MELBOURNE INSTITUTE
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CommBank–Melbourne Institute National Innovation Index

Trends in Australia's Innovative Activity and Capability

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CommonwealthBank

Foreword

Mike Vacy-Lyle
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Every day, Australian businesses put practical ideas to work. From family businesses to larger, more established companies, they are solving problems, improving how they operate and looking for ways to grow.

Sometimes that means developing a new product or technology. More often, it is a practical change inside a business. It might be a better way to quote a job, manage stock, use data, improve safety, reduce waste, serve customers or bring a new product or service to market.

These changes do not always look like major breakthroughs, but they can make a real difference to how a business runs and grows.

That is why innovation matters. Stronger productivity helps businesses compete and grow and, over time, supports Australia's prosperity and higher living standards. For a business owner, productivity can mean less time lost to manual processes, better decisions, stronger margins and more time to focus on customers.

For Australia, that means backing new ideas developed here, while also helping businesses make better use of leading technologies and ways of working from around the world. Both can contribute to stronger businesses, jobs and growth.

The Melbourne Institute developed the CommBank-Melbourne Institute Innovation Index in partnership with CommBank to help give Australia a clearer and more detailed picture of innovation activity. Built from secure, de-identified Government data sources covering Australian firms and workers, rather than a survey sample, it brings together measures spanning R&D, skilled employment, intellectual property and knowledge-intensive trade, and tracks them across industries, regions and time.

We supported this Index because better evidence matters. It helps show where innovation is happening today and where support can make a difference. It also helps focus attention on how to encourage experimentation, development and commercialisation, so more businesses can turn good ideas into practical outcomes.

Through our relationships with businesses across the country, we also see that access to finance is only one part of the picture. Businesses need information, skills, trusted advice and connections to expertise, customers and markets. Working with universities, government and other partners, CommBank can help businesses connect with a broader network of support.

Innovation also shapes how CommBank serves customers. We continue to invest in technology, data, AI and digital capability to help make banking simpler, safer and more useful. Our experience is that innovation creates the most value when it solves a clear problem, is implemented well and is widely adopted.

This research sits alongside CommBank's broader work to support Australian business innovation. The CommBank Business Innovation Awards recognise and celebrate small and medium businesses already putting ideas into practice, while free online training through the Wade Institute of Entrepreneurship helps more people build the skills to test new approaches and make informed decisions.

I thank the Melbourne Institute for its work on this Index. Its expertise in applied economic research and ability to work with detailed ABS-linked data have created a valuable new evidence base for Australia.

Australia has strong businesses, world-class researchers and no shortage of ideas. Our shared opportunity is to bring those strengths together, so more ideas become useful products, better services and businesses that succeed at home and around the world. That is how innovation can lift productivity, create jobs and support higher living standards.

Mike Vacy-Lyle
CommBank Group
Executive Business Banking

Executive Summary

This report, produced by the Melbourne Institute in partnership with CBA, introduces an integrated **National Innovation Index for Australia** — a composite measure tracking innovation intensity across geography, industry, and time from 2006–07 to 2023–24. It responds directly to the 2025 *Ambitious Australia* review, which highlighted issues associated with innovation measurement for over-focusing on inputs (R&D spend, patents) while neglecting how ideas are translated into products, jobs, and growth. While there is still much more to do in understanding the effects of innovation on productivity, the Index represents a big step forward in the first important step – a clear, comprehensive and transparent way of measuring the many facets of innovative activity in Australia.

Built from richly detailed ABS microdata (BLADE and PLIDA) covering the population of Australian firms and workers – not survey samples – the index combines a range of innovation indicators via principal component analysis including **Inputs** (R&D expenditure, high-skilled employment, overseas royalty payments); **Outputs** (Patents in force); and **Market translation** (Trademarks, design rights, and complex global-value-chain (GVC) imports and exports). Scores are benchmarked so the national average in 2016–17 equals 100, allowing comparison across industries, States, and time.

The key findings are as follows:

- **National trend:** Innovation intensity rose steadily over the period, but has stagnated since 2021–22 — with no clear post-COVID rebound materialising as yet.
- **By industry:** Wholesale trade, Manufacturing, and Professional, scientific and technical Services dominate the Index as the most innovative industries. Manufacturing's strength reflects a pivot toward high-value, tech-intensive niches (robotics, advanced materials).
- **By state:** NSW and Victoria consistently outperform the national average, with Victoria overtaking NSW since 2017–18. WA has surged since 2020–21, overtaking Queensland, coinciding with diversification into clean energy, agtech, and space tech.
- **Emerging technologies:** Benchmarked against R&D and patent-intensive firms, Biotechnology ranks as the most innovative emerging sector, followed by Space, Clean Energy, and Quantum. Firms engaged in complex global-value-chain exports also rank highly — reinforcing evidence that trade engagement and innovation are mutually reinforcing.

The index aligns with *Ambitious Australia's* call for coordinated action on innovation policy. It can help identify where regional innovation strengths already exist and inform priorities around basic research funding, workforce capability (including skilled migration), and deeper industry-university-government collaboration. However, note that the index measures *quantity* of innovation-related activity, not quality or novelty. It also undercounts innovation protected by trade secrecy, activity by non-corporate entities, and R&D from universities, government and non-profits.

1. Introduction

Innovation is central to Australia's long-term prosperity. While productivity growth can come from numerous sources, one of the most important foundations for long-run growth is to create and commercialise new and improved ways of doing business. While much of the focus is often on the creation of new technology – vaccines that can save lives and encryption technologies that power internet commerce – a very important part of the innovation story relates to adapting and customising existing technologies to our markets.

Innovation is among the principal drivers of long-run productivity and economic growth, yet the breadth and depth of Australia's innovation system remain only partly understood. The *Ambitious Australia* report frames this as an RD&I "flywheel": research creates knowledge and expertise; innovators translate that knowledge into new products, services and businesses; scaling businesses create high-skilled, high-value jobs; and a more competitive economy attracts further investment in RD&I. The report also observes that Australia's measurement of this system has concentrated too heavily on inputs and too little on the translation of ideas into products, growth and jobs.

The available indicators reflect that imbalance. A small number of measures, notably research and development expenditure and patenting, are relatively well established and widely cited, but they capture only part of how firms innovate. Other forms of innovative activity, such as the introduction of new products and services, the building of high-skilled workforces, and participation in knowledge-intensive global value chains, are far less systematically measured, even though these are precisely the translation and scaling stages of the flywheel where, as *Ambitious Australia* notes, the economic impact of innovation is realised. Participation in complex global value chains also bears directly on the report's concern with Australia's low economic complexity.

This composite index is the first attempt in many years to bring these strands together into a single, integrated and repeatable measure spanning innovation inputs (R&D expenditure, high-skilled employment, overseas royalty expenditure), outputs (patents) and translation into the market (trademarks and design rights as proxies for new products and services, and complex global value chain engagement). Benchmarking the result against a fixed reference period allows innovation to be tracked consistently over time.

In the next section, we provide an overview of the literature on innovation, with a particular focus on the determinants of innovation investment decisions and factors that are related to innovation success, including location, managerial acumen and appropriability (including intellectual property rights). These are important to understand because they directly inform the choice of variables selected in the index.

2. Defining Innovation and its Causes

What is innovation? Innovation just means change using a new idea. The established (OECD) definition of innovation is: '…the implementation/commercialisation of a product with improved performance characteristics such as to deliver objectively new or improved services to the consumer… the implementation/adoption of new or significantly improved production or delivery methods… involv[ing] changes in equipment, human resources, working methods or a combination of these.' (Oslo Manual 2005). Invention and innovation are not synonymous. Invention is the creation of a new idea, device, method, composition or process which is 'new-to-the-world'. Innovation is the application or use of inventions which is typically 'new-to-the-firm'. Both 'new-to-the-firm' and 'new-to-the-world' innovations are valuable, but it is important to understand the difference between the two.

New-to-the-world innovation can involve systems of interrelated inventions that feedback and reinforce each other as exemplified by the introduction of the steam engine, electricity or computers.[1] New-to-the-world innovations can also be minor or incremental. Much learning-by-doing and learning-by using generates cost and quality changes that are new to the world. Early-stage technology is typically rudimentary with numerous glitches. In many cases, the original idea becomes a catalyst for improvements in complementary technologies which reinforce the efficacy of the initial invention. Inventions are typically far from their original incarnation by the time they acquire wide-spread use (Mowery and Rosenberg 1998).[2]

New-to-the-firm innovation is also called copying, imitation and adaption. All new-to-the-world innovators undertake new-to-the-firm as well – it does not pay to reinvent the wheel. It is estimated that most productivity improvement flow from new-to-the-firm innovation. However, new-to-the-firm innovation is not without risks as firms must adapt their existing organisational structures and equipment to new processes, which can be expensive.

Adam Smith argued that vigorous competition – fuelled through free markets – is sufficient to force firms to operate at best practice (i.e. at minimum cost and price). However, a growing body of economists – in the tradition of Joseph Schumpeter – believe firms primarily compete on process, organisation, market and product competition. Price is a secondary and minor consideration. This shift in understanding competition has occasioned a re-think of government policy towards the behaviour of markets and firms. If competition mainly takes the form of price changes, it is difficult to see a role for government. However, if competition requires changes to very sophisticated production technologies, including long and complex production chains and the creation and generation of public goods, there can be major roles for large economy-wide institutions.

The decision to undertake new-to-the-world innovation

There is clear evidence that **resourcing** is at the heart of what eventually succeeds – but it is less clear whether the residual unfunded ideas would have succeeded if funded. Nonetheless, governments around the world have altered the portfolio of funded innovations through direct procurement, grants and R&D subsidies.

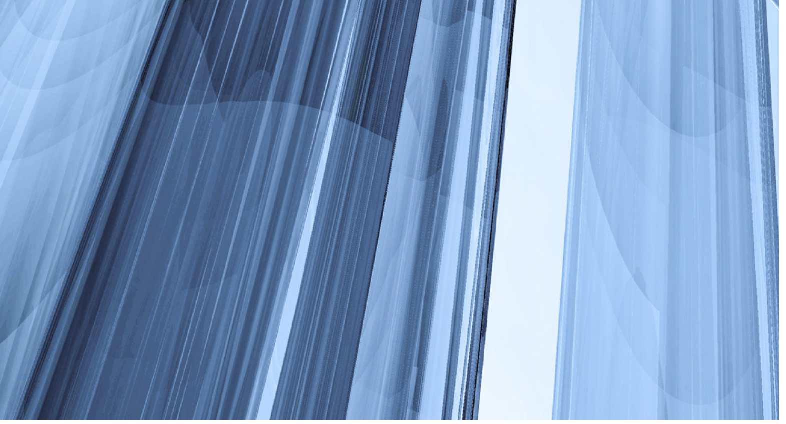
Government funding
For most of the second half of the 20th century, the size and structure of government defence spending in the US, UK, Sweden, Israel and France has had a major impact on the innovative activities of their civilian firms. This largely occurred via public procurement programs by defence departments. Defence contracts tend to be patient, curated and prioritise quality (over cost). According to Mowery and Rosenberg (1998), in the US post-WWII period, the federal government funded between half and two thirds of total US R&D. Most of this government funded R&D was performed by private industry through procurement programs in especially defence but also agriculture, space and health.[3]

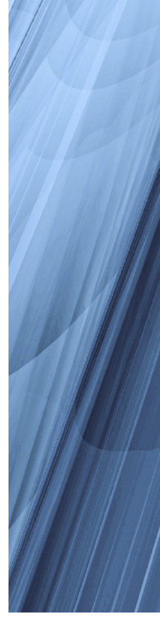
The issue of 'returns to R&D expenditure' is complicated by the fact that some of the returns don't accrue to the firms undertaking the R&D – despite the best efforts of the investing firm to appropriate all the returns – through patenting and other mechanisms – the knowledge or new technologies created often leak (or 'spillover') to other firms. From a societal point of view, this is potentially beneficial because of its impact on aggregate

1 The use of coking coal, for instance, reduced the costs of iron making, made precision parts for Watt's steam engine possible, which in turn created the engines to pump water from the coal mines and make cheaper coal mining possible. Electricity was just a hobby until the event of central power stations, transmission wires and metres. Bell Laboratories pioneering work on cellular telephony did not diffuse and develop until the US Government allocated an electromagnetic spectrum to carry wireless signals.

