



Australian Government

Department of Infrastructure, Regional Development and Cities

Bureau of Infrastructure, Transport and Regional Economics



Measuring Gross Regional Product

At a glance:

- This information sheet provides an introduction to measuring the total value of goods and services produced in a region, known as Gross Regional Product (GRP), as well as conceptual and practical limitations of this measure.
- GRP is often used to illustrate the size of a regional economy relative to the size of the Australian economy in order to promote a region's investment appeal or to promote the importance of the region to the national economy.
- Although other more direct measures exist, GRP is also sometimes used to approximate the welfare of households within a region (such as GRP per capita), and when disaggregated by industry, the 'specialisation' of regions and the role of various industries in each region.
- While estimates of GRP attempt to allocate production to particular regions, in practice the Australian economy is a single, interconnected and often interdependent system. No region is self-contained: activities are carried out both within and across other regions, including internationally.
- The interconnections in the Australian economy are complementary and the whole economy is greater than the sum of its parts. For this reason GRP estimates do not fully capture the contribution of a region to the economy.
- Estimating GRP accurately relies on three conditions: (1) being able to measure value, (2) having a complete picture of the economy, and (3) being able to uniquely locate the value of economic activity in space.
- The third condition makes measuring GRP relatively more difficult than measuring the production of the whole economy (Gross Domestic Product or GDP), as it requires defining functional economic areas and uniquely locating production within them.
- There are often other more direct sources of data which provide a more accurate view of a regional economy and welfare than estimates of GRP.

Introduction

The Australian economy is an interconnected network, with all regions contributing to the national economy. Despite these interconnections, there is often a desire to estimate the value of what is produced at a regional scale. This results in many estimates in the public domain attempting to measure the Gross Regional Product (GRP) of a region.

Measures of GRP are generally used to promote a region's investment appeal or to promote the importance of the region to the national economy. Although other more direct measures exist, this measure is also sometimes used to approximate the disposable income of households in a region, and when disaggregated by industry, the 'specialisation' of regions and the role of various industries in each region.

GRP is an estimate of the gross value added of all producers resident in a region. Gross value added represents the difference between the total cost (to producers) of all of the inputs into production and the cost (to consumers) of the output that is produced. These measures are an attempt to quantify the size of a regional economy in a way analogous to national Gross Domestic Product (GDP).

There are many conceptual and data limitations in the construction of a national GDP, and there are still more conceptual and data limitations in estimates of GRPs. This information sheet is a quick guide to interpreting GRP estimates and these conceptual and data limitations.

