Tasmanian School of Business and Economics

What is productivity?

Paul Blacklow, Graeme Wells, Mala Raghavan[1], Bao Nguyen, Oscar Pavlov, Joaquin Vespignani, Maria Yanotti, Mark Bowles

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UNIVERSITY of TASMANIA

[1] Corresponding author: Mala Raghavan (mala.raghavan@utas.edu.au)

What is productivity?

Productivity typically measures how much output can be produced with a given input.

$$\boldsymbol{Productivity} = \frac{\boldsymbol{output}}{\boldsymbol{input}} \quad (1)$$

It is commonly understood as the ratio of outputs to inputs in a production process, reflecting the efficiency with which labour, capital, and other resources are transformed into goods and services. At national level, productivity is also often expressed as output per hour worked or GDP per capita (Syverson, 2011).

Why is productivity important?

A simple textbook answer to this question is that if we can raise productivity, we get more output from the same set of inputs, i.e.

$$\boldsymbol{Output} = \boldsymbol{input\ x\ productivity} \quad (2)$$

Inputs are typically classified into three categories:

- **Labour:** Human effort, both physical and mental, used in production.
- **Capital:** Physical assets used to produce goods and services.
- **Intermediate Inputs:** Goods and services used up in the production process.

Output refers to the total value of goods and services produced by firms. Since different firms produce various types of products, it's important to have a standard unit of measurement for comparison. This is where monetary value plays a role, allowing us to convert physical units into dollar values based on the price of each firm's output.

Imagine a farm in Tasmania. By converting physical outputs into monetary values, we can compare this farm's productivity with others that grow different crops. We can also assess efficiency by comparing the value of the output to the input costs.

$$\Delta\ \boldsymbol{Output} = \Delta\ \boldsymbol{input}\ + \Delta\ \boldsymbol{productivity} \quad (3)$$

As shown in Equation (3), productivity growth is the part of output growth that is not accounted for by growth in inputs. Productivity is not a singular concept; it can be evaluated across multiple dimensions.

- **Labour productivity,** which measures output per worker or per hour worked, is one of the most used indicators.

- In contrast, **capital productivity** reflects the efficiency with which machinery, buildings, and infrastructure are utilized. It is measured as the amount of output per $1 of capital.

- A more comprehensive measure is **multiple factor productivity (TFP),** represents how efficiently labour and capital are combined to produce output. It is measured as a residual, representing the portion of output growth that cannot be attributed to the accumulation of labour and capital.

While Equations (1–3) provide the general definition of productivity, productivity is not just about measuring output; it involves a broader understanding of how resources are effectively allocated and utilised within an economy. It reflects advancements in technology, the benefits of economies of scale, and the effects of improved management practices. Additionally, productivity emphasises the importance of innovation and the sharing of knowledge, showing how well economies create value from their resources with minimal impact to the environment. This many-sided approach reveals the complex factors involved in measuring productivity.

Challenges in measuring productivity

1. The basic concepts in productivity measurement

As mentioned earlier, productivity is a measure of how efficiently a producer uses its production process to convert resources into a final output for sale. As shown in Equation (1), the concept would be straightforward if there was only one input and one output. In that case, productivity could be defined in simple physical terms.

For example, if one hour of labour is required to pick twenty kilograms of apples, then the productivity of the farm worker can be easily measured as twenty kilograms per hour. However, this example is not realistic. Producers typically have a variety of inputs and outputs, measured in different ways. For instance, fruit picking involves the use of both machinery and labour, and the final product may consist of different fruits, such as oranges, apples, and grapes.

Inputs and outputs within economic analysis can often be quantified in monetary terms, allowing for the calculation of a monetary aggregate that represents both inputs and outputs. However, statistical agencies strive to maintain the integrity of productivity measures by aligning them closely with the fundamental principle of a ***one-input-one-output model***. This approach ensures that the measures provide a more straightforward and

accurate representation of productivity, minimising distortions that may arise from broader aggregations.

- ***Labour costs***, which include wages, superannuation contributions, and associated expenses, can be aggregated and converted into real terms by dividing the total value by a relevant labour cost price index.

- To determine the ***"real" cost of a unit of machinery***, start with its initial cost, apply an allowance for depreciation, and then convert the resulting amount to constant prices using an appropriate price index.

- ***Other inputs***, such as fuel or insecticide, can also be converted to 'real' or constant-price terms in a similar manner.

- Additionally, a ***variety of outputs*** can be deflated by dividing each one by the corresponding price index.

- In some cases, it might be possible to convert labour hours into ***'quality-adjusted'*** labour hours to facilitate comparisons across different industries. Quality-adjusted labour hours, equals total hours worked, weighted by the quality (skill, education, or experience) of the labour, to make productivity comparisons across industries fair and meaningful.

Statistical agencies face significant ***challenges in developing suitable price indexes and physical measures***, particularly within service industries such as aged care. Unlike tangible goods, such as those produced in an apple orchard, the outputs in aged care are not transacted in straightforward market conditions. Consequently, these agencies must carefully navigate these complexities to produce accurate statistical series that effectively represent both real outputs and real inputs of the industry.

