



Methodology for Compiling State Estimates of Multifactor Productivity

A report prepared by Queensland Treasury

**Office of Economic and
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Abbreviations

ABS	Australian Bureau of Statistics
ASNA	Australian System of National Accounts
CVM	Chain Volume Measure
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
GSI	Gross State Income
GSP	Gross State Product
GVA	Gross Value Added
MFP	Multifactor Productivity
PPP	Population-Participation-Productivity
QSA	Queensland State Accounts

1 Introduction

1.1 Background

The purpose of this paper is to provide a technical overview of the methodology used to calculate estimates contained in *An Historical Analysis of Productivity in Queensland*. It contains details of the methodology used by the Office of Economic and Statistical Research (OESR) to calculate estimates of multifactor productivity (MFP) and the methodology for the Population-Participation-Productivity (PPP) decomposition, as outlined in ABS (2004)¹.

1.2 The concept of productivity

Productivity is a broad concept that refers to the relationship between economic output and inputs. The level of productivity is the amount of output produced per unit of inputs consumed. It measures how an economy is using resources (labour and capital) in the production process in order to deliver a final output (goods and services).

Productivity growth is the difference between the growth rate of output and the growth rate of inputs, that is, productivity will increase if output grows faster relative to inputs. This simple relationship means that productivity growth can be realised through any of the following four combinations:

- a larger increase in output than inputs;
- an increase in output with no change in inputs;
- output remaining unchanged while inputs fall; or
- a smaller decline in output than inputs.

The final point indicates that it is possible for productivity to increase (and have a positive influence on economic growth) while an economy is entering a downturn. However, because productivity tends to be cyclical in nature, it is best analysed over the long term (at similar points in the economic cycle). Short term movements may not accurately reflect true productivity trends due to distortion created by economic cycles.

Productivity growth can be achieved through innovations in the production process. Broadly defined, innovation is the behaviour or activity in which new economic possibilities are tested via purposeful changes to products and production techniques². The ability to create new products or to increase the production efficiency of existing products leads to more output being produced from available inputs, increasing productivity. Successful innovative activity across the economy emerges from decision makers acting on both new technical possibilities and new market opportunities.

¹ ABS (1370.0) – Measures of Australia's Progress, 2004, page 177.

² Industry Commission (1995), *Research and Development*, Report No. 44, AGPS, Canberra.

At the aggregate economy level, most interest centres on the two measures of productivity: labour productivity and multifactor productivity.

Labour productivity is real output per unit of labour (usually measured as hours worked). It is clear that increases in output can be obtained by adding additional employees or using the existing employees more intensely (through extra hours). Labour productivity is an attempt to account for these changes in order to measure the movement in efficiency of an hour worked. In other words, it is the increase in output not attributable to an increase in labour inputs.

Labour productivity is the most common productivity measure, due to its ease of calculation and the availability of data at the state and national level. However, despite its name, it is only a partial measure of technological progress, which represents much more than just the efficiency or productivity of workers. Due to the way it is measured, labour productivity also captures any changes in the amount of capital available to workers. This increase in capital per worker hour, measured as a rise in the capital to labour ratio, is termed 'capital deepening'. Hence, labour productivity is often decomposed into capital deepening and a 'pure' productivity component called multifactor productivity.

Capital Deepening is the application of more capital per unit of labour (an increase in the ratio of capital to labour). It means that the workforce has, on average, access to more capital and can therefore generate more output.

Multifactor productivity (MFP) is real output per combined unit of labour and capital. It measures the change in output once labour and capital inputs have been accounted for. Growth in MFP can be driven by enhanced efficiency (finding superior techniques to combine inputs in the production process) and by advances in available technology (achieved predominately through human capital investments and innovation).

In principle, MFP is a better measure of efficiency. It measures how efficiently the main factors of production labour and capital combine to generate output.

By definition, the contribution of MFP and capital deepening equate to labour productivity.

1.3 Measuring productivity

The measurement of economic output, inputs and productivity is not simple, and the results depend critically on methodology and assumptions. The relationship of output to inputs is typically '*one-to-many*' as a single product may require inputs of labour, capital, land and other natural resources. In productivity measurement, it is desirable to hold quantity and quality constant for as many inputs as possible, in order to ascertain how productively those inputs are transformed. The methodology behind productivity estimates accounts for changes in labour and capital inputs but does not include any quality adjustments³. This will be the subject of further research.