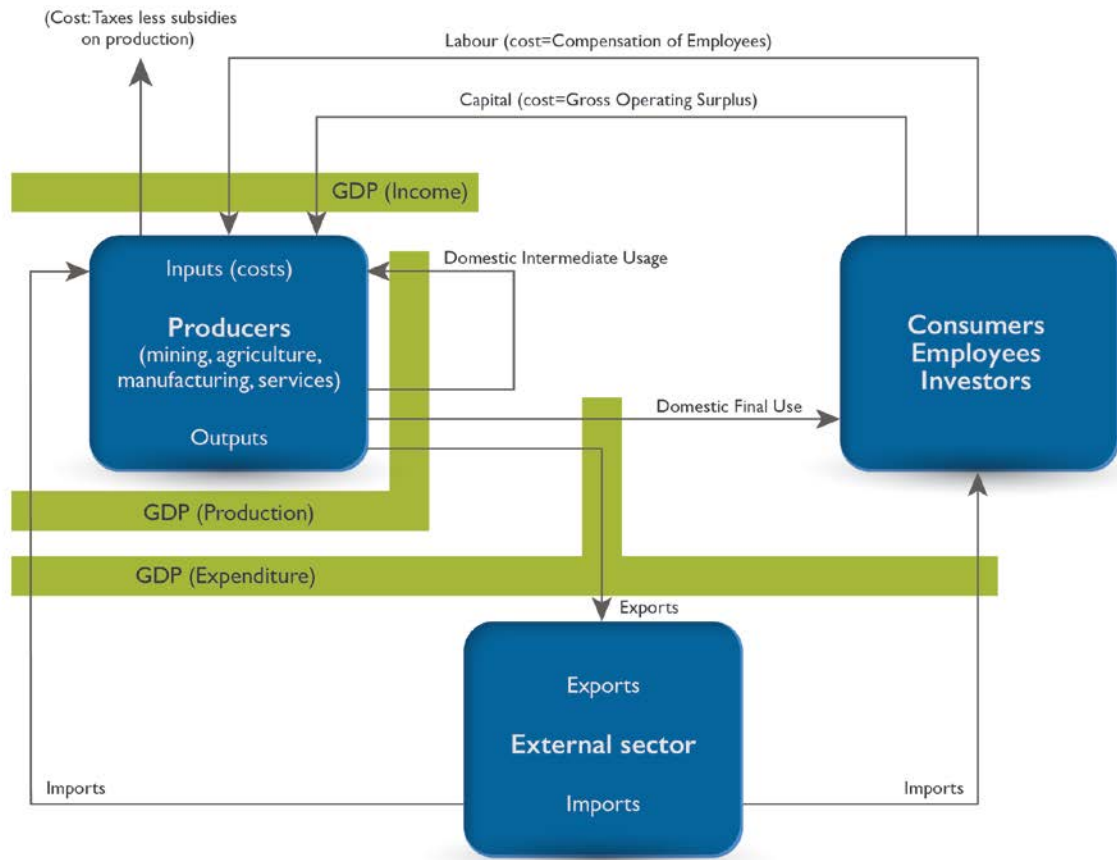
The first section introduces the national economy and concept of regional economies in light of the economic interaction between regions. The second provides an overview of the consideration in defining geographic regions for economic analysis. The third briefly introduces how GRP is estimated while the final section discussed the conceptual and practical limitations. Two appendixes are also included; Appendix A provides detail on the conceptual underpinnings of GRP estimates while Appendix B provides a brief glossary of technical terms often encountered in the GRP literature.

Dividing the Australian economy into regions

The Australian economy is a single, interconnected and often interdependent system. It represents the endless transactions of businesses, consumers and governments, each with a unique spatial pattern of activity. No region is self-contained: activities are carried out both within and across other regions, including internationally.

Figure 1 shows a conceptual diagram of an economy, and the interconnections between producers, consumers, employees, investors and the external sector that together produce Australia's GDP (note: this diagram does not include government, which also plays an important role).

Figure 1 The economy – flows of goods and services



Source: Adapted from ABS 2003.

An important component is the value of imports and exports (international trade), which is captured through international trade flows. Australia has never existed as a closed economy without international trade or investment, but has a long history of global linkages in terms of exports and imports, investment and human capital (through immigration) (Dyster and Meredith 2012).

Figure 1 can also be used as an illustration of a regional economy. *The challenge is to capture the trade that occurs with other regions.* In contrast to international trade, goods, services and people flow freely within Australia and to capture these flows is currently infeasible. Consequently, what is achievable in calculating GDP is not possible at the regional scale for the calculation of GRP.

Types of regional interconnections

The interconnections shown in Figure 1 exist across regions. Regional interconnections occur in terms of investment, production and consumption and operate at multiple scales – for example, across cities, regional towns and their surrounding areas. Flows occur in the areas of employment/firm activity, education and training, knowledge and technology, investment, recreation and tourism, cultural activities and commerce (spending on goods and services).

A business located in one region may receive investment from overseas; have workers travelling from other regions; provide their goods and services to surrounding regions and contract particular corporate services from a capital city. Likewise, consumers can make purchases locally, anywhere in Australia, or overseas. Many businesses, for example major retail chains, have capital city headquarters, as well as stores located across Australia. People can also move temporarily or permanently. For example, a person may be educated in one location and go on to work and live in other places.

Interdependence of regions

These interconnections and a focus on particular functions mean that regions are interdependent. From the perspective of an individual or business, both production and consumption needs are met across regions, by the varied flow types discussed above.

A widespread example of regional interdependence is the relationship between a service centre and its surrounding agricultural area (hinterland). The hinterland produces goods for export, and the service centre supports the workers through provision of goods and services, and provides inputs for the agricultural businesses.

Even within a city, the arrangement of activity is such that some areas are focused on goods and services production, and others on residential activity—both being necessary. A similar complementary relationship exists between small towns in close proximity to larger centres which have a role as commuting towns.

