Australian Government
Department of Industry, Science and Resources

Office of the Chief Economist

Emerging industries in Australia

Preliminary insights from microdata

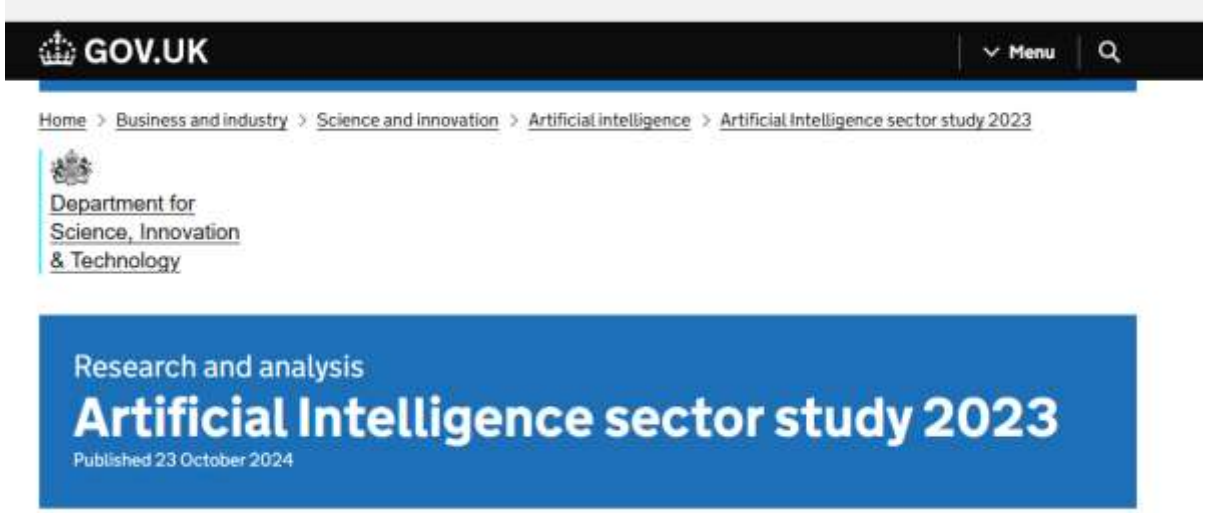
Presented by Tris Sainsbury | Australian Conference of Economists | July 2025

Analysis by Isabelle Greco, David Hansell, Minh Nguyen, Tris Sainsbury, Jo Small, Geoff Wells

The emerging industries database can provide interesting insight into the Australian economy

- There are 7 critical technologies in the national interest, including AI technologies, quantum technologies, clean technologies, and space.
- A common question: How big is fast-growing emerging industry X and what's driving its growth?
  - Regular demand for "state of" reporting across each emerging industry.
- ANZSIC codes don't map very well to emerging industries
  - Modernisation efforts around codes not expected until 2030s.
- Want to bring the power of administrative microdata to analysis.
  - Well suited to estimates of industry extent, contribution to productivity and firm performance.

Enter an UK AI firm examining the UK AI sector

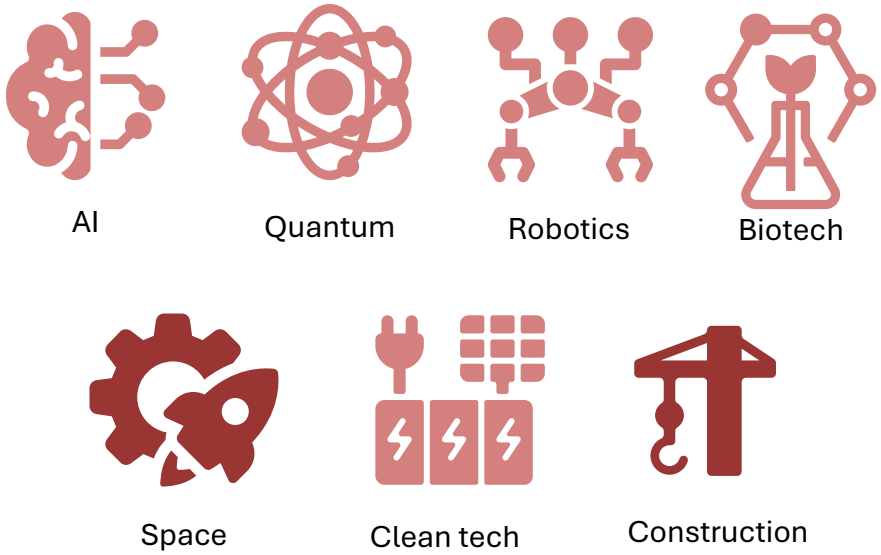


Glass.AI

- The UK Department for Science, Innovation and Technology has published a state of AI report for past three years
- They commissioned Glass.AI which uses a proprietary artificial intelligence application to measure “impossible sectors”:
  - Looked at virtual and augmented reality adoption rates
  - Compared scale-ups in the UK, US and Germany
  - Compared the AI sector in the US, UK and China,
  - Measured the UK’s nuclear supply chain
  - Compared AI capabilities across countries for the OECD
- Can we apply their method to emerging industries in Australia? And combine with admin data?

What are the emerging industries?

1. Artificial Intelligence
2. Quantum technologies
3. Robotics
4. Biotechnologies
5. Space
6. Clean energy generation and storage
7. Pre-fabrication (modularisation) in construction



Pink icons represent Critical Technologies in the National Interest

Defining an emerging industry

Sample taxonomy for artificial intelligence

Specialisation (5)	Related themes (31)	Keywords (~300)
AI infrastructure	• Cloud Services • Edge AI • Hardware • …	• Action recognition • Adaptive boosting • Agent-based modelling • Ambient intelligence • Cloud infrastructure • Construction robot • Neutral network • Chatbot • …
AI development tools	• Smart energy/grid management • Consulting • Business transformation • …	
AI Technology	• Machine learning • Natural language processing • Speech and Audio Processing • …	

Artificial intelligence: an industry (not a personal laptop).

Glass.AI suggested **taxonomies for each industry,** developed through their exercises in other contexts (US, UK, Germany, Canada, OECD, etc)

For AI, terms included a wide range of applications including cloud computing and infrastructure, chatbots, and neural networks.

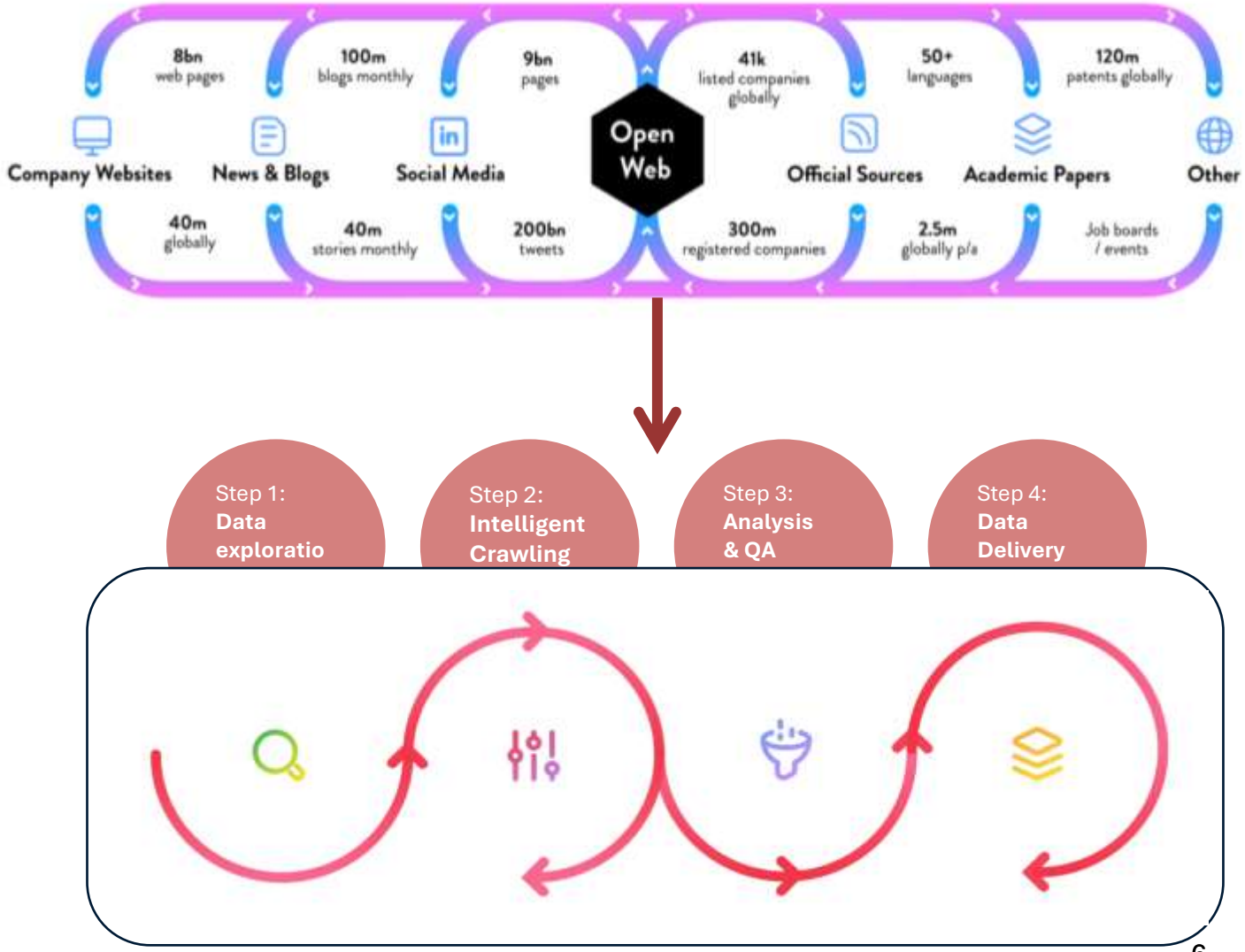
DISR's policy and analysis areas reviewed keyword list for suitability in the Australian context.

