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**Agenda item: 8.1**

**Backcasting – Australia**



**National Accounts Branch Documentation**

**Backcasting, Bridging, Parallel Runs, and  
Seasonal Adjustment**

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## **A - Overview**

The ABS maintains long time series for national accounts, with series starting in the September 1959 quarter for major aggregates. These data items are produced on a consistent 2008 SNA basis across the entire time series.

Start dates for national accounts series across components and underlying data sources vary significantly even for series which build to the same aggregates. This means that for most aggregates there is a “live” compilation period, as well as a maintained compilation period.

### **A1 - Live compilation period**

The live compilation period is a broad term, and relates to parts of national accounts time series where time series can be recalculated in response to changes in standards, methodology and data. This depends both on the detail of the aggregation hierarchy of components as well as time series length of current data sources.

For aggregation hierarchy the live period relates to the 1990s and beyond, where modern computing systems have allowed detailed data and metadata storage. This allows compilation of underlying data to aggregates using 2008 SNA frameworks, and importantly any future change to this framework.

As an example, the inclusion of Research and Development (R and D) with the 2008 SNA changes could be added simply by changing the aggregation hierarchy of capital formation, domestic final demand, GDP etc.

Live periods for source data such as business surveys are generally shorter in line with operational changes effecting survey operations. This varies significantly, but in some cases is as late as the last decade.

### **A2 - Maintained Period**

The maintained period for aggregation hierarchy is generally where detail becomes more limited. Because there is more limited aggregation hierarchy in the maintained period, this means it is much more difficult to ensure changes in methodology or standards are represented in the maintained period.

In the national accounts this resulted when conversion to electronic systems occurred where generally only published or top level estimates were transferred to current systems, resulting in the above mentioned loss of detail.

For source data series this is where data sources and business surveys finish and where current surveys have to be combined with historic data sources. As described above, this is generally much more recent than for the aggregation hierarchy.

This leaves two broad options, the first being doing nothing and having breaks in series where data sources change or aggregation hierarchy can no longer adjust to methodological change. The other option is using a range of backcasting techniques to remove breaks in series and ensure a consistent time series. The ABS chooses the latter option. Techniques for backcasting are described in more detail in following paragraphs.

### **A3 - Backcasting**

Backcasting describes a number of techniques to remove breaks in series between live and maintained periods in the national accounts. These include splicing back with historic series (preserving growth rate), splicing back with an indicator series and the use of bridging factors.

There are also considerations on whether to start splicing back at certain dates, for example, when looking at computers, it may be inappropriate to start a splice in September 1959 before computer usage was widespread.

Further complexity is added when looking to splice back Chain Volume Estimates (CVM) as well as dealing with seasonal adjustment and trend estimation.

## **B – Splice Methodology**

Splicing is the most common method in the Australian national accounts to deal with breaks in series. A splice removes a break in series using an indicator series to define the growth of the new series at a level or value defined in the live compilation period.

### **B1 – Splicing Example**

A simple example of splicing using an historic indicator is set out below.

	<u>Maintained period</u>				<u>Live period</u>		
	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<b>Live calculation - new</b>					109000	123000	13900
<b>Historic Series</b>	59290	71767	84685	96609	105000	118700	134600
<b>Historic Growth rate</b>		21%	18%	14.1%	8.7%	13%	13.4%

In the above example the live period dates back to 1977/78, a change in methodology increases the series by 4000 in the first value of the live period (1977/78). If nothing is done, this will increase the growth of the series between 1976/77 and 1977/78 from 8.7% to 12.8%.

The splice recalculates the historic series using the ratio of the values at the splice point. In this case, the splice point is once again 1977/78. The ratio is  $109000/105000 = 1.038095$ . The calculation is shown below.

	<u>Maintained period</u>				<u>Live period</u>		
	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<b>New Series</b>	61549	74501	87911	100289	109000	123000	13900
<b>New series growth</b>		21%	18%	14.1%	8.7%	12.8%	13%
<b>Historic Series</b>	59290	71767	84685	96609	105000	118700	134600
<b>Historic Growth rate</b>		21%	18%	14.1%	8.7%	13%	13.4%

This preserves the historic growth rate, by increasing levels in the maintained period to remove the step.

### **B2 - Principles of Splicing**

Splicing has been done on a case by case basis. There are a number of principles applied.

#### 1 - Undertake Splicing at lowest feasible level

Splicing as a backcasting method will work best if it is undertaken at the lowest possible level of aggregation.

The aggregation hierarchy usually won't stop in the maintained period; it will just become less detailed. For example, if in the maintained period  $GDP = Consumption + Capital formation + Net trade$ , then it is much better to splice the addition of R and D at the level of capital formation than total

GDP. If the aggregation structure in the maintained period includes the ability to aggregate R and D, then the best action in this case might be to use a proxy indicator.

## 2 - Ensure economic plausibility

Splicing used as part of backcasting needs to produce results which are economically plausible. There will be limited information with which to undertake a splice. It is important that key known economic events are not altered by the splice. Examples of this are introducing changes for technology such as computers to periods prior to their common usage. Business cycles should not be changed due to splicing methodology.

## 3 - Choice of splicing indicator

The above factors will influence the choice of splicing indicator. There are three main choices of indicator: historic series; independent indicator; graduated start date.

### A – Historic series indicator

The most common choice in national accounts is the historic series for pragmatic reasons as it preserves the historic growth rate. This is detailed in the example above. It is used where aggregation hierarchy doesn't allow use of an independent indicator, or where none is available. It is also used where data sources change to ensure that there is no step between these series.