2. Alternative productivity measures

The Australian Bureau of Statistics (ABS) employs a growth accounting framework to assess productivity. This method is commonly used by statistical agencies worldwide and aligns with international standards. The ABS primarily measures output using Gross Value Added (GVA) and considers labour hours worked and capital services as inputs.

The primary accounting identity states that the total output must equal the sum of all inputs used in its production, or in other words

$$\boldsymbol{Q} = \boldsymbol{rK} + \boldsymbol{wL} + \boldsymbol{I} \qquad (4)$$

Where:

$\boldsymbol{K}$	The real stock of capital (machinery, buildings etc.)
$\boldsymbol{r}$	The rate of return to capital
$\boldsymbol{L}$	The real quantity of labour
$\boldsymbol{w}$	The wage rate, or return to labour
$\boldsymbol{I}$	The quantity of intermediate inputs
$\boldsymbol{Q}$	The real quantity of output; the ABS refers to this as gross output, because the use of intermediate inputs has not been netted out.

While the ***real value added (VA)***, measures the return to the two factors of production, capital and labour. Hence value added is represented as

$$\boldsymbol{VA = rK + wL = Q - I} \quad (5)$$

- The most common measure referenced in *political discourse* is

$$\boldsymbol{Labour\ productivity = VA/L} \quad (6)$$

This metric assesses the ratio of output generated by the factors of production to the amount of labour input provided. It is typically discussed at the national level, where real Gross Domestic Product (GDP) represents the total value added across all production sectors. In this context,

$$\boldsymbol{Labour\ productivity = GDP/L} \quad (7)$$

where L represents the total labour input in the economy

- An alternative measure based on gross output (Q),

$$\boldsymbol{Labour\ productivity = Q/L} \quad (8)$$

Since intermediate inputs are not deducted from the output measure, industry measures of gross output cannot be simply added together to calculate a nationwide measure like GDP. However, gross output serves as a valuable complement to value added when analysing individual industries.

- As shown in Equation (5), it is essential to recognise that the index measuring value added is influenced by multiple factors, not just labour contributions. For example, changes in the use of intermediate inputs or capital also play a significant role.

Additionally, technical changes impact value added, making this index reflect more than just labour's contribution. In this context, a broader definition is provided by ***multifactor productivity (MFP).***

Value added MFP is given by the formula

$$\boldsymbol{MFP = VA/(K + L)} \tag{9}$$

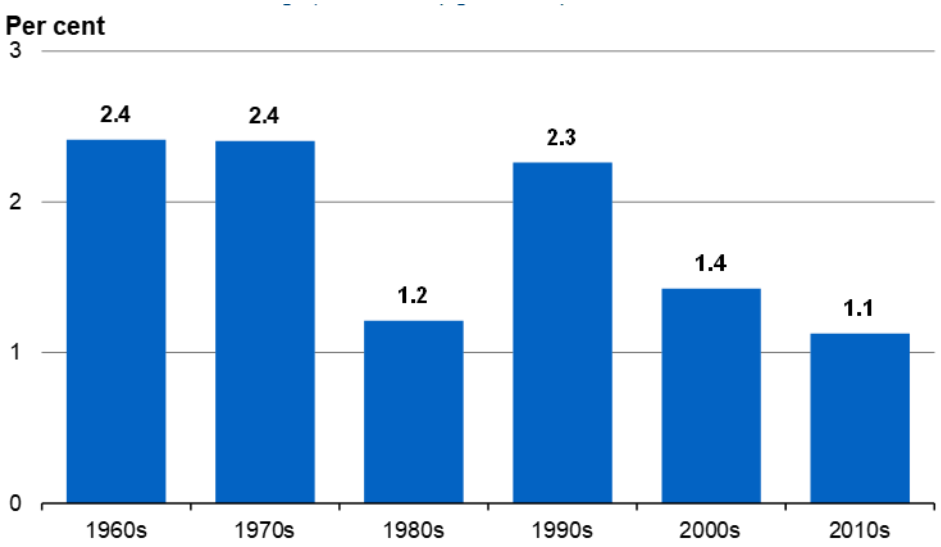
where now the use of capital as well as labour is considered. A gross output measure is given by

$$\boldsymbol{MFP = Q/(K + L)} \tag{10}$$

3. Which measure should be used?

A primary focus of the recent Economic Reform Round Table in August 2025 was the slowing growth rate of Australia's labour productivity, i.e. the decline of the annual percentage change in GDP/L . The following Figure 1, taken from Round Table papers, reflects this concern[2] .

Figure 1: Average productivity growth by decade, 1960s-2010s



Labour productivity varies with the level of capacity utilisation throughout the business cycle. As a result, data is often averaged over longer time periods. These averaged figures are frequently utilised in long-term projections, such as those found in the Intergenerational Report. They help

[2] Commonwealth of Australia (2025) *Economic Reform Round Table; Productivity*, p.2.

outline the expected trends for household incomes and the Federal budget position, if the current tax structure and other policies remain unchanged. From this perspective, ***two factors*** are important.