DISR also suggested some examples of firms in each industry to train the algorithm.

Looking for multiple sources of evidence rather than passing references.

Glass.AI then searched across the web

- Web reading to find firms with an online presence (that aligns with the taxonomies).
- Draws on a broad range of open sources of data incl. websites, news, social media, reports, academic papers
- Also assigns firms into developers (knowledge creators), adopters (knowledge diffusers) or both.
- DISR underwent a privacy assessment process. Data collection is consistent with website terms of service and Australian laws
- DISR worked with Glass.AI to quality assure datasets
- ABS integrated final dataset into administrative micro datasets (on ABN basis with BLADE)



Going from micro to macro: a partnership of government and private sector capabilities

What are we doing

- Partner with Glass.AI to generate database
- Partner with ABS to integrate database with BLADE

Government alternatives

- ‘Manual’ exercises (e.g. by DISR on space sector)
- Arbitrary ANZSIC code attribution
- Create a new ABS satellite account (as for tourism, or creative/cultural industries)
- Other government surveys (e.g. AI Adoption Tracker)
- Reports (e.g. CSIRO AI Ecosystem Reporting)

Private sector alternatives

- Job ad (e.g. Lightcast) or entrepreneurship (e.g. Dealroom) datasets
- Consultant reports (McKinsey/Brookings etc)
- Private surveys (e.g. Macquarie University BOSS survey)

Going from micro to macro: requires us to attribute activity to emerging technologies

- Creating a flag for emerging industries means picking up some very large firms with a small presence in industries of interest
- We trial a transparent approach to simulating *technology penetration rates* based on type of business activity or innovation model.
  - A repeatable and contestable improvement on past exercises (analysts attributing a share of each tech to each organisation).
- Survey-based estimates of emerging technology uptake vary widely; generally considered to be a small fraction of businesses.
  - US Congressional Research Service estimates 5% of US businesses use AI (as at Feb 2024).
  - Other surveys are more optimistic. E.g. AI Adoption Tracker in which 40% of surveyed SMEs were adopting AI in Q4 2024.
- Two findings anchoring our approach:
  - Glass.AI estimates that 3% of (FTE) employees within Australian AI adopters have an AI role/background, based on criteria they use in UK.
  - Previous DISR estimates for space industry that attribute 1% of government activity, 5% of complex firms and 30% of specialised firms.

Share of firm activity (turnover, employment) that is related to an emerging industry	**Method 1: by type of business activity**			**Method 2: By type of innovation**		
	Firm type (identified through microdata)			Firm type (assigned by glass.ai)		
	Government	Complex business groups	Specialised firms	Adopters (knowledge diffusers)	Complex innovators (developers and adopters)	Developers
Lower estimate	0.5%	2.5%	15%	1%	2%	3%
Central estimate	1%	5%	30%	2%	4%	6%
Upper estimate	2%	10%	60%	4%	8%	12%

Small, selective sample

A relatively small number of firms, further reduced by linkage processes

Initial selection

The emerging industries database contains approximately 3,500 employing firms and a further 1,300 non-employing firms.

These employing firms are large - employ an average of just under 800 workers each.

AI is largest by count, quantum is smallest.

Technology Developers were more likely to make it into the dataset than Adopters

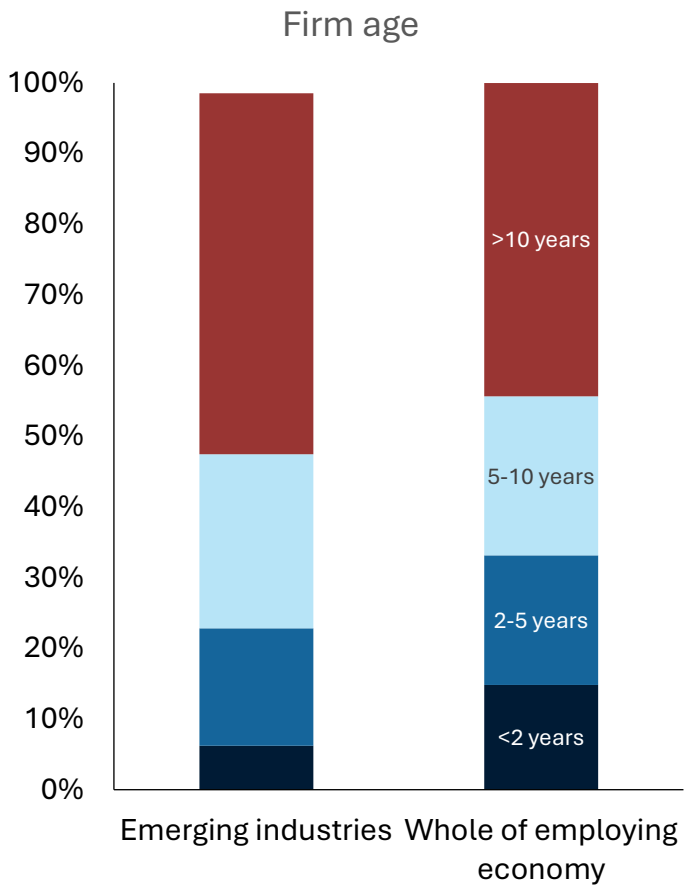
Linkage

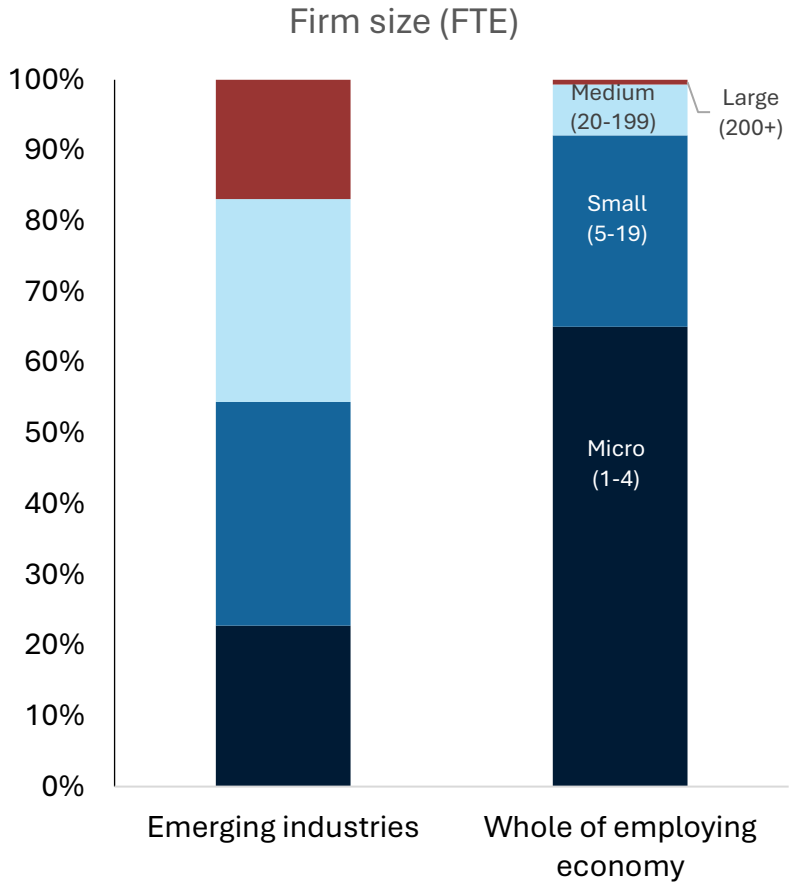
Not all of (approx. 5,500) firms Glass.AI detected could be ingested into the DataLab (3%) or linked to BLADE data (a further 13%).

Firms may not be linked because the ABNs are new and have not yet engaged with the data sources that make up BLADE.