2 Examples are numerous but include the improvements to transistors, the petrol engine and electric generators inter alia. However, the impact of minor improvements will dissipate without regular major inventions.

3 These government agencies typically had elaborate mechanisms and rules for selecting firms to undertake high-risk research for radical problems; staged processes for further development of nascent ideas; and enforced rules for idea exchange and technology transfer among client firms. These policies were designed to reduce investment uncertainty and reduce the need to re-invent what is already known.





productivity growth. Recent evidence from the US on one of the largest government R&D programs – the moonshot program – examined the economic effect of the huge investment in space technology that NASA made during the US-Soviet space race of the 1950s and 1960s and found that returns were much more localised than previously thought (Kantor and Whalley, 2025).

Recent Australian studies, using treatment and control groups, found the Australian R&D tax concession and its successor, the R&D Tax Incentive, each raised firm R&D by 50 to 60 per cent (Holt, Thomson and Skali 2015; Thomson, Kollmann and Yamashita 2024; and Kollmann, Palangkaraya and Webster 2026). Comparable recent international evidence found R&D tax concessions increased by 60c for every dollar spent, over the short run, and by $1.20 in the long run. A recent study by Palangkaraya et al. (2026) found that research subsidies for collaboration between universities and firms, raised the employment of large (but not SME) Australian firms by 12 per cent.

Funding gap and the information problem
There is consistent international and Australian evidence that R&D and IP active firms are more profitable and productive. The question then is why do many firms complain of a lack of funding for their ideas? Why do they find it difficult to raise loans or equity? One possibility is that some unfunded ideas are simply sub-viable. Another is that potentially viable innovations are being left on the table for lack of funds. We simply do not have the counterfactual.
One theory is that lack of funding may occur because financial intermediaries do not have the nuanced and detailed information to give them the confidence to invest. The finance sector is required to return a profit and are therefore required to make an assessment based on their knowledge set about the likelihood of getting their funds back with a reasonable return. New-to-the-world ideas are precisely the ones about which the intermediaries have the least nuanced and detailed information, and so the least confidence to invest.

Agglomeration and networks
As a consequence, there is consistent evidence that (funded) innovation is stronger when a firm is located in **an industrial agglomeration**, network, or cluster of localised supporting industries. Individuals and single firms have a limited basis on which to collate and judge the meaning of fast moving and complicated information. As knowledge becomes more complex and dispersed, it is not possible for a single firm to keep up with and exploit all relevant knowledge. Trusted outsiders, colleagues and friends can reduce uncertainty and the anxiety associated with costly decisions through the provision of nuanced information and know-how. Firms need to be connected in appropriate ways to be alert to opportunity. Networks, which includes financial organisations, reduce the perceived cost of deciding to invest into a new idea. Silicon Valley is the leading contemporary example of a cluster, but competitor clusters exist in Korea, Taiwan, and China's Yangtze River and Pearl River Deltas.

The fact that firms choose to locate in certain clusters is prima facie evidence that clusters provide an advantage. Most empirical research seeks to identify which firms within a cluster are most affected by being located there rather than whether the cluster induced innovation per se. Firms with low technological competence may benefit more from being located in a cluster, whereas firms with high technological competence face the risk of detrimental outward knowledge spillovers. Interestingly, evidence from Australian clusters suggests that local competitive intensity attracts new firms to the cluster rather than repelling them (see Kim et al. 2022).

Proximity to research institutions matter in a similar way. There is evidence that regions hosting leading-edge research departments produce significantly more inventions and more innovations. Mowery and Ziedonis (2015) analysed data from nearly 1000 invention disclosures in the US. They found proximity matters for formal contracts between universities and firms possibly because the incompleteness of contracts means that firms know they should be near inventors for the know-how to transfer. Mowery and Rosenberg (1998) make a similar argument, that the creation of the academic medical centres that linked academic scientists with practitioners was responsible for the rapid development of medical devices and pharmaceuticals in post-WWII America. This co-location and co-organisation arrangement allowed for rapid feedback between the inventors and users of ideas.

Most major economies have all instigated programs to reinforce their industrial agglomerations. These programs, which may be characterised as policy frameworks for engineered agglomeration, typically include: Cluster designation (e.g., "innovation hubs"); Coordination bodies linking firms, universities, government; Incentives for collaborative R&D; and Networking and knowledge-sharing platforms to build knowledge spillovers.

Internationalisation
The relationship between innovation and **internationalisation** of a firm's activity, measured by the propensity to export or foreign ownership, has attracted considerable attention in the innovation literature. The overwhelming evidence is that exporting firms do more new-to-the-world innovation. What is less clear is the direction of causation – does export lead to innovation or the other way around? On the question of causation, the best available evidence suggests the relationship runs in both directions: the empirical analysis in Aw, Roberts and Xu (2011) – modelling Taiwanese electronics firms' joint choices of R&D investment and export participation – find that the two activities are complementary, each raises future productivity and thereby the returns to the other.

Issues relating to what drives firms' internationalisation decisions are crucial here and the frontier of work on this issue looks at the role of government export marketing grant programs (like Austrade runs) in supporting firms to locate suitable opportunities in export markets (see Munch and Schaur 2018) and/or the use of linked employer-employee datasets such the BLADE-PLIDA asset to understand how firms prepare their workforce to export (see Labanca et al. 2024).

IP Rights
IP rights operate most effectively when the cost of inventing and taking a commercial idea to market is expensive. There is considerable evidence that patents increase innovation on a partial equilibrium basis (i.e. from the perspective of the patentee) (Mansfield 1981; Webster and Jensen 2011). This effect is largest for pharmaceuticals, chemicals and instruments – that is where the boundaries between ideas are clear and the potential for reverse engineering is large. The evidence that IP encourages invention, creation or innovation for non-patent forms in IP is scarcer. However, there is strong evidence that non-IP ways to preserve innovation profits, such as secrecy, lead time and production complexity, are effective. If the patent system was abolished, innovation would probably shift towards areas where non-patent forms of appropriation are effective.

Management capability
Different measures of **managerial capability** and processes are regularly associated with the innovative functions of firms. Bloom and Van Reenen (2010) found that imperfectly competitive markets, family ownership, regulations restricting management practices, and informational barriers allow poor management practices to persist. Webster (2004) also notes that more flexible styles of management and more aggressive managerial approaches were significantly associated with more innovative modes of production. However, it would be difficult to use this evidence to conclude that these managerial functions cause the firm to be innovative. It could also be plausibly argued that when a company decides to undertake a product or process innovation, they introduce changes to the organisation or managerial practices. However, without panel firm-level datasets, it is very difficult to identify whether certain managerial practices cause or complement innovation.

The decision to undertake new-to-the-firm innovation

New-to-the-firm innovation usually requires copying lead firms and incremental changes are typically financed through retained earnings.

Business improvement programs are devised to bring firms up to best international practice in their industry. There is considerable evidence that most firms are well below best practice with respect to operations, export and management. Many government-sponsored reports have identified deficiencies in management capabilities that constrain the growth of existing firms and cause a high failure rate among new firms.

Australian governments have since the 1970s offered a suite of these programs. Subsidised programs are justified on the basis that they strengthen regional economies, create jobs and improve productivity. The rationale for a subsidy is rarely explicit but there is a presumption that competition is not robust enough for firms to seek out these services and pay for themselves. In other cases, they are offered as a mechanism to smooth industry adjustment following a change of government policy, such as a reduction in import tariffs.

Most evaluations[4] of these programs are public sector reports rather than peer-reviewed studies, and many have never been publicly released, possibly because they were intended only to inform internal policy development. Toner et al. (2023) reviewing 57 federal and state business management programs, identified only two rigorous departmental evaluations (Enterprise Connect and Commercialisation Australia) which found positive effects on participant firm performance relative to matched non-participants. Palangkaraya and Webster (2015) similarly found positive effects of their evaluation of Victorian business programs. We cannot glean from these studies, however, how long the benefits last as most evaluations can only measure benefits for a few years post-program, and randomised control trial evaluations of business programs are very rare. Using quasi-experimental methods, Kollmann, Yamashita and Webster (2022) found that the business improvement program under the IMCRC was associated with increases in turnover sales of 6 percentage points, an increase in wages of 2 percentage points and an increase in headcount employment of 3 percentage points in addition to small changes in patent, trademarks and design applications.

Proximity to a **cluster or research precinct,** collaborative status and presence of skilled ICT, science and research workers might also stimulate new-to-the-firm innovation. Workers are hired and collaborations are made if parties are proximate and relationships nurtured. In-person relationships de-risk the business environment by giving firms, or would be firms, triangulated information about new relevant technologies; market trends; changes to government regulation; tacit information from suppliers and clients; and political events that could have major implications for markets. ICT, science and research staff may behave as a conduit technology for the firm. Casual contact with peers, competitors, suppliers, clients and research organisations can provide the uncodified, frontier bits of knowledge that enable firms to piece together a scenario with confidence.

Using data on Australian firms, Palangkaraya et al. (2010) found a clear positive association between new-to-the-firm innovation and investment in new physical capital. Australian findings from BLADE concur with international studies which have found that more innovative firms are also more collaborative and operate in more competitive product markets. In contrast with these studies however, we do not find that firms which have previously been refused debt or equity finance are less likely to innovate that other firms.

The research all points to firm's lack of confidence in their information set as the major impediment to innovation – both new-to-the-world and new-to-the-firm, which may translate into:

- not knowing how far behind their competitors they are; or
- knowing they are behind but not knowing how to innovate without undue financial risk; or
- knowing they are behind and knowing how to successfully innovate but not being able to convince their governing boards or creditors that they should invest in the innovation.

Being embedded within an active and effective ecosystem has been found to offer information advantages that can mitigate these situations, especially if financial intermediaries are active participants.

4 An evaluation should include data on both program and a comparable set of non-program firms. The latter is often based (or 'matched') on post-program characteristics and often do not account for selection into the program.

3. The National Innovation Index: An Overview

The index in brief

The centrepiece of this report is a new Innovation Index for Australia. The index is calculated annually for each financial year from 2006–07 to 2023–24, and at fine detail. It scores the innovation intensity of small statistical areas, typically the size of a suburb or country town, within each broad industry. From this base it can be aggregated to regions, cities, states and industries, up to the nation as a whole. To our knowledge it is the first measure of Australian innovation available at this combination of geographic, industry and time detail.

The basic idea will be familiar from credit scoring. A credit score condenses many correlated indicators of a borrower's finances and behaviour into a single number, allowing borrowers to be compared on a common scale even though no one indicator tells the whole story. The Innovation Index does the same for innovation. It condenses eight measures of innovation-related activity into a single number that summarises the innovation intensity of each place and industry, comparable across Australia and over time. For ease of reference, the index is expressed relative to a benchmark: the national average in 2016–17 is set to 100, so an area-industry scoring above 100 is more innovation-intensive than that benchmark, and one scoring below 100 less so. Like a credit score, the number is a relative standing rather than a quantity, a point taken up below in the discussion of interpretation.

The index responds directly to the measurement critique in *Ambitious Australia*, the 2025 report of the Strategic Examination of R&D, which called for Australia's innovation reporting to shift from inputs to outcomes and impact, supported by better data. Existing indicators lean heavily on two inputs, R&D expenditure and patenting, which capture only part of how firms innovate. This index is the first attempt in many years to bring the inputs, outputs and market translation of innovation together in one integrated, repeatable measure.

Novelty of the index

Since innovation is a hard concept to measure – and no single indicator can capture the complexity of the concept – it isn't uncommon to see index methods being used to measure innovation. Examples from around the world using this method include the World Intellectual Property Organisation's Global Innovation Index and the European Innovation Scoreboard. These examples typically take aggregate level data on indicators of innovative activity at the national level to construct an index which can then be tracked over time and compared to other nations (as long as they collect comparable aggregate level innovator data).

The novelty of our approach is that we are using incredibly rich micro data on firm-level innovation activity compiled from within Australia's national statistical agency (which includes data from other agencies like the Australian Taxation Office and IP Australia). This means our data are comprehensive (covering the entire population of firms), robust (actual R&D expenditure reported to the tax office not simply self-reported survey measures of innovation activity) and consistent (enabling accurate measurement over time). All of this results in a comprehensive, innovative and detailed account of Australian firms' innovative activities.

