Measurement of Agricultural output in the Australian System of National Accounts: methods and issues

Brunton, Rick
Australian Bureau of Statistics
45 Benjamin Way
Belconnen ACT 2617
Australia
rick.brunton@abs.gov.au

Trickett, Carol
Australian Bureau of Statistics
45 Benjamin Way
Belconnen ACT 2617
Australia
carol.trickett@abs.gov.au

Abstract
Agriculture gross value added represented 2% of Australia's total Gross Value Added (GVA) in volume terms in 2006-07 but production can vary significantly from year to year in line with variability in weather conditions. As such, measuring agricultural output is important in assessing Australia's overall annual rate of economic growth in Gross Domestic Product (GDP).

Value added for the farm sector is derived using a production approach and is measured in both current price and chain volume terms as gross value of agricultural production less the costs incurred. For most commodity groups gross value of production is used as the measure of output. The only exceptions are wheat and wool, where a production valuation adjustment is applied. The valuation adjustment is required because the gross value of production for wheat and wool are based on estimated or realised future sales prices, which may be different from average current period prices.

Australia collects data on 54 commodity groups in compiling the gross value of agricultural production. The major commodity groups are livestock, wheat, milk, wool, barley, and sugar. In 2006-07 these accounted for 58% of the total gross value of production.

The paper describes the approach used in the Australian System of National Accounts (ASNA) to measure the output and value added of the Australian Agriculture industry, annually and quarterly.

The paper also discusses some of the measurement issues associated with estimating value added for the agricultural industry including the allocation of production to the appropriate quarter and the difficulty of seasonal adjustment when production can vary significantly from season to season.

1. Introduction

Agriculture Gross Value Added (GVA) represented 2% of Australia's total GVA in volume terms in 2006-07. While 2% is a small proportion, the variability of Australia's agricultural output from year to year can have a significant impact on Australia's total GVA. For example, Australia is currently experiencing a drought and agricultural gross value added in volume terms has fallen by 19% in 2006-07 and has made a negative contribution of 0.5% to Australia's Gross Domestic Product (GDP) volume growth in 2006-07. To put these numbers into context, Australia's GDP grew by 3.3% in 2006-07.

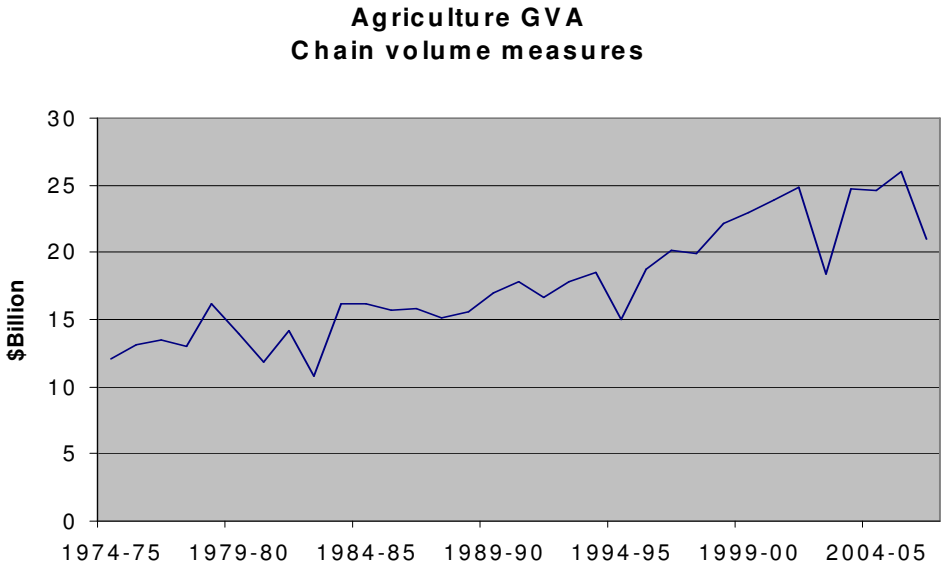
Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

Table 1: Contribution of agriculture value added at basic prices to GDP volume growth

Year	Contribution of agriculture to GDP (% change)	GDP volume growth (% change)
2000-01	0.1	1.9
2001-02	0.1	3.8
2002-03	-0.8	3.2
2003-04	0.8	4.1
2004-05	0.0	2.7
2005-06	0.2	2.9
2006-07	-0.5	3.3

The graph below shows the growth in agriculture gross value added in chain volume terms from 1974-75 to 2006-07. It highlights the significant impact that droughts in 1982-83, 1994-95, 2002-03 and 2006-07 had on GDP growth.