Industry	EID firms		Employing firms	Firms without observed employment
	Base data (glass.AI)	Ingested in DataLab (rounded)	BLADE-linked (rounded)	
Artificial intelligence	1,609	1530	1,030	330
Space	789	790	580	180
Clean Technologies	1,528	1480	850	450
Robotics	574	540	220	80
Quantum	100	90	60	20
Prefabricated construction	356	350	230	120
Biotechnologies	900	860	550	160
		Total	3,470	1,310

A selected sample





Columns do not add to 100% as the age of some firms is not known.

Firms in the Emerging Industries Database are large and old

Some key stats

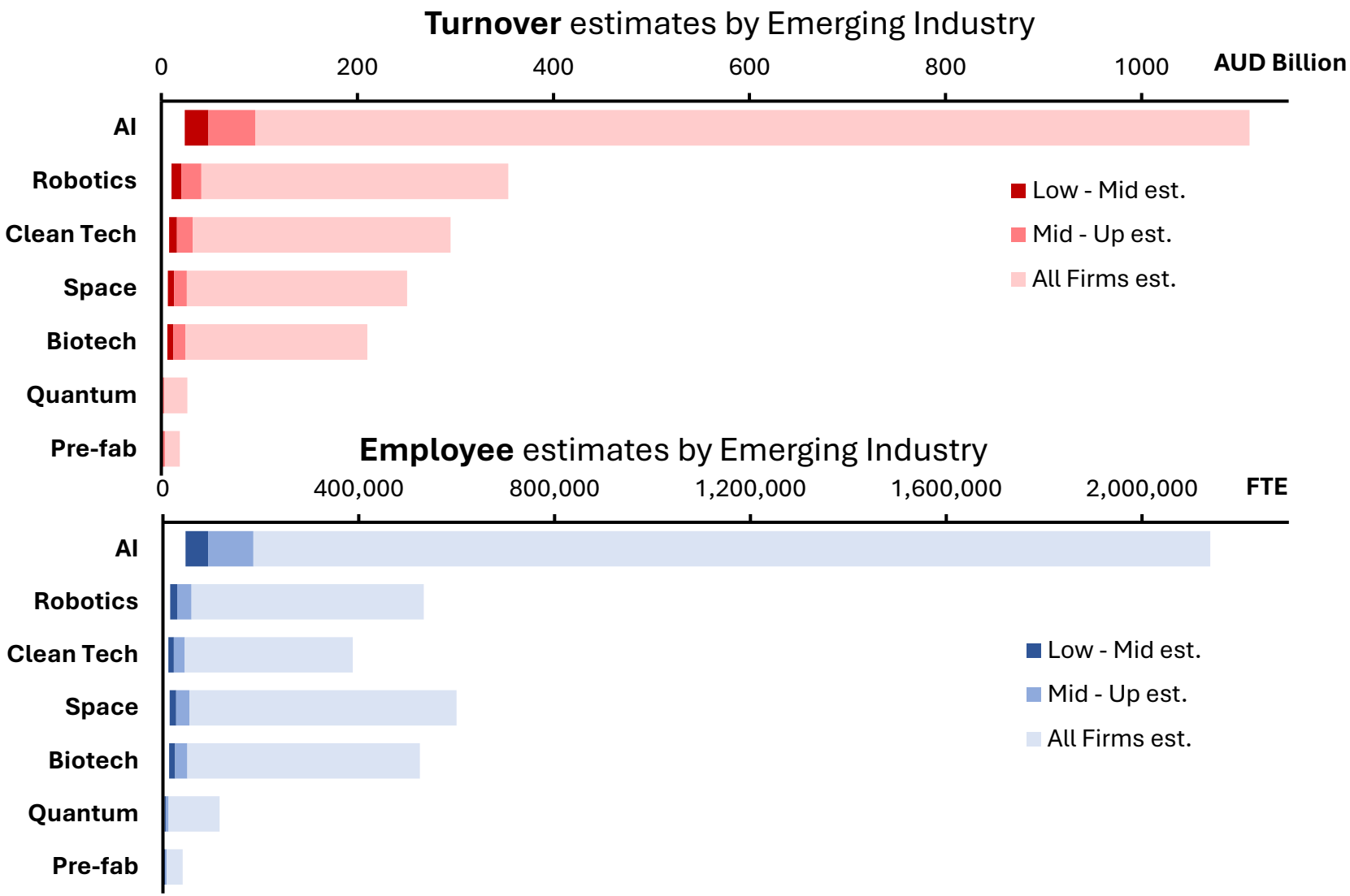
- 52% of firms aged over 10 years in emerging vs 44% for whole of economy
- 16% of large firms in emerging industries vs 1% for whole of economy.

Some reason why

- Excluded ~ 400 sole traders in collection for privacy reasons.
- Developers are more of a census but adopters are more of a sample (limits to compute for first run of it)
- Larger firms are easier to detect through their web presence.
- Certain types of firms (defence/security applications) linked with critical technologies are less likely to have a well-publicised presence.

Scope of emerging industries

A large economic contribution



Economy-wide presence

Microdata reveals that firms with a **presence** in emerging industries account for a large share of the Australian economy: 25% of turnover and 22% of the labour force.

- 2.1 million workers in 2023-24 are in firms that use some form of AI.

Emerging technology penetration

Not all EI firm activity is associated with the technology it is involved with.

- Taxonomies pick up large conglomerates (incl. banks and supermarkets)

We show a lower, middle and upper bounds of the contribution of technologies (within identified firms)

- “AI jobs” closer to 90k (range 40k –180k) in 2023-24.

No firm answer to technology penetration rates

How many jobs in emerging industry firms are actually linked to their emerging technologies?

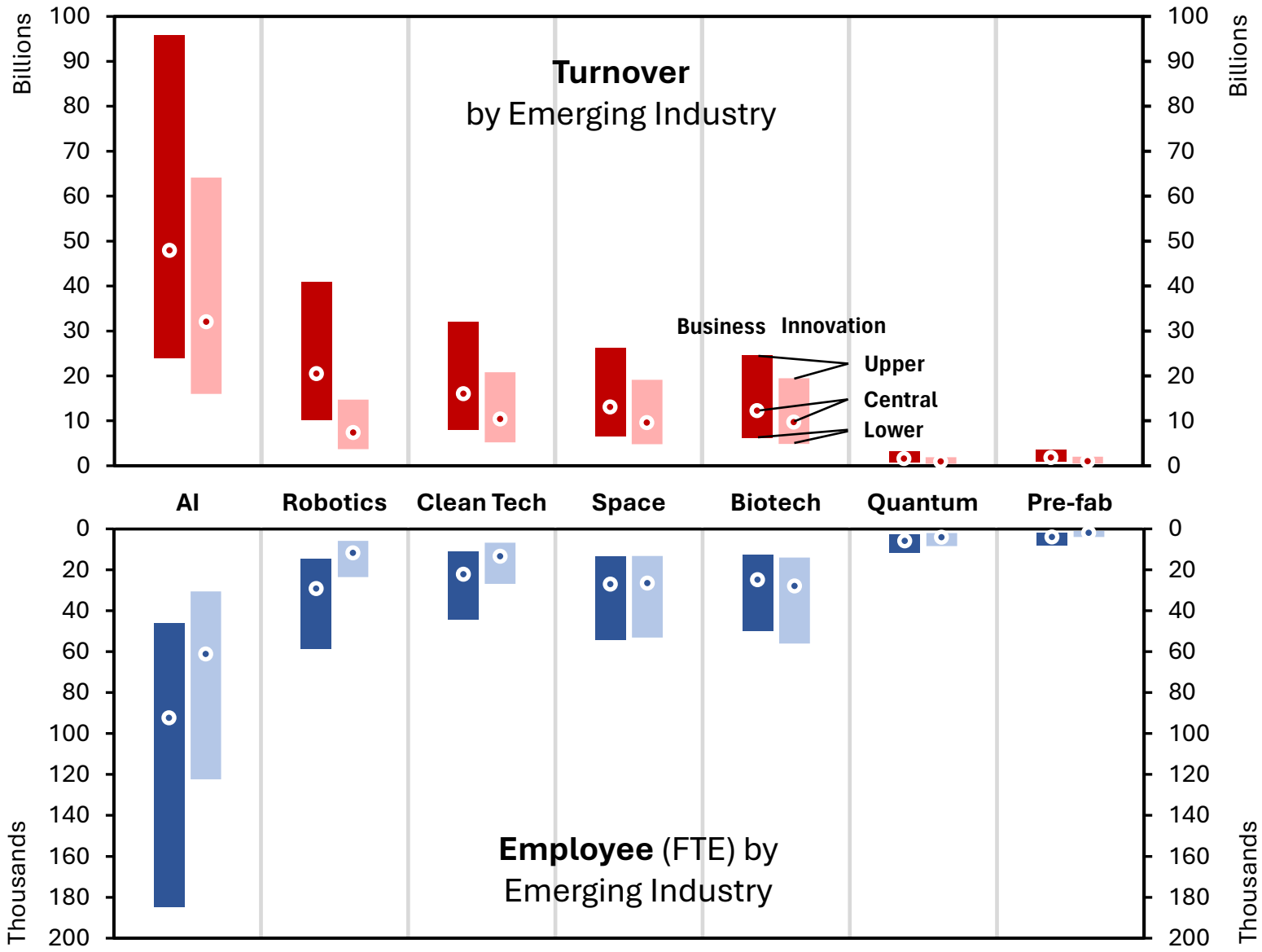
The chart presents:

- Weightings by business type (in bold colour).
- Weightings by innovation type (in pastels).

