

THE PRODUCTION APPROACH TO MEASURING GDP

The purpose of this paper is to describe the experience of the Australian Bureau of Statistics (ABS) with the production approach to measuring GDP.

With reference to production based GDP the paper will discuss:

- the statistics ABS produces;
- what the statistics are used for;
- the methods used to compile them;
- the data sources used;
- the resources required; and
- challenges for the future.

Productive activity defines the "boundary" of the economy for measurement. It includes the production of all market traded goods and services, whether or not they are exchanged for cash; all household production of goods for consumption within the household plus the shelter services provided by owner occupied homes.

Logically, a production based measure is the primary and direct estimate of GDP. If there was no production there would be no goods or services to consume and no income would be earned.

Statistics Produced

Each quarter ABS produces annual chain volume measures of production based GDP for the quarter, and for the year to date. These are presented in original (unadjusted) terms, and in the case of the quarterly estimates in seasonally adjusted and trend terms. Tables show annual percentage changes, changes from the previous quarter, and from the same quarter of the previous year.

Total GDP is disaggregated for 32 industries (plus ownership of dwellings which is treated as a nominal industry), with quarterly chain-volume estimates of Gross Industry Value Added produced for each in original, seasonally adjusted and trend terms. An analysis of industry contribution to the quarterly change in GDP is also compiled.

The quarterly time-series starts in the June 1975 quarter. An annual production based GDP series dates from 1960.

Each year the ABS also publishes production based chain-volume measures of Gross State Product for each of Australia's eight states and territories. The series includes analysis by 18 industries. This time-series dates back to 1990.

These statistics are illustrated in Appendix 1.

Uses of Statistics

Production based measures of GDP are used to understand the contribution which industries make to the Australian economy. On a quarterly basis, the data shows industry contribution to growth between quarters and over the year. In the September quarter of 2008, for example the statistics highlighted that if it weren't for the contribution of agricultural industries the Australian economy would have recorded negative growth.

Over time the data shows the changing structure of the economy, as measured by change in industry contribution (see Appendix 2).

ABS publishes annual statistics on Multifactor and Labour productivity. Production based industry value added for industries falling within the "market sector" provide the measure of output used in constructing these estimates. (Appendix 3)

Industry Value Added statistics are used in developing Industry Policy. Annual input/output tables prepared by the ABS breakdown the value of output and value of intermediate consumption for 109 industries by 109 commodity categories. These tables

are used as input into economic modeling. An example is recent work done by the Australian Treasury to model the economic impact of a Carbon Emissions Trading scheme (Appendix 4).

In economic analysis and forecasting, production based estimates are used in conjunction with complementary estimates using expenditure and income approaches. In combination they produce a more complete picture of the national economy. Changes in household and government final consumption expenditure reveal changes in demand which can be expected to flow into stock change and production. Changes in capital formation are indicative of future expectations of growth (Appendix 5). Economic Forecasts in Australia are usually based on the expenditure based estimate of GDP (Appendix 6).

Estimates of GDP are themselves compiled within a wider system of MacroEconomic Accounts which includes National Accounts (Appendix 7), Balance of Payments and International Investment Position Statistics, Monetary and Finance Statistics and Government Finance Statistics. This wider set of information enhances the value of GDP data. For example in response to the recent Global Financial Crisis the Australian Government announced a number of increases in transfer payments in the December quarter of 2008 with a view to maintaining the level of demand. There was some evidence in GDP data that household consumption levels were maintained, however the related Household Income Accounts showed that there was a significant increase in savings, suggesting that much if not most of the stimulus payments had been saved rather than spent (Appendix 8).

Methods

Production based estimates of GDP are produced as part of an integrated System of National Accounts.

Consistent with SNA guidelines, ABS compiles three conceptually related measures of GDP:

GDP(P): The production measure that calculates the total value added by producer enterprises in the economy: i.e. the difference between the value of outputs produced and the value of goods and services consumed in production (intermediate inputs)

adjusted for taxes and subsidies on those products.