Figure 1: Agriculture gross value added at basic prices



Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

2. The concept of gross value added

Gross value added is defined as output less intermediate input costs. Output consists of the value of goods and services produced within a producing unit and available for use outside the unit. Output includes work-in-progress and finished goods produced during the accounting period that have not been sold and are therefore held in inventories. Intermediate input costs consist of the value of goods and services consumed in the production process, other than depreciation of fixed assets, which is recorded separately as consumption of fixed capital. Intermediate input costs includes the value of goods transformed in the production process, goods and services consumed entirely in the process, and consumption of ancillary services (e.g. accounting, marketing, transportation, storage) within the institutional unit undertaking the production.

Australia calculates gross value added at basic prices for the agriculture industry as follows:

Figure 2: Calculation of gross value added for the agriculture industry

Gross value of agricultural production
Less
Intermediate input costs
Equals
Gross value added at producers prices (commonly referred to as Farm GDP)
Less
Taxes less subsidies on products
Equals
Gross value added at basic prices

3. Data sources

Australia uses a range of data sources to calculate gross value added for the agriculture industry. Data are collected through both Australian Bureau of Statistics (ABS) surveys and other government agencies.

3.1 ABS data collections

The ABS conducts an agricultural census every five years, with large sample surveys in intervening years. While the census should capture all farm businesses, for practical reasons the scope of the census is restricted to farm businesses above a certain activity cut-off. In the most recent agricultural census run in 2005-06, around 155,000 farm businesses were in scope of the census representing around 98% of total commodity production. The scope of the agricultural census / sample survey is restricted to collecting quantity information.

Market prices and marketing costs are collected through two separate annual ABS surveys. Market prices are used in combination with the quantities collected from the agriculture census / survey to calculate gross value where gross value represents the value placed on commodities at the point of sale (i.e. in the marketplace). These prices are inclusive of any product taxes paid and any product subsidies received which is a different valuation basis compared with farm gate prices.

The ABS also collects economic and financial data on agriculture and services to agriculture through its annual economic activity survey. The economic activity survey collects data on all industries excluding units classified to the general government sector and units classified to the finance and insurance industry. This survey is supplemented by administrative tax records which effectively increases the coverage of the survey to represent a census, known as "EASTAX". It was only from

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

2002-03 that agriculture was fully captured through EASTAX. Prior to 2002-03, economic and financial data on agriculture was captured through the Agriculture Financial Survey (AFS). However, only limited use is made of EASTAX data, partly due to the problem of measuring secondary production explained below and partly due to the data gap mentioned above.

In addition to these annual collections, the ABS runs a quarterly livestock products survey which collects current price and quantity information on livestock slaughterings, meat production, exports of live sheep and live cattle, exports of fresh, chilled, frozen and processed meat, and whole milk intake by factories, market milk sales by factories and receivals of wool by wool brokers and dealers.

Australia also collects quarterly production quantities directly from marketing authorities. Data collected from these marketing authorities provide an important addition to the above collections that enable the annual production of certain commodities to be allocated across the four quarters in the year.

3.2 External data collections

A large amount of agriculture data on annual farm production, annual farm costs and annual farm prices is published by the Australian Bureau of Agricultural and Resource Economics (ABARE). The ABARE data include forecasts for the latest year and in some cases, forecasts are available five years out from the latest year. These forecasts form an important part of our estimates for measuring the gross value of agricultural production and are progressively replaced within our gross value of agricultural production estimates as the agriculture census / survey data and EASTAX data become available. ABARE farm costs data form the largest part of our estimates for measuring intermediate input costs.