Uses of the index

The index is designed to serve four purposes.

First, it shows where innovation is happening. Innovation concentrates in particular places and industries, so national and state aggregates conceal most of the interesting variation. Because the index is built at small-area geography, it can reveal productive pockets of innovative activity well beyond the central business districts, places that broader statistics would otherwise mask.

Second, it supports comparison. The index is calculated for each combination of area and industry, so it can compare industries within a region, regions within an industry, or any place against the national benchmark.

Third, it tracks change. Because the index is benchmarked to a fixed reference period and constructed consistently over the 2006–07 to 2023–24 financial years, it can show whether a place or industry is gaining or losing innovation intensity over time, not just where it stands today.

Fourth, it provides an outcomes-oriented baseline for policy. *Ambitious Australia* proposes National Strategic Initiatives operating across the whole of Australia, including the regions, and calls for performance monitoring focused on outcomes rather than inputs. A place-based measure of this kind can help identify where regional innovation strengths already exist, where they might be fostered, and whether conditions in a targeted place are improving after an intervention.

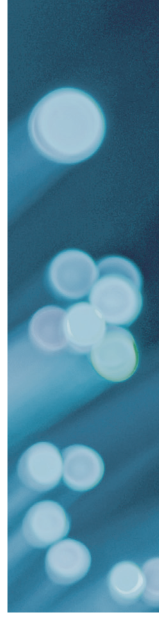
Components of the index

The index combines eight components, chosen to span the stages of what *Ambitious Australia* calls the RD&I flywheel: research creates knowledge, innovators translate it into new products and businesses, and scaling businesses create high-skilled jobs and attract further investment.

On the input side, the index includes R&D expenditure claimed under Australia's R&D tax provisions, employment in high-skilled scientific, engineering and ICT occupations, and royalty payments to overseas parties, which signal access to knowledge developed abroad. Protected outputs are captured by patents in force. Translation into the market is captured by three components: trade marks in force, since a trade mark is typically registered to protect the brand under which a new product or service is launched; design rights in force, which protect the appearance of new products; and imports and exports in complex, knowledge-intensive merchandise categories such as pharmaceuticals, scientific instruments and telecommunications equipment, which indicate participation in sophisticated global value chains.[5] This last component also speaks to the concern in *Ambitious Australia* about Australia's low economic complexity.

No single component is a satisfactory measure of innovation on its own. Together, however, they cover the journey from resources committed, through protected ideas, to products and trade in the market. Full definitions, the occupation and trade code lists, and the measures considered but excluded are set out in the appendix.

5 A number of further candidate measures were considered but not carried into the final index. Summary statistics, including those of the excluded variables, are provided in Table 1.



Construction of the index

The construction rests on an unusually strong evidence base. The index draws on two integrated, de-identified data assets managed by the Australian Bureau of Statistics: BLADE, which contains financial, trade and intellectual property data on the population of active Australian businesses, and PLIDA, which contains person-level data on employment, income and occupations for the population of Australian individuals. In other words, the index is built from the records of essentially every firm and worker in the country, over eighteen financial years, rather than from a survey sample. No survey could offer this combination of coverage, geographic detail and consistency over time.

Confidentiality is strictly protected. These data are only accessible to authorised researchers inside the ABS DataLab, a secure environment without internet access, and every output must be cleared by ABS staff before release. All analysis is conducted on grouped area-and-industry cells, never on identifiable firms or people, and results for cells with too few contributors are suppressed.

From these data, the index is assembled in four steps. Each firm's records are assigned to the locations where it operates and to its industry, and the records of all firms in the same small area and industry are added together. The result is a set of cells, one for each combination of area, industry and year, and these cells, rather than individual firms, are the units from which the index is derived.

The second step translates each component into an intensity measurement, where the innovation activity is scaled relative to the size of the local wage bill. An index built on raw totals would largely rank places by the sheer density of economic activity, and would equate simply to a map of Sydney and Melbourne. Measured as intensities, the index instead captures how innovative a place is for its size, which is what allows it to surface strong performers outside the major centres.

The third step combines the components into a single score by letting the data determine the weights. Places that are strong on one dimension of innovation tend to be strong on the others, and the index is constructed, using a standard statistical technique called principal component analysis, to capture that common thread of innovation intensity running through all eight components. The same technique underpins the ABS Socio-Economic Indexes for Areas (SEIFA), the established measure of advantage and disadvantage across Australian regions. Weighting this way avoids double-counting overlapping indicators and avoids imposing judgements in advance about which component matters most.

Finally, the resulting score is benchmarked so that the national average in 2016–17 equals 100, and is published for areas and industries at several levels of detail. The transformations, estimation results and sensitivity tests behind these steps, which show the index is robust to reasonable changes in specification, are reported in the appendix.

Interpreting the index

The index is a relative measure. A score of 130 for an area-industry means its innovation intensity is well above the 2016–17 national benchmark; a score of 80 means well below. A movement from 95 to 110 over several years means the place has become substantially more innovation-intensive relative to that fixed benchmark. The most meaningful statements are comparative: this region against that region, this industry here against the same industry elsewhere, this place now against the same place a decade ago.

Some care is needed in reading individual scores. The index is not a count of innovations, so a score of 120 does not mean 20 per cent more inventions; it summarises relative intensity across eight indicators. Small differences should not be over-read, particularly for small cells where a handful of firms can move the result. And because firm financial data are recorded against a company's head office, central business districts are somewhat flattered by the index; strong CBD scores partly reflect where activity is booked rather than where every part of it occurs.

Readers should also be aware of one feature of the index's internal composition. The trade components carry the heaviest weights in the combined score, so the index leans towards trade-engaged forms of innovation. This is defensible, and consistent with the strong evidence linking exporting and innovation discussed earlier in this report, but it means comparisons between trade-exposed regions and services-heavy regions should be made with that lean in mind.

Comparison benchmarks

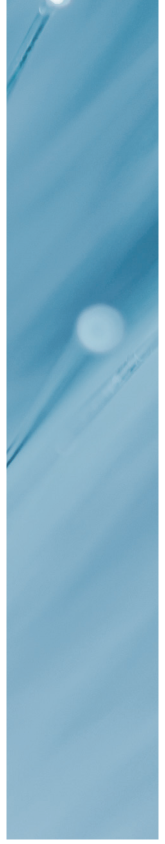
Emerging Industries

Alongside the economy-wide index, a parallel index is compiled for firms in seven emerging industries: artificial intelligence, biotechnology, clean energy, prefabrication, quantum, robotics and space. Firms are classified into these industries using firm-level definitions developed by the Department of Industry, Science and Resources, which identify emerging-industry firms from the public websites of companies with an Australian presence, classified by machine-learning analysis of website content. This allows us to understand the structure of businesses, without having to rely on broad industry classifications as an AI firm may be classified into software, professional services or even manufacturing.

There are two important elements with these benchmarks. First, the emerging industry classifications include both users and developers of the technology. A cohort's score therefore describes the innovation of the industry, broadly conceived. Second, the classification is algorithmic and based on what firms publicly present. Therefore, it is not certain that this snapshot fully represents the broader industry across Australia.

Unlike the innovation indexes scored either by geography or industry, scores for these cohorts need a different point of comparison. A comparison of an emerging industry against the national average baseline, is true but uninformative. The great majority of Australian firms record no formal innovation activity, so the average firm sets a very low bar. Therefore, finding that AI or quantum firms are more innovation-intensive than the economy at large tells the reader almost nothing they could not intuitively guess.

Therefore, our preferred benchmark is against the median R&D active firm. Firms recording R&D expenditure are ranked by the scale of their expenditure and grouped into quarters with the benchmark being the midpoint of the scores of the two middle quarters. The benchmark is meant to represent the innovation intensity of a typical R&D active firm. Compared against this benchmark, a cohort's score instead examines whether these firms match the innovation intensity of the kind of firm the formal system is built around.



Global value chain exporters
The same benchmark is subsequently applied to firms that export in complex global value chain categories. Exporting firms tend to do more new-to-the-world innovation, and the evidence suggests the two activities reinforce one another, with each raising the returns to the other. It is therefore natural to compare how trade-engaged firms compare with formal innovators, exploring whether the typical complex-GVC exporter matches the innovation intensity of the typical R&D active firm.

Innovation Activity among Australian Firms

Before turning to the index results, it is worth establishing a picture of the firms being measured. Table 1 reports summary statistics for the population of Australian firms in 2023-24, drawn from the data extracted from BLADE and PLIDA. Because the data spines come are based on two different tax forms, the table is presented in two panels. Panel A covers the roughly 1.37 million firms filing Business Activity Statements, whereas Panel B covers the 782,000 companies filing tax returns.

As we can see from the data, the typical Australian firm is small and young. The mean turnover is $866,000, with wages averaging $205,000 per firm. The median firms are smaller. Nearly one-third of all firms were formed within the previous five years.

The summary statistics reveal some interesting observations regarding innovation activity. While only a small fraction of firms hold any form of IP, 0.38 per cent hold a patent and fewer than 0.1 per cent hold a design right, the estimated proportion of firms that introduced a new good/service or new process within the previous two years was quite high, which only serves to highlight the point that much innovative activity occurs outside the formal IP registration system.

Table 1: Summary Statistics (mean and median of firm-level variables), 2023-24

Panel A: Firms filing Business Activity Statements	Mean	Median
Number of firms	**1,373,700**	
Turnover ($'000)	866.4	595.9
Wages ($'000)	205.9	99.1
Firm age (years)	9.7	8.0
High-skilled employees (no.)	0.42	0.00
High-skilled salaries ($'000)	25.8	0.0
Start-up (% of firms)	30.2%	
Complex-GVC importer (% of firms)	5.0%	
Complex-GVC exporter (% of firms)	2.1%	
Holds a trade mark (% of firms)	7.4%	
Holds a patent (% of firms)	0.38%	
Holds a design right (% of firms)	0.09%	
Introduced new good or service (predicted %)	20.6%	43.0%
Introduced new process (predicted %)	42.5%	19.5%

Panel B: Firms filing Company Tax Returns	Mean	Median
Number of firms	**782,400**	
Sales ($'000)	892.7	315.8
Current assets ($'000)	256.1	61.9
Total assets ($'000)	511.7	146.0
R&D expenditure ($'000)	7.8	0.0
Royalty expenses ($'000)	4.4	0.0

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: Firms are identified by their Australian Business Number, and where a firm operates in more than one location its financial values are divided equally across those locations. The table covers firms that were financially active or that have used the formal IP system. Financial variables are expressed in real 2023–24 dollars, adjusted for price changes in each firm's own industry, and extreme values are capped so that a handful of very large firms do not dominate the averages; the reported means are conservative as a result. High-skilled employees are those working in professional and technical occupations in fields such as science, engineering and ICT. Complex-GVC importers and exporters are firms trading in the kinds of merchandise characteristic of sophisticated global value chains, such as pharmaceuticals, telecommunications equipment and scientific instruments. The trade mark and patent indicators record whether a firm holds the relevant right, drawn from IP Australia's registers linked into the ABS data. Precise definitions, including the occupation and trade classifications used, are set out in the Technical Appendix.

4. Index Outputs

National-level

The headline index is the National Innovation Index using data from 2006-07 to 2023-24, which we present below. Note that we have used financial year 2016-17 as the base year (index=100) for the index.[6] The headline index shows a steady increase in innovative activity over the period, reaching a high point in 2023-24 of almost 110, with average growth over the period from 2006-07 of 1.94% p.a. It is worth noting, however, that the index has been stagnant since 2021-22, during the post-COVID period, one largely defined by persistent global disruptions and stubborn inflation in Australia's economy.

This stagnation is somewhat surprising given the rebound in consumer and business confidence after the COVID lockdowns. But it is quite possible that investment decisions – like the decision to invest in new R&D projects – responds with a lag and that we might see a bump up in innovative activity in 2024-25 (when the data is released). Of course, this might also be offset by the persistence of issues which have characterised the post-COVID period.

Of course, we know that innovation is unevenly distributed across time and space, so it is interesting to break the national innovation index down by various dimensions including both ANZSIC classification (i.e. industry) and State. In Figure 2, we present the index by industry, for which we use the standard 1-digit industrial classification system which categorises industries into 19 broad divisions. The only caveat to this is that to simplify the graph we have kept the 5 largest industries (by index value) as stand-alone industries and grouped together the smallest 1-digit divisions into a single category called "Other industries".[7] Note that national statistical agencies allocate firms to industries in ANZSIC according to the activity that contributes the largest share of value-added which may not correlate particularly closely with innovation investments at the firm level.