- The ***first*** is the extent to which growth in labour productivity generates private sector incomes.

- The ***second*** is the extent to which growth in value added generates tax revenues required to sustain the budget position.

The Australian economy is notably open to foreign investment, which contributes to a difference between income and production. As previously mentioned, value-added measures the returns to capital and labour, serving as an indicator of income. However, not all of this income goes to Australian residents.

Some returns to capital are paid to foreign investors who own Australian industries or have lent money to state and Federal governments. In the national accounts, this difference, along with the effects of changes in export and import prices, is reflected in an adjustment to real GDP, resulting in Real Net National Disposable Income. This measure tends to show greater volatility due to short-term fluctuations in the terms of trade. While GDP represents the total value added across all industries, fluctuations in the growth rate of VA/L does not fully capture changes in income that accrue to Australians.

The relationship between growth in VA/L and the Federal Budget is inherently complex and non-linear. Australia's tax system comprises a diverse range of taxes that differ in both their bases and rates, resulting in heterogeneous and often asymmetric fiscal responses to changes in economic activity. For instance, capital gains tax revenues do not necessarily move in tandem with receipts from the Goods and Services Tax (GST), which applies only to selected components of value added. Moreover, some taxes, such as the Petroleum Resource Rent Tax, are poorly structured and yield disproportionately low revenue relative to the magnitude of the underlying economic activity they are designed to capture.

A key challenge in measuring labour productivity is deciding whether to express it per hour worked or per worker.

$$\boldsymbol{Labour\ productivity\ (per\ worker) = VA/number\ of\ workers} \quad (11)$$

$$\boldsymbol{Labour\ productivity\ (per\ hour\ worked) = VA/total\ hours\ worked} \quad (12)$$

The **per-worker measure** is useful for gauging total output across an industry or economy, but it does not accurately reflect how efficiently labour is utilized. In contrast, **per-hour worked** is generally the better

metric preferred by the Australian Bureau Statistics (ABS) because it accounts for variations in working time, such as overtime, leave, and flexible arrangements, providing a more precise picture of labour efficiency. Relying on per-worker measures can be misleading when average hours per person fluctuate, whereas per-hour data captures changes in standard working hours and productivity over time. Moreover, using per-worker measures can obscure structural shifts in the labour market, such as the growing prevalence of part-time work replacing full-time positions, or regional differences in working hours for example, if average hours worked in Tasmania are lower than in other states.

4. Which productivity measure is relevant to Tasmania?

Tasmania is a small, open economy, and the key considerations surrounding the use of labour productivity as an indicator of income and tax revenue remain relevant. Given that Tasmania raises only a relatively small proportion of its own-source revenue, it would be misleading to assume that higher productivity growth would necessarily strengthen the State's budget position. A more comprehensive analysis of the factors influencing tax collections and expenditure demands is therefore required to assess the fiscal implications of productivity growth accurately.

While labour productivity (VA/L) or multifactor productivity (VA/(K+L)) are commonly used as overall measures of productivity, gross measures such as Q/L or Q/(K+L) may be more effective for assessing the performance of different industries or specific regions, such as Tasmania. It's important to note that gross output measures can yield different results compared to value-added measures. This discrepancy can be illustrated through an example where the treatment of intermediate inputs plays a crucial role.

Tasmania is home to **three major metal refineries**, which play a crucial role in the region's industrial landscape. These refineries primarily rely on **two key sources** for their intermediate inputs: electricity generated by Hydro Tasmania and imported materials, including alumina as well as various metallic ores and concentrates. The prices of these inputs can be highly volatile, and fluctuations in their costs relative to the expenses associated with the two main components of value added, i.e. capital and labour can significantly impact productivity growth rates. Therefore, understanding these dynamics is vital for assessing the performance and competitiveness of Tasmania's metal refining sector.

In terms of growth rates, for example, the relationship between the value-added and gross output measures can be shown to be

$$\boldsymbol{Growth\ in}\ \left(\frac{\boldsymbol{VA}}{\boldsymbol{K+L}}\right) = \frac{\boldsymbol{\$Q}}{\boldsymbol{\$VA}} * \ \boldsymbol{Growth\ in}\ \left(\frac{\boldsymbol{Q}}{\boldsymbol{K+L}}\right) \tag{11}$$

where the '$' symbol indicates that gross output and value added are measured in current (nominal) prices[3]. A similar relation holds for measures of labour productivity. If firms' cost of intermediate input increases, $(\frac{\$Q}{\$VA})$ rises, and if the firms become more efficient and rely less on intermediates, the ratio falls.