Economy wide productivity growth depends not just on productivity improvement within individual industries or firms, but also on the extent to which the weight of output shifts from

³ For Australia as a whole, the ABS produces, in addition to its hours worked measure of labour input, a quality adjusted hours worked measure of labour input for its aggregate market sector estimates.

firms with lower productivity to firms with higher productivity. This implies that as industry composition within an economy changes, so too will measured aggregate productivity levels.

Output

The Australian Bureau of Statistics (ABS) aggregate measure of MFP⁴ is based on 'twelve selected ANZSIC06 industries', comprising: agriculture, forestry and fishing; mining; manufacturing; electricity, gas, water and waste services; construction; wholesale trade; retail trade; accommodation and food services; transport, postal and warehousing; information, media and telecommunications; financial and insurance services; and arts and recreation services. The ABS selected these industries as it is this grouping that most closely reflects the previous market sector and relates broadly to marketed activities for which the ABS have satisfactory estimates of the growth in the volume of output.

There are an additional four industries included in an updated definition of the 'market sector': rental, hiring and real estate services; professional, scientific and technical services; administrative and support services; and other services. Although the ABS produce an aggregate measure of MFP based on the updated definition, a full time series is not currently published. The ABS is working on estimates for each of the additional industries in the expanded definition of the market sector.

There are three industries excluded from the updated market sector and these are known as the 'non-market sector': public administration and safety; education and training; and health care and social assistance. The ABS excludes these industries as the volume estimates of gross value added are derived using a method in which inputs data are used as measures of output (although ongoing ABS work is improving the measurement of output for industries currently in the non-market sector). As a result, meaningful productivity measures cannot be derived for these industries at present as the measure of real gross value added effectively assumes that there has been no change in productivity. The ABS also excludes the special industry, ownership of dwellings⁵.

Economic output is measured by real Gross State Product (GSP), which includes the market sector and the 'non-market sector' as defined by the ABS, less output from the ownership of dwellings industry. This reflects the difficulties in sourcing data on capital investment by industry at the state level to facilitate the estimation of capital inputs for the twelve selected industries, and consequently estimates of MFP for Queensland and the Rest of Australia. The ownership of dwellings industry is excluded because it has substantial capital inputs but no corresponding labour inputs (as measured in the National Accounts). For the remainder of this report the terms 'GSP' and 'output' will refer to the measures which exclude the ownership of dwellings industry.

Labour inputs

The measure used for labour inputs is total hours worked. Using hours worked rather than the number of persons employed allows for a more accurate measure of labour inputs. While hours worked is currently the best available measure of labour inputs, there is scope for

⁴ ABS (5260.0.55.002), *Experimental Estimates of Industry Multifactor Factor Productivity*, 2008-09.

⁵ Ownership of dwellings is an artificial industry created to measure the gross rent of dwellings.

improvement in quantifying the impact that a change in the quality of labour used has on productivity performance. For example, deriving productivity estimates using the summation of hours worked across all employees in an economy implicitly assumes a homogenous labour force. Therefore, over time, there is no adjustment to labour inputs for any compositional change in the skill set or experience of labour used. As this compositional change is not captured as an increase in labour inputs it will be reflected in the MFP estimates.

As noted previously, MFP is a better measure of productivity than labour productivity as it controls for changes in capital inputs. However, the estimation of capital inputs is a complex task at the state level due to the paucity of data.

Capital inputs

The measure used for capital inputs by the ABS is capital services, defined as the amount of 'service' each asset provides during a period. This is calculated by the ABS by weighting the chain volume measure of the productive capital stock by asset type, by their rental prices. Estimates of capital services were compiled by first estimating net capital stock by asset type for Queensland and the Rest of Australia. These estimates by asset type were then scaled by the corresponding ratio between the Australian capital service index and the Australian net capital stock index for the twelve selected industries. See Section 2.1 for additional explanation on the estimation of capital inputs.

Multifactor productivity

The construction of MFP estimates requires a combination of hours worked data (labour inputs) and capital services data (capital inputs) to form an inputs index. This process is accomplished using a Tornqvist index (see Section 2.2 for details). The output measure is then divided by this combined inputs index to derive an MFP estimate.

