices. In this case a weighted average price should be calculated based on the quantities of the product sold at each price. If however the products or services are of a different "quality" then it should not be seen as a price difference but rather a volume difference.
- ix. Product mixes can not be separated.

6. Practical problems associated with quality adjustment

- i. A considerable amount of information is necessary to enable the statistician to make a decision about the adjustment to be made. This might impact on respondent burden and the willingness of respondents to be honest in completing the questionnaires. It may lead to the "no change" syndrome that many of our respondents suffer from.

- ii. The Commodity Price Survey has a selection of reasons for change (in the price) on the questionnaire, which can be used as a guide to identify possible quality changes in the product or service. These reasons can however have an element of quality which is not always possible to pick up since not all the reasons are a clear indicator for a change in quality (reasons (a – e) eg “suppliers’ price”). Are the reasons sufficient to cover possible quality issues for all the indexes?
- iii. The time of replacement can be problematic.
- iv. There is a very limited amount of knowledge available on quality adjustment in the PPI. Therefore it is difficult to test decisions.
- v. The GIFT structure makes it difficult to apply a decision. One item feeds into more than one index and the quality adjustment for one index is not necessarily correct for another.

SOURCES:

1. Commission of the European Unions, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank, 1993, *System of National Accounts 1993*, USA.
2. International Monetary Fund , *Draft PPI Manual*.
3. Statistics New Zealand, December 1999, *Producers Price Index Concepts, Sources and Methods*, New Zealand.