

Australian Current GDP, GDP deflator, CPI, Population and Share Price Index:

Sources and Methods

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1. Current Price GDP & GDP Deflator

Series scope and limitations

The current price GDP series presented here is a composite series covering the whole period of white settlement since 1788/9. This series provides the foundation for indicators commonly used now to gauge an economy's performance and its peoples' material progress over time. GDP represents the value of output produced over a year, and broadly corresponds to the total income derived from that production. Once the effect of price changes is removed, GDP can be used as an indicator of the economy's performance – whether production has increased or decreased relative to previous years. GDP per capita similarly can be used as an indicator of the material progress of the people - whether their average income has increased or decreased relative to previous years.

With such complex phenomena as economic performance or material progress, any single indicator is at best an estimation or approximation. This is certainly true of estimates constructed retrospectively for periods where there was very limited extant direct data. Yet it is also true of current official estimates of GDP based on data collected specifically for the purpose. These official estimates of GDP are subject to substantial and often retrospective revisions, especially when new and better estimation methods are developed. However, when separate estimates which use different data and different methods are combined to create a long series, discontinuities are inevitable and adjustments must be made to construct a continuous series. The GDP series presented here was constructed by taking the official estimates for the period since 1960 as the foundation to which the various estimates for earlier years are linked to provide a continuous series. These data and linking methods are discussed in more detail below. The resulting series most certainly overestimates GDP for the earlier years, and these should be considered very rough approximations of GDP. The same observations apply to the inflation adjustment factor, the GDP deflator.

Data sources: overview

The first official set of Australian national accounts, including current price GDP and the GDP deflator, was made in 1945 by the Bureau of Census and Statistics (now the Australian Bureau of Statistics or ABS). In 1955, the Bureau also published retrospective GDP estimates back to 1938-9, providing a long run of official GDP estimates. However, the ABS subsequently made numerous changes to its sources and methods which are only partly redressed by retrospective revisions to the historical series. The resulting breaks in the official series are discussed in more detail below.

Economic historians estimated current GDP from 1788 to 1939, and the GDP deflator from 1825 to 1939. This extraordinary set of estimates is due in part to the wealth of raw statistical data collected by colonial and, from 1901, Australian governments and their statisticians to document the progress of their domains (although their efforts were focused more on output, employment and other material indicators of progress – they were less concerned with prices). But it took a massive effort and great expertise to convert this data into historical estimates of GDP and the GDP deflator. In this we are fortunate that N.G. Butlin and his colleagues at the Australian National University saw national accounting as a valuable way to better understand Australia development. There have been other attempts to estimate GDP or the related measures, gross national expenditure and national income, both before and after Butlin, but none have produced such a long and relatively consistent series. The Butlin estimates are not without flaws, but the primary criticisms relate to the GDP deflator rather than the current price GDP estimates, and stem from the paucity of raw price data with which to construct this series. Bryan Haig has employed an alternative approach of constructing constant price GDP estimates directly (much as the ABS does today), for the periods 1861-1911 and 1911/12-1948/49. There has been some debate over the relative reliability of the Haig and Butlin series but the emerging consensus favours the Butlin series for providing a view of the late nineteenth century economy that is more consistent with other evidence, notwithstanding the weakness of his GDP deflator (Broadberry and Irwin, 2007; Maddison, 2006). The Butlin series are used here, in part to give users the choice of using the GDP deflator or the CPI to adjust for inflation. However, Haig's 1911-1939 series does have strong support from Maddison and others. If users are concerned only with the post 1911 period, they may prefer to use Haig's constant price series (Haig, 2001).

Current Price GDP Data Sources and Methods: This series was constructed from the following sets of estimates.

1788-1860, GDP at factor cost - Source: Butlin and Sinclair (1986). This was the final set of estimates Butlin published, in this case with W. A. Sinclair. They applied the same production approach that Butlin employed in his earlier work, by estimating the input costs for each sector to derive GDP at factor cost, although the heavily regulated penal colony posed some unique problems in valuing labour inputs for the earlier years. In addition, Butlin (1986) estimated British spending on the colonies, which in the early 1790s was 300-400 per cent greater than GDP; even in 1821, British spending was 45 per cent of GDP, representing a substantial boost to national expenditure. Those interested in indicators of living standards in the early colonies would be advised to consult Butlin's gross national expenditure estimate in preference to the GDP estimate used here.

Butlin and Sinclair's estimates are for calendar years, and are converted here to years ending June, by taking an average of the two calendar years. This has the effect of smoothing out some of the annual variations, but it allows their data to be linked to the current data. However, unlike Butlin's

estimates for later periods which are for GDP at market prices (by adding subsidies and deducting indirect taxes to the GDP at factor cost estimates), Bultin and Sinclair's estimates for this first period are for GDP at factor cost, resulting in the first break in the long series constructed here.