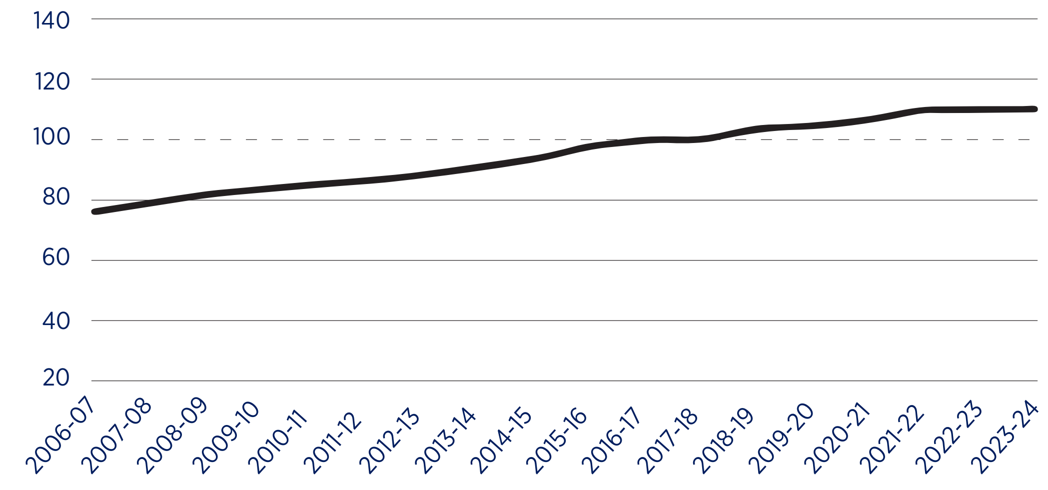
The most obvious observation to make about the index by industry is that the dominance of the following three industries – Wholesale trade, Manufacturing, and Professional, scientific and technical services – all of which have experienced strong and positive growth in innovative activity over the entire period. Up until 2016-17, growth in innovative activity for these three industries was highly correlated and almost a mirror image of each other, but since then the growth in innovative activity in Professional, scientific and technical services has been much softer than the other two industries.

The manufacturing industry in Australia is an interesting case study in innovation: since it can't compete with low-cost international manufacturers, it has pivoted towards high-value – and often technology-intensive – areas of activity and niche markets, which has often been facilitated by deep collaborative arrangements with organisations like the CSIRO and leading universities with capability in advanced manufacturing (e.g. robotics, advanced material design, nanotechnology, and 3-D printing). These collaborative arrangements are often funded by government initiatives such as the Cooperative Research Centres e.g. the Additive Manufacturing CRC, which recently announced a program of funds for SMEs and startups interested in introducing 3-D printing into their workflows. Such schemes can provide valuable ways for SMEs to re-risk the innovation process.

6 The base year should be relatively recent and free of major economic shocks. We selected 2016-17 because it enabled some analysis of the pre- and post-COVID years.

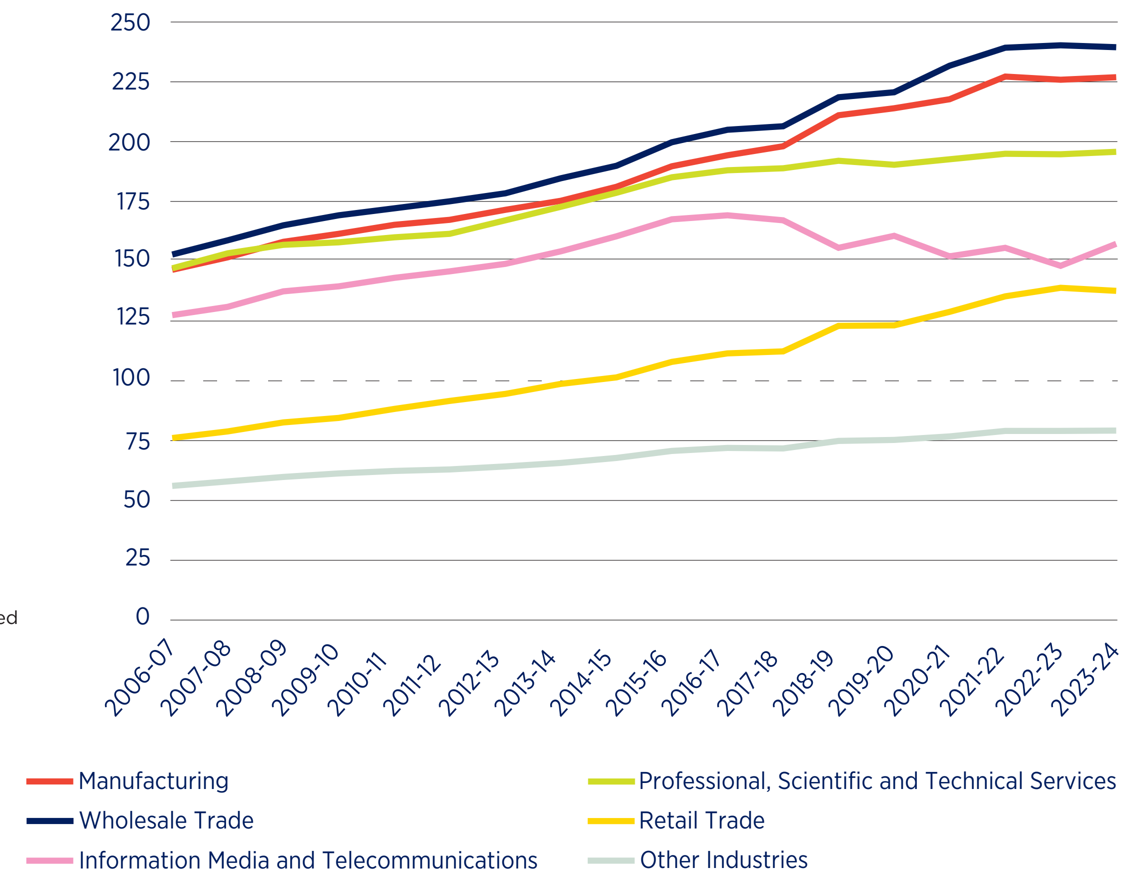
7 Other industries are a weighted average of the remaining ANZSIC divisions where weight is the industries log(turnover).

Figure 1: National Innovation Index, 2006-07 to 2023-24 (2016-17=100)



Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Figure 2: National Innovation Index, by Industry (1-digit ANZSIC division)



Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

It is not immediately obvious why Wholesale trade should figure so prominently in innovation rankings. According to Petrie et al. (2023), firms in this industry are often fabless manufacturing or own-brand importer-marketers. These firms may undertake considerable R&D and design innovative products but outsource the assembly the goods. There is also a major push by innovative wholesale traders in Australia to modernise supply chain logistics via automation (e.g. automated distribution centres and digital ordering platforms) and increasingly through the use of Artificial Intelligence (AI). Wholesale trade is also often characterised as a highly competitive industry with small profit margins, so innovation generating operational efficiencies is crucial to survival and growth.

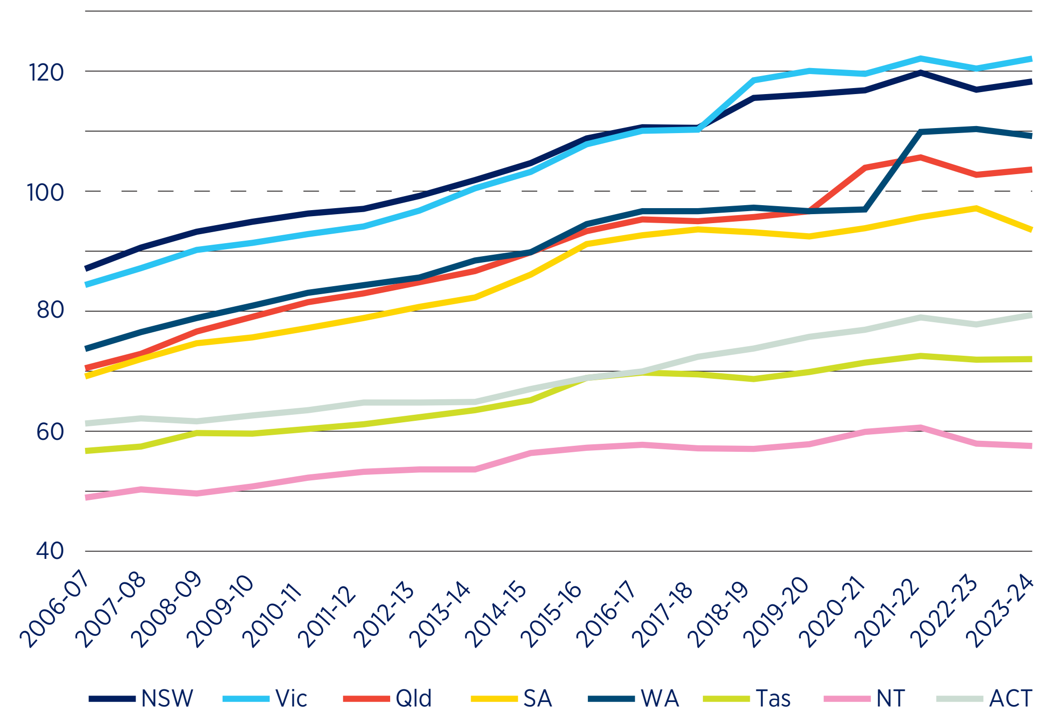
Two other industries – Retail trade and Information, media and telecommunications – had similar rates of growth in the period from 2006-07 up until 2016-17 but since then have experienced quite different growth trajectories. Retail trade has continued on the same path as before 2016-17 while Information, media and telecommunications has trended downwards, to the point where the two industries had almost identical index values in the final year of observation, 2023-24. The underlying source of the slowdown in innovative activity in this industry – which includes firms involved in publishing, broadcasting and telecommunications – is perhaps surprising given the rise of the digital age.

State- and Territory-level

To break the innovation index down by geographical regions, we start by analysing the trends over time by State and Territory as per Figure 3 below. The two largest states – New South Wales and Victoria – are the only states consistently above the national average in terms of innovative activity. And the rivalry between the two states is apparent here in that NSW had the highest innovation index level for most of the period between 2006-07 and 2017-18, whereas Victoria has taken over in the period since then. Victoria obviously has a major manufacturing hub in the south-eastern suburbs and is home to a world-class medical and biotechnology precinct in the suburb of Parkville – including CSL, WEHI and the biomedical incubator, Jumar, supporting biotech startups – which undoubtedly contributes to the State's successful innovation activity levels.

Western Australia has also demonstrated remarkable growth in innovative activity since 2020-21, overtaking Queensland as the third most innovative state in the latest years of observation, 2023-24. Although it isn't possible to detect causal factors driving this growth, it is noteworthy that it coincides with a major push by the WA Government to diversify away from traditional resource extraction industries into new areas like clean energy, agtech and space tech which are all domains where WA has considerable comparative advantage. Despite being recently overtaken by WA, Queensland has also had very strong growth in innovative activity over the entire period, with signs of an uptick in the latest year of observation 2023-24.

Figure 3: Innovation Index by State and Territory



Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: Values above 100 indicate innovation activity above the national average in 2016-17. Values before 2016-17 are adjusted for a structural break in turnover; differences should be interpreted in index points. See the accompanying methodology for construction details.

Disaggregating the index by both Industry and Region (State or Territory) can provide more nuanced analysis of the heterogeneity in innovation activity across time and space. Ideally, we would present the trends in the index over time, disaggregated by both Industry and State, but that isn't easy to graphically present. So, we present a one-off snapshot of the disaggregated results in tabular form (see Table 2, right) for the latest year of the period of study, 2023-24.

We use a simple colour gradient to differentiate between very high index value (darkest shade) and very low (lightest shade). This enables comparisons by State within a specific Industry (e.g. Wholesale Trade) to look at varying levels of innovative activity – by looking across a specific row. Alternatively, it also enables comparisons of innovative activity in different industries within a State – which can be done by looking at a specific column.