Absolute/comparative advantage and the function of regions

Linkages between regions allow producers to draw on regional advantages. Absolute advantages include natural resources (for example, mineral resources, natural beauty), labour resources (industry expertise/ human capital), and capital resources (including existing infrastructure). A simple example is an inland mine connected via transport links to a port town. The mineral resources of the mining region and the port town's connection to the ocean give each region a function in the creation and movement of value.

All regions also have a comparative advantage. A region's comparative advantage is in those activities which can be performed there more efficiently than in any other region. Because choosing to produce one good or service in a region means that resources will not be available for other uses in that region there is always an opportunity cost. Even a region that is less productive in all respects will have a comparative advantage because the alternative uses of the resources specific to that region are less valuable than those that would need to be given up in other regions. This makes it in effect cheaper to produce some products in a region relative to other regions as producers give up less in terms of their other opportunities.

The interlinkages between regions allow producers in each region to specialise in the goods and services in which they have an advantage. The products produced in each region are then traded between the regions, creating important regional interdependencies.

Complementarity and regional 'contributions'

GRP is a measure of the value added by producers resident in a region. This is conceptually distinct from the contribution of the region to the total economy due to regional interconnections and interdependencies. Complementarity, or the situation where two goods are better together than each are separately, means that it is not possible to measure the individual 'contribution' or value of those two goods (or two regions) separately. To draw an analogy, the cost of a car, and the cost of fuel can be measured. However, it is impossible to accurately divide the contribution of the car vs the fuel to a car trip; both are necessary. Because these are perfect complements trying to divide the value of the trip between each good to measure a 'contribution' is conceptually problematic.

Relating this analogy back to regions, the flows of goods, services, labour and capital between regions have many complementary relationships. Since the whole is always greater than the sum of the parts, and separating out the contributions is not possible, GRP estimates do not fully capture the 'contribution' of a region to the whole economy.

Regional definitions

Defining the region for which production will be measured shapes both the results and interpretation. Practically speaking, this choice is never straightforward because of the complex interactions discussed above. There is only one Australian economy (itself linked to the world economy) and the problem is to divide the single Australian economy into meaningful sub-regions. This comes down to a choice of which economic activities will be (mostly) captured in the geographic definition, and which will not be fully captured and will have a large component imported or exported from the region.

A region may take on a completely different shape if it is designed to capture the local labour market, as opposed to one focused on the purchase of goods and services. Consequently, there is no perfect single geographic partition of the Australian economy into economic sub-regions. Even when choosing a geography to contain a particular part of the economy, in practice there are still interactions with other regions, and so the best practice is to make an informed choice about the acceptable threshold for the amount of economic interaction. For example, in defining geography which captures the area in which people both live and work (i.e. a local labour market), there are large numbers of journey to work flows that are not contained within the region (see, for example, Centre of Full Employment and Equity 2013 and BITRE 2018).

It is very common to use administrative boundaries, such as Local Government Areas (LGAs), to define geography. Administrative boundaries are necessary for delineating responsibilities, but do not reflect economic interactions. For example, Albury and Wodonga are separate LGAs but together constitute a single regional city. Because administrative boundaries are not designed to reflect economic interactions, it is often not possible to gain meaningful total GRP estimates of these areas, as they are not sub-economies (in any sense) in their own right. Best practice is to