Business type assumptions: ~4% penetration rate in AI industries and ~5% penetration rates for other emerging industries.

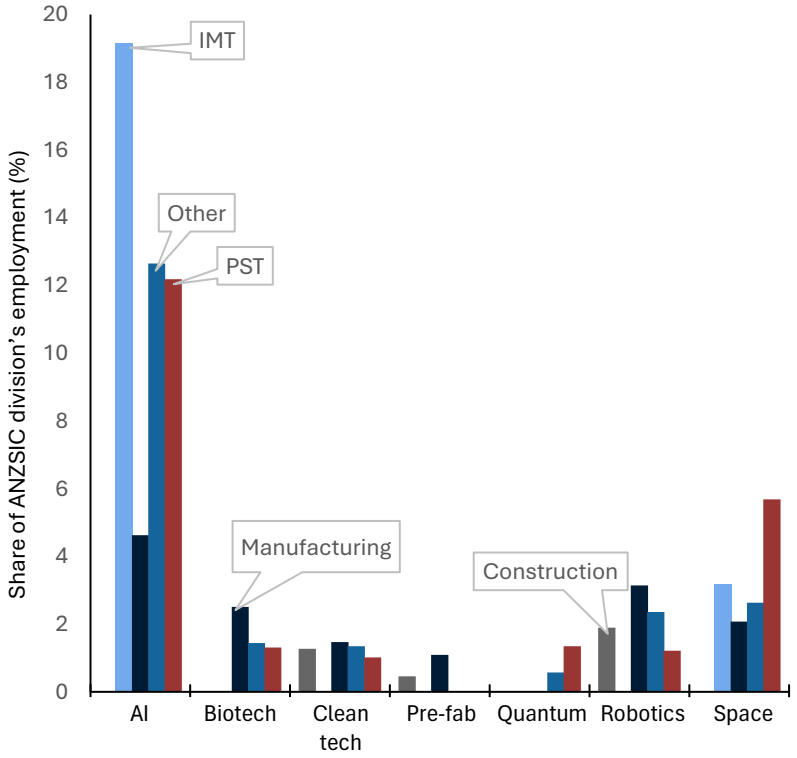
Innovation-type estimates are generally about 1/3 more conservative than business-type estimates

Turnover and jobs rates are similar for each range



A large share of traditional industries

Contribution to ANZSIC Division jobs



Firms are connecting different technologies

Links across emerging industries (min 10 firms)	
Core Industry	**Additional focus**
AI adopter	Space developer Biotech developer Clean tech developer Robotics adopter
AI developer	Robotics developer Space developer
Clean tech developer	Biotech developer
Space adopter	Robotics adopter

EI firms contribute to and across traditional industry classes

Some noteworthy presences to ANSZIC Divisions:

- Firms with some presence in AI industry employed 19% IMT and 12% PST jobs in 2023-24
- Firms with some presence in AI and robotics comprise a similar share of manufacturing employment (approx. 3% of each industry division).

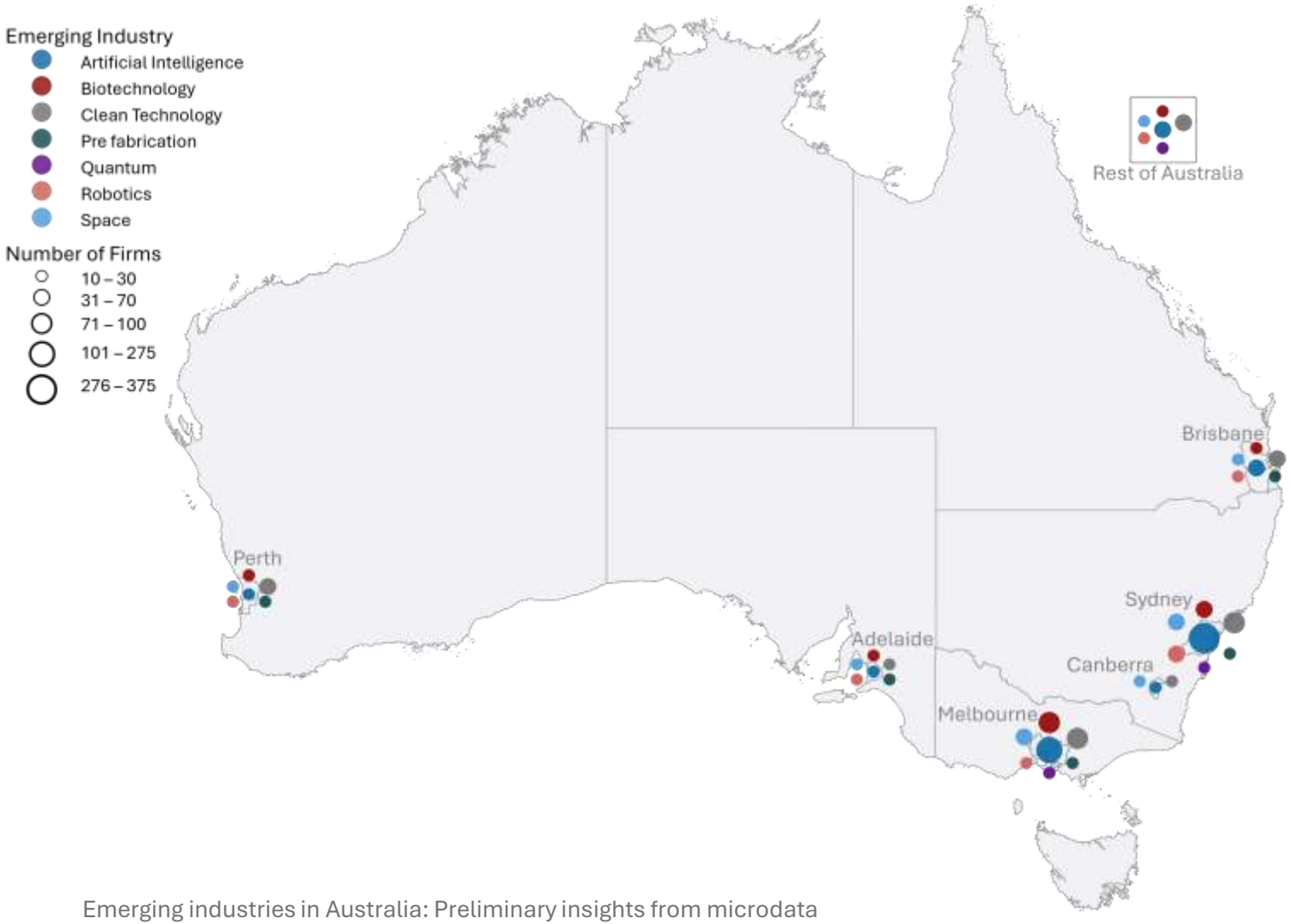
EI firms stretch across industries:

Pre-fab is a mix of manufacturing and construction sectors.

Approximately 10% of firms in emerging industries are flagged in multiple emerging industries.

- AI adopters focussing on bio/clean tech
- Space robots.

Activity is clustered around 6 capital cities



Geographically clustered

- around 6 major cities: Sydney, Melbourne, Brisbane, Perth, Adelaide and Canberra.

Rest of Australia is mostly an east coast story:

- spread across mainland east coast (regional Victoria, NSW and Queensland)

Under-representation of firms with a limited, or no, web presence

A wide range of specialisations

The modal specialisation is 'uncategorised'

Most firms in most industries weren't assigned a clear specialisation category.

- Can be hard to detect specialisation from public sources (but expect the AI to get better over repeat samples).