Table 2: Innovation Index by Industry (ANZSIC 1-digit) and State/Territory, 2023-24

ANZSIC Industry Division	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	Aust
Wholesale Trade	260	278	220	191	247	93	72	127	239
Manufacturing	244	257	209	204	221	149	81	128	227
Professional, Scientific and Technical Services	206	215	189	185	196	131	114	158	196
Information Media and Telecommunications	159	168	155	152	154	166	84	127	157
Retail Trade	154	164	127	106	116	84	58	88	138
Financial and Insurance Services	124	121	103	86	109	64	51	70	110
Rental, Hiring and Real Estate Services	93	108	95	96	83	55	38	59	92
Arts and Recreation Services	122	99	74	60	70	63	54	75	92
Other Services	97	102	87	81	91	55	58	74	92
Construction	87	88	80	70	87	53	52	63	83
Mining	76	78	78	60	113	48	50	36	82
Education and Training	85	85	77	49	79	57	53	83	79
Agriculture, Forestry and Fishing	81	82	80	89	76	73	45	37	78
Transport, Postal and Warehousing	84	82	69	64	69	55	55	52	75
Administrative and Support Services	78	79	71	61	76	49	49	71	74
Electricity, Gas, Water and Waste Services	70	88	64	61	81	48	47	52	73
Public Administration and Safety	72	61	63	56	69	45	60	71	65
Health Care and Social Assistance	59	63	56	44	63	47	41	48	58
Accommodation and Food Services	57	69	48	35	49	38	39	46	55
Overall	118	122	104	94	109	72	58	79	110

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: Rows are ordered by the national (Aust) value. Values above 100 indicate innovation activity above the national average in 2016-17; differences should be interpreted in index points. See the accompanying methodology for construction details.

Regional clusters

To look at the overall picture across Australia, we constructed a map of the nation at the Statistical Area (4) level – which is the largest sub-state regional classification in the Australian Standard Geographical Standard (AGSG) developed by the ABS – and colour-graded the level of innovative activity according to the relevant index value for 2023-24, as in Figure 4 below. Note that there are 108 SA4s across the nation, each comprising of 100,000-500,000 people.

Within the capital cities, particular the most populous capital cities, there are multiple SA4s, so we have also presented the city-level maps for Sydney, Melbourne, Perth, Brisbane and Adelaide as insets in the graph. As expected, most of the innovation hotspots are in the capital cities or in the SA4s immediately adjacent to the capital cities. The regional innovation exemplars are in far north Queensland, north-western Western Australia, Margaret River and Tweed River.[8]

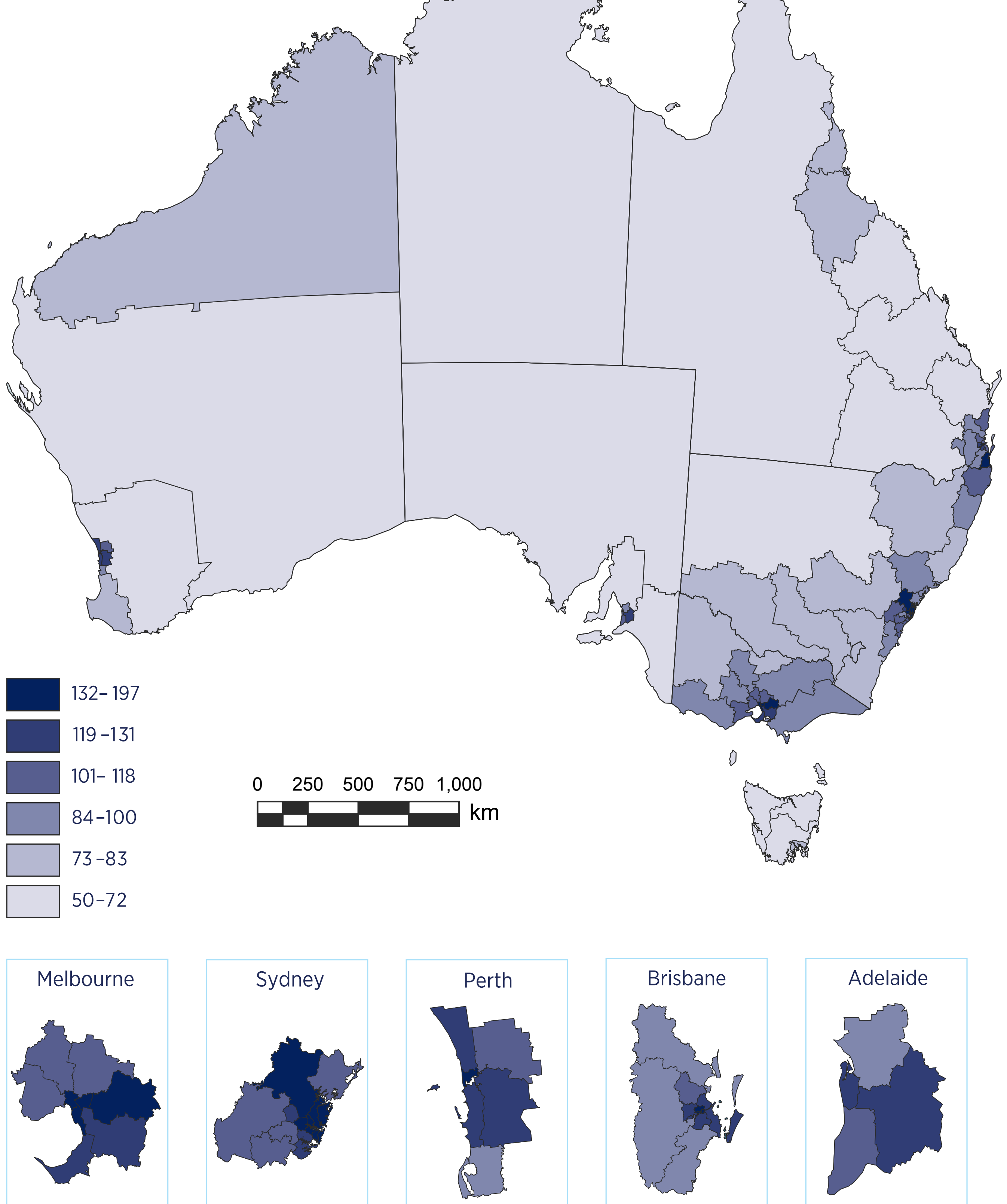
In the Data Appendix (Tables A1-A3), we also provide information identifying the Top 10 regions (at the SA3 level) across the country for selected industries which provides more nuanced information about the level of variation in innovative activity across the regions at a finer level of disaggregation (NB: SA3 is a smaller geographic area than SA4 – there are 359 distinct SA3s across the country with populations ranging from 30,000 to 130,000). Looking at the data suggests that even at the SA3 level, there is a strong representation of capital cities.

Emerging technologies and knowledge-intensive trade

Finally, we wanted to understand something about the innovative activity in new and emerging areas of technology and firms that participate in knowledge-intensive trade (either exports or imports). To analyse this for emerging technologies, we relied upon the Department of Industry's classification of the following emerging areas based on firm-level characteristics: Artificial Intelligence (AI), Biotechnology, Clean Energy, Prefabrication, Quantum, Robotics and Space. To understand how innovative firms in these industries are, we compared their innovation index value with the R&D-intensive and IP-intensive industries (by quartile).

For the analysis of knowledge-intensive trade, we created a measure which we call complex-Global Value Chain (GVC) importer/exporter which is constructed using merchandise trade data in BLADE.[9] Engagement in complex GVCs is measured using the Standard International Trade Classification (SITC) of merchandise imports and exports, restricted to a subset of SITC divisions (for more on the definition of GVCs, see the Technical Appendix). Essentially, these two indicators are one way of assessing the innovative activity of firms that are actively engaging in trade with international firms as part of a complex global value chain. We include this because there is strong evidence that this type of international trade engagement is important for exchange in skills and ideas that are important for firms in understanding the technology frontier.

Figure 4: Innovation Index by Statistical Area (4) level



Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Boundaries: ABS Australian Statistical Geography Standard (ASGS), Edition 3.

8 We also have detailed maps for the innovation index disaggregated by SA4 and ANZSIC division, which we have not included here.

9 The concept of a complex Global Value Chain (GVC) is a standard way of describing production networks where production is split across multiple countries. Such networks involve high fragmentation of tasks, intermediate goods, and specialized firms operating on a global scale.

One important cultural shift that should be reinforced in Australia relates to the need for businesses to innovate with a mindset that they are developing goods and services that are competitive not just domestically but also globally. A lack of export focus could be one reason why some small to medium-sized companies have “capped out” at a particular size because they have reached the limit of the domestic market and are not exporting (or actively exploring exporting opportunities). And we know from the literature that engaging in the global market can expose firms to new ways of thinking and doing, and that the additional competitive pressure can provide high-powered incentives to innovate. The Australian mining industry a good example of where significant innovation has occurred – e.g. the development of driverless heavy-haul trains in the Pilbara – which has been necessary to remain internationally competitive.

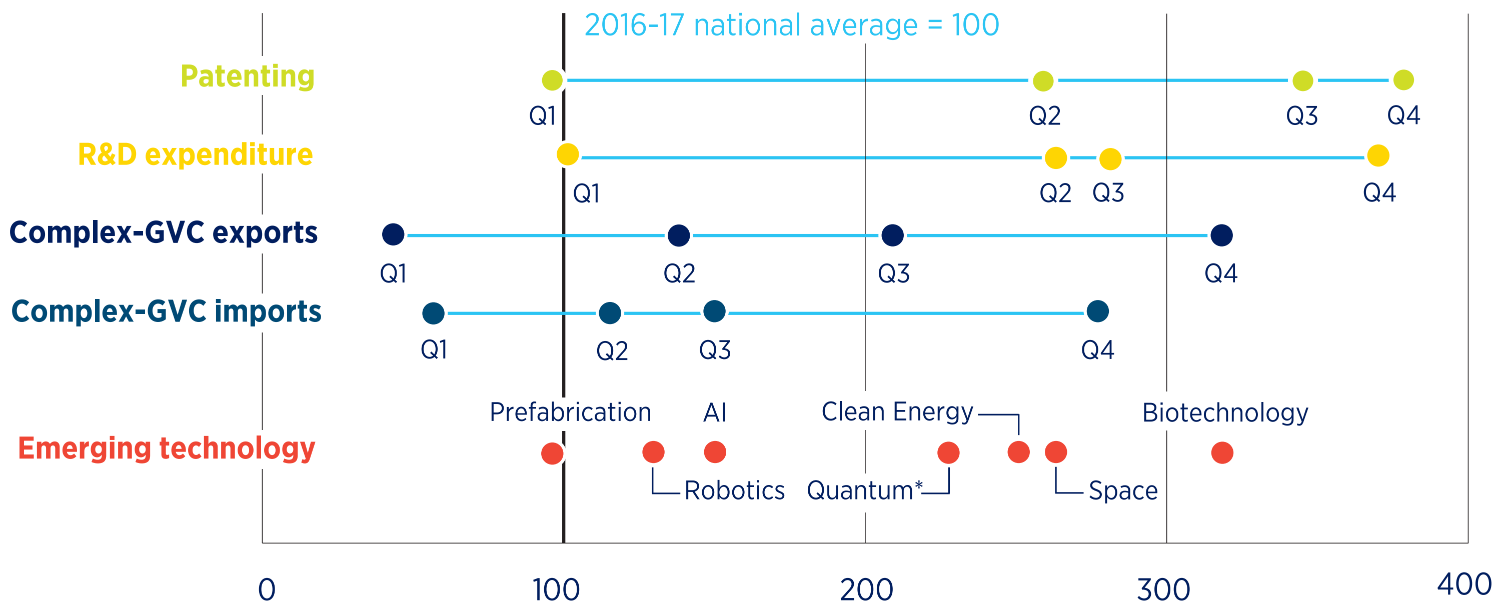
Figure 5 is a visual representation of our data with regard to the innovativeness of firms in a few key emerging technologies in Australia and the innovativeness of firms involved in knowledge-intensive trade. We provide two distinct benchmarks which can be used to assess the innovativeness of these sectors: R&D expenditure and patenting activity. Rather than simply provide the (R&D/patenting) benchmarks as a simple mean, we provide information on the distribution of these variables in the form of quartiles (Q1-Q4), where Q1 is the lowest 25% of firms in the distribution and Q4 is the highest 25% of firms in the distribution.[10]

Figure 5 shows, for example, that the most patent-intensive and R&D-intensive firms are clearly the most innovative in the country, with very high innovation index activity scores (above 350), which is well above the national average in 2016-17.[11] Interestingly, the next two ranks are held by those exporting firms engaged in complex global value chains (innovation index score: 320) and the those in the Biotechnology space (innovation index score: 320). As already mentioned, it is perhaps unsurprising that Biotechnology is so innovative given Australia’s research capability in medical sciences and the effort put in by Federal and various State Governments to support local biotech development (especially in hotspots surrounding universities in Sydney, Melbourne and Brisbane). CSL is the clear leader in the space – dominating the industry – but there are also a number of mid-cap emerging players and a range of up-and-coming ASX-listed companies currently at the clinical trial stage with a range of primarily immunology and oncology therapeutics.