4. Measurement of estimates for the Australian agriculture industry output and value added

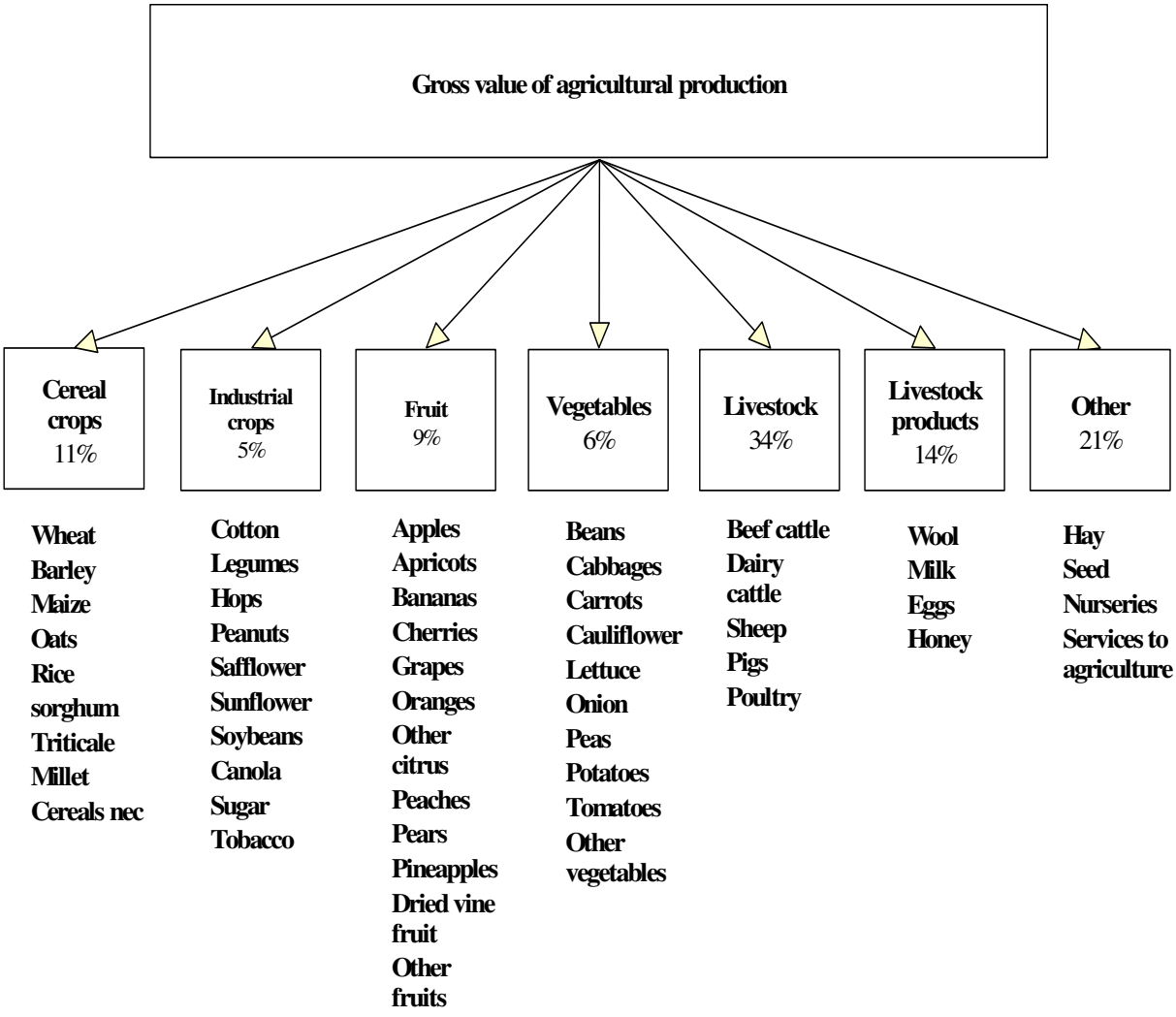
Agriculture is the only industry in the Australian System of National Accounts (ASNA) where gross value added at basic prices in chain volume terms is derived on a quarterly basis using the double deflation method that is recommended in System of National Accounts 1993 (SNA93).

It should be noted that Australia presents its annual estimates on a fiscal year (July-June) basis and not on a calendar year basis.