1.4 Productivity cycles

Short term movements in productivity should be interpreted with caution as productivity estimates are volatile from year-to-year. Year-to-year changes in measured productivity may not be truly indicative of changes in productivity as these short term fluctuations could reflect business cycle issues such as the degree to which firms are utilising their capital stock or that employment growth tends to lag output growth. A common method of examining changes in productivity over an extended period involves identifying and dividing the data into productivity 'growth cycles'⁶. By analysing average productivity performance over a complete productivity growth cycle, the impact of business cycle distortions can be minimised, allowing better analysis of the components of growth in different periods.

For the market sector, the ABS determines productivity growth cycles by comparing the annual MFP estimates with their corresponding long term trend estimates compiled by applying an 11-term Henderson moving average to the original MFP series⁷. The maximum

⁶ For more information on growth cycles, see ABS (5204.0) – Australian System of National Accounts, 2007-08.

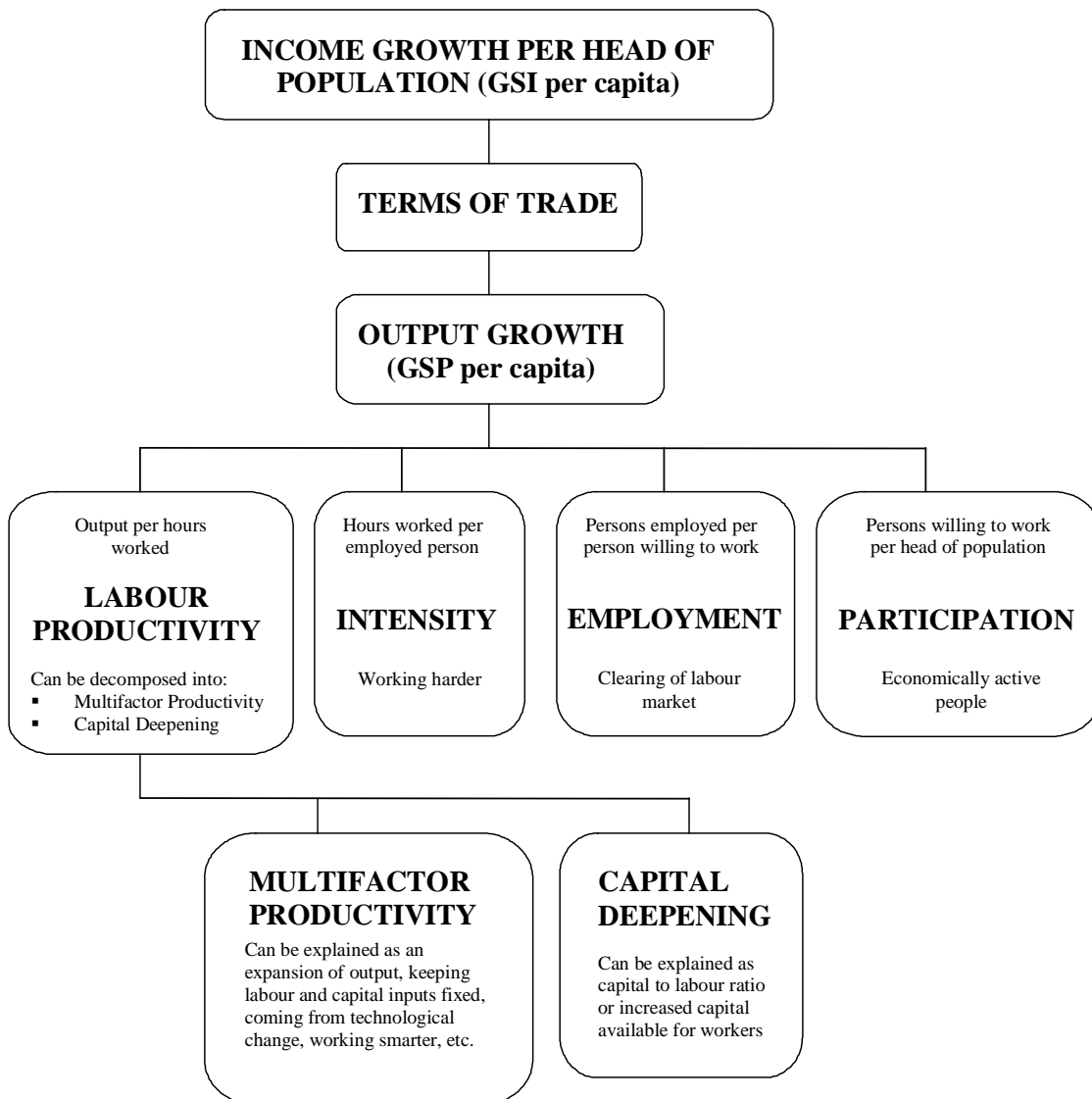
⁷ For more information on applying the Henderson moving average, see *Trend estimates* section of *Queensland State Accounts*, OESR, Queensland Treasury (www.oesr.qld.gov.au/releases/qsa).