Fluctuations in relative prices, $\frac{\$Q}{\$VA}$ drive a wedge between the two growth rates, suggesting that value added productivity is more volatile than the gross output measure. While gross output measures are not available for Tasmanian industries, we can illustrate the relative volatilities using data from the Australia-wide manufacturing sector, as shown in the Figure 2[4]. The volatility in $VA/(K+L)$ is significantly greater than $Q/(K+L)$.

Figure 2: Manufacturing Australia (% Change in MFP)

The value-added measure illustrated in Figure 2 indicates a significant slowdown in productivity growth in manufacturing since the late 1990s. Both measures demonstrate a downward trend throughout this period. However, to analyse the causes, a clearer understanding of the relationship between the two is necessary.

- Is this slowdown due to changes in the relative prices of the different components in the productivity calculation? or
- Is it indicative of a fundamental shift in the efficiency with which these factors are utilised?

[3] See Schreyer and Pilat, *Measuring Productivity*, *OECD Economic Studies No. 33, 2001/II.*
[4] Australian Bureau of Statistics *Estimates of Industry Multifactor Productivity, Australia*. cat no. 5260.0.55.002.

Changes in firms' production processes can also be significant. In recent years, firms have increasingly outsourced a larger portion of their production, relying more on intermediate inputs purchased from other firms or industry sectors, rather than using their own capital and labour. This shift impacts productivity measurements in two ways.

- On the one hand, labour productivity, when assessed using a gross output measure, tends to show an increase due to the enhanced efficiency gained from outsourcing.

- However, it's important to note that this rise in productivity is accompanied by a decline in value added, which is an indicator of the net contribution of the firm's own operations. Consequently, this reduction in value added partially offsets the gains reflected in the gross output measure, highlighting the complexity involved in measuring productivity dynamics.

Australian labour productivity by industry

Australia serves as a valuable example of productivity dynamics within a small open economy. According to Parham (2004), in the 1990s, extensive reforms, including deregulation, privatisation, and labour market liberalisation, triggered a notable surge in productivity growth. These changes encouraged competition, improved resource allocation, and accelerated the adoption of technology. However, since the early 2000s, multifactor productivity (MFP) growth has slowed down, reflecting weaker innovation, declining business dynamism, and structural challenges in non-mining sectors (Productivity Commission, 2023). While the mining boom significantly increased national income and investment, these gains were primarily the result of capital deepening rather than improvements in efficiency (Connolly & Gustafsson, 2013).

Figure 3 illustrates average labour productivity by industry for the periods 2003-04, 2013-14, and 2023-24. Historically, the most productive industries in Australia have been:

- Mining,

- Electricity, Gas, Water, and Waste Services,

- Financial and Insurance Services, and

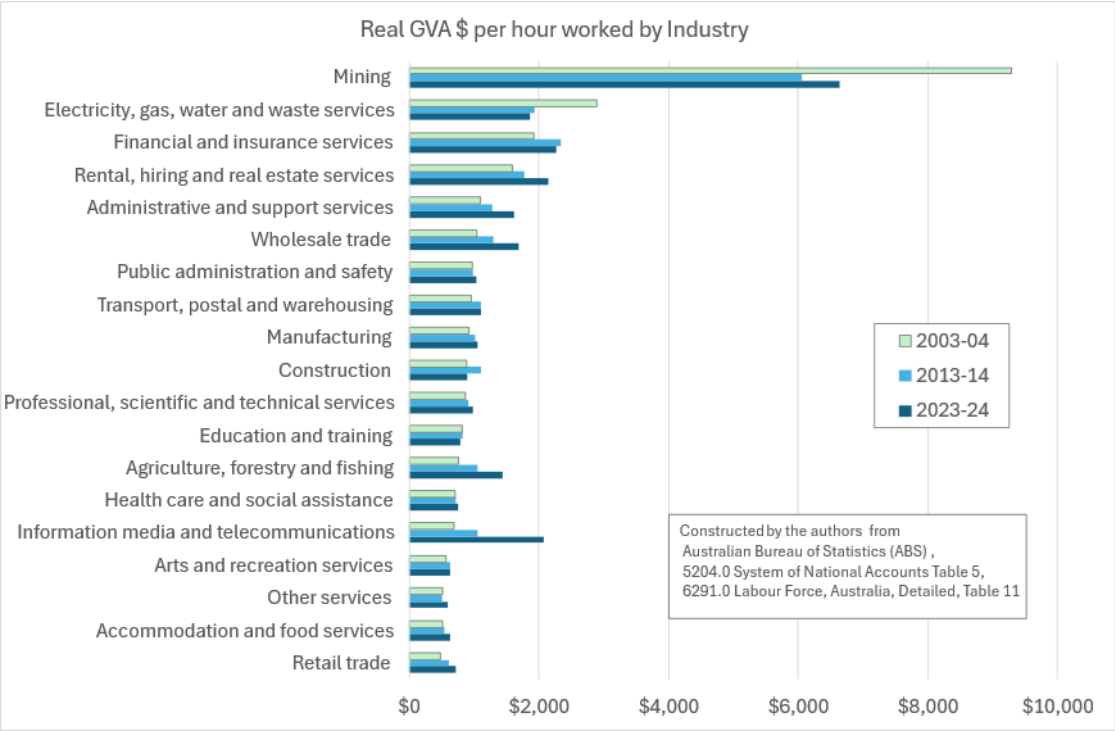
- Rental, Hiring, and Real Estate Services.