4.1 Gross value of agricultural production

The major commodity groups within the gross value of agricultural production are livestock, wheat, milk, wool, barley, and sugar. In 2006-07 these accounted for 58% of the total gross value of agricultural production.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.



4.1.1 Annual estimates

4.1.1.1 Cereals and non-cereal crops

Cereals consist of wheat, barley, maize, oats, rice, sorghum, triticale, millet and cereals nec. In Australia cereals is dominated by wheat which makes up around 65% of cereals production. Non-cereal crops consist of industrial crops, fruit, vegetables, hay, seed and nurseries.

Data on annual production quantities are collected from the agricultural census / survey. Quantity data is revalued to current prices using prices collected from the market prices survey.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

4.1.1.2 Livestock

Livestock is measured using the following model:

$$L_t = SLG_t + EXP_t + GFCF_t + WIP_t$$

Where:

SLG_t = slaughterings in period t

EXP_t = live exports in period t

$GFCF_t$ = capitalised livestock in period t

WIP_t = work in progress livestock in period t

Annual estimates of slaughterings and live exports are calculated by simply annualising the quarterly source data explained below under the quarterly estimates section. Estimates for capitalised livestock and work in progress livestock are made for beef, sheep and dairy cattle explained in more detail below.

Capitalised livestock is calculated as acquisitions less disposals. Acquisitions and disposals are separated into price and quantity components. Acquisition quantities for capitalised livestock are estimated from information collected from the agriculture census / survey on animals raised for breeding purposes. Disposal quantities for capitalised livestock are estimated from slaughterings data. Acquisition prices for beef are based on a beef saleyard price indicator. Acquisition prices for dairy are based on detailed dairy cattle values by type of breed while sheep acquisition prices are estimated from the greasy wool producers' price. Disposal prices for the three animal types are based on a saleyard price indicator for each respective animal.

Work in progress annual quantities for beef calves, dairy calves and lambs are estimated using information collected from the agriculture census / survey on the numbers of these animals that are less than one year in age. Corresponding annual prices for beef calves, dairy calves and lambs are estimated from the saleyard price for each animal.

4.1.1.3 Livestock products

Livestock products consists of wool, milk, eggs and honey.

Wool and milk estimates are calculated by annualising the quarterly source data in both current prices and quantities. Annual estimates for egg quantities are sourced from the agriculture census / survey which are revalued to current prices using prices from the market prices survey. Annual honey production quantities were last collected from the agriculture census / survey in 2001-02. From 2001-02 annual honey production in current prices is estimated by extrapolating the 2001-02 benchmark using a honey production indicator series published by ABARE.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

4.1.1.4 Services to agriculture

Annual estimates of services to agriculture in current prices are estimated using data collected from EASTAX. Volume estimates for cotton ginning and sheep shearing services are deflated using a Labour Price Index (LPI) while aerial services are deflated using a weighted fuel producers' price index and LPI. The remaining components are deflated using the all groups Consumer Price Index (CPI).

4.1.1.5 Other components

There are two other components that are included in Australia's measurement of the gross value of agricultural production. These are:

- output for own consumption
- production valuation adjustment

As recommended by SNA93, Australia includes an estimate for output for own consumption. Annual current price and volume estimates are calculated by annualising the quarterly source data explained below under the quarterly estimates section.

A production valuation adjustment is made for wheat and wool. These commodities have historically been sold through marketing authorities which estimate an initial price based on their expected sales over the following year. For wheat, the price is not finalised until all wheat is sold which occurs around 15 months after harvest. Both the initial and final prices are collected through the market prices survey but are different to the average current period prices required on an SNA93 basis. Average current period prices are derived as a weighted average of a producers' price index for domestic sales and an export price index for export sales. The production valuation adjustment is calculated as the difference between average current period prices and the prices used in the estimation of gross value of agricultural production. Since the production valuation adjustment is purely a price adjustment it only applies to current prices and has no impact on chain volume measures.