GDP(E): The expenditure based measure which values what government and households spend on the acquisition of those products.

GDP(I): The income based measure which sums the earnings which households derive from providing labour and capital services for use in generating production.

As shown in the diagrammatic representation (Appendix 9) The economy is a closed system in which: $GDP(P)=GDP(E)=GDP(I)$

Supply/Use Tables

The central component of the method used to produce GDP by the ABS involves the construction of annual supply/use tables.

The Supply table (Appendix 10) shows the value of production for each of 225 commodity categories by each of 53 Industries, which collectively embrace the whole domestic economy. To this is added the value of imports of each of the 225 commodities. Adjustments for trade and transport margins and taxes less subsidies on products enables total value of the supply of each commodity to be calculated at purchasers' prices (the sum of each row in the table).

The Use table (Appendix 10) has two components.

The first component at the top of the table records the use of each commodity category, either as intermediate input to each of the 53 industry categories, or in final use: in consumption by households and governments, in Capital Formation, in inventories or for export. The sum of intermediate and final use categories equals total use for each commodity.

The second component in the bottom part of the table records for each industry the income components of Industry Gross Value Added: compensation of employees, gross operating surplus and taxes (less subsidies) on production.

Together both tables incorporate the three measures of GDP:

Output - Intermediate Use + margins + taxes on products - subsidies on products =
Compensation of Employees + gross operating surplus + other taxes on production -
subsidies on production
GDP(P) = GDP(I)

Supply=Use

Output + margins + Imports + Taxes on products - Subsidies on products = Intermediate
Use + Domestic Final Use + Inventory changes + exports

Output - Intermediate Use + Margins + net taxes on products = Domestic Final Use +
Inventory Change + Exports - Imports

GDP(P) = GDP(E)

The cells in the supply use table are populated by information derived from a variety of sources; including data provided by businesses and households to the Australian Tax Office, data sourced from government financial records, data from Customs Authority records of goods exports and imports and data derived from surveys of businesses and households. In some cases data is entered to the tables directly from its sources, and in other cases such as estimates of the value of Financial Intermediation Services or the value of services provided by Owner-Occupied homes, the source data is subject to modeling processes to derive the inputs to the Supply/Use tables.

Because data is derived from multiple sources of varying quality, coverage, timeliness etc, the tables don't balance when first populated. The balancing process involves, for each commodity making adjustments to the raw data to resolve supply equal to use. This involves systematic investigation of the source of significant differences and informed judgment about the relative robustness the respective data sources. For example the supply data on steel is sourced from comprehensive customs import records and surveys of domestic production. Deriving use in each of intermediate consumption, final consumption capital formation and inventories is likely to be less accurate as it is more subject to reporting and estimation error. Therefore balancing adjustments would be made to the use categories rather than to supply.

Compiling annual balanced supply use tables provides a systematic framework for investigating sources of error in the data used to measure GDP. Consistent or widening discrepancies can highlight more systematic quality concerns and can help in

targeting investment in improvements to source data where it can best make a difference.

Each year the ABS compiles 3 sets of annual supply and use tables.

In 2008, for example, tables were compiled for the years 2007, 2006 and 2005. The 2005 data is finalized, on the basis of any new information available during 2008. Amendments are made to the 2006 table, and a preliminary 2007 table is produced. Any revisions to published GDP series are incorporated into the next annual publication following completion of the balanced and updated tables. Each year's table is produced in both current year prices and prices of the previous year to enable derivation of chain-volume measures of change in real GDP. The ABS undertakes a program of consumer, producer export, import and labour price indexes to allow derivation of annual price change in the Supply/Use table commodities. The advantage of chain volume indexes (see Appendix 11) is to ensure measures of real output are not distorted by long term movements in relative prices.