deviation of the MFP index above its trend is the primary indicator of a growth cycle peak. A similar approach has been adopted to analyse Queensland MFP results.

1.5 Contribution of MFP to living standards

A common way of quantifying the contribution of productivity growth to material living standards at the state level is by decomposing the historical increase in real Gross State Income (GSI) per capita into the components. GSI is a traditional measure of living standards and is defined as GSP adjusted for the terms of trade.

Figure 1: Understanding Income Per Capita Growth



The linkage of productivity and other factors to real GSI per capita provides an useful framework for understanding productivity. Broadly, income growth can be achieved by improvement in the terms of trade, increasing labour inputs (average hours worked, employment rate and participation rate), increasing capital inputs (via capital deepening) and MFP improvements.

2 Methodology

2.1 Capital inputs estimates

The ABS publishes two distinct and complementary capital measures:

- an end of year net capital stock, as part of the Australian System of National Accounts; and
- a measure of capital services that is used to calculate MFP series.

Net capital stock is defined by the ABS as the written down value of an economy's gross capital stocks. It represents the net present value of the future capital services produced by an asset. Net capital stock is essentially a measure of wealth and is recorded in an economy's balance sheet.

Capital services reflect the amount of 'service' each asset provides during a period. For each asset, the service provided in a period is directly proportional to the asset's productive capital value in a period. As an asset ages and its efficiency declines so does the productive capital value and the services the asset provides. The capital services index is derived by weighting together the productive capital stock of different asset types using their rental price as weights to produce an aggregate index of capital services.

Productive capital stock is derived by writing down the asset in accordance with its decline in efficiency due to age, while net capital stock is derived by writing down the value of an asset in accordance its age-price profile.

The growth patterns of capital services and net capital stock measures can differ due to one of two factors. The first of which occurs when there are differences in the functional form of the age-efficiency and age-price profiles. Age-efficiency profiles are used to construct productive capital stocks where the unit of measurement is a quantity measure, or 'efficiency-units'. The unit is not a price or value. The ABS uses a hyperbolic functional form which means that declines in efficiency are slow at first, but then accelerate, whereas, age-price profiles are used in the construction of net capital stocks. The use of this functional form results in price declines being more rapid early on relative to declines in efficiency.

The second factor which can result in different growth patterns of capital service and net capital stock occurs when there are differences in the aggregation weights applied to asset types. Net capital stocks effectively apply weights based on capital asset price deflators, whereas productive capital stocks by asset type are weighted together using rental prices to form a capital services index.

The estimation of capital inputs for Queensland and the Rest of Australia was undertaken in two stages. Firstly, estimates of net capital stock by type of asset were compiled. Secondly, these estimates were scaled-up to produce estimates of capital services. The methodology is discussed in more detail below.

Capital stock

In the past, the lack of state level capital estimates had restricted productivity estimates at the state level to that of labour productivity. In order to derive MFP estimates, net capital stock at the state level were estimated for Queensland and Rest of Australia based on the Perpetual Inventory Model (PIM), where:

$$\text{Equation (2.1)} \quad K_{j,t} = (1 - \delta_{j,t}) * K_{j,t-1} + I_{j,t}$$

Where:

$K_{j,t}$ is the value of net capital stock in jurisdiction j in the current period;

$K_{j,t-1}$ is the value of net capital stock in jurisdiction j in the previous period;

$I_{j,t}$ is the value of the gross fixed capital formation (GFCF) in jurisdiction j in the current period; and

$\delta_{j,t}$ is the rate of consumption of fixed capital (COFA) (or depreciation) in jurisdiction j in the current period.