While defence/security specialisations are particularly likely to be absent from list, noteworthy applications include:

- Space Defence
- Drones and unmanned aerial vehicles
- Quantum cryptography and security
- Quantum sensing and metrology

Emerging industry	Top specialisations (share of firms)
Artificial intelligence (1609 firms)	Uncategorised (41%) Enterprise AI (13%) AI platforms (12%) Industry-specific (9%)
Prefabricated construction (354 firms)	Modular buildings (24%) Construction innovation (21%) Concrete modular construction (18%) Uncategorised (12%)
Quantum (100 firms)	Uncategorised (24%) Quantum cryptography and security (14%) Quantum sensing and metrology (12%) Quantum computing (10%)
Biotechnology (900 firms)	Uncategorised (18%) Biopharmaceuticals (10%) Pharmaceuticals (8%) Bioproducts (7%)
Robotics (574 firms))	Uncategorised (53%) Robotics (15%) Industrial automation (7%) Drones/unmanned aerial vehicles (6%)
Clean technology (1528 firms)	Uncategorised (29%) Solar power systems (28%) Batteries (8%) Grid-scale energy storage (7%)
Space (789 firms)	Uncategorised (57%) Space communications (8%) Remote sensing and earth observation (5%) Space Defence (5%)

Performance of emerging industries

Labour productivity is stronger than other parts of the economy

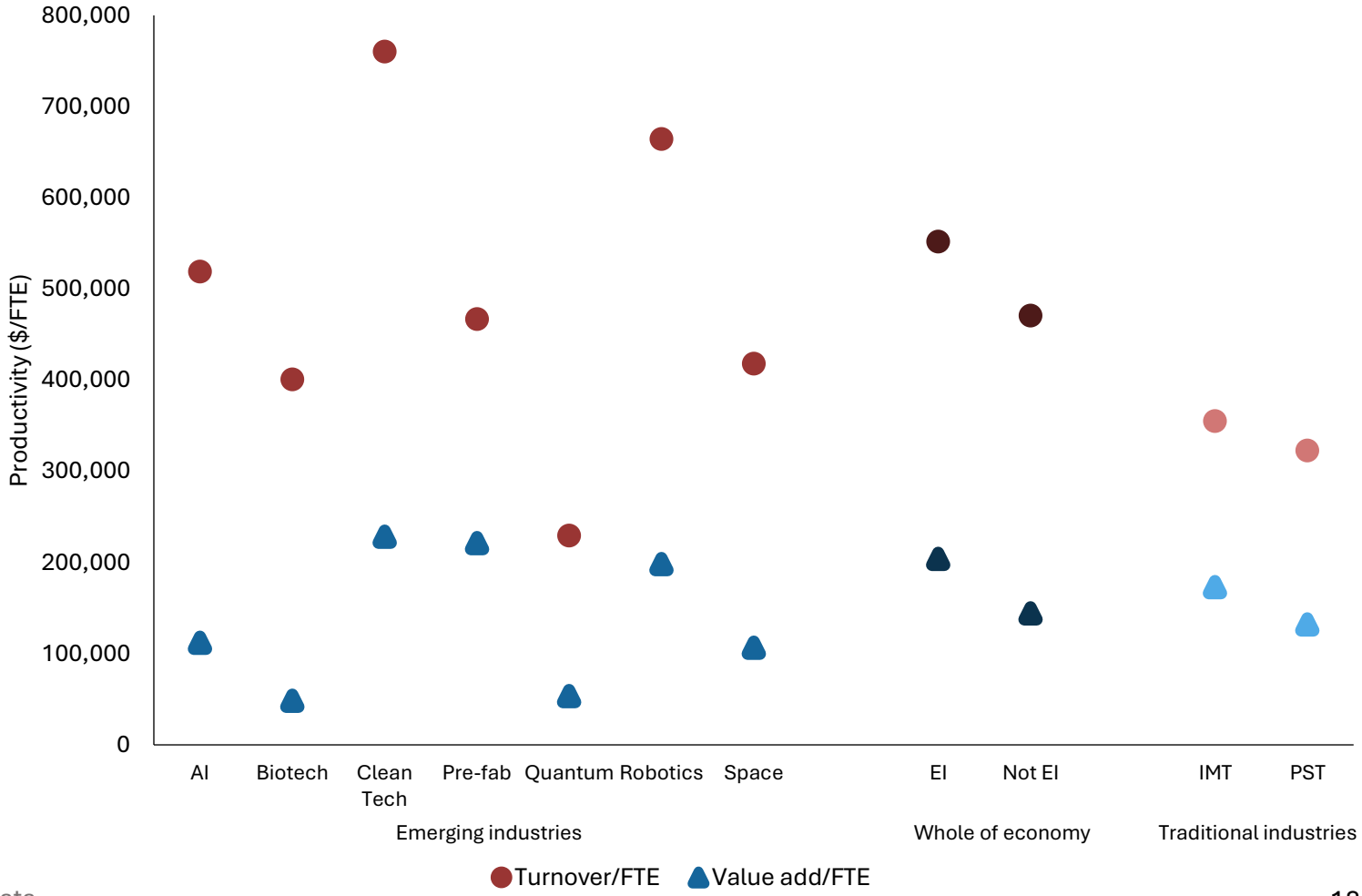
Emerging industries are 17% more productive than the rest of the economy

Within emerging industries:

- Clean Technology, Robotics and AI comparatively higher productivity
- Biotechnologies and space are below average.
- Quantum very low; likely to be explained by being earlier in industry life course.

Similar conclusions when looking at turnover and value-add measures of output.

Care warning is warranted when looking at static point-in-time estimates of productivity



Knowledge creators as a growth engine?

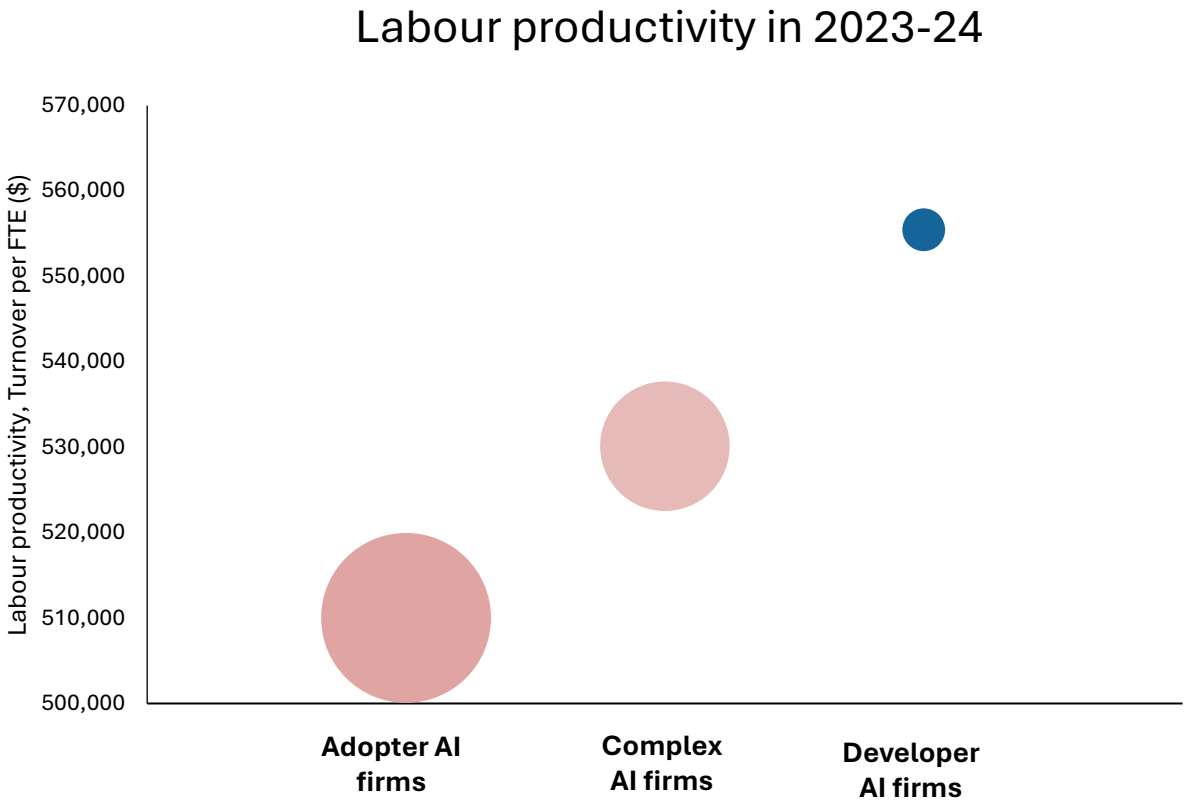
Developers are smaller and more productive than adopters

In firm counts, the emerging industries database has more AI developers (knowledge creators) than:

- AI adopters (knowledge diffusers)
- AI complex firms (both developer and adopter).