Whilst the Supply/Use tables provide the basic tool for compiling annual measures of GDP estimates, quarterly estimates of GDP are derived by extrapolating the volume measures from the latest annual Supply Use table, based on data derived from a mix of quarterly indicators. For the production based measures of GDP, business surveys provide the primary source of data on quarterly change in industry value added

Some particular aspects of methodology of interest:

Agriculture.

Quarterly estimates of change in the volume of agricultural commodities produced are derived from models maintained by a specialist government agency, the Australian Bureau of Agricultural and Resource Economics (ABARE).

Owner Occupied Housing

To enable cross country comparisons of GDP between countries with diverse proportions of owner-occupied housing, an estimate of the value of the shelter services provided by owner occupied homes is derived. An estimate of the rent foregone by owner occupiers

is calculated from data on the owner occupied housing stock, comparable rentals paid for houses of similar quality and from a quarterly index of rental price movements.

Financial Intermediation Services-Indirectly Measured (FISIM)

A "reference rate approach" is used to "indirectly measure" the value of Financial Intermediation Services. FISIM equals the sum of the imputed financial services consumed by those who borrow from financial institutions in the form of loans, and by those who lend to financial institutions in the form of deposits. Under this approach the value of the output of services is deemed to be equal to the value of services consumed. This output is then allocated to the users of the service.

$$\text{FISIM} = \text{Total loans} * (\text{effective interest rate on loan} - \text{reference rate}) + \text{Total deposits} * (\text{reference rate} - \text{effective interest rate on deposits})$$

As the reference rate we use the mid-point of the effective rates on loans and on deposits.

FISIM represents approximately 40% of the output of the Financial Services Industry. It is allocated as intermediate consumption to industries on the basis of use of financial services, and to final consumption by households and government.

International Comparability

ABS GDP statistics are compiled in accordance with the International System of National Accounts (1993) Standards.

The Industry, Commodity and Sector Classifications are Australian and New Zealand Standards compatible with related International Standards: the International Standard Industrial Classification (ISIC Rev3); the Central Product Classification (CPC) and the International Standard Institutional Sector Classification (ISISC).

Seasonal Adjustment

Seasonally adjusted estimates and trend estimates of quarterly change in production based GDP, and for Industry Value Added are calculated using the "concurrent" adjustment method which incorporates the current quarter's data into the calculation of the seasonal adjustment factors. This approach takes account of any recent changes

affecting seasonality, and reduces the level of data revisions compared with the use of the traditional “forward factors” method. Concurrent adjustment can be problematic if the current period data includes a significant irregular component. This has been apparent with the recent volatility arising from the impact of the Global Financial crisis on movements in export prices.

ABS adopts an additive approach. The trend and seasonally adjusted estimates of GDP(P) are derived by summing the trend and seasonally adjusted estimates of value added for each component industry.

Data Sources

As already noted, the Integrated System of Macro-Economic Statistics, of which the SNA is the central component, provides a conceptual framework within which GDP and other National Accounts statistics are compiled. The same conceptual framework also provides a basis for developing an operational infrastructure to support integrated data sources. This structure ensures comprehensive coverage of all economic transactors, it prevents duplication and double counting, and promotes greater consistency and comparability of data, collected across a range of different sources. It also reduces the cost of extending data collection by enabling best use of all existing sources, including both surveys and administrative records.

The outline of the framework is presented in Appendix 12.

Classifications:

A basic element is the application of common classifications across all data sources: for example common industry, institutional sector, and where relevant commodity classifications are applied consistently in business surveys, household surveys and tax office records. This means, for example, that statistics on hours worked collected in a household based employment survey can be related at an industry level to production or value added statistics sourced from annual business surveys and tax data to derive estimates of labour productivity.