From 2003-04 to 2034-24, labour productivity increased in the Information, Media, and Telecommunications sector, but decreased in the Electricity, Gas, Water, and Waste Services sector. As a result, Information Media and

Telecommunications has surpassed Electricity, Gas, Water and Waste Services to become Australia's fourth most productive industry. Average labour productivity has also improved in Agriculture, Forestry and Fishing, Wholesale Trade, Rental, Hiring and Real Estate Services, and Administrative and Support Services from 2003-04 to 2034-24, while remaining stagnant in nearly all other industries.

Australia's small market size, heavy reliance on international trade, and susceptibility to global commodity cycles appear to influence the productivity outcomes. Geographic isolation limits the potential for economies of scale and restricts the agglomeration benefits typically found in larger economies. As a result, policymakers have focused on strengthening innovation systems, enhancing digital infrastructure, and improving competition frameworks to boost productivity growth (Productivity Commission, 2017). Maintaining high institutional quality is particularly critical for small open economies like Australia, which are highly vulnerable to external shocks and must rely on internal efficiency to sustain long-term competitiveness.

Figure 3: Average labour productivity by industry over time[5]



[5] Sources for Figures and Tables

(i) 6291.0.55.001 Labour Force, Australia, Detailed, Table 05. Employed persons by State, Territory and Industry division of main job (ANZSIC).

(ii) ABS 5204.0 Australian System of National Accounts, Table 5 Gross Value Added (GVA) by Industry.

Tasmanian productivity compared with Australia

As shown in Table 1, Tasmania accounts for slightly more than 2% of all jobs in Australia; however, its contribution to the nation's GDP is a mere 1.6%. This significant gap can be attributed to several factors: Tasmanians tend to work around 7% fewer hours per job compared to their counterparts in other states, and their average labour productivity (ALP) is 19% lower than the national average. These factors together highlight the challenges faced by the Tasmanian workforce and the impact on the state's economic output.

In Tasmania, the average number of hours worked per job is significantly lower, sitting at just 34.9 hours per week, compared to the national average of 37.6 hours across Australia. Tasmania's average labour productivity is 19% below Australia's. This disparity can largely be attributed to a higher prevalence of part-time employment in Tasmania. Additionally, part-time workers in Tasmanians tend to work fewer hours than their counterparts nationwide, highlighting a distinctive trend in the region's labour market.

Table 1: Hours, productivity and GDP Tasmania and Australia 2023-24

	Jobs ('000s)	**Hours per job**	**Hours (millions)**	**ALP = GVA per hour**	**GDP ($ billion)**
Australia	15,626	37.6	5,877	$416	$2,446
Tasmania	325	34.9	114	$338	$38
TAS (%)	2.1%	92.9%	1.9%	81.2%	1.6%

Source: Authors' calculations based on various Australian Bureau of Statistics (ABS) publications. See endnotes for details.[6]

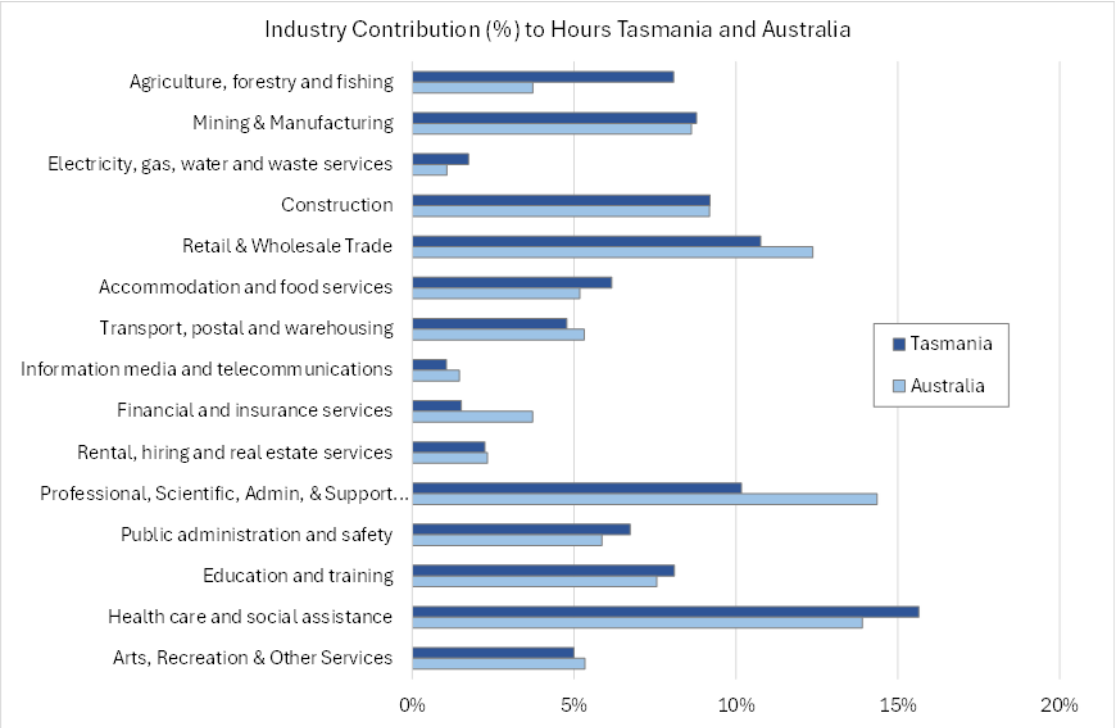
Why is Tasmania's average labour productivity lower?