From Equation (2.1), the construction of PIM estimates requires the following data inputs for each jurisdiction j:

- net capital stock $K_{j,t}$ for the initial period (t = 0);
- investment levels $I_{j,t}$ for each period; and
- rates of depreciation $\delta_{j,t}$ for each period.

Data on investment or GFCF levels, in chain volume measures (CVM), are available at a state level from 1985-86 to 2009-10, sourced from ABS 5206.0 *Australian National Accounts* (quarterly data) and ABS 5220.0 *State Accounts* (annual data). These data are split into the different asset types for the private sector while public sector GFCF is split into levels of government but not by type of asset.

Official ABS estimates on COFA or depreciation are obtained from ABS 5204.0 Australian System of National Accounts (annual data). However, as these data are only available at a national level and for the public and private sectors combined, the depreciation rates (by asset type) are assumed to be the same for both the private and public sectors and across all states. The rate of depreciation for each type of asset is derived as:

$$\text{Equation (2.2)} \quad \delta_{j,t} = \frac{COFA_{j,t}}{K_{j,t-1}}$$

Where:

$\delta_{j,t}$ is the rate of consumption of fixed capital (or depreciation) in jurisdiction j in the current period;

$COFA_{j,t}$ is the consumption of fixed assets (or depreciation) in jurisdiction j in the current period; and

$K_{j,t-1}$ is the net capital stock in jurisdiction j in the previous period.

While state level data on investment levels are readily available and the rates of depreciation were derived by assuming the national depreciation rate, data input on net capital stock for the initial period is much more difficult to derive. Hence, the approach to estimating net capital stock for the initial period is described in more detail below. As state investment or GFCF data are available from 1985-86 onwards, the initial period for net capital stock estimates is 1984-85.

For Australia, ABS estimates of net capital stock by asset type are only available in total (private and public sectors combined). Pre 1984-85 Australian investment data by asset type for the private and public sectors was used to estimate a 1984-85 breakdown of private and public net capital stock by asset type at the national level.

These 1984-85 national private and public sector net capital stock data by asset type are then allocated between jurisdictions using their shares of past national GFCF or investment data (pre 1984-85), or other appropriate proxies where GFCF data are unavailable (for example population shares). It is assumed that Queensland's and the Rest of Australia's share of net capital stock is the same across the type of assets for the public sector.

These 1984-85 estimates of net capital stock by type of asset were then estimated for Queensland and the Rest of Australia using the PIM discussed above. Finally, private and public estimates of net capital stock were summed to form a total net capital stock estimate by asset type and jurisdiction.

Capital services

As indicated above, the appropriate measure of capital inputs to calculate MFP is capital services. Capital services reflect the amount of 'service' each asset provides during a period. For each asset, the service provided in a period is directly proportional to the asset's productive capital value in the period. As an asset ages and its efficiency declines so does the productive capital value and the services the asset provides.

The national capital service index is derived by weighting together the productive capital stock of different asset types using their rental price as weights to produce an aggregate index of capital services for the twelve selected industries. This index is then compared with the corresponding net capital stock index to derive a 'scaling factor', which is applied to Queensland and the Rest of Australia net capital stocks to calculate capital services indexes for both regions. The scaling factor essentially represents the extent to which capital services differ from net capital stock.

For each asset type and year, the estimates of net capital stock are scaled by the corresponding ratio between the Australian capital service index and Australian net capital stock index (scaling factor) for the ABS twelve selected industries. As capital services for the twelve selected industries generally grew at a faster rate than net capital stock for Australia, the scaling factors raise Queensland and the Rest of Australia capital inputs growth rates.

The scaling factors change by year, but are assumed to be the same for Queensland and the Rest of Australia for each type of asset. The factors are applied to net capital stock estimates for non-dwelling construction, machinery and equipment, intellectual property products, livestock and orchards, and the portion of ownership transfer costs allocated to industries other than the ownership of dwellings industry.

As net capital stock data are not available for land and inventories, these estimates are not currently included in Queensland and the Rest of Australia capital service measures. Growth in the Australian capital services indexes for land and inventories indicate that the exclusion of these assets likely introduces a modest downward bias in capital inputs growth rates.