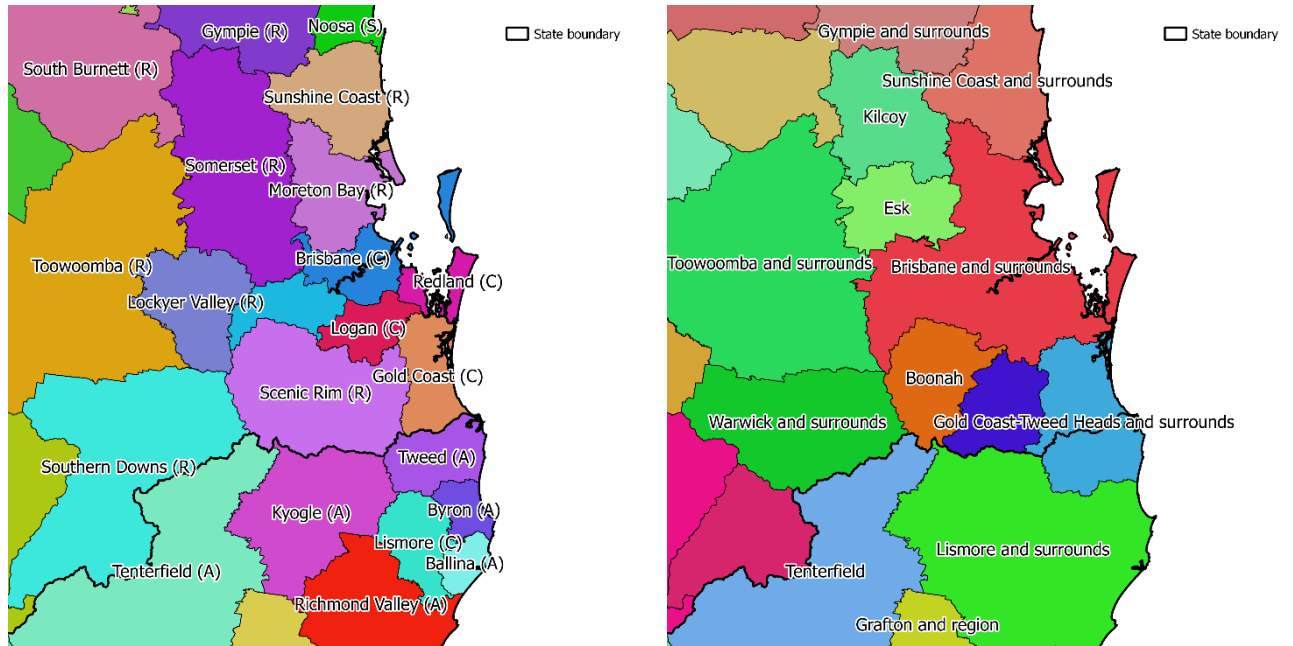
define regions so that they reflect the economic activity of most interest, for example a geography that reflects goods, services, or labour markets.

Figure 2 compares the administrative boundary of 2018 Local Government Areas to BITRE’s working zones, which are a geography that reflects the area in which people both live and work (i.e. a local labour market).

Figure 2 The Australian economy – flow of goods and services

(a) Local Government Areas 2018

(b) BITRE’s Working Zones 2016



Source: BITRE analysis.

Consider the bottom right corner of each map, around Lismore. For administering local government services the area is separated into five LGAs; Kyogle, Byron, Lismore, Ballina and Richmond Valley (left). However, all five are part of the same local labour market (right), with many people living and working in the different LGAs. Although it may make sense to separate each LGA for administrative purposes, if we are interested in the economics of employment, it does not make sense to consider each LGA separately, as they are interconnected and interdependent.

Estimating a region's Gross Regional Product

Measuring GRP rests on the analogy between measuring the value of what is produced in the national economy (GDP) and what is produced in a region (GRP).

- GDP typically makes comparisons between countries, while GRP is usually used to make comparisons between regions or to the national economy.

The ideal GRP would be a complete measure of the value of all that is produced during a period of time in a given region. In technical terms, it would show the unduplicated value of goods and services produced in a given period in a given region.

To measure the unduplicated value we need to measure the value of the flow of goods and services, but only once. Broadly this means that there are three ways we can measure the value of production in an economy:

- by measuring the value of everyone's income (income approach),
- by measuring the value of what everyone spends (expenditure approach), or
- by measuring the value of what everyone produces (production approach).

In theory each approach will provide the same total value of what is produced in the economy. In practice they differ slightly as each requires a different set of information that can be gathered at different levels of accuracy. A more detailed description of each approach can be found in Appendix A.

To compile a GDP estimate for the national economy (the Australian National Accounts) the Australian Bureau of Statistics (ABS) uses all three approaches. The ABS uses the production approach as well as a hybrid combination of the income and expenditure approaches to compile the GRP for each state and territory (GSP).