Other emerging technology areas such as Space (Innovation Index score: 261), Clean energy (Innovation Index score: 248) and Quantum (Innovation Index score: 226) are also well above the middle of this pack in terms of their innovation index score. The AI tech area (Innovation Index score: 156.5) is still above the national average, but is a long way behind the other emerging tech areas as of 2023-24. It is worth noting that – according to the National AI Centre (NAIC) – there has been a recent substantial expansion of AI-related R&D investments in Australia, with AI-related research publications and patents showing signs of rapid growth (NAIC 2025), which we would expect to see in the innovation index score in future years.

10 Table A4 provides the underlying data for this graph in terms of a rank-ordering of the variables according to their innovation index score as well as the number of firms in each group.
11 Recall that the index is a relative measure, so a score of 130 for an area-industry means its innovation intensity is well above the 2016–17 national benchmark, while a score of 80 means its innovation intensity is well below.

Figure 5: Innovation Index of Benchmark Firm Groups, 2023-24



Source: Authors’ analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: Quartile groups rank firms by the value of the relevant activity in 2023-24 among firms with positive values; Quartile 4 is highest. Groups are not mutually exclusive. * Fewer than 100 firms.

The Cleantech sector is one of the most interesting areas to explore given Australia’s current reliance on fossil fuels (for domestic use and for export) coupled with our abundant renewable energy sources. As a result, there is a huge amount of innovation investment around the country on a range of areas including energy storage (batteries), green hydrogen, electrification and climate adaptation. Tasmania’s clean tech sector is obviously much smaller than other states, but they have the highest penetration of renewables in the country (mainly due to their hydroelectric schemes), and there are some exciting potential cleantech infrastructure investments (e.g. Project Marinus, which will create a clean energy highway from Tasmania to the mainland) underway.

The final point to note from this table is that importing firms involved in the complex global value chain are also very innovative. Looking at the graph, it shows that the most innovative of the exporters of complex products into the global value chain – those in Q4 – are right up there with the top emerging sectors like Biotechnology. Which suggests that intensive engagement in knowledge-intensive trade is incredibly important for exchanging new ideas and developing new skills and capabilities. Obviously, this is not a causal interpretation – we can’t conclude from simple cross-sectional analysis like this that engagement in global value chains causes increased innovative activity – but it is certainly indicative of positive association between the two. To understand this further would require more sophisticated modelling using BLADE data, which will be the subject of follow-on research.

5. Conclusions and Next Steps

The construction of a new index of innovative activity in Australia using rich firm- and person-level micro data enables us to undertake a detailed descriptive analysis of the trends in innovative activity across space, industry and time. The importance of understanding this can't be under-stated – because a careful articulation of what is actually happening (through measurement and visualisation) is the foundation for all robust discourse on policy options. At a time when Australia's productivity and living standards seem to be in stasis, there is no better time to re-examine our innovative foundations in order to better understand how we can do more to invent and commercialise our way to a brighter future.

It's worth stepping back and thinking about how these observations align with the issues (and policy recommendations) outlined in the Government's recent SERD report, *Ambitious Australia.* The key dimensions of the SERD were: overhauling R&D tax incentives, workforce capability, boosting business R&D, supporting basic research, and national coordination of the innovation effort. Some of these issues are certainly relevant to the finding of this report. For example, there is good evidence that the most innovative firms and industries have benefited from support for basic research, through university funding but also via support for commercialising academic research and development of biotech precincts. In general, there is a need for deeper collaboration between academia, government and industry in other emerging technology areas such as clean energy, space technology and quantum, all of which rely heavily on underlying basic research.

The initiative to boost innovation in this country is a shared one: it doesn't just fall on government to improve its innovation policies and interventions. Government's role is to get the economic settings right that encourages innovation and it is the private sector that has the primary responsibility through markets to allocate capital efficiently and effectively (via both the formal banking sector and the venture capital sector). This also includes the possibility of attracting foreign capital to help provide the optimal level of investment funds to support the development of Australia's innovative capability.

In this light, business can do a lot more to develop the innovation potential of the economy. For example, encouraging large and small companies to work together in the context of procurement contracts which can be used to underwrite the production and manufacturing of certain goods to support innovative activities and investments. The SERD report lays out the vision for a coordinated approach to innovation, but business and government both need to buy into this vision.

Another important area for Australia to develop its future innovation potential relates to workforce capability. We have observed how important connecting into the global value chain is for the quality and impact of innovation, so there is good reason to think about ways in which more Australian firms can be supported to think about potential export markets and much more that could be done to develop targeted immigration programs to attract stars in emerging areas aligned with Australia's existing (and emerging) industries.

Finally, research in understanding the underlying causes and effects of innovation in Australia is surprisingly under-developed. This report has highlighted a number of key questions that need to be answered if the ambitions of *Ambitious Australia* are to be achieved. Unless we understand the drivers of innovative investment and how it shapes productivity, the chances of public policy interventions being successful are not being optimised. With the continued development of the BLADE database, Australia is in a perfect position to move closer to the global frontier of public policy evaluation in the innovation, science and technology domain.

In conclusion, this Report highlights some of the key issues Australia needs to focus on and shines a light on some areas for follow-on research such as the effects of innovation on productivity growth, the role of VC funding and export focus on firm growth, and how to support the development of new technologies that drive the emergence of new industries that are crucial to our long-term economic prosperity. If we are to continue to achieve such high standards of living, innovation will need to play an increasingly important role in driving productivity growth. So, it is imperative that we continue to invest in the development of a sophisticated innovation ecosystem in this country. The Innovation Index presented here will need to grow more rapidly than we have seen in the last few years if we are to achieve this ambition.

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Data Appendix

Table A1: Top 10 regions (SA3) by Innovation Index in Manufacturing, 2023-24

Rank	Vic	NSW	WA	Qld	SA	Other states
1	Monash 514	North Sydney - Mosman 499	South Perth 450	Brisbane Inner - West 408	Norwood - Payneham - St Peters 413	Canberra East (ACT) 305
2	Yarra 471	Pittwater 485	Stirling 427	Brisbane Inner 388	Burnside 384	South East Coast (Tas) 255
3	Melbourne City 455	Ku-ring-gai 471	Belmont - Victoria Park 418	Southport 380	Unley 360	Meander Valley - West Tamar (Tas) 224
4	Whitehorse - East 450	Dural - Wisemans Ferry 467	Canning 391	North Lakes 374	Holdfast Bay 358	South Canberra (ACT) 214
5	Bayside 450	Chatswood - Lane Cove 453	Perth City 379	Nundah 368	West Torrens 334	North Canberra (ACT) 214
6	Stonnington - East 448	Ryde - Hunters Hill 439	Cottesloe - Claremont 337	Carindale 364	Adelaide City 316	Hobart - South and West (Tas) 201
7	Manningham - West 434	Manly 433	Joondalup 319	Gold Coast - North 364	Mitcham 313	Hobart Inner (Tas) 179
8	Port Phillip 433	Botany 433	Melville 311	Wynnum - Manly 362	Charles Sturt 296	Devonport (Tas) 161
9	Boroondara 428	Sydney Inner City 425	Rockingham 295	Coolangatta 359	Port Adelaide - East 287	Hobart - North East (Tas) 153
10	Whitehorse - West 423	Rouse Hill - McGraths Hill 420	Gosnells 290	Mt Gravatt 351	Prospect - Walkerville 283	Hobart - North West (Tas) 152

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: For each SA3, the larger of the Manufacturing and Wholesale Trade index values is shown, as Wholesale Trade can contain fabless manufacturing firms. States are ordered by state Innovation Index. Other states comprises TAS, NT and ACT. Regions are ABS Statistical Areas Level 3 (SA3).

Table A2: Top 10 regions (SA3) by Innovation Index in Professional, Scientific and Technical Services and Information Media and Telecommunications, 2023-24

Rank	Vic	NSW	WA	Qld	SA	Other states
1	Bayside PSTS 372	Chatswood - Lane Cove PSTS 352	South Perth PSTS 347	Buderim IMT 349	Unley PSTS 347	Hobart Inner (Tas) IMT 234
2	Monash PSTS 334	Sydney Inner City PSTS 330	Cottesloe - Claremont PSTS 311	Nundah PSTS 314	Adelaide City PSTS 344	Hobart - South and West (Tas) PSTS 227
3	Knox PSTS 311	North Sydney - Mosman PSTS 314	Gosnells PSTS 272	Noosa Hinterland PSTS 312	Marion PSTS 334	Huon - Bruny Island (Tas) IMT 223
4	Melbourne City PSTS 309	Auburn PSTS 297	Belmont - Victoria Park PSTS 272	Brisbane - Innner West PSTS 301	Adelaide City IMT 317	North Canberra (ACT) IMT 214
5	Yarra PSTS 309	Canada Bay PSTS 289	Fremantle PSTS 262	Southport PSTS 298	Mitcham PSTS 317	South Canberra (ACT) PSTS 212
6	Stonnington - West PSTS 302	Eastern Suburbs - North PSTS 288	Cockburn PSTS 256	Capalaba IMT 288	Burnside PSTS 275	Hobart Inner (Tas) PSTS 198
7	Whitehorse - West PSTS 299	Dural - Wisemans Ferry PSTS 288	Stirling PSTS 250	Sherwood - Indooroopilly PSTS 282	Port Adelaide - West IMT 264	North Canberra (ACT) PSTS 186
8	Kingston PSTS 294	Pittwater PSTS 287	Canning PSTS 246	Strathpine PSTS 281	Charles Sturt PSTS 264	Belconnen (ACT) PSTS 166
9	Melbourne City PSTS 287	Merrylands - Guildford PSTS 278	Melville PSTS 242	Kenmore - Brookfield - Moggill PSTS 277	Holdfast Bay PSTS 247	Darwin City (NT) PSTS 158
10	Port Phillip PSTS 280	Leichhardt PSTS 276	Swan PSTS 241	Loganlea - Carbrook PSTS 277	West Torrens PSTS 238	Devonport (Tas) IMT 148

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: PSTS denotes Professional, Scientific and Technical Services; IMT denotes Information Media and Telecommunications. Regions may appear more than once where both divisions rank in the top 10. States are ordered by state Innovation Index. Other states comprises Tasmania, the Northern Territory and the Australian Capital Territory. Regions are ABS Statistical Areas Level 3 (SA3).