4.1.2 Quarterly estimates

4.1.2.1 Cereals and non-cereal crops

Each quarter information is collected on the quantity of wheat receivals from farmers. Most of the wheat is received in the December quarter with the remainder being received in the March quarter (i.e. no wheat is received in June or September quarters). The quarterly wheat receivals data are used to allocate the annual production quantities to each quarter. The annual wheat price collected through the market prices survey is used to revalue the quarterly production quantities into current prices. For the remaining cereals and non-cereal crops, annual production quantities are allocated to quarters using quarterly fixed harvesting ratios. Quarterly production quantities are revalued to current prices using annual prices collected through the prices and marketing costs survey.

4.1.2.2 Livestock

Quarterly slaughterings and live exports are estimated directly from our quarterly livestock products survey. Quarterly estimates for capitalised and work in progress livestock are estimated by allocating the annual equally across the four quarters in both current prices and quantities.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

4.1.2.3 Livestock products

Quarterly wool production in current prices and quantities are estimated from the wool received from brokers and dealers series which is sourced from the quarterly livestock products survey. Australia makes an adjustment to the wool received from brokers and dealers series because it generally does not correspond well with the period in which the wool is shorn. Initially, it is assumed that the annual quantity of wool received from brokers and dealers is shorn equally across the four quarters. This allocation is then adjusted using seasonal factors calculated from the quantity of wool received from brokers. The adjusted quantity series is revalued to current prices using the implicit prices from the quarterly brokers and dealers series.

Quarterly milk production quantities are estimated directly from the raw milk processed in factories series sourced from the quarterly livestock products survey. Current prices are calculated by revaluing quarterly production quantities using annual prices collected through the market prices survey.

Quarterly egg production quantities are estimated by spreading annual production quantities equally across the four quarters. Quarterly egg production quantities are revalued to current prices using annual prices collected through the market prices survey.

Honey production in current prices and quantities is allocated to the four quarters using historical quarterly ratios.

4.1.2.4 Services to agriculture

Quarterly estimates of services to agriculture in current prices are estimated by allocating the annual estimate equally across the four quarters. The only exception is sheep shearing services where the annual estimate is allocated across the four quarters using shorn wool production. Quarterly volume estimates are derived in the same way as that explained for the annual above.

4.1.2.5 Other components

The annual benchmark for output for own consumption was derived using detailed annual commodity level data in current prices from the 1991-92 survey of home production of selected foodstuffs. This data has then been extrapolated using the movement in the food category for quarterly household final consumption expenditure. Volume estimates are derived using prices for the food category within the CPI.

The production valuation adjustment is derived by applying the difference between the annual estimated future sales prices and the current year sales price to quarterly wheat and wool production quantities.

4.2 Intermediate input costs

Intermediate input costs are subtracted from the gross value of agricultural production to arrive at value added at producers prices. Intermediate input costs are separated into four main categories:

- Marketing costs
- Seed costs
- Fodder costs
- Other input costs

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

4.2.1 Annual estimates

4.2.1.1 Marketing costs

Annual data on marketing costs in current prices are collected from the marketing costs survey. Volume estimates for marketing wheat are calculated by annualising the quarterly wheat receivals data while remaining marketing costs are calculated using production quantities of the commodities that incur marketing costs.

4.2.1.2 Seed costs

Seed costs in current prices are calculated using the following model:

$$S_t = \sum_{1}^{n} P_{t-1} A_t H_t$$

Where:

P_{t-1} = Seed price in year t-1

A_t = Area planted per hectare in year t

H_t = Yield per hectare in year t

n = seed commodity

The model uses seed prices of previous year because planting uses seed produced in the previous production cycle. Seed quantities in the above model are equal to A_t x H_t.

4.2.1.3 Fodder costs

Fodder costs are separated into three main types:

- Hay
- Manufactured
- Grains

Fodder costs for hay in current prices are calculated by subtracting hay inventories from hay production. Volume estimates for hay are based on hay production quantities from the agriculture census / survey.