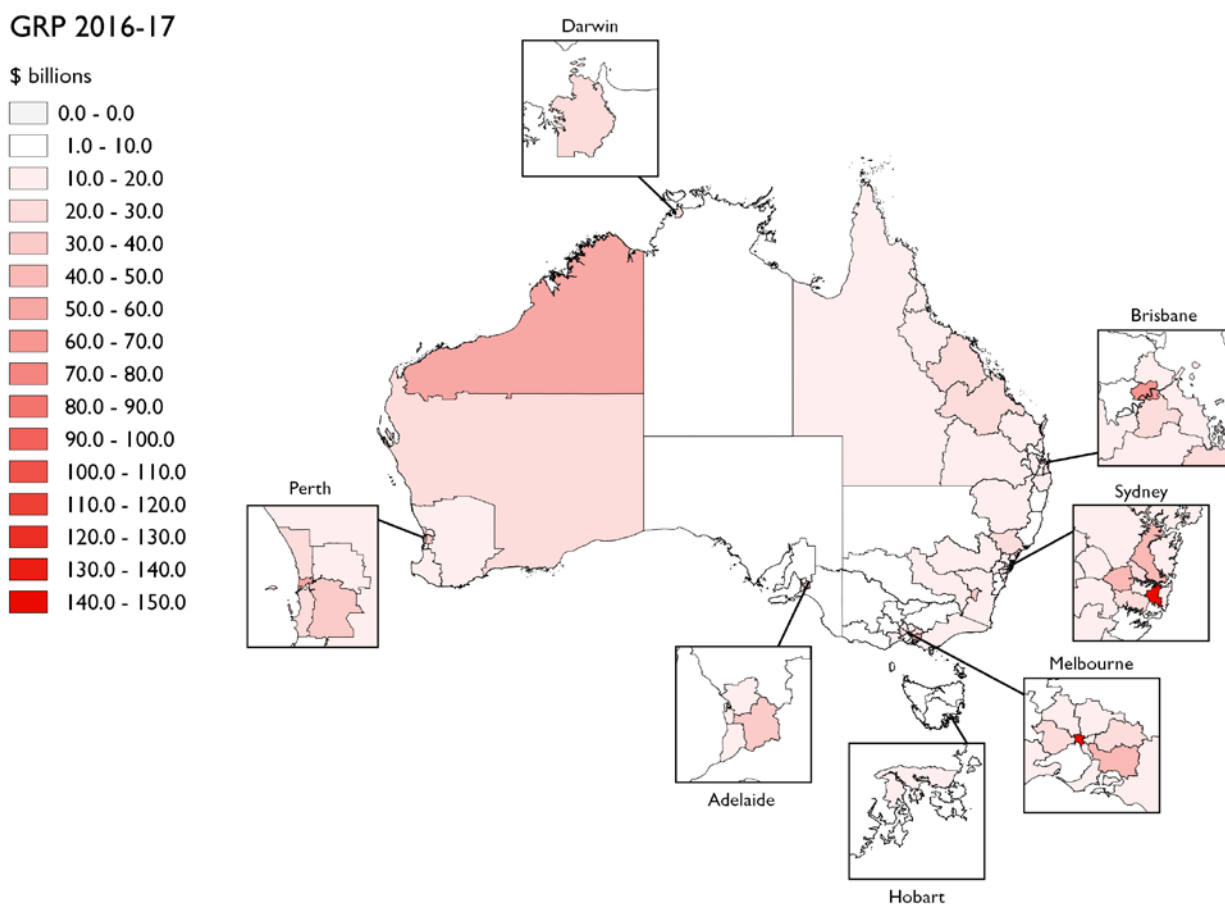
The Australian Bureau of Statistics (ABS) provides two levels of economic activity estimates:

1. GDP estimates for the nation's economy (As at June 2018 GDP was estimated at 471 billion dollars in current prices, growing by 3.4 per cent over the year (ABS 2018a)).
2. GSP is the state/territory estimate (which is a GRP estimate).

The ABS does not publish figures on a finer geographic scale. The ABS notes that even GSP estimates for smaller states and territories are generally less accurate than those for the more populous states (ABS 2014).