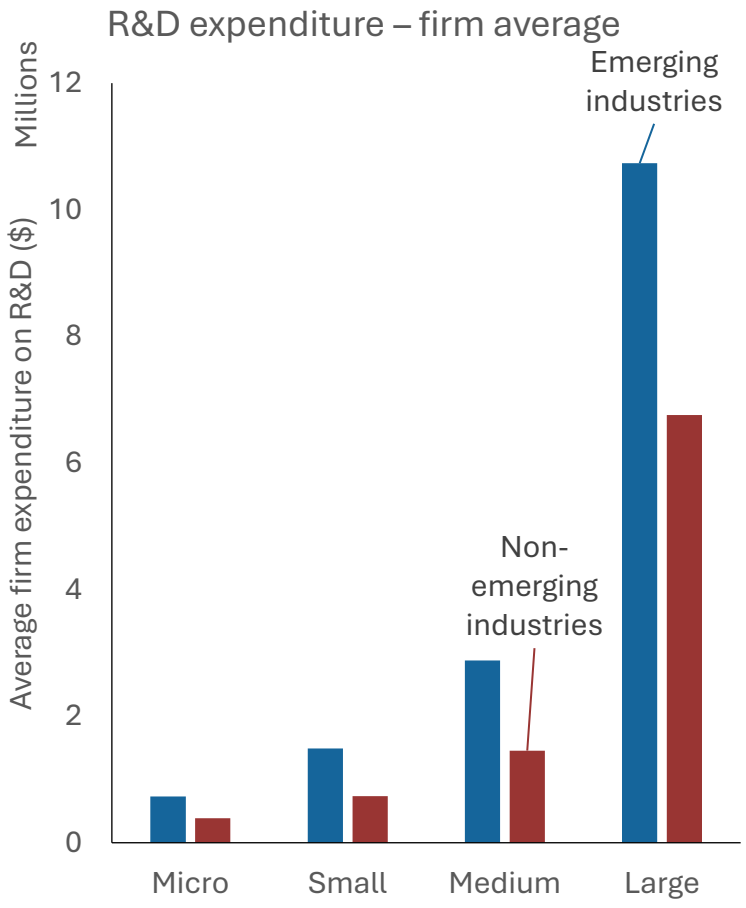
However developers are smaller and collectively employ only ~80k workers, compared to ~ 1.3m in adopters.

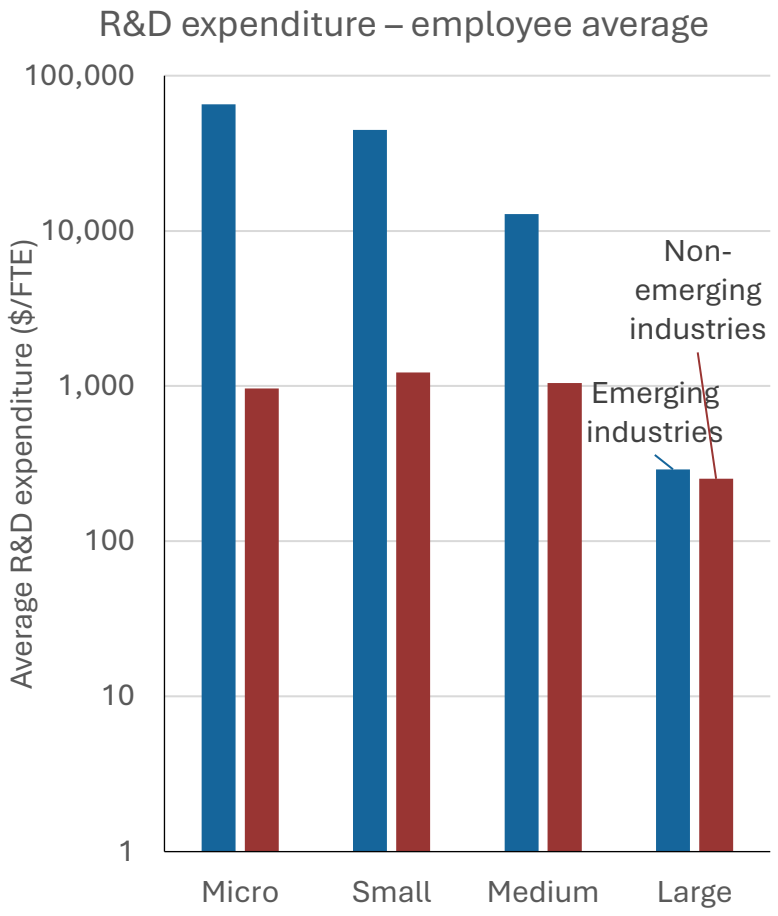
Developers have approximately 9% higher labour productivity than adopters..



Bubbles represent the number of employees (FTE) per firm

Emerging industries are R&D active





Firm sizes are calculated by FTE, with Micro (1-4), Small (5-19), Medium (20-100), Large (200+)

Emerging industry firms spend more on R&D

Emerging industry firms at all size levels spend on average more on R&D per firm.

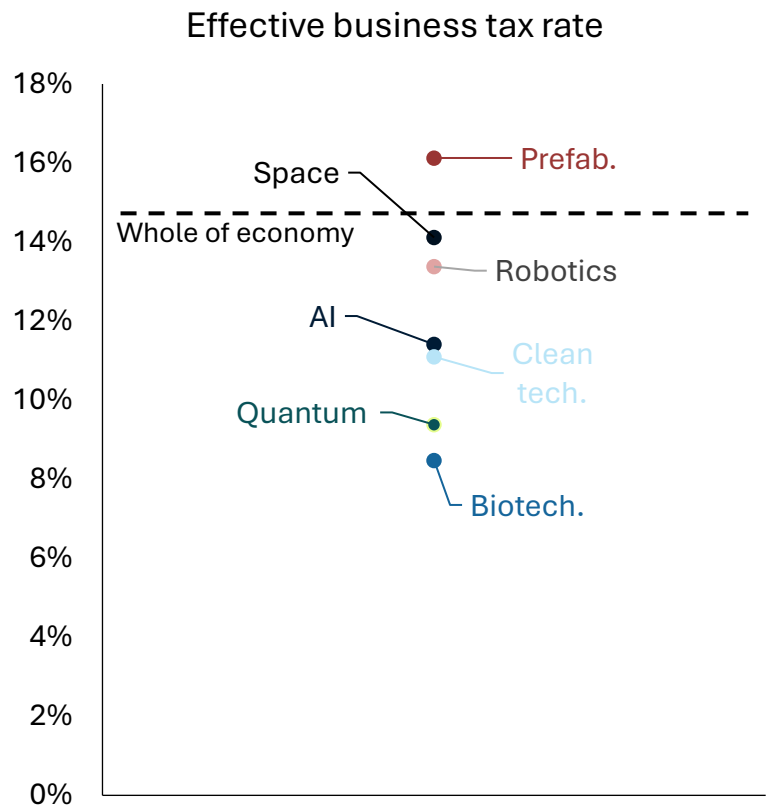
- Micro and small firms in emerging industries spent almost 100 times more on R&D *per employee* than non-emerging industries firms in 2022.
- Medium-size firms also spend about 10 times more on R&D per worker than non-emerging industries

Explained partly by sample selection (algorithm finding active participants)

Could also be explained as:

- Micro and small emerging industry firms may be R&D-intensive start ups (the firms often associated as emerging industries).
- Larger emerging industries might be adopters who have a relatively small R&D or technology area.

Emerging industries pay lower average tax rates



The Australian tax system supports emerging industries

Calculation is effective business income tax rates (tax paid divided by gross revenues).

- All 'technology intensive' emerging industries (i.e. not prefab) are below average.
- Biotech is particularly low.

Low effective tax rates could reflect:

- Tax concessions (for example as a result of higher R&D spend by firms)
- A higher share of complex business groups among emerging industries (income taxes might be paid by other parts of groups).
- Higher cost bases/low profitability
- Firm losses, and their position in the product cycle

Workforce in emerging industries

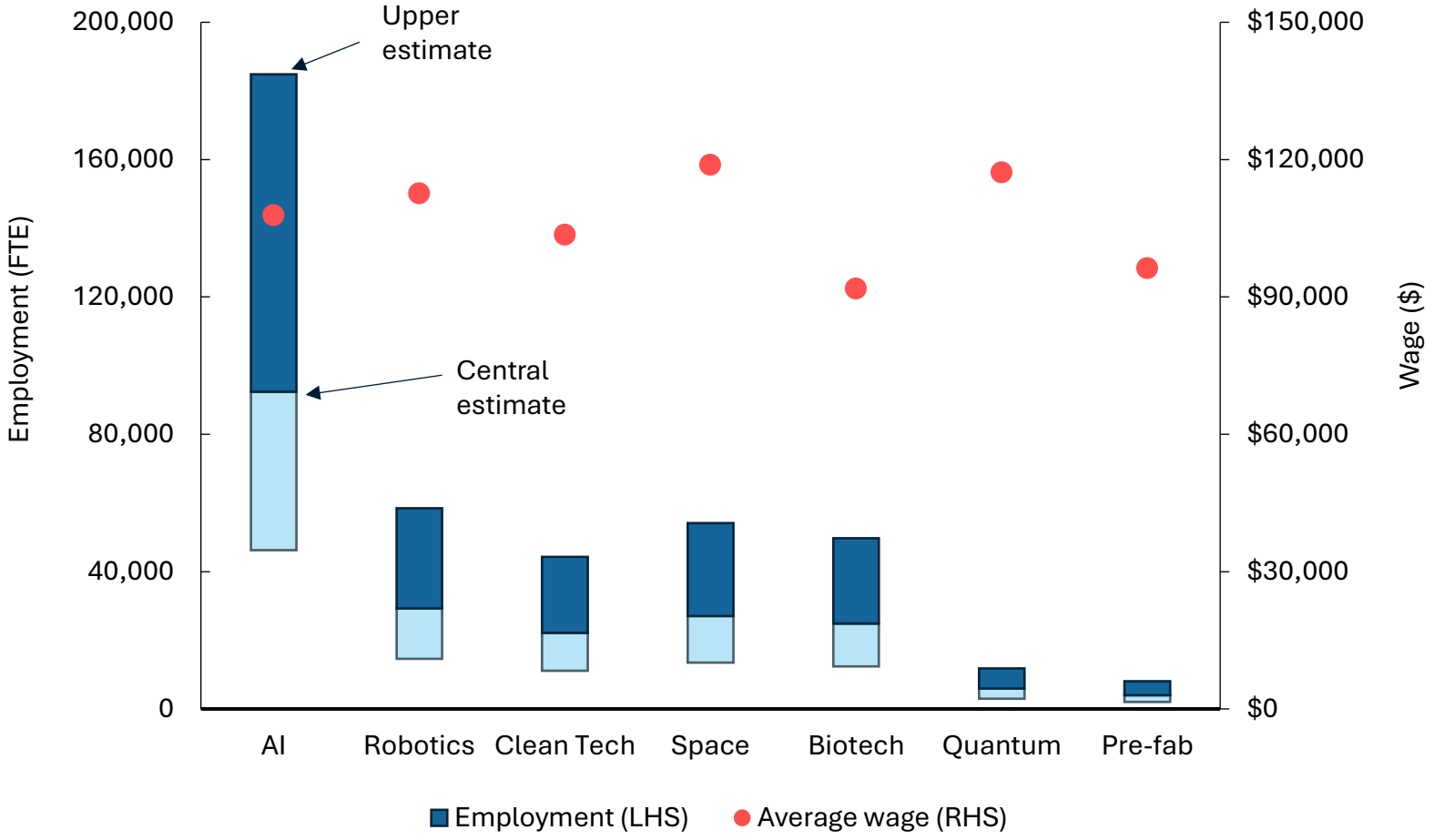
Are emerging industry jobs good?