2.2 MFP

The calculation of the experimental MFP estimates for Queensland and the Rest of Australia required:

- An output index (derived from real GSP less Ownership of dwellings industry);
- Labour inputs index (derived from total hours worked data);
- Capital inputs index (derived from capital stocks being scaled up to a capital services measure - see above for details on this procedure);
- The labour and capital indexes were then combined to form an 'inputs index'. The Tornqvist methodology⁸, which utilises income shares of labour and capital (derived from gross operating surplus and compensation of employees and splitting gross mixed income into its labour and capital returns), was used to combine the inputs indexes into a single inputs index; and
- MFP is then calculated as the ratio of the output index to the combined inputs index (labour and capital) to derive that part of the growth in output that cannot be explained by growth in labour and capital inputs.

2.3 GSI per capita decomposition

The approach followed here is based on the standard decomposition methodology outlined by the ABS (2004)⁹. The standard Population-Participation-Productivity (PPP) methodology decomposes GSP per capita into four factors: productivity, time worked, employment and participation. It is based on the following identity:

⁸ See ABS (5216.0) – Australian National Accounts: Concepts Sources and Methods, 2000, chapter 27.

⁹ ABS (1370.0) – Measures of Australia's Progress, 2004, page 177.

$$\text{Equation (2.3)} \quad \left(\frac{GSP}{POP} \right)_{jt} \equiv \left(\frac{GSP}{THW} \right)_{jt} \times \left(\frac{THW}{EP} \right)_{jt} \times \left(\frac{EP}{LF} \right)_{jt} \times \left(\frac{LF}{POP} \right)_{jt}$$

The standard PPP analysis of GSP per capita is then expanded to undertake a decomposition analysis of Gross State Income (GSI) per capita to also account for the terms of trade effect. GSI per capita is defined as GSP per population adjusted for the terms of trade.

$$\text{Equation (2.4)} \quad \left(\frac{GSI}{POP} \right)_{jt} \equiv \left(\frac{GSP}{POP} \right)_{jt} \times TOT_{jt}$$

where the terms of trade is defined as relative export prices compared with import prices (P_x/P_m).

Inserting *Equation (2.3)* into *Equation (2.4)* gives;

$$\text{Equation (2.5)} \quad \left(\frac{GSI}{POP} \right)_{jt} \equiv \left(\frac{GSP}{THW} \right)_{jt} \times \left(\frac{THW}{EP} \right)_{jt} \times \left(\frac{EP}{LF} \right)_{jt} \times \left(\frac{LF}{POP} \right)_{jt} \times \left(\frac{P_x}{P_m} \right)_{jt}$$

in which, for jurisdiction j and time period t :

GSI (GDI) is real gross state (domestic) income;

GSP (GDP) is real gross state (domestic) product;

POP is the estimated resident population;

THW is total hours worked;

EP is employed persons;

LF is labour force; and

P_x/P_m is the terms of trade.

The left hand ratio is annual income per capita or ‘output’.

The five right hand ratios can be interpreted as factors causing, or driving annual output per capita. The intuitive meaning of these factors can be described as follows.

- GSP/THW – ‘productivity’ – this ratio, expressed in chain volume terms, is commonly termed ‘labour productivity’ as it is output per labour inputs (total hours worked).
- THW/EP – ‘intensity’ – this ratio represents the average hours worked per worker over a given time period (one year in this case). For given hours, increased output may be caused either by an increase in productivity, with the same effort by workers (‘working smarter’) or by an increase in effort, or greater intensity, by workers (‘working harder’). *Ceteris paribus*, if workers reduce their time worked, output will decrease, although not necessarily proportionately.
- EP/LF – ‘employment’ – this ratio represents the employment rate, or the complement of the more commonly used unemployment rate.

- LF/POP – ‘participation’ – this ratio is the commonly used and understood participation rate or the proportion of the population that are participating in the labour force.
- P_x/P_m – ‘terms of trade’ – the terms of trade is the ratio of export and import prices. Increases in terms of trade raise real incomes.

3 Glossary of Terms

The majority of definitions provided in this section are sourced from the ABS¹⁰.

Assets

Entities functioning as stores of value and over which ownership rights are enforced by institutional units, individually or collectively, and from which economic benefits may be derived by their owners by holding them, or using them, over a period of time (the economic benefits consist of primary incomes derived from the use of the asset and the value, including possible holding gains/losses, that could be realised by disposing of the asset or terminating it).