Table A3: Top 10 regions (SA3) by Innovation Index in 'Other industries', 2023-24

Rank	Vic	NSW	WA	Qld	SA	Other states
1	Monash Retail trade **295**	Carlingford Retail trade **320**	Mundaring Other Services **211**	Maroochy Retail trade **263**	Burnside Retail trade **275**	Hobart Inner (Tas) Utilities **163**
2	Port Phillip Retail trade **287**	Auburn Retail trade **289**	Perth City Mining **203**	Noosa Hinterland Rental & Real Estate **260**	Adelaide City Rental & Real Estate **264**	South Canberra (ACT) Other Services **227**
3	Melbourne City Retail trade **282**	Sydney - Inner City Retail trade **285**	Kalamunda Finance & Insurance **220**	Strathpine Rental & Real Estate **259**	Adelaide City Mining **259**	South East Coast (Tas) Agriculture **125**
4	Stonnington - East Rental & Real Estate **267**	North Sydney - Mosman Retail trade **278**	Perth City Retail trade **196**	Nundah Mining **237**	Norwood - Payneham - St Peters Rental & Real Estate **253**	North Canberra (ACT) Retail trade **118**
5	Stonnington - East Retail trade **264**	Ryde - Hunters Hill Retail trade **268**	Canning Retail trade **187**	Nundah Retail trade **229**	Holdfast Bay Finance & Insurance **211**	Hobart Inner (Tas) Education & Training **116**
6	Knox Retail trade **244**	Chatswood - Lane Cove Retail trade **265**	Belmont - Victoria Park Mining **187**	Nundah Retail trade **222**	Port Adelaide - West Finance & Insurance **211**	North Canberra (ACT) Utilities **115**
7	Stonnington - West Retail trade **243**	Eastern Suburbs - North Retail trade **263**	Fremantle Construction **182**	Rocklea - Acacia Ridge Rental & Real Estate **219**	Port Adelaide - East Construction **185**	Canberra East (ACT) Transport **115**
8	Melbourne City Mining **242**	Sydney - Inner City Finance & Insurance **256**	Perth City Utilities **179**	Wynnum - Manly Retail trade **219**	Unley Retail trade **180**	North Canberra (ACT) Education & Training **111**
9	Port Phillip Mining **236**	Dural - Wisemans Ferry Rental & Real Estate **248**	Belmont - Victoria Park Retail trade **178**	Brisbane Inner - North Retail trade **216**	Adelaide City Retail trade **178**	Darwin City (NT) Transport **109**
10	Whitehorse - East Retail trade **220**	Chatswood - Lane Cove Finance & Insurance **244**	Stirling Retail trade **175**	Wynnum - Manly Rental & Real Estate **215**	Unley Rental & Real Estate **177**	North Canberra (ACT) Public Admin **108**

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Notes: Includes all ANZSIC divisions not covered in Tables 1 and 2. Regions may appear more than once where multiple divisions rank in the top 10. Utilities denotes Electricity, Gas, Water and Waste Services; Public Admin denotes Public Administration and Safety. States are ordered by state Innovation Index. Other states comprises Tasmania, the Northern Territory and the Australian Capital Territory. Regions are ABS Statistical Areas Level 3 (SA3).

Table A4: Innovation Index of Benchmark Firm Groups, 2023-24

Category	Group	Number of firms	Innovation Index
Patenting	Quartile 4 (highest)	1,200	367.4
R&D expenditure	Quartile 4 (highest)	4,300	355.5
Patenting	Quartile 3	1,000	331.7
Complex-GVC exports	Quartile 4 (highest)	7,100	319.9
Emerging technology	Biotechnology	900	319.7
R&D expenditure	Quartile 3	4,700	278.1
Complex-GVC imports	Quartile 4 (highest)	18,100	273.7
R&D expenditure	Quartile 2	4,500	264.0
Emerging technology	Space	1,000	260.8
Patenting	Quartile 2	1,500	259.6
Emerging technology	Clean Energy	1,600	248.0
Emerging technology	Quantum	< 100	226.2
Complex-GVC exports	Quartile 3	7,000	208.9
Complex-GVC imports	Quartile 3	16,800	156.5
Emerging technology	Artificial Intelligence	5,200	156.5
Complex-GVC exports	Quartile 2	7,200	143.8
Emerging technology	Robotics	1,400	134.3
Complex-GVC imports	Quartile 2	16,200	116.7
R&D expenditure	Quartile 1 (lowest)	4,700	102.1
Patenting	Quartile 1 (lowest)	1,500	97.0
Emerging technology	Prefabrication	400	95.3
Complex-GVC imports	Quartile 1 (lowest)	17,800	57.9
Complex-GVC exports	Quartile 1 (lowest)	7,700	39.6

Source: Authors' analysis of ABS BLADE and PLIDA microdata, accessed through the ABS DataLab.

Technical Appendix

Data Components

The components that contribute to the index are described below and map onto the following dimensions: high-skilled employment, research and development expenditure and overseas royalties are added as inputs. Patents as outputs, complex merchandise trade as global-value-chain engagement, and trade marks and design rights as proxies for the introduction of new products and services. A number of further candidate measures were considered by were ultimately excluded from the final index based on the selection criteria typical for indexes. This includes a survey-based, imputed measure of new goods and services, a similar measure for new processes and finally, counts of new start-up firms.

High-skilled employment
A measure of high-skilled employment is derived from person-level ATO data, identifying individuals employed in selected occupation groups. Because the occupational classification standard applied to the ATO data changed during the study period, two 3-digit code sets are used. For 2006–07 and 2007–08, occupations are identified using the Australian Standard Classification of Occupations (ASCO), the predecessor to ANZSCO. The Australian and New Zealand Standard Classification of Occupations (ANZSCO) code lists are applied to the ATO data from the 2008–09 financial year onward.

Table A5: ASCO minor groups (2006–07 and 2007–08):

Code	Title
211	Natural and Physical Science Professionals
212	Building and Engineering Professionals
223	Computing Professionals
242	University and Vocational Education Teachers
311	Medical and Science Technical Officers
312	Building and Engineering Associate Professionals

Table A6: ANZSCO minor groups (2008–09 onward):

Code	Title
232	Architects, Designers, Planners and Surveyors
233	Engineering Professionals
234	Natural and Physical Science Professionals
242	Tertiary Education Teachers
261	Business and Systems Analysts, and Programmers
262	Database and Systems Administrators, and ICT Security Specialists
263	ICT Network and Support Professionals
311	Agricultural, Medical and Science Technicians
312	Building and Engineering Technicians
313	ICT and Telecommunications Technicians

Engagement in complex global value chains (GVCs)
Engagement in complex GVCs is measured using the Standard International Trade Classification (SITC) of merchandise imports and exports, restricted to the following SITC divisions:

Table A7: SITC divisions defining engagement in complex global value chains (GVCs)

Code	Title
54	Medicinal and pharmaceutical products
75	Office machines and automatic data processing machines
76	Telecommunications and sound-recording and reproducing apparatus and equipment
77	Electrical machinery, apparatus and applicances, n.e.s., and electrical parts thereof
87	Professional, scientific and controlling instruments and apparatus, n.e.s.

Other categories of merchandise trade are classified but excluded from the analysis.

Patents
Patents are used as a measure of innovation output, the protected results of innovative activity. Patent data are sourced from the Intellectual Property Longitudinal Research Data (IPLORD) within BLADE. Stock measures (patents in force) are used in preference to application counts to reduce volatility in the indicator.

Trademarks
Trademarks are used as a proxy for the introduction of new products and services. A trademark is typically registered to protect the brand under which a firm brings a new product or service to market, so trademark activity provides an indirect, firm-level signal of new-product and new-service introduction, a dimension that is otherwise difficult to observe in administrative data. Trademark data are likewise sourced from IPLORD, and stock measures are used in preference to application counts.

Design rights
Registered design rights are included as a further measure of innovation reaching the market. A design right protects the visual appearance of a product, so design right activity provides a firm-level signal of new-product development and differentiation that complements trade marks (brand-level signals of new products and services) and patents (protection of underlying inventions). Design right data are sourced from IPLORD, and stock measures are used in preference to application counts.

Research and development (R&D) expenditure
R&D expenditure is sourced from company Business Income Tax (BIT) records and reflects expenditure claimed under Australia's R&D tax provisions. From income years commencing in the 2011 financial year, claims are made under the Research and Development Tax Incentive (RDTI); earlier years reflect the predecessor R&D Tax Concession, which applied a different definition and claim structure, so the measure is on a consistent RDTI footing from around the 2012–13 financial year. The measure therefore captures R&D only where the activity meets the legislated definition and the firm registers and claims it.

Overseas royalty expenditure
Overseas royalty expenditure is sourced from BIT records and corresponds to royalty expenses paid to non-residents, reported at a dedicated label of the company tax return;

it serves as an input proxy for access to knowledge developed abroad. The tax-law definition of a royalty broadly covers payments for the use of copyright, patents, designs, trademarks and similar property, know-how, and industrial, commercial or scientific equipment, and the final withholding tax on these payments, with no deduction allowed until it is remitted.

Wages
Wages are sourced from the Business Activity Statement (BAS). Wages serve as a denominator in the normalisation of the component indicators.

Excluded measures
The following candidate measures were considered but excluded from the final index:

- **Intangible depreciation expenditure (BIT):** Excluded due to a structural break in the treatment of these expenses from 2016–17.
- **Imputed measures of new goods and services, and of new processes (Business Characteristics Survey, BCS):** Excluded on the basis of selection criteria. Both measures are nonetheless examined in the sensitivity analysis.
- **Startup firms:** An indicator of the number of firms under 5 years of age, excluded on the basis of selection criteria. This measure is likewise examined in the sensitivity analysis.

Data Preparation

Deflation and winsorisation
Monetary variables are deflated using a 4-digit ANZSIC (Australian and New Zealand Standard Industrial Classification) industry price deflator, constructed from the ABS Producer Price Index (PPI).

Following deflation, firm-level financial variables are winsorised at the top end at the 99.5th percentile. Winsorisation thresholds are determined from the pooled dataset.

Backfilling of industry codes
Missing or unknown 4-digit ANZSIC industry codes are backfilled for firms wherever feasible.

Geographic assignment of firm financial data
Firm financial data are reported at the ABN level and are not provided by location. To assign activity to Statistical Area Level 2 (SA2) regions (ASGS Edition 3), a longitudinal locations module is used to identify the location(s) of each ABN across Australia. Where a firm operates across multiple locations, financial and innovation measures are assumed to be split equally across those locations. The practical impact of this assumption is limited, most ABNs operate at a single location.

Imputation of locations
Missing locations are imputed where feasible:

- Where a firm is observed operating at an SA2 location, and observations of that location lapse for a gap of no more than five years before the location is observed again, the location is assumed to have remained operational across the gap, and the intervening years are in-filled accordingly.
- Where the number of locations is stable across the first two years and/or the last two years in which the firm's location is observed, any earlier or later years with firm financial data are assumed to occur at those first- or last-observed locations.

Imputation of occupations
For the purposes of imputation, workers are classified into four broad occupation categories: High-Skilled, Professional, Manager and Labourer.

Missing employee occupations are imputed in two stages:

- Internal gaps of no more than three years are imputed, provided the surrounding observations share the same major occupation category and employer.
- For any remaining gaps, the imputed occupation is the modal observed occupation. Where multiple modes exist, ties are resolved using the priority order High-Skilled > Professional > Manager > Labourer.

Intensity measure
Each component in the PCA is expressed as an intensity measure. For a given variable, the intensity is:

$$\textit{intensity} = \operatorname{asinh}(\textit{variable} \,/\, \textit{wages} \,/\, \delta)$$

where δ is a variable-specific median computed in the 2016-17 base year, excluding zeros. Variable totals are formed at the relevant unit of analysis before transformation. The principal component loadings are derived from cells at the SA3 × ANZSIC Division × Financial Year level. Cells with zero wages are excluded from the analysis. The inverse hyperbolic sine (asinh) transformation is used so that zero and small values are retained while heavy right-tails are compressed.

Expressing the components as intensities (ie. scaling each variable by wages) is a deliberate choice intended to prevent the index from simply reproducing the agglomeration effects of density.

An index built on levels would tend to rank locations chiefly by the sheer concentration of economic activity. Under the intensity measure, central business districts (CBDs) will still register strongly, both because they are areas of genuinely high productivity and because firm financials are recorded against the location of a firm's headquarters and therefore concentrate in these districts. Scaling to intensities nonetheless allows the index to identify highly productive areas beyond the CBD and inner suburbs.

Standardisation
Following the intensity transformation, each measure is standardised to have a mean of zero and a standard deviation of one. The mean and standard deviation for cells at the SA3 × ANZSIC Division × Financial Year level are pooled across all years of the series, rather than computed year by year, so that standardised scores are comparable over time.

When the loadings from the principal component model are subsequently applied to the SA2 × ANZSIC Division × Financial Year observations, the SA2-level intensities are standardised using these same SA3-level parameters, rather than parameters recomputed within the SA2 sample. This enables the SA2 data to be placed on the same scale as the data used to estimate the loadings.

Multivariate Analysis and Variable Selection

Rationale for principal component analysis
The index is constructed using principal component analysis (PCA). Several properties of PCA make the tool well suited to this task. The candidate measures are correlated, areas and firms that are strong on one dimension of innovation tend to be strong on others. PCA summarises this shared variation in a small number of components, avoiding the double-counting that would otherwise result from adding correlated indicators directly.