### B – Independent indicator

The growth patterns of an independent indicator series is imposed. This is most effective for the addition of new series to the maintained period. Examples of this in the Australian implementation of 2008 SNA were the use of resident population to splice back R and D prior to the availability of live data, as well as a range of ad-hoc crop statistics for cultivated biological resources.

This approach was used for series where the aggregation hierarchy in the maintained period allowed low level splices, and the indicators proved to be accurate descriptors of series behaviour based on analysis in the live period.

### C – Graduated start date

A graduated start date splice is more complex than splices described above with, the main difference being that, rather than factoring up/down the indicator series with a fixed factor, the factor will start at one and move towards the factor at the splice point.

For example, in the above, instead of using a factor of 1.038095, the factor will from one to the ratio over the period (in the below case 4 years).

	<u>Maintained period</u>				<u>Live period</u>		
	1973/74	1974/75	1975/76	1976/77	1977/78	1978/79	1979/80
<b>New Series</b>	59290	72450	86298	99369	109000	123000	13900
<b>Factor</b>	1	1.009524	1.019048	1.028571	1.038095		
<b>Historic Series</b>	59290	71767	84685	96609	105000	118700	134600
<b>New Series growth rate</b>		22%	19%	15%	10%	13%	
<b>Historic Growth rate</b>		21%	18%	14%	8.70%	13%	13.40%

#### 4 – Choice of Splice Point

Some care should be taken in choosing a splice point to ensure that it is not an outlier or affected by large seasonal patterns for sub annual estimates. The factors for splicing don't have to be calculated at the same date as the splice start, and can be calculated as an average of a number of data points. If using an historic indicator, it can be assumed that the seasonal pattern will be defined by the historic series, more investigation may be required if using independent indicators.

#### **Splicing Chain Volume Estimates**

Current and constant price estimates are relatively easily spliced back. However, splicing back chain volume estimates is more complex. This is because CVM estimates are not additive.

The ABS undertakes CVM splice back as a number of steps:

Step 1 – Splice back current price estimates (as described above)

Step 2 – Splice back price deflators (in general, with historic IPDs)

Step 3 – Deflate Spliced current price to create estimates in previous year prices

Step 4 - Aggregate and chain estimates

It is possible to splice back live CVM estimates using constant price estimates. However, there is a loss of consistency as estimates are aggregated to higher aggregates, so this is not recommended.

#### **C - Bridging Factors**

##### **C1 – Overview**

Bridging factors are used to change classifications prior to the live period. These were used heavily for the update of industry standards in Australia from ANZSIC93 to ANZSIC06, The Australian version of ISIC Rev4.

With the change to ANZSIC06, internal source data providers such as business surveys tried to backcast new industry standards as far back as possible using statistical techniques. This was done only for recent history due to changes in business and other surveys. For example, the main quarterly business survey used in the national accounts only dates back to 2000.

Bridging factors use a common period to transform the back history to a comparable basis to the new classification. This is different to splicing as it recalculates components of aggregates, generally leaving aggregates unchanged.

In the example below, a common year is used to split the old ANZSIC93 classification of property and business services to its three new equivalent industries of Rental, Hiring and Real Estate, Professional Scientific and Technical and Administrative and Support Services.

This is done by creating factors in the dual processing period, which are then applied to the rest of the historical series.

##### **C2 – Example Bridging Factors**

Below is a simple example of how bridging factors can be applied

Factors are first calculated on the 1999/00 year

Values      Ratios

### 1999/00

<b>Property and Business services</b>	133677	
<b>Rental Hiring and Real estate</b>	26901	0.20
<b>Professional Scientific and Technical</b>	73891	0.55
<b>Admin and support services</b>	32885	0.25

These are then applied to the historic series convert historic data on the old classification to one which is consistent with the new classification.

<b><u>ANZSIC 93</u></b>	<b>1993/94</b>	<b>1994/95</b>	<b>1995/96</b>	<b>1996/97</b>	<b>1997/98</b>	<b>1998/99</b>	<b>1999/00</b>
<b>Historic Property and Business services</b>	76491	86989	95193	102844	111289	122919	133677
<b><u>ANZSIC 06</u></b>							
<b>Rental Hiring and Real estate</b>	15393	17506	19157	20696	22396	24736	26901
<b>Professional Scientific and Technical</b>	42281	48084	52619	56848	61516	67944	73891
<b>Admin and support services</b>	18817	21400	23418	25300	27377	30238	32885

### **C3 - Principles of bridging factors**

Like splicing, bridging factors are applied on a case by case basis. However, there are a number of guiding principles which are followed when applying bridging factors.

#### 1 - Apply at lowest feasible level

Similar to splicing this technique works best when applied at the lowest possible level of data. The above example is one which is applied at division level. However, in the national accounts most bridging factors were calculated at the sub division and even class level. This allowed for the move of industry subdivisions and classes to be more accurately accounted for in the classification changes.

#### 2 - Create factors over a longer time period

This will depend upon the availability of dual coded series, but ideally bridging factors should be calculated over a period to minimise any effect of short term changes and fluctuation in industries.

#### 3 - Account for Seasonality

For sub annual estimates seasonality needs to be accounted for both in creating bridging to ensure that seasonality is properly represented. In a quarterly, this would involve creating factors for each quarter (or sub annual period) of the year, so that seasonal factors are accounted for in bridging factors.

#### 4 - Ensure plausibility

Once again, it is important to use judgement to ensure that key economic event such as the rise and fall of industries and classifications are not removed as part of the bridging factors. This may require interpolation factors.