1861-1900, GDP at market prices - Source: N. G. Butlin (1962). Butlin's initial estimates for this period were published in 1958. It was path-breaking research, drawing on imperfect data and applying the still new concepts of national accounting. This, and the fact that his initial estimates were published without an explanation of the methodology, provoked considerable debate but he refined his estimates, adopted definitions consistent with current national accounting standards, and published the final estimates including a detailed explanation of his sources and methods in a monograph in 1962. His estimates are for calendar years and are converted here to years ending in June by the method explained above. The linking ratio between these estimates and those of the previous period is 1.036 (derived from the ratio of the two calendar year estimates for 1961).

1900-01 to 1947-48 GDP at market prices – Source: M. Butlin (1977), in Butlin (1988). N. G. Butlin's 1962 monograph had included estimates to 1938-39, along with the retrospective official estimates for 1938-39 to 1948-49. In 1977, Mathew Butlin converted these estimates to a financial year basis, made a number of revisions and brought them into line with current national accounting standards (SNA68) to link with the official estimates from 1948-9, creating a single series for the period 1900-01 to 1973-74. While his revisions created a consistent twentieth century data set, they do mean there is a break in our long series at 1900-01. The linking ratio between pre- and post 1900/01 estimates is 1.052. Subsequent changes in national accounting standards and methods since 1977, and retrospective revisions to the official estimates for the post 1948 period, have also resulting in other breaks in our long series.

1948-9 to 1958-59 GDP at market prices – Source: ABS, Yearbook (2001). Official estimates for this period were revised in the 1990s to conform with SNA(68) standards. This is broadly consistent with the standards used by Mathew Butlin to revise the 1901-1948 estimates. The linking ratio between pre- and post- 1948-9 estimates is 1.039. At the time, these official revised estimates for 1948-9 to 1959-60 also linked relatively cleanly with official estimates for subsequent years. However, there have been substantive changes in official methodology and data sources, and subsequent retrospective revisions to back to 1960 have created a major break in the official series at 1959-60.

1959-60+ GDP at market prices: Source ABS, 5206.0 (Series ID A2304617J). These estimates have been subject to on-going revision. Prior to 2006, the revisions were normally for the previous 10-12 years. In 1998-9 retrospective revisions back to 1959/60 were published and from 2006 a full and often revised series from 1950/60 was published each year. The revisions have normally been upwards, and their cumulative effect is to leave a gap of almost 16% between this series and the preceding series for the overlap year of 1959-60. Other countries have also made retrospective revisions to their official historical estimates, creating a large gap for the overlap year. However, in the case of the US, the main revision was due to the retrospective application of the new chain-linked, volume based estimation methods, SNA(93), where current price GDP is calculated by reflating the directly estimated constant price GDP. In Australia, the revisions have been more piecemeal. The switch to chain volume methods in Australia in 1998 accounted for part of the upward revision but there were other upward revisions to the official estimates both before and

after this. For some years the post 1998 revisions have been substantial. For instance, they account for more than half the total upward revision in the estimate of GDP for 1970-1.

These piecemeal Australian revisions are variously explained by the ABS as due to the adoption of new national accounting standards, improved methods of data collection and improved estimation methods. While these changes have undoubtedly increased the reliability of current estimates, it is not clear that the pre-1960 estimates should similarly be revised up by the same amount to link with the recent data. The pre-1939 estimates in particular were constructed using existing data and often indirect estimation methods and post-1960 revisions that are due to the development of better, customised data sources may not be applicable to these earlier estimates. Those revisions due to the development of better methods to deal with new phenomena such as computer software are certainly not applicable. However, we simply do not have enough information at this stage to assess what proportion of the upward adjustment might reasonably apply to the earlier estimates. From the late 1990s, the ABS has published an estimate of the impact of each change on the immediate preceding years, but this information is not available for earlier revisions, or for the full historical estimates back to 1960. In the absence of a viable alternative, we have applied the full linking ratio between the pre- and post-1960 estimates of 1.159.

Users should be aware that while this linking ratio does eliminate the discontinuity at the series break in 1960, it has in all likelihood created a bias in the series for earlier years. There is some reassurance from the fact that, in common with all previous series breaks, the linking ratio is greater than one: that is, for this and every other series break, the earlier estimates were adjusted upward to link with the next set of estimates, so any resulting overall bias for the early years of this series must be upward. These adjustments do not affect growth rates, but they do affect absolute values and our GDP series should be used only with great caution in drawing any inferences about absolute levels of output. Users should exercise even greater caution in using this series to make cross-country comparisons for the pre-1960 period. For that purpose, the original data would be more reliable, or perhaps Maddison's (2006) Geary-Khamis based series. Maddison also had to link the pre- and post- 1960 Australian GDP estimates to construct his series, but because he only captured revisions up to 2001, the gap was smaller than it is in the latest estimates used here.

GDP Deflator

This series was constructed from the following sets of estimates.

1828-1850 – source: Butlin and Sinclair (1986). The problems in constructing price indices for the second half of the nineteenth century (discussed below), apply in even greater measure here.