Capital deepening

Capital deepening is an increase in capital intensity as measured by the capital to labour ratio. It is the capital stock available per labour hour used.

Capital rental price

This is also referred to as the user cost of capital. The rental price is the unit cost for the use of an asset for one period, that is, the price for employing or obtaining one unit of capital services.

Capital services

Capital services reflect the amount of 'service' each asset provides during a period. For each asset, the services provided in a period are directly proportional to the asset's productive capital value in the period. As an asset ages and its efficiency declines so does the productive capital value and the services the asset provides.

Capital stock

Capital stock estimates provide information about the stock of capital available in an economy at a particular point in time. Net (or economic) capital stock estimates are the written down values of an economy's gross capital stocks. They represent the net present values of the future capital services to be provided by the assets. The difference between the net and gross value of an asset is accumulated depreciation. Net capital stock is essentially a measure of wealth and is shown in an economy's balance sheet.

Chain volume measures

Chain volume measures (also known as a real measure) provide time series estimates which are free of the direct effects of price changes. Current price estimates have two components: a price and a quantity. Because these two components change from one period to the next, estimates of current price growth reflect both changes in quantity and price. In order to estimate changes in the underlying 'volume' between two periods, the price effect needs to be removed. This is achieved by measuring the variable in question in each

¹⁰ See ABS (5216.0) – Australian National Accounts: Concepts, Sources and Methods, 2000.

period using the same unit prices (that is, the prices from a reference year). Chain volume measures are therefore derived to estimate the 'real' movement in variables over time.

Compensation of employees

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).

Consumption of fixed capital

Consumption of fixed capital is the value, at current prices, of the reproducible fixed assets used up during a period of account as a result of normal wear and tear, foreseen obsolescence and the normal rate of accidental damage. Unforeseen obsolescence, major catastrophes and the depletion of natural resources are not taken into account.

Dwellings

Dwellings comprise houses and other dwellings (flats, home units, villa units, duplexes, mobile homes, caravans used as the principal residences of households, etc.). Expenditure on the construction of hostel-type accommodation, prisons and motels is included in non-dwelling construction.

Employment rate

This rate represents the ratio of employed persons to the labour force, or the complement of the more common unemployment rate – an increase in the employment rate is equivalent to a reduction in the unemployment rate.

Gross fixed capital formation

Expenditure on fixed assets such as dwellings, non-dwelling construction, machinery and equipment, livestock and orchards, intellectual property products, ownership transfer costs and weapons systems. Expenditure on repair and maintenance of fixed assets is excluded as this is treated as an intermediate use. Additions to fixed assets are regarded as capital formation. Also included is compensation of employees and other costs paid by private enterprise in connection with own-account capital formation. Expenditure on dwellings, non-dwelling construction, and machinery and equipment is measured as expenditure on new and second-hand assets, less sales of existing assets.

Gross mixed income

The surplus or deficit accruing from production by unincorporated enterprises. It includes elements of both compensation of employees (returns on labour inputs) and operating surplus (returns on capital inputs).

Gross operating surplus

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 state income

Gross state income is equal to gross state product adjusted for changes in a state's terms of trade. An alternative estimate of the volume of exports of goods and services is calculated by deflating exports of goods and services at current prices by the implicit price deflator of imports of goods and services. This provides a better measure of income generated by domestic production than chained volume gross state product.

Gross state product

GSP is defined equivalently to gross domestic product (GDP) but refers to production within a state or territory rather than to the nation as a whole.

Gross value added

The value of output at basic prices minus the value of intermediate consumption at purchasers' prices. The term is used to describe gross product by industry and by sector.

Hours worked

The hours worked by all labour engaged in the production of goods and services, including hours worked by civilian wage and salary earners, employers, self-employed persons, and persons working one hour or more without pay in a family business or on a farm. It is the product of average hours worked and total employment.

Intellectual property products

Includes such assets as computer software, entertainment, literary or artistic originals, and mineral exploration intended to be used for more than a year.

Intensity

This ratio represents the average hours worked per worker over a given time period (here one year). For given hours, increased output may be caused either by an increase in productivity, with the same effort by workers ('working smarter') or by an increase in effort, or greater intensity, by workers ('working harder'). All other things being equal, if workers reduce their time worked, output will decrease, although not necessarily proportionately.