The method also derives the contribution of each measure endogenously from the observed covariance structure of the data, rather than relying on weights imposed in advance. Therefore, the weighting reflects the patterns of common variation actually present in the data. This approach is consistent with the OECD handbook, which identifies PCA and factor analysis among the established methods for weighting and aggregating composite indicators, and with the ABS's own use of the technique in constructing SEIFA.

The principal component model

Let X denote the $n \times p$ matrix of standardised intensity measures, where the n rows are the pooled observations at the SA3 × ANZSIC Division × Financial Year level and the p columns are the component indicators retained after variable selection discussed below. Because each column has been standardised to mean zero and unit variance, the PCA is performed on the correlation matrix of the indicators,

$$R = \frac{1}{n-1} X^T X ,$$

which is equivalent to a covariance-matrix PCA on the standardised data. This choice ensures that no indicator dominates the analysis merely by virtue of its scale.

PCA proceeds by the eigendecomposition

$$R = V \Lambda V^T ,$$

where $\Lambda = diag(\lambda_1, \dots \lambda_p)$ contains the eigenvalues ordered $\lambda_1 \geq \lambda_2 \geq \dots \geq \lambda\_p \geq 0$ and the columns of $V = (v_1 \dots v_p)$ are the corresponding orthonormal eigenvectors. The k-th principal component is the linear combination $z_k = X v_k$; its elements are the component scores, and the elements of v_k are the *loadings* of each indicator on that component. Equivalently, the first eigenvector solves

$$v_1 = argmax\{w^T Rw : \|w\| = 1\} ,$$

so the first principal component is the unit-norm linear combination of the standardised indicators with maximum variance (ie. the axis along which the observations vary most). The variance of the k-th component equals λ_k, and the proportion of total variance it explains is $\lambda_k / \Sigma_j \lambda_j$.

The index is defined as the score on the first principal component. Because the component indicators are positively intercorrelated, the first component loads with a common sign across the indicators and admits a natural interpretation as a general dimension of innovation intensity. The sign of the eigenvector (which is arbitrary in the decomposition) is oriented so that higher scores correspond to greater innovation intensity.

Two features of the implementation bear emphasis. First, the eigendecomposition is estimated once, on the pooled SA3 × ANZSIC Division × Financial Year observations, rather than separately by year; pooling across years places all periods in a common loading space, which is what permits consistent comparison over time against the 2014–15 baseline. Second, the estimated loadings are then applied out of sample to the SA2 × ANZSIC Division × Financial Year observations, after standardising the SA2 intensities with the SA3-level parameters, so that the SA2 scores are expressed on the same scale as the estimation sample.

The estimated eigenvalues, the proportion of variance explained by the first component, the loadings on the retained indicators, and the correlation matrix of the component indicators are available from the authors.

Estimated on the pooled sample of 112,472 SA3 × ANZSIC Division × Financial Year observations spanning 2006–07 to 2023–24, the first principal component has an eigenvalue of 2.97 and accounts for 37.1 per cent of the total variance of the eight component indicators; the second eigenvalue is 1.01 and no other exceeds one, so the first component explains close to three times the variance of any other. All eight indicators load positively on the first component, consistent with its interpretation as a general dimension of innovation intensity. The complex GVC trade measures carry the largest normalised loadings (imports 0.79, exports 0.76), followed by trade marks (0.63), patents (0.62), R&D expenditure (0.58), overseas royalty expenditure (0.51), high-skilled employment (0.48) and design rights (0.42). The Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy is 0.79 overall, with indicator-level values between 0.73 and 0.89, indicating that the correlation structure of the data is well suited to principal component analysis.

Variable selection

Variable selection follows the ABS convention applied in the construction of the Socio-Economic Indexes for Areas (SEIFA), in which the screening for highly correlated variables is performed on the same correlation matrix on which the principal components are subsequently estimated. Accordingly, the pairwise correlation screen here is applied to the transformed, standardised intensity measures, not to the underlying raw intensities.[12]

Consistent with SEIFA practice, the screen is applied with judgement. Where a pair of variables exhibits a correlation above 0.8 in absolute value and the two measure conceptually similar aspects of innovation, one member of the pair is removed, with discretion applied depending on the variables in question and the size of the correlation. Following the initial estimation, variables whose normalised loadings fall below 0.3 in absolute value are excluded as weak contributors to the component, removed one at a time starting with the lowest-loading variable, with the analysis re-estimated after each removal. The component weights themselves are derived through PCA.

Weighting, Aggregation and Units of Analysis

PCA loadings are estimated on pooled observations at the SA3 × ANZSIC Division × Financial Year level.

These loadings are then applied to observations at the SA2 × ANZSIC Division × Financial Year level; prior to application, the SA2 intensities are standardised using the SA3-level mean and standard deviation described above.

Before aggregation, the first-component score at the SA2 × ANZSIC Division × Financial Year level is transformed into the published index as:

$$InnovIndex = \left(\frac{pca - \mu_{base}}{\sigma_{base}} + 1 \right) \times 100,$$

where μ_{base} and σ_{base} are the weighted mean and weighted standard deviation of the component score across SA2 × ANZSIC Division units in the 2016-17 base year, computed over units with more than 20 active firms, with *ln(Turnover)* as the weight.

The rebased index is then aggregated to coarser units of analysis as a weighted average, using *ln(Turnover)* as the aggregation weight. The logarithmic weighting recognises the economic size of each cell while damping the dominance that the very largest cells would exert under proportional (turnover-share) weights; cells with zero turnover are assigned a weight of zero. The units of analysis produced are:

- SA3 × Financial Year, both with and without an ANZSIC Division split
- SA4 × Financial Year, both with and without an ANZSIC Division split
- State × Financial Year, both with and without an ANZSIC Division split
- National × Financial Year, both with and without an ANZSIC Division split

Cell Suppression

To preserve confidentiality, an output cell is suppressed if **any** of the following criteria are met. These rules apply to all units of analysis.

- **Minimum active firms.** The cell contains fewer than 20 active firms, where a firm is treated as active if at least one of the following measures is non-missing: total

12 This distinction is important as the asinh transformation is nonlinear.

- income (BIT); sales (BIT); turnover (BAS); merchandise trade; patent or trade mark applications filed. We further remove cells that contain fewer than 10 firms with non-zero turnover reported within BAS.
- **Dominance.** Under the ABS dominance rules, the cell is dominated by one or two large contributors. Specifically, the largest single firm contributes more than 50 per cent of the cell's total turnover, or the two largest firms together contribute more than 66.66 per cent of it.

Chain Linking at the 2016-17 Series Break

To account for a discontinuity in the underlying methodology used to build the longitudinal location module between the 2015-16 and the 2016-17 financial year with the establishment of the Common Frame (ABS Address Register Users' Guide; Smedes et al. 2025), we chain-link both periods of our index at the break, the conventional treatment for series breaks in official statistics.

To chain link the index, each series is split at 2016–17, and movements within the pre-break segment (2006–07 to 2015–16) and the post-break segment (2016–17 to 2023–24) are preserved exactly as estimated. The two segments are joined by replacing the change in the index between 2015–16 and 2016–17. This approach is further applied to South Australia in 2022-23 due to a substantial change in location data that appears to be driven by a further revision in the collection of locations data.

Two consequences follow. First, the published movement of the index between 2015–16 and 2016–17 is an imputed trend value rather than an estimate of the change in innovation activity in that year.

Measurement Challenges

Population coverage and undercounting
Innovation activity undertaken by individuals, partnerships and trusts, and by firms that rely on secrecy as their principal form of intellectual property protection, may be undercounted. In addition, the Private Non-Profit, Government and Higher Education R&D modules are not currently included, as properly imputing the sample across the population would require more time than the current release allowed.

Plant Breeders Rights
Plant Breeders Rights are a form of registrable intellectual property of particular relevance to plant-breeding and agricultural innovation. They are not captured in the index because the relevant data are no longer available in the ABS DataLab. Innovation that is protected primarily through Plant Breeders Rights, concentrated in parts of the agriculture sector, may therefore be undercounted.

Startup activity and early-stage investment (Dealroom)
The Department of Industry, Science and Resources' Dealroom dataset provides descriptive information on startup firms, their founders, and the funding they have received. The present components currently capture these elements indirectly, and a startup or early-stage investment measure could complement the index accordingly.

Patent novelty
Swinburne University of Technology and IP Australia have partnered to integrate measures of patent novelty into BLADE. These measures apply natural language processing to the title, abstract and claims of each patent to assess its novelty against US patents within the same International Patent Classification (IPC) classes filed in the 5 years preceding the patent's application in Australia. A novelty measure of this kind would enrich the index's patent component, moving it beyond counts of protected output towards the quality and originality of that output.

Research workforce (PhD enrolments and completions)
The supply of doctoral-qualified researchers is an important dimension of the innovation workforce, and one identified as a constraint on Australia's research, development and innovation performance. PhD enrolment and completion data are available within PLIDA and could, in principle, extend the high-skilled employment component towards a fuller measure of the research workforce. They are not incorporated in the present index because these data currently extend only to the 2020–21 financial year.

Table A8: Abbreviations

Abbreviation	Meaning
ABN	Australian Business Number
ABS	Australian Bureau of Statistics
AI	Artificial Intelligence
ANZSCO	Australian and New Zealand Standard Classification of Occupations
ASCO	Australian Standard Classification of Occupations
ATO	Australian Taxation Office
BAS	Business Activity Statement
BCS	Business Characteristics Survey
BIT	Business Income Tax
BLADE	Business Longitudinal Analysis Data Environment
DISR	Department of Industry, Science and Resources
GVC	Global Value Chain
IPC	International Patent Classification
IPLORD	Intellectual Property Longitudinal Research Data
OECD	Organisation for Economic Co-operation and Development
PCA	Principal Component Analysis
PLIDA	Person Level Integrated Datas Asset
PPI	Producer Price Index
R&D	Research and development
RD&I	Research, development and innovation
SA2 / SA3 / SA4	Statistical Area Levels 2, 3 and 4
SEIFA	Socio-Economic Indexes for Areas
SITC	Standard International Trade Classification

Table A9: Eigenvalues and proportion of variance explained

Component	Eigenvalue	Proportion of variance (%)	Cumulative (%)
1	2.97	37.1	37.1
2	1.01	12.6	49.7
3	0.86	10.7	60.4
4	0.82	10.3	70.7
5	0.75	9.4	80.1
6	0.67	8.3	88.4
7	0.62	7.7	96.1
8	0.31	3.9	100.0

Table A10: First principal component — eigenvector weights, normalised loadings and Kaiser–Meyer–Olkin sampling adequacy

Indicator	Eigenvector weight	Normalised loading	KMO
Complex GVC imports	0.456	0.786	0.726
Complex GVC exports	0.440	0.759	0.737
Trade marks (in force)	0.366	0.631	0.848
Patents (in force)	0.359	0.618	0.868
R&D expenditure	0.334	0.576	0.819
Overseas royalty expenditure	0.294	0.507	0.891
High-skilled employment	0.277	0.478	0.825
Design rights (in force)	0.246	0.424	0.852
Overall KMO		**0.794**	

Table A11: Correlation matrix of the component indicators

Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) High-skilled employment 1.00	0.456							
(2) Complex GVC imports	0.31	1.00						
(3) Complex GVC exports	0.25	0.68	1.00					
(4) Trade marks	0.17	0.40	0.33	1.00				
(5) Patents	0.21	0.35	0.36	0.32	1.00			
(6) R&D expenditure	0.29	0.28	0.29	0.33	0.27	1.00		
(7) Overseas royalty exp.	0.16	0.30	0.27	0.24	0.20	0.27	1.00	
(8) Design rights	0.06	0.24	0.24	0.21	0.27	0.13	0.13	1.00

Table A12: Sensitivity analysis — pairwise correlations of index predictions across specifications

Specification	Base	Full Specification	Start-up Firms	Wages	No Scaling Factor
Base	1.00				
Full Specification	0.99	1.00			
Start-up Firms	0.69	0.79	1.00		
Wages	1.00	0.99	0.69	1.00	
No Scaling Factor	0.88	0.88	0.67	0.88	1.00