Manufactured fodder in current prices is estimated based on historical patterns in the time series. The discontinuation of the AFS has led to a data gap for manufactured fodder which is currently a small area of weakness in the Agriculture estimates. Volume estimates are derived by deflating the current price estimates using a producers' price index based on animal and bird feed.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

Grains in current prices are estimated using a supply and use model as shown below:

$$F_t^g = \sum_1^n Y_t - E_t - D_t - S_{t+1}$$

Where:
Y_t = grain production in year t
E_t = exports in year t
D_t = factory use in year t
S_{t+1} = seed used in year t+1
n = grain commodity

Grains in volume terms are derived by deflating grains in current prices using a fodder price index sourced from ABARE.

4.2.1.4 Other input costs

Other input costs contributes around 65% to total intermediate input costs. Other input costs include chemicals, electricity, fertiliser, fuel, insurance and repairs and maintenance and services to agriculture. Australia includes an estimate for financial intermediation services indirectly measured which is based on financial data collected from the government regulatory authority for finance and insurance businesses. An estimate is made for the costs associated with output for own consumption where costs are assumed to be 20% of output for own consumption. A similar estimate is made for the costs associated with capitalised livestock production where costs are assumed to be 20% of capitalised livestock production.

Other input costs in current prices (excluding services to agriculture) are mainly based on ABARE data. Volume estimates for the ABARE data component of other input costs are derived by deflating the current price data using associated ABARE price indexes for each component while services to agriculture is deflated using the all groups CPI. Volume estimates for the costs associated with output for own consumption and capitalised livestock are calculated in the same way as their production counterparts.

4.2.2 Quarterly estimates

4.2.2.1 Marketing costs

Marketing costs for wheat in current prices and volumes are allocated to quarters using quarterly wheat receivals data. The remaining marketing costs in current prices and volumes are allocated to quarters using the quarterly profile in the production commodities that incur the marketing costs.

4.2.2.2 Seed costs

Seed costs in current prices are allocated to quarters using fixed quarterly seed planting ratios. Quarterly volume estimates are calculated by deflating the quarterly current price estimates using the annual seed price.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

4.2.2.3 Fodder costs

The variables that feed into the grains fodder costs model already have a quarterly dimension to them in current prices except for factory use where the annual is allocated equally across the four quarters. Volumes estimates for grains, hay and manufactured fodder costs are calculated in the same way as that described for the annual.

4.2.2.4 Other input costs

Other input costs in current prices are allocated equally across the four quarters except for specific costs such as fertiliser where most of the costs are incurred in the planting quarters of March and June. Volume estimates are calculated in the same way as that described for the annual.

4.3 Taxes less subsidies on products

SNA93 recommends that basic prices is the preferred basis for valuing output. In Australia's case, the prices collected through the annual market prices survey are generally wholesale prices. These prices are inclusive of any product taxes paid and any product subsidies received. Annual quantity data collected through the agricultural census / sample survey is revalued to current prices using these prices. In order to derive gross value added at basic prices, it is necessary to remove these taxes less subsidies on products.

Estimates of taxes less subsidies on products is currently an area of weakness in the calculation of gross value added at basic prices.

4.3.1 Annual estimates

Taxes and subsidies in current prices are estimated using EASTAX data, Australian Tax Office data and commodity production related indicators. Volume estimates for taxes less subsidies on products are derived using the volume estimate from the gross value of agricultural production calculated above as the quantity indicator.

4.3.2 Quarterly estimates

Annual taxes less subsidies on products in current prices are allocated to quarters using the quarterly production profile in each commodity to which the tax or subsidy relates. Quarterly volume estimates are derived using the quarterly volume estimate from the gross value of agricultural production calculated above as the quantity indicator.

5. Seasonal adjustment

Difficulties can arise with the seasonal adjustment of quarterly cereals production which is almost exclusively in the December and the March quarters. The approach taken can have a significant impact on year-to-year growth, especially in a year coming into, or following the breaking of, a drought. In the quarterly accounts, the choice of seasonal adjustment method is of major importance to the interpretation of the data. Instead of the standard multiplicative time series model, where the seasonal and residual components are both directly proportional to each other and to the trend, a pseudo-additive model is used, where the relationship with the trend is preserved but seasonal and residual components are no longer proportionally related to each other. This allows for an adequate seasonal adjustment to be made of time series data, such as cereals production, where regular null quarterly estimates are observed in the original time series. This method of seasonal adjustment is applied to cereals production and to wheat marketing costs in both current price and volume terms

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

.