The Department of Industry, Innovation and Science's Office of the Chief Economist provides estimates of GRP at the Statistical Area Level 4 (SA4) scale for 2000-01, 2005-06, 2010-11, 2015-16 and 2016-17. SA4s are a geographic classification designed for the collection and dissemination of statistics, specifically ABS Labour Force Survey, and do not closely reflect any kind of functional or economic geography. The 2016-17 estimates at the SA4 scale are shown below in Map 1.

Figure 1 Gross Regional Product by SA4 region



Source: Department of Industry, Innovation and Science's Office of the Chief Economist (2018) - Experimental estimates of GRP 2016-17.

Map 1 shows that in Australia most production takes place in the capital cities (69 per cent), and especially Sydney, Melbourne, Brisbane, Perth and Adelaide (65 per cent). This very closely reflects the distribution of the Australian population; two thirds of the population live in the Capital cities (ABS 2018b). The exception are the mining regions, especially north western Western Australia. In these regions, the high value of the natural resources being extracted is reflected in the GRP figures.

BITRE further apportions the SA4 level estimates to create estimates for the Significant Urban Areas (SUA) that have populations over 80,000 persons. SUAs are a geographic classification that represents the urban extent of large towns and cities with concentrations of urban development and a population of 10,000 or more. They do not necessarily represent a single urban centre and can represent a cluster of related urban centres with a core urban population over 10,000. They can also include related peri-urban and satellite settlements and the area into which the urban development is likely to expand (ABS 2012). These estimates are released by BITRE as part of the National Cities Performance Framework to assist users understand the economic strength and productivity of Australian cities. The GRP estimates presented in the National Cities Performance Framework should be considered together with the other city level indicators presented for each SUA.

Limitations and criticisms

The following section briefly outlines how difficult it is to measure the total production in a region.

Conceptual requirements

To accurately measure the value of goods and services produced in a region we need three things:

1. We need to be able to measure value.

- In practical terms, we are unable to observe the value of production or consumption. At best, when we observe the price a consumer has to pay in a perfectly competitive market, we observe the accounting price at the margin, without taking into account market failures and distortions.
- This conceptual problem is not unique to regional product – it is also an issue for GDP.

2. We need a complete picture of the economy.

- To provide a complete picture of the economy all of the data requirements of the approach need to be met. In practice this is not possible and so measures will be incomplete (to a greater or lesser extent).
- A lack of information is the primary reason that the ABS does not provide GRP figures below the level of States (the GSP estimates noted above).

3. We need to uniquely locate the value of production in space.

Two factors make it difficult to locate the value of production, or even apportion the value of production, to only one region.

Factor 1: All regions within the Australian economy are interlinked.

- There are constant interregional flows that we need to accurately measure. These include:
 - labour (commuting)
 - capital (trucks, trains, planes, mobile plant and equipment) and
 - intermediate goods.
- Production often takes place in multiple locations at the same time.
 - Many head offices and sub offices share services such as management, finance and human resources management, which are inputs into production at many locations at the same time.
 - In general, financial intermediation services, energy generation and transmission and telecommunications infrastructure are sectors in which production takes place in multiple locations simultaneously.

Factor 2: the value of a product is usually greater than the sum of its parts.

- This is not a problem in total GDP estimates, in so far as they reflect a complete economy, as there is no need to apportion the value of complementary products between each product.
- In GRP estimates these separations are implicit and may reflect the ability of producers to capture value in their value chain (i.e. by having market power) rather than their the value they add to that value chain.

Differences in assumptions and methods

To overcome the lack of available information all GRP estimates rely on assumptions and are often built on secondary estimation of the missing underlying components. The quality of the estimates will only be as good as the assumptions made and the quality of the secondary estimation used. This underscores the need to be confident in an estimate before it is used in decision making.

Due to the variation in assumptions and method, estimates that claim to measure the same regional economy can vary considerably.

For example, the ACIL Allen supporting report for the *Australian Infrastructure Audit* (2016) estimated a Pilbara GRP of \$43.5 billion in 2011, while the Western Australian Government estimated a GRP of \$14.0 billion for the same year. PWC's GRP estimate for the Pilbara in 2013-14 was well over \$70 billion.