Approx. 2.7 million jobs in emerging industries pay an average of $106k

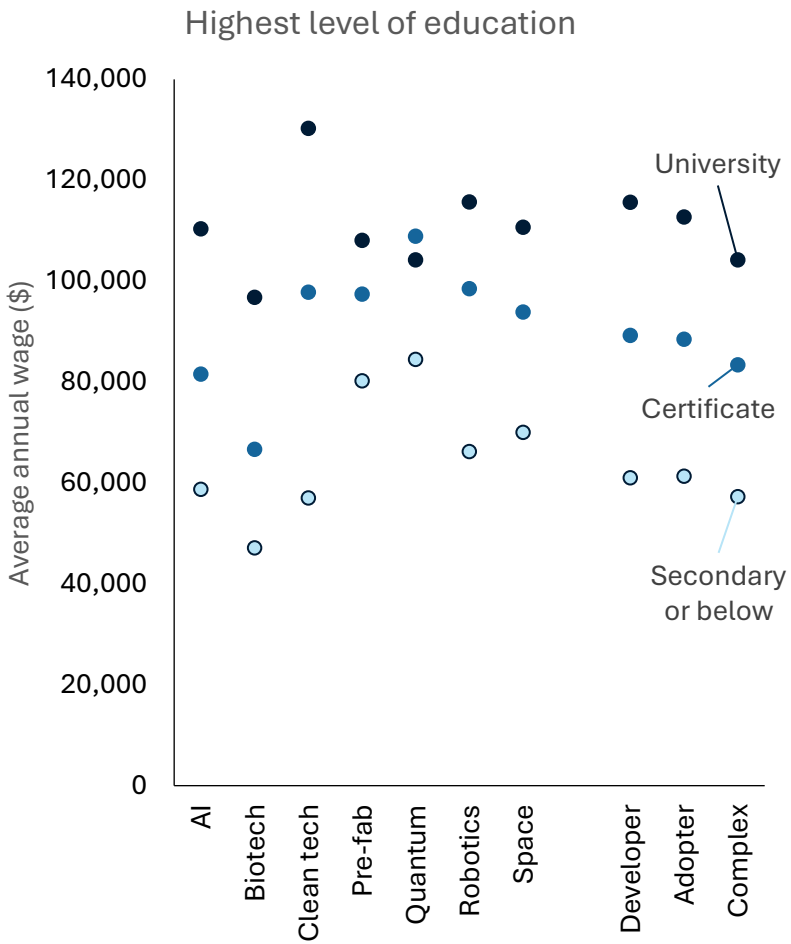
Jobs in emerging industries pay an average of $107,000 per FTE, 19% higher than non-emerging industries.

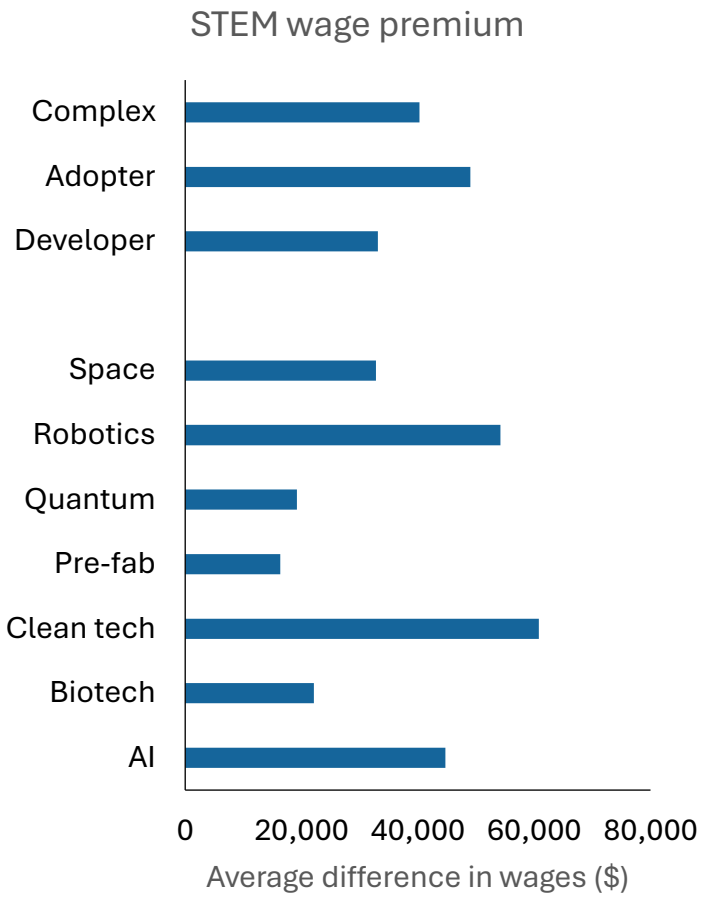
Space and quantum firms have the highest pay rates among emerging industries.

Jobs in emerging industries are high pay



A (strong) skill and STEM premium





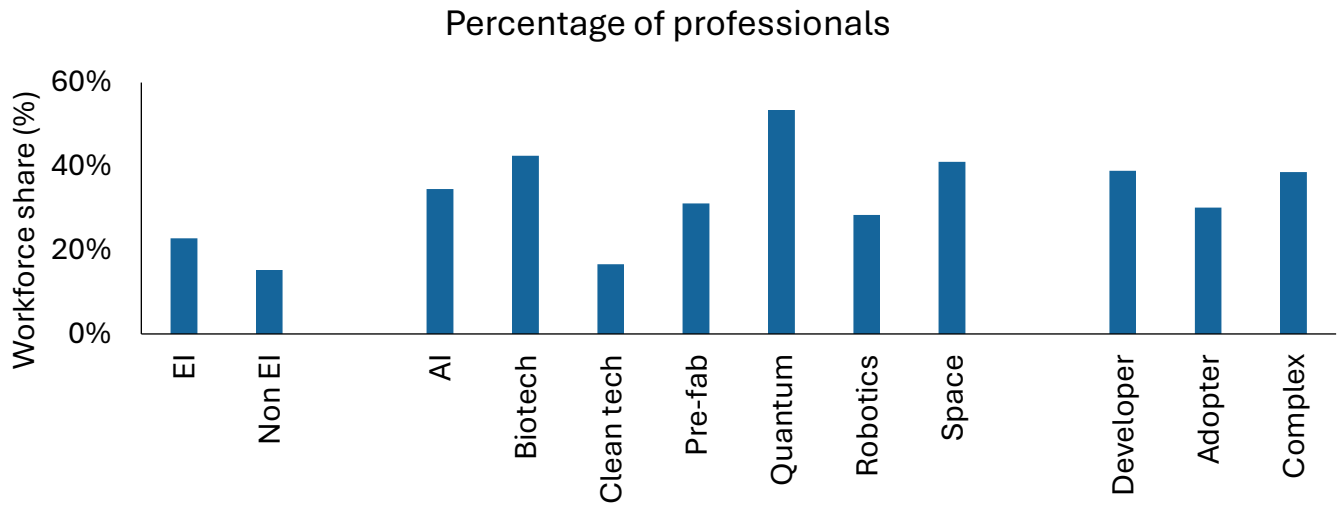
Emerging industry pay is responsive to skills