[6] Sources for Figures and Tables
(i) ABS 6150.0.55.003 - Modelled state and territory jobs and hours worked estimates by industry - Labour Account Australia
(ii) ABS 5204.0 Australian System of National Accounts, Table 5 Gross Value Added (GVA) by Industry and Table 58. Capital Stock, by Industry.
(iii) ABS 5220.0 Australian National Accounts: State Accounts, Table 7. Expenditure, Income and Industry Components of Gross State Product, Tasmania Table 26. Tasmania Capital Stock by Type of asset, Institutional sector and Industry.

1. Industry composition

Tasmania exhibits a distinctive economic landscape characterised by a lower level of activity in several high-productivity sectors when compared to the national average. For instance, in Figure 4, the Financial and Insurance Services sector in Tasmania accounts for only 1.5% of total working hours, a stark contrast to its 3.7% share across Australia. Similarly, the Professional, Scientific, Administrative, and Support Services sector accounts for 10.2% of total working hours in Tasmania, while this figure rises to 14.4% at the national level.

Figure 4: Hours worked Tasmania and Australia 2023-24[7]



In contrast, Tasmania has a notably higher concentration of workers in low-productivity industries such as Agriculture, Forestry, and Fishing. In this sector, 8.1% of total hours worked in Tasmania are dedicated to these industries, compared to just 3.7% nationally. This trend is also observed in the Health Care and Social Assistance sector, where Tasmania's work hours significantly exceed those of Australia as a whole. As shown in Figure 4, Tasmania has more hours worked in the relatively high productivity Electricity, gas, water and waste services, i.e. 1.7% compared to 1.1% for Australia. However, we will see in the Figure 5, below that Tasmania's productivity is lower than Australia's for this industry.

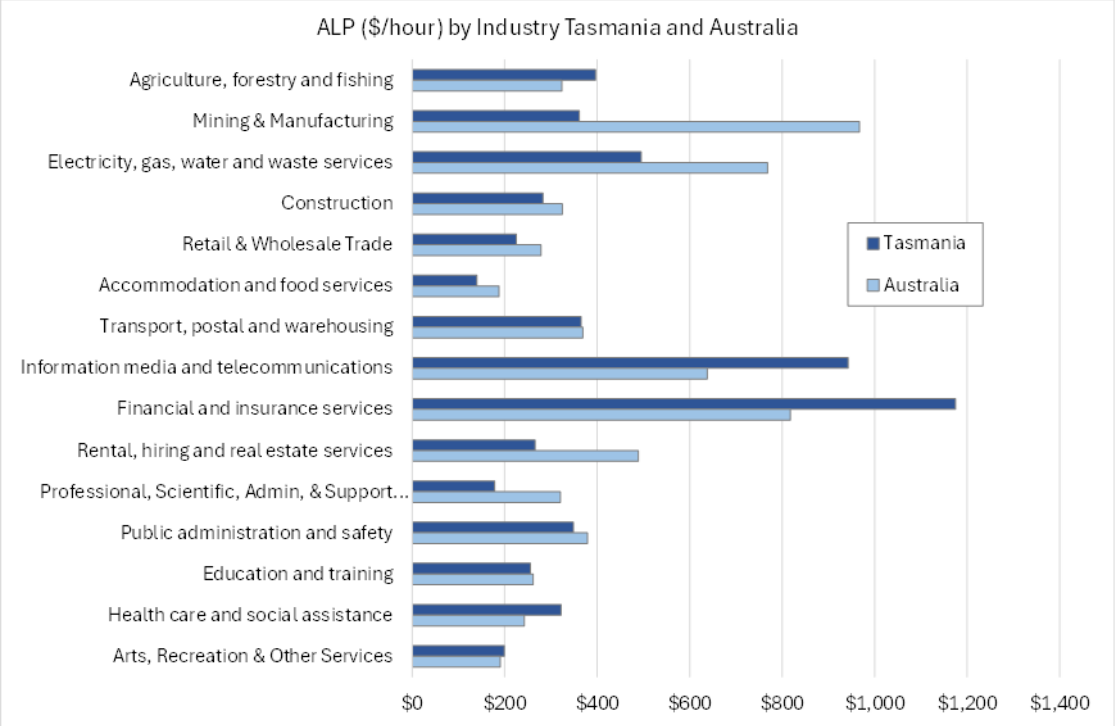
[7] Refer to Footnote 6.