Business Register

A second element of the data source framework is a comprehensive register of businesses and government entities engaged in the production of goods and services. Each and every business is recorded only once. Basic industry and sector classifications are recorded for each business together with a measure of the size of each business to support the use of stratified sampling in business survey design. Where the production of statistics on a regional basis is required, then a location code is desirable. It is also important that the register is consistently maintained for "births" of new businesses and "deaths" of existing businesses. The large and complex firms need to be "profiled" or broken down into component production units where the activities of the business span multiple industries.

The ABS makes use of the register of businesses maintained by the Australian Tax Office. The primary purpose of this register is to ensure all businesses are identified for purposes of collecting taxes-in particular taxes on business incomes and value added taxes. Any business in Australia with annual turnover of A\$75,000 (US\$58,000) is required to register and most smaller firms do so as a matter of course. All businesses are classified consistently by industry and sector by the tax office. Data is collected annually and quarterly on income and expenses from all businesses by the Tax Office, and provides a measure of the size of each firm for use in survey design, as well as a direct source of statistical data. In total there are 2.5 million businesses recorded on the register. The largest 15,000 of which, having annual value added above A\$38 million, are separately profiled and maintained by ABS staff. The register provides the population source for virtually all ABS surveys of businesses, including farms.

The use of a common register reduces inconsistency between data derived from business surveys, and allows the linking of data sourced from tax and survey sources at a unit level. Each business recorded on the register has a unique identifier, the Australian Business Number (ABN), which is widely used in other administrative data sets, such as Customs data on imports and exports and data collected from Financial Sector businesses by the Australian Prudential Regulatory Authority (APRA).

Business Survey Program

The third key data source is an integrated program of annual and quarterly surveys. The Annual Integrated Collection (AIC) collects data from a sample of 15,000 businesses across the whole economy (other than Agriculture and Government) including data on turnover, expenses, profits and salaries and wages. Associated with the AIC is an on going program of commodity data collection that provides information on the value of commodities used, produced, carried or traded. The AIC provides the principal source of data used in compiling the production and income components of the annual supply and use tables. The ABS also undertakes a Quarterly Business Indicators Survey (QBIS) which collects similar data to the AIC from a sample of 16,000 firms, and provides data used in estimating quarterly change in the annual benchmark data derived from the AIC.

Annual Agricultural production data is derived from a separate annual survey of farm businesses. The Australian Business Register also provides the source of the population for farm surveys. Data from government sector businesses is obtained from the accounting systems of the Commonwealth and the eight State and Territory governments, and from a survey of Australia's 588 territorial local governments.

Data from the Prudential Regulatory Authority is used in calculating FISM and data derived from the 5 yearly Census of Population and from the Consumers Price Index is used in deriving the value of shelter services provided by owner occupied housing.

Producer Price Indexes

A fourth key data source is a program of Producer Price Indexes (PPIs) which provides quarterly price movements for the commodity categories used in the annual supply use tables, enabling annual volume changes in industry value added to be calculated. The PPIs are also used in deriving quarterly chain volume indexes from data collected in the Quarterly Business Indicators Survey. The PPI's are compiled from quarterly surveys of 2600 businesses.

Costs and Resources

In total the production of macro-economic statistics in the ABS (including National

Accounts, International Accounts, Government Finance Statistics and Price Statistics) requires approximately 220 person years of effort annually. Of this approximately 64 person years is involved in compiling annual and quarterly national accounts. Of these approximately 43 person years is required to produce annual and quarterly measures of GDP. It is estimated that approximately 25% of the effort of these people (11 person years) is involved in producing the production based estimates. It is difficult to precisely estimate this number as Production Based GDP measures. As this paper has explained, production based GDP is only one output of an integrated process of macro-economic statistics compilation.

These figures also exclude those who work on the maintenance of the source data infrastructure: The Business Register, Annual and Quarterly business and local government surveys and Producer Price Indexes required to support production of quarterly and annual GDP. In total these involve a further 292 person years of work. It is not possible to easily separate the component of this work required to support production based GDP as the collection infrastructure provides data for all three measures: production, expenditure and income.

These figures also exclude the work of technology specialists required to support the information technology systems used.