1850-1960 – source: Shergold (1988). This is a composite series constructed by David Pope. It draws on N.G. Butlin's (1962) estimates for the period 1851-1938-9, and Mathew Butlin's (1977) estimates for 1939-40 to 1947-48, which were linked to official estimates from 1948-49. While N. G. Butlin had enjoyed a relative wealth of raw data on output and expenditure, he found it more difficult to locate the consistent and sustained series of raw price data he needed to construct a reliable GDP deflator. Butlin himself was particularly critical of his estimates for the period after 1920 for two reasons: first, with changes in consumption patterns, adjustments for changes in the quality of

goods in the consumer bundle became more important but his raw data, collected for other purposes, simply was not up to this task. Second, when Butlin used his GDP deflator to calculate real GDP and tested the resulting series against the known experience of the period, he thought the estimates plausible up to 1920, but believed they had “little meaning after 1920” and that, by the early 1930s, they had “drifted into the realms of unreality” (Butlin, 1962:34). Others have also been critical of his price deflators, believing that even in the nineteenth century “the data probably are not adequatewithout recourse to heroic assumptions” (Haig, 2001:7). Mathew Butlin (1977) trialled the use of alternative deflators for the period 1901-1939, but concluded that they too had limitations so N.G. Butlin’s estimates remained his preferred series and were used also in the series compiled by Pope.

1960+ - Source: ABS 5206.0, Key Aggregates and analytical series, Table 36 (Series ID A2304682C). Note that this historical series has also been subject to retrospective revisions but their magnitude is not as substantial as the revisions to the GDP estimates.

2. CPI.

1850/1-1912/3: Mclean (1999), converted to financial years by averaging.

1913/4-1950/1: Shergold, ‘Prices and Consumption’ Table PC31, p.214, This is a composite series with some years presented as calendar years and others presented as years to June. Calendar years are converted to financial years by averaging, but the conversion precluded an estimate for the 1921/2 financial year.

1951/2-2014/5: RBA calculation of annual, financial year Consumer Price Index based on quarterly data from ABS 6401.0, Consumer Price Index, March 2016

3. Population

1788-2010: ABS 3105.0.65.001, Australian Historical Population Statistics, Table 1.1, 2008. There are important changes in definitions within this series, the most important of which is that estimates of the indigenous population are included only from 1961. See the explanatory notes for other changes. These data are for the year ending December.

2011-2015: ABS 3010.0 Australian Demographic Statistics, Estimated Resident Population, Table 4, column AB, March 2016. These estimates are for the year ending December.

4. Stock price index (month of June)

This index is based on David Pope’s(1988) composite ‘All Ordinaries’ index to 1984, with more recent data drawn from the ABS. Both Pope’s series are and the ABS series are titled an index of prices for the year ending in June. The methods used to construct each series are not well documented, but

the data which each series presents is in fact the average price for the month of June only. Since the timing of the stock market cycle varies, users should be aware that the index may therefore show greater volatility than an average calculated over the whole financial year. Both sources use November 1979 as the base year of 500.

1875-1936. Pope's index is a composite of 3 series.

1. 1875-1936: Monthly price indexes for the Sydney Stock Exchange, constructed retrospectively in the 1950s by D. L. Lamberton (Security Prices, n.d). Lamberton constructed separate indices for Mining, Finance, and Commercial & Industrial share prices and Pope followed the normal practice of using the Commercial and Industrial index as the nearest equivalent to the current "All Ordinaries" index. Through his indexes, Lamberton attempted to capture the experience of an investor who allocated his funds across the whole market each month in proportion to the monetary value of each share. This is similar to the method used by the ASX in calculating current indices, although the latter uses paid-up capital rather than market value weighting. The exclusion of the financial sector is a more important limitation, since this sector is included in later series, but the reasons for it are clear. In the nascent Sydney equity market of the late nineteenth century, the securities of investment grade financial companies would have dominated a true "all ords" index. However, Lamberton's index does have other more important limitations. The main one is that it included only companies who traded continuously for three or more years. Thus, as Lamberton acknowledges, his series represents the experience of those who invested in a portfolio of survivors, rather than those who invested across the whole market. The broad consensus is that, aside from the exclusion of the finance sector and an upward bias imparted by using survivors, Lamberton's methodology was appropriate and his series was well constructed. For our purposes though, there is one weakness which should be noted. In the thin, high risk market of the late nineteenth century, few commercial and industrial companies actually survived for three years. Thus, Lamberton's index is based initially on only 5 observations, rising to 20 by 1920. With such small numbers, the idiosyncratic experiences of a single company could have a substantive impact on the index, especially when we remember that Pope's index captures a single month only.

1936-1979: The Sydney Stock Exchange (SSX) All Ordinaries Index, with the 1936-1957 data as reported in Lamberton (1958).

1980-84: The Australian Stock Exchange (ASX) All Ordinaries Index.

1984-2011: ABS 13500DO018 *Australian Economic Indicators*, Table 13, Table 8.7

2012+: The Australian Stock Exchange (ASX) All Ordinaries Index, End of Month Values for June, retrieved from <http://www.asx.com.au/about/historical-market-statistics.htm>

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