6. Measurement issues of value added

6.1 Secondary production

One of the main measurement issues that Australia faces is how to accurately identify secondary production. In the agriculture industry, secondary production may include transport services and accommodation services for tourists.

While secondary production activity is captured in aggregate through the annual economic activity survey, it is difficult to allocate this secondary production to products because the annual economic activity survey does not separate income and expense items into products.

6.2 Double counting of outputs

Double counting of outputs may occur in a vertically integrated business unit where the business unit carries out agriculture activity but its predominant activity is not agriculture. For example, let us assume a business unit operates an abattoir and a cattle farm and the business unit is classified to the manufacturing industry. The business unit receives an annual economic activity survey form on which it reports financial information on both the abattoir and the cattle farm. The business unit also receives an agriculture survey form since it carries out agricultural activity. The potential for double counting occurs when the annual economic survey information is allocated to the manufacturing industry (including both the abattoir and the cattle farm activity) and the agriculture survey information to the agriculture industry. Double counting of outputs would potentially be avoided by using the annual economic survey as the single data source for vertically integrated businesses.

6.3 Own account capital formation

Own account capital formation, such as fences, sheds and dams, are captured through our annual economic activity survey. However, the sampled units within the survey are relatively small. Sampled units are supplemented using Australian Tax Office (ATO) data. The ATO data mainly covers the unincorporated business units which is the most common type of business unit in agriculture. Unfortunately, the ATO data does not provide any information on own account capital formation which may lead to an undercoverage of this activity within agriculture.

6.4 Crops — time of recording in output and GDP

The SNA93 recommends that cultivated natural growth be included in output as work-in-progress or gross fixed capital formation over the entire period of the growth process. This includes growth of agricultural crops, livestock, vineyards and orchards. The existing Australian treatment is to include agriculture in output when harvested or slaughtered with the exception of beef, dairy and sheep livestock. For beef, dairy and sheep livestock estimates of work-in-progress and gross fixed capital formation are made using the method described above.

Australia has not implemented the recommendations for crops and plantation growth because of data availability and operational reasons. Implementation of the revised standards for crops would require crop output to be forecast at the beginning of the crop year and then distributed to quarters as the production process occurs. Because the crop year generally spans more than one financial year in

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

Australia, it would also require a redistribution of output across years. Given Australia's variable weather conditions and variations in prices for these commodities, revisions going back into the previous year could be substantial if the SNA93 approach were to be adopted. A further difficulty is that measurement of the crop production process throughout the season would be quite arbitrary. SNA93 recommends allocation of output using costs incurred in each period, including an allowance for the use of own labour. The major expenses associated with wheat production would be incurred in the June (planting) and December and March (harvesting) quarters, although substantial crop growth would also occur during the September quarter. Notwithstanding the somewhat arbitrary nature of the allocator, quarterly costs data by type of crop are not available.

7. Summary

This paper has presented the measurement of agricultural output and value added in the ASNA, including some of the issues surrounding these measures. The contribution that agriculture value added has made to Australian GDP growth and the significant impact weather conditions can have on agriculture and hence Australian GDP growth have been highlighted. The concept of gross value added, the data sources used and calculating gross value added on an annual and quarterly basis have been explained. Finally, some specific measurement issues related to gross value added such as seasonal adjustment, secondary production, double counting of outputs, own account capital formation and crop production for the agriculture industry have been discussed.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.

References

Australian System of National Accounts, Concepts, Sources and Methods
Australian Bureau of Statistics (2000)

System of National Accounts
Commission of the European Communities, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations, World Bank (1993)

5204.0 Australian System of National Accounts
Australian Bureau of Statistics (2006)

5206.0 Australian National Accounts: National Income, Expenditure and Product
Australian Bureau of Statistics (2007), June Quarter 2007 issue

Weblink: Impact of the Drought in Agricultural Production in 2006-07 (Feature Article)
5206.0 Australian National Accounts: National Income, Expenditure and Product
Australian Bureau of Statistics (2006), September Quarter 2006 issue.

Please purchase PDF Split-Merge on www.verypdf.com to remove this watermark.