If the ABS were only to compile production based GDP, we believe we would still need to build and maintain most of the infrastructure required to support all three measures. We would still need to develop and maintain core classifications, a business register, a program of annual and quarterly business surveys, producer price indexes, surveys of local and central government finances, and build expertise in the SNA, in index construction and in seasonal adjustment. The major additional costs relate to compiling statistics on exports and imports of goods and services required for the Expenditure measure. (Appendix: 13).

Challenges for the Future

Scope

With one important, and fundamental proviso: namely the definition of its scope; the SNA makes no judgment about whether or not a particular economic activity does or

does not add or subtract from human well being. The production, distribution and use of cocaine is treated no differently to chocolate. In defining its scope, however, the production boundary excludes household provision of most services produced for own consumption (such as home based care of children and the elderly) and the SNA asset boundary excludes most natural, social and human capital. The indifference to social "goods" and "bads" and the perceived limitations of the SNA production and asset boundaries are at the heart of criticism of the undue prominence given to GDP as an indicator of well-being (Appendix 14).

The global concern with the impact of climate change, for example, highlights the dependence of human activity on the capital services provided by the atmosphere and the ocean: capacity to absorb greenhouse gasses. The implementation of Emissions Trading Schemes or Carbon Taxes, by placing a price on these services, will at least begin to bring them within the scope of the SNA production boundary.

The development of various "alternative" measures, such as the Genuine Progress Indicators or "green GDP" are at least in part a response to these perceived limitations. The work of the "Stiglitz Committee", and successive OECD sponsored forums on "Measuring Progress of Societies" illustrates the level of interest in developing broader based measures of well-being.

The ABS response has been to provide a range of complementary indicators of social and environmental status to complement GDP, rather than develop subjectively weighted "single number" composite indicators. These are presented in an annual publication: "Measures of Australia's Progress". ABS favours further development of environmental and social satellite accounts that extend the national accounts framework beyond the core asset and production boundaries, without compromising the integrity of the core economic accounts.

Within the scope of the production boundary, there is periodic need to ensure that informal household production and elements of the hidden economy, both illegal activity and undeclared "legal activity", are not excluded. Periodic surveys of household expenditure and income provide one independent source for validating coverage of core business survey based estimates, and are a source of information about household based production (home renovation and other DIY activity and home based production of food). Audits undertaken by the Australian Tax Office are a further periodic source of

information on the size of undeclared activity. ABS believes that in total, informal and "hidden" activities excluded from the coverage of GDP data sources make up less than 2 percent of total GDP.

New Industry Classification

ABS needs to invest in maintaining the relevance and accuracy of its production based measures of GDP. Currently, the ABS is in the process of implementing a new Industry classification, the 2006 Australia and New Zealand Standard Industry Classification (ANZSIC06) which provides a more detailed breakdown of service industries which now contribute over 2/3 of Australian GDP (Appendix 15). The new classification adopts a similar approach to the North American Industrial Classification System (NAICS) and is consistent with the latest revision of the International Standard (ISIC -Rev4). The implementation of the new classification affects key annual and quarterly data sources. Survey samples have been expanded to collect data for both the old and new industry breakdowns to provide an essential link enabling publication of "backcast" production GDP data on the new classification. The new series are scheduled for release in December this year.

SNA 2008

ABS is also implementing methodological changes to the System of National Accounts arising from the 2008 update recently approved by the United Nations Statistical Commission. The major impacts on the production based estimate include capitalizing expenditure on Research and Development and the capitalizing of expenditure on Defence Weapons Platforms. Both impacts have the effect of a small reduction in intermediate consumption and an offsetting small increase in the level of GDP. Statistics compiled on the new basis will be released in parallel with the implementation of the new industry classification.

Improved Service Industry Output Measures

ABS has introduced output based volume measures for some public sector industries (health and education) to replace input based measures. We are also collaborating in a joint research program with the University of New South Wales to develop improved measures of the output of the banking, insurance and financial services industries.