Other examples include:

- WA Goldfields Statistical Area 3 (SA3) region – ACIL Allen's estimate for 2010-11 is \$5.0 billion, while figures published by id Consulting amount to \$9.8 billion¹.
- Far North South Australia RDA - the South Australian Government estimates GRP of \$4.5 billion. id Consulting provides an estimate of less than half this amount at \$1.9 billion.
- Even capital city GRP estimates vary. For example, Perth's GRP estimate for 2012-13 was \$168.3 billion according to the Western Australian Government, but \$134.3 billion in SGS Economics & Planning's Australian Cities Accounts.

Assessing Gross Regional Product

Despite their limitations, various GRP estimates are used (for example, by local governments, regional organisations and other government bodies). Below are three general considerations to help a reader to assess estimates and the claims that these generate.

¹ These id Consulting estimates are an aggregate of Local Government Areas.

1. Does the data represent the whole economy?

Each approach to measuring the economy has different data requirements. An estimate lacking any of the components needed for that measure (listed in Appendix A) will be an incomplete representation of the economy.

- If the production or expenditure approach is used, an estimate of interregional trade is needed.
- If the income approach is used, an estimate of both the gross operating surplus of organisations and the income of individuals is needed.

2. What is the geographic size of the region(s) being estimated?

Many of the limitations described above have greater consequences for estimates of small geographic areas (particularly at the level of Statistical Area Level 2 and Local Government Area).

- It is more difficult to get a complete picture:
 - small geographic areas do not represent a whole economy
 - less data is available
 - there is higher variability from sampled data (such as surveys) due to smaller sample size
- It is more difficult to uniquely locate economic activity:
 - there is a high degree of unmeasurable 'trade' between regions
 - there are greater proportional flows of labour, capital and intermediate inputs
 - there are more businesses operating across multiple regions

3. Are details of the method, assumptions and data sources available?

No method is perfect. Each have strengths and weaknesses and some may be more useful in some contexts than others. Some low quality estimates may not be useful in any context. This can only be evaluated if details of the method, the assumptions that underpin it and information about the data sources are available.

Existing regional indicators

Using GRP involves a need to evaluate the accuracy of the estimate, and it will always be subject to conceptual and data limitations. Instead, there are other indicators that can be used to illustrate

the size and characteristics of economies and provide a more transparent and direct measure.

Indicators such as:

- Population
- Demographic profiles
- Income
- Unemployment
- Employment
- Building approvals
- Industry structure etc.

The BITRE's [Progress in Australian Regions Yearbook](#) is an illustration of the many indicators used to provide a more holistic approach to understanding a region's economy. A way to consider the use of these indicators for various questions is presented in Table 1.

Table 1 Possible indicators for common regional economic questions

What users want to know	Examples of "Indicator approach" (which indicators can be used for regions?)
Size of the economy	Total employment Total labour force Total personal income Number/size of businesses operating in a region Population
Change/growth in the economy	Change in employment Change in personal income Business entries and exits
Industry structure of the economy	Employment by industry (Census and Labour Force Survey data)

An important exclusion from these indicators is the degree of "trade" between regions and the resulting important interconnections. It is this lack of understanding of functional markets and how they fit into the wider economy, which results in artificial composite estimates (such as GRP) at small geographic scales.

Conclusion

GRP is useful in understanding where production takes place geographically. However, GRP estimates are often used to promote the importance of a particular region or the region's 'contribution' to the national economy. In practice the Australian economy is a single, interconnected and interdependent system in which no region is self-contained.

Where GRP is used to measure the size of a regional economy, it is important that the region accurately reflects the economic interactions of interest. Administrative boundaries or statistical geography, which are designed for other purposes, do not necessarily capture economic interactions. Best practice is to select a geographic representation of the economic activity of interest, for example labour markets when considering employment or goods and service markets when considering the production of goods and services.

The accuracy of GRP estimates depends on the extent to which it has been possible to measure value, gain a complete picture of the economy and uniquely locate the value of economic activity in space. The estimate will always be subject to conceptual and data limitations and require the user to judge the estimate's accuracy. Other indicators that illustrate the size and characteristics of economies should be used in conjunction with GRP to ensure an accurate picture of an economy. Where GRP is used to approximate specific characteristic of an economy, such as income or employment, there are often more direct sources of data that are more accurate than estimates of GRP.