2. Industry labour productivity

In Figure 5, we observe the average labour productivity (ALP) for the fiscal year 2023-24, comparing various industries in Tasmania to those across Australia. The data highlights a significant disparity, particularly in the Mining and Manufacturing sectors, where Tasmania's ALP stands at nearly one-third of the national average, despite dedicating similar proportion of total work hours worked as the national level.

Furthermore, in the Rental, Hiring, and Real Estate Services, as well as the Professional, Scientific, Administrative, and Support Services sectors, Tasmania's productivity is approximately half of what is observed in Australia overall. Lastly, in the Electricity, Gas, Water, and Waste Services sector, Tasmania's ALP is approximately two-thirds of the productivity levels found in the rest of Australia.

Figure 5: Average labour productivity Tasmania and Australia 2023-24[8]



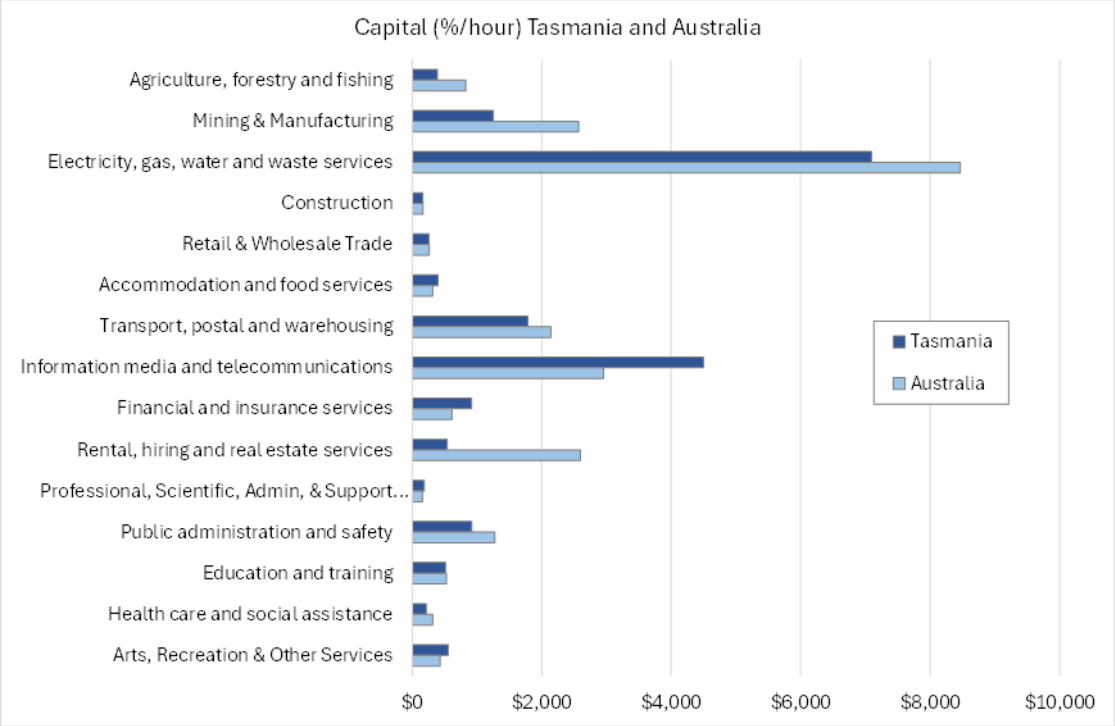
3. Industry capital

One of the key factors influencing labour productivity is capital, which includes essential resources such as land, buildings, tools, equipment, and other durable inputs utilised in production. In Tasmania, the net capital stock available per hour worked stands at $1,156. This figure is notably 15% lower than the Australian national average, which is $1,358 per hour. This

[8] Refer to Footnote 6.

disparity indicates that workers in Tasmania have access to less capital or capital of lower quality, which may be a significant contributing factor to their productivity being 19% lower than that of their counterparts in the rest of Australia. A closer examination reveals specific sectors where these differences in capital investment are particularly obvious.