Labour productivity

Labour productivity estimates are indexes of real GSP per person employed or per hour worked. They have been derived by dividing the chain volume measure of GSP by employment (or hours worked). Labour productivity indexes reflect not only the contribution

of labour to changes in product per labour unit, but are also influenced by the contribution of capital and other factors affecting production.

Livestock and orchards

Livestock assets are classified as either fixed assets or inventories. Those livestock which are used in production of other products (e.g. breeding stock, animals for entertainment, sheep for wool and dairy cattle) are fixed assets. Inventories cover all other livestock types and includes those animals raised for meat or other one-off products (e.g. leather). The ABS defines orchards as any plant that can produce a marketable quantity of fruit for more than one year, for example, trees, vines, bushes and shrubs.

Machinery and equipment

Consists of transport equipment, computing equipment and other machinery and equipment other than that acquired by households for final consumption. Tools that are relatively inexpensive and purchased at a relatively steady rate, such as hand tools, are excluded. Also excluded are machinery and equipment integral to buildings such as lifts, these being included in dwellings and non-residential buildings. Machinery and equipment acquired by households for final consumption (e.g. motor vehicles) are not treated as fixed assets. However, they are included in the memorandum item 'consumer durables' in the balance sheet for households. Houseboats, barges, mobile homes and caravans used by households as principal residences are included in dwellings.

Multifactor productivity

MFP estimates are indexes of real GSP per combined unit of labour and capital. They have been derived by dividing chain volume estimates of GSP by a combined measure of hours worked and capital services. The estimates of GSP used to compile the MFP estimates exclude the Ownership of dwellings industry.

Non-dwelling construction

Other buildings and structures covers such assets as industrial, commercial, and non-dwelling residential buildings; water and sewerage installations; lifts, heating, ventilating and similar equipment forming an integral part of buildings and structures; land development; roads; bridges; wharves; harbours; railway lines; pipelines; and power and telephone lines. The category also includes expenditures that lead to major improvements in the quantity, quality or productivity of land, or prevent its deterioration.

Ownership of dwellings industry

Ownership of dwellings is an artificial industry created to measure the gross rent of dwellings (actual rent paid in the case of tenanted dwellings and an imputed rent for owner-occupied dwellings). It is excluded from the GSP estimate and productivity measures compiled for Queensland and the Rest of Australia.

Ownership transfer costs

Consist of stamp duty, real estate agents' fees and sales commissions, conveyancing fees and miscellaneous government charges.

Participation rate

This ratio is the proportion of the population that is willing and available to work.

Perpetual inventory method (PIM)

The PIM is a method of constructing estimates of capital stock and consumption of fixed capital from time series of gross fixed capital formation. It allows an estimate to be made of the stock of fixed assets in existence and in the hands of producers which is generally based on estimating how many of the fixed assets, installed as a result of gross fixed capital formation undertaken in previous years, have survived to the current period.

Productive capital stock

This is a measure of productive capacity and forms the basis for the measure of capital services. Productive capital stock estimates are derived as the written down value of each asset in accordance with its decline in efficiency due to age.

Terms of trade

This measures the relative price movements of imports and exports. It is calculated by dividing the export implicit price deflator by the import implicit price deflator and multiplying by 100. An improvement (or increase) in the terms of trade raises real income as a country can now purchase more imports per unit of exports sold.

Tornqvist index

MFP construction requires that an output index be divided by a single inputs index. The Tornqvist index is a methodology used to combine input indexes into one aggregate index. MFP requires the inputs of both labour and capital to be fixed and therefore the combining of these two indexes is essential in its calculation. The Tornqvist methodology uses labour and capital income shares derived from gross operating surplus, compensation of employees and gross mixed income to combine the labour and capital indexes.

Utilisation

Defined as the ratio of hours worked to population, labour utilisation is the extent to which the population is engaging in the labour force (in paid work). It is composed of labour intensity, employment and participation ratios (see above).

Weapons systems

The structural systems from which destructive weapons such as missiles, bombs and torpedoes are launched or fired. They include submarines, warships, fighter planes and tanks. All expenditure on weapons systems that have ongoing use (longer than one year) is recorded as gross fixed capital formation.