Appendix A Methods of GRP estimation

What would one like to see in a Gross Regional Product measure?

The ideal GRP would be a complete measure of the value of all that is produced in a given region. In technical terms, it would show the unduplicated value of goods and services produced in any given period in a given region. This is otherwise referred to as the *gross value added* in a region.

How can Gross Regional Product be measured?

Broadly there are three ways to measure production in an economy:

- by measuring the value of everyone's income (income approach),
- by measuring the value of what everyone spends (expenditure approach), or
- by measuring the value of what everyone produces (production approach).

Each approach measures economic activity at a different point in the production and consumption cycle. They are made up of different components and each has unique information requirements.

The **income** approach uses the following components to measure the total value of production:

GRP =

- the compensation of employees (i.e. wages, salaries, superannuation, in kind payments etc.)
- + the gross operating surplus (or revenue less costs) of:
 - a. businesses
 - b. not-for-profit organisations
 - c. governments
- + other revenue less costs (technically *mixed income*), such as rent less costs from investment properties
- + taxes
- subsidies on incomes and on gross operating surplus

The **expenditure** approach uses the following components from households, businesses and government to measure the total value of production:

GRP =

- the total value of what is consumed in the economy
- + the total value of *capital formation* (i.e. investments, like building houses or undertaking research and development; changes to inventory, like buying goods to on-sell or stockpiling raw materials; or acquiring valuables, like precious metals or works of art)
- + the total value of exports to people outside the economy
- the total value of imports from people inside the economy

The **production** approach uses the following components to measure the total value of production:

GRP =

the value of *final consumption* (used to directly satisfy a want or need) of

- a) households
 - b) businesses (only in so far as the owners directly consume the product, such as farmers consuming some of what they have grown or a landlord who also lives in their rental property)
 - c) not-for-profit organisations (only in so far as the goods or services produced are directly consumed by households)
 - d) government (only in so far as the goods or services produced are directly consumed by households)
- + capital formation (as described above) by households, businesses, not-for-profit organisations and governments
- the value of all *intermediate products* (used to produce other products) consumed by households, businesses, not-for-profit organisations and governments

For any of the above to be a complete measure of the value of all that is produced in a given region there must be information on all components used to construct the measure.

Source: Adapted from [ABS 2015, Chapter 8: Gross Domestic Product in Australian System of National Accounts: Concepts, Sources and Methods, 2015, Cat. No. 5216](#)

Appendix B Glossary of terms

Compensation of employees (COE)

The total remuneration, in cash or in kind, payable by an enterprise to an employee in return for work done by the employee during the accounting period. It is further classified into two sub-components: wages and salaries, and employers' social contributions. Compensation of employees is not payable in respect of unpaid work undertaken voluntarily, including the work done by members of a household within an unincorporated enterprise owned by the same household. Compensation of employees excludes any taxes payable by the employer on the wage and salary bill (e.g. payroll tax).

Gross domestic product (GDP)

GDP is the total value of the goods and services produced by a national economy.

Gross mixed income (GMI)

The surplus or deficit accruing to owners of unincorporated enterprises from the process of production. It includes elements of both owners' returns on labour inputs and operating surplus (returns on capital inputs) within a region.

Gross operating surplus (GOS)

The operating surplus accruing to all enterprises, except unincorporated enterprises, from their operations in a region. It is the excess of gross output over the sum of intermediate consumption, compensation of employees, and taxes less subsidies on production and imports. It is calculated before deduction of consumption of fixed capital, dividends, interest, royalties and land rent, and direct taxes payable, but after deducting the inventory valuation adjustment. Gross operating surplus is also calculated for general government, and it equals general government's consumption of fixed capital.

Gross regional product (GRP)

GRP is the total value of the goods and services produced in a regional economy.

Gross state product (GSP)

GSP (the total value of the goods and services produced in a state or territory) is the GRP of a state or territory economy.

Gross value added

The cost of output to consumers minus the cost of inputs used in production to producers. It is also equal to factor income plus taxes less subsidies on production.

Total factor income

The sum of compensation of employees (COE), gross operating surplus (GOS) and gross mixed income (GMI). In effect, that part of the cost of producing gross domestic product that consists of gross payments to factors of production (labour and capital).

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