Figure 6: Capital stock ($/hour) Tasmania and Australia 2023-24

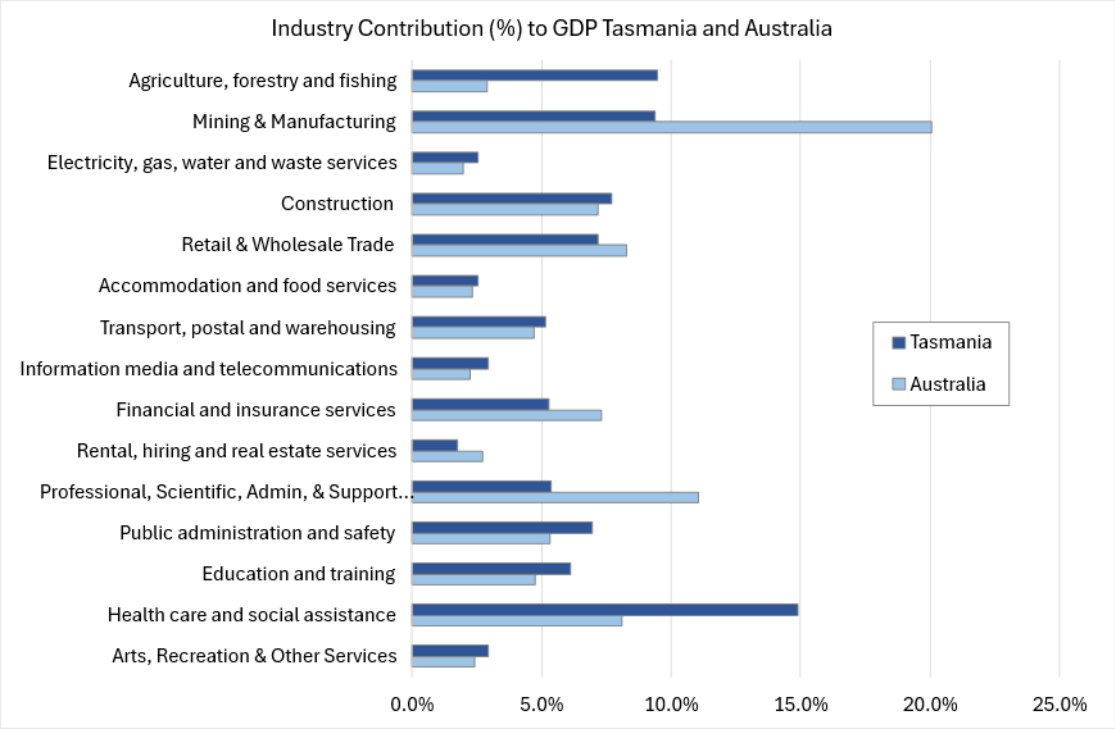


According to Figure 6, Tasmania displays substantially lower capital resources in critical industries, including Agriculture, Forestry and Fishing, Mining and Manufacturing, as well as Rental, Hiring, and Real Estate Services. Conversely, the same figure highlights that Tasmania has a relatively higher capital stock compared to the national average in sectors such as Information, Media, and Telecommunications, as well as Financial and Insurance Services. This nuanced perspective highlights the varying levels of capital investment across different industries in Tasmania and its impact on overall productivity and contributions towards the Gross Domestic Product (GDP).

In Figure 7, we can observe the percentage contribution of various industries to the GDP for both Tasmania and Australia for the fiscal year 2023-24. Notably, Tasmania's GDP generated from the Mining and Manufacturing sectors is significantly lower than the national average, accounting for just 8% compared to Australia's 20%. Conversely, Tasmania excels in Agriculture, Forestry, and Fishing, with its contribution to GDP nearly three times that of the entire nation, at 9% against Australia’s 3%. Additionally, the Health Care and Social Assistance sector shows a striking

disparity, with Tasmania's contribution at 15%, nearly double the 8% contribution seen in Australia. Finally, the Professional, Scientific, Administrative, and Support Services sector represents a smaller share of Tasmania's economy, contributing 11% compared to 5% nationally, highlighting the state's unique economic landscape in comparison to the broader national context.

Figure 7: Contribution to GDP Tasmania and Australia 2023-24



4. Other factors

On average, Tasmanian workers possess lower levels of education and training compared to their counterparts across Australia. This disparity in educational attainment and vocational preparation may be a contributing factor to the observed lower labour productivity in Tasmania.

Additionally, Tasmanian workers tend to have poorer health and are, on average, older than workers in the rest of Australia. This demographic difference and associated health challenges may further contribute to the decreased levels of labour productivity observed in Tasmania.

Conclusion

The measurement of productivity continues to attract considerable attention across countries and industries, as it provides a vital benchmark

for assessing economic performance. This article has examined the key challenges and limitations of productivity measurement, particularly the difficulties of constructing comparable indicators across sectors and regions. Recognising and addressing these challenges is essential for ensuring the accuracy of productivity estimates and for strengthening their usefulness in economic analysis and policy formulation.

In conclusion, productivity serves as a crucial engine for Australia, driving both economic growth and overall prosperity, significantly shaping the decisions made by businesses and governments alike. While measuring productivity and grasping its various factors and outcomes can be complex, their importance is undeniable. The experiences of Australia and Tasmania demonstrate that a combination of structural reforms, external economic conditions, and institutional choices is crucial for enhancing productivity performance. This emphasises the need for continuous adaptation and refinement of policies to ensure sustained improvements over time.

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