ABS has also developed an experimental price index for retail margins, however recent cuts to ABS funding have curtailed the implementation of this work. The index has the potential to allow development of a quarterly volume measure of change in retail margins, in place of the current sales based indicators.

The Global Financial Crisis

The current downturn in the global economy means more intensive user scrutiny of ABS statistics. Some volatility has been apparent in estimates of the output of financial services industries, arising from changes in interest rates and shifts of borrowing from non-bank to banking institutions. Changes in exchange rate and global commodity price fluctuations have also created volatility in estimates of import and export volumes.

The three measures of GDP have separately tracked the impact on expenditure, production and incomes. The impact of the global recession also highlights the limitations of any one measure of GDP.

Maintaining Professional Capability

ABS success in producing reliable and relevant measures of the performance of the Australian economy rests on our ability to maintain a cohort of staff across the economic statistics program who share a sound knowledge of the theory and practise of national accounting. This applies across all components of the work: registers, classifications, survey design and operations, time series analysis, price indexes, government finance and international accounts. All those involved need to understand not only the technical aspects of their day to day work, but also appreciate how they contribute to the final product: the quarterly and annual national accounts. Maintaining expertise is a growing challenge as the "baby-boom" generation retires. The growth of the financial services industry has also created an expanding range of career options nationally and internationally available to people with macro-economic knowledge and skills, and practical experience in measuring the economy. Currently turnover of staff in the core macro-economic statistics group is 12% per annum. In this environment staff training and development become more important, and computer based systems need to be easier to use to enable people to become more effective as economic statisticians more quickly. Staff rotation also helps people to broaden their knowledge of the whole of

macro-economic statistics.

Conclusion

This paper has outlined the Australian Bureau of Statistics approach to the measurement of GDP on a Production basis. Australia has well established systems for the administration of business taxation, government finances and prudential regulation. These administrative systems are comprehensive in their coverage of productive activity by businesses and government. The ABS has worked closely with the key agencies of government responsible for these functions to enhance the utility of their databases both as a direct source of information for compiling economic statistics and a base on which to build our complementary program of business surveys. For example the Australian Tax Office imbeds industry and institutional sector coding into its business processes for maintaining its register of Australian businesses. ABS worked with the Tax Office in the design of Australia's Value Added Tax system to include additional questions on capital purchases and disposals to make the data collected each quarter from all firms more statistically useful. A senior ABS person is a member of the Board responsible for the oversight of the Australian Business Register, and a small group of ABS staff are "out-posted" to work in the Tax Office to manage data quality risks.

The informal and hidden components of the Australian economy are a very small part of total economic activity in Australia, and can be monitored through a regular household survey program.

Without this strong base of comprehensive administrative data, a production based measure of GDP would be a more expensive and challenging undertaking requiring considerable investment in building and maintaining business registers, and undertaking extensive programs of economic censuses to provide the underlying benchmark data required. The compilation of annual benchmark data is likely to be much less comprehensive and timely, and both annual and quarterly statistics are likely to be more subject to revision. In the case of the ABS, the development of National Income and Expenditure accounts in the 1950s and 1960s preceded the development of production based measures of GDP, reflecting the lower cost and easier access to source data for these measures.

A key feature of Australia's national accounts is integration. No measure of GDP is perfect. Even the best data sources suffer from shortcomings in coverage and accuracy. Administrative processes introduce arbitrary noise and lags in capturing real-world events. Surveys are affected by sampling and non-sampling errors; price-indexes suffer from measurement biases and some concepts such as research and development, FISIM and Trade Margins are inherently hard to measure reliably. All these issues are apparent in the three separate measures of GDP compiled by the ABS, but each provides a complementary insight into the performance of the economy. In combination, the strength of the three measures is that in their average, GDP(A), we are most likely to be deriving a good approximation of the real state of economic growth.