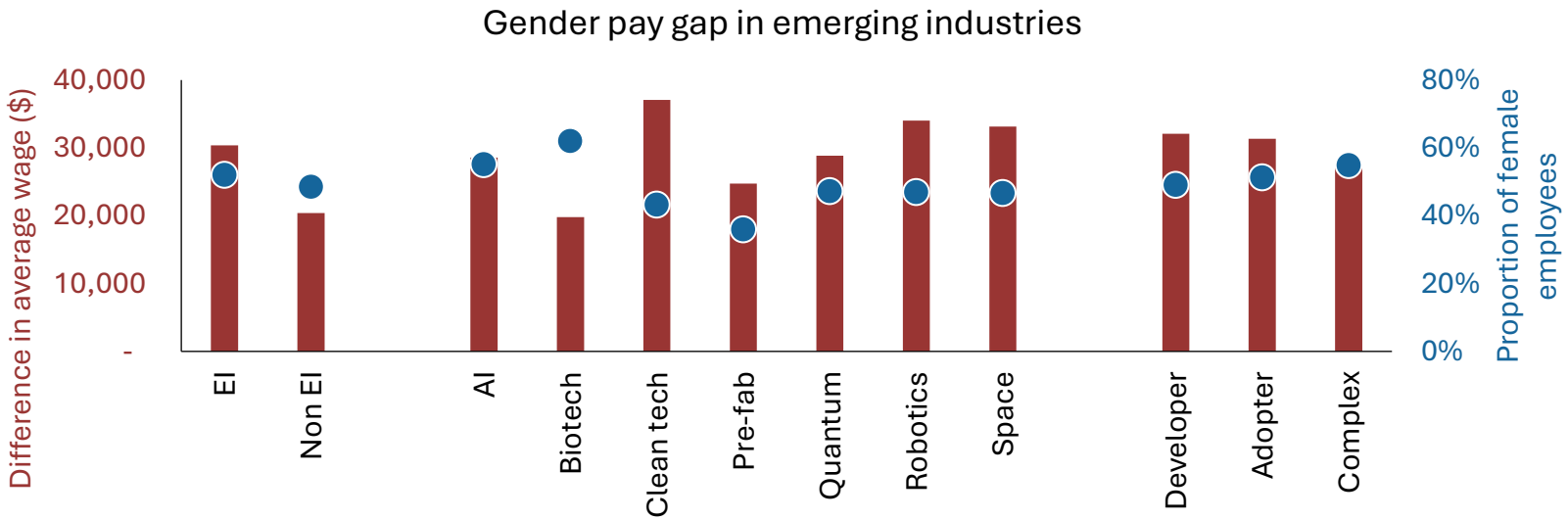
Emerging industry workers with university qualifications earn on average:

- 25% more than those with certificate level qualifications
- almost double those with high school education or below

There is a clear and strong wage premium for STEM (relative to non-STEM) qualifications as well.

More professionals – and a gender pay gap





Emerging industries employ more professionals

Top chart shows that among occupation classes

- developers are 39% professionals;
- adopters are 30% professionals.

This compares with 15% professionals in non-emerging industry firms.

Firms involved in quantum, biotech and space are more likely to employ professionals.

Gender pay gap across emerging industries

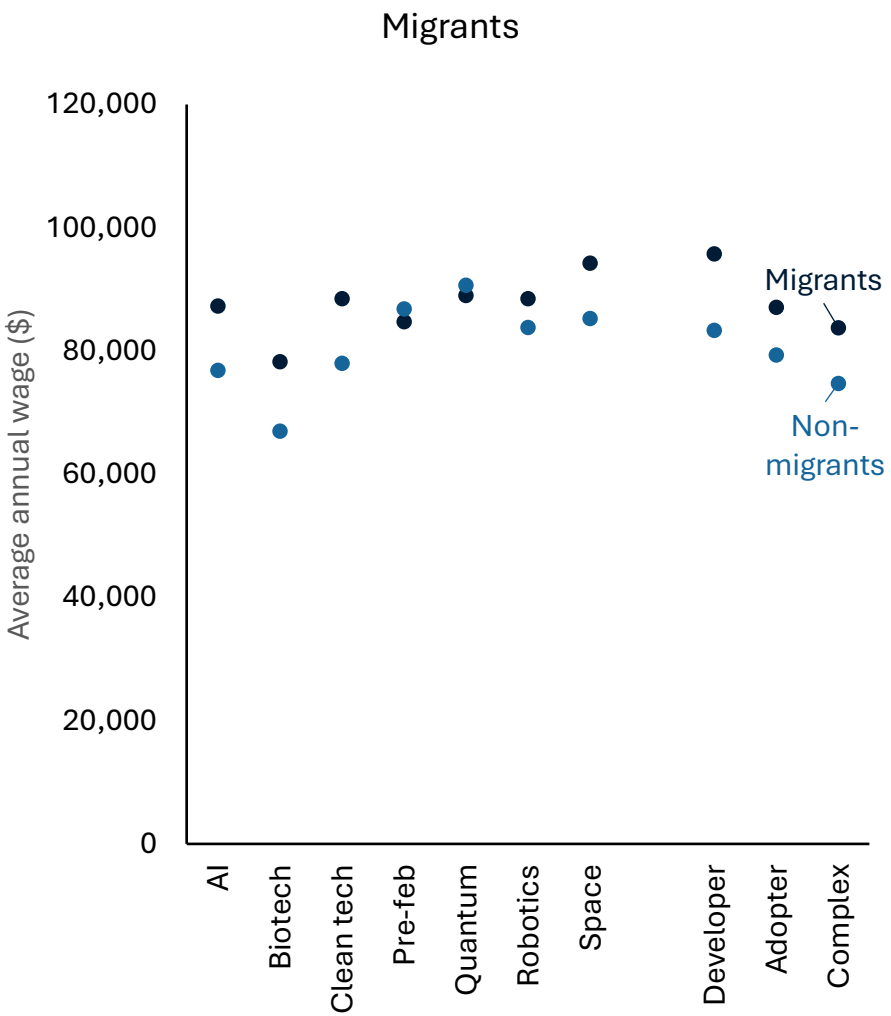
Both developers and adopters employ the same share of males and females.

There is a gender pay gap across all emerging industries

- Higher for developers than adopters
- Space and biotech gaps are largest

A future area of work in deconstructing and explaining this gap (occupations, part time, etc).

Migrants play an important role



Emerging industry	Proportion Migrants in industry	Top 3 source jurisdiction
Artificial intelligence	27.5%	India (18.0%) UK (13.5%) NZ (11.9%)
Prefabricated construction	29.0%	NZ (15.8%) UK (12.0%) Europe excl. UK (11.0%)
Quantum	37.8%	India (15.0%) China (14.6%) Europe excl. UK (11.3%)
Biotechnology	28.4%	India (13.5%) UK (12.7%) NZ (10.1%)
Robotics	27.6%	India (15.9%) NZ (15.8%) UK (15.2%)
Clean technology	26.9%	India (19.7%) NZ (13.8%) UK (11.8%)
Space	27.8%	UK (16.2%) India (16.0%) Europe excl. UK (9.4%)
Whole of economy	**26.3%**	**India (13.5%)** **NZ (12.8%)** **UK (12.3%)**

Australia's open stance on migration in recent decades has contributed to today's outcomes

Firms with a presence in quantum (38%) industries have significantly higher share of migrants than the economy as a whole.

The Indian workforce stands out

Compared to a 13.5% overall share of visa holders, Indian visa holders are much more likely to participate in firms that have a presence in emerging industries, particularly clean tech (20%) and AI (18%).

New Zealand and the UK are the second and third highest source countries for emerging industry talent.

The tech boom in both US and Indian tech workers outlined in Khanna and Morales (2021) may have had an additional channel in contributing to Australian emerging industries – another interesting avenue for future work.

Summary of findings

Extent of emerging industries

- Firms with a presence in emerging industries stretch across approximately ¼ of Australian economy.
    - AI particularly large presence.
- We have provided an initial attempt to estimate technology penetration, suggesting around 5% of economic activity.
    - Will be important to refine in the future.

Performance of emerging industries

- Productivity is higher among firms with a presence in emerging industries than other firms.
- Productivity performance varies across industries; quantum and biotech particularly low.

Workforce of emerging industries:

- Jobs in emerging industries are higher pay
- There is a clear skill and STEM premium
- Migration pathways appear to be playing an important role.

Lots more work to do! Welcome thoughts, comments and collaborative offers.

- Part of DISR's ongoing work to build out business data sets.

Contact us

Dr Tris Sainsbury
Manager, Firm, Innovation and Technology Analysis
Analysis and Insights Division
Department of Industry, Science and Resources
Tris.Sainsbury@industry.gov.au

www.industry.gov.au/office-chief-economist

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