Using NLP to detect data/AI hiring intensive jobs and firms

Julia Schmidt (presenting), Graham Pilgrim, Annabelle Mourougane

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Motivation and scope

Objective

- Estimate AI/data-intensive jobs for the United Kingdom 2012-2022
- For 2015-2021 match data to two firm-level databases to generate insights on productivity/export behaviour

Methodology

- Develop a natural language processing algorithm on online job advertisements
- Classify jobs into data, as well as AI-related jobs

The pros and cons of using online job advertisements

- Provided by Lightcast data, previously BurningGlass Technologies
- Job online advertisements are a measure of labour demand (flow as opposed to labour stock)
- No information about the quantity of hiring
- Recruitment agencies cause duplications

Advantages	Disadvantages
Timely data (2012 – present)	Decreasing quality of the data the further back in the time (e.g., 2012 data are of worse quality than 2023 data)
Linkage to firm-level and regional data	Limited coverage depending on year and country, no insights on how firms hire
Standardised occupation and industry classifications	Representativeness is heterogeneous (industry, occupation level; white collar jobs)
Identify skill demands beyond standard labour market statistics	

What are data/AI-intensive jobs?

- A data intensive job can be defined based on the data value chain concept (Corrado et al. (2022) and Statistics Canada (2019))
- An AI intensive job is related to generic and specific, AI related skills (Borgonovi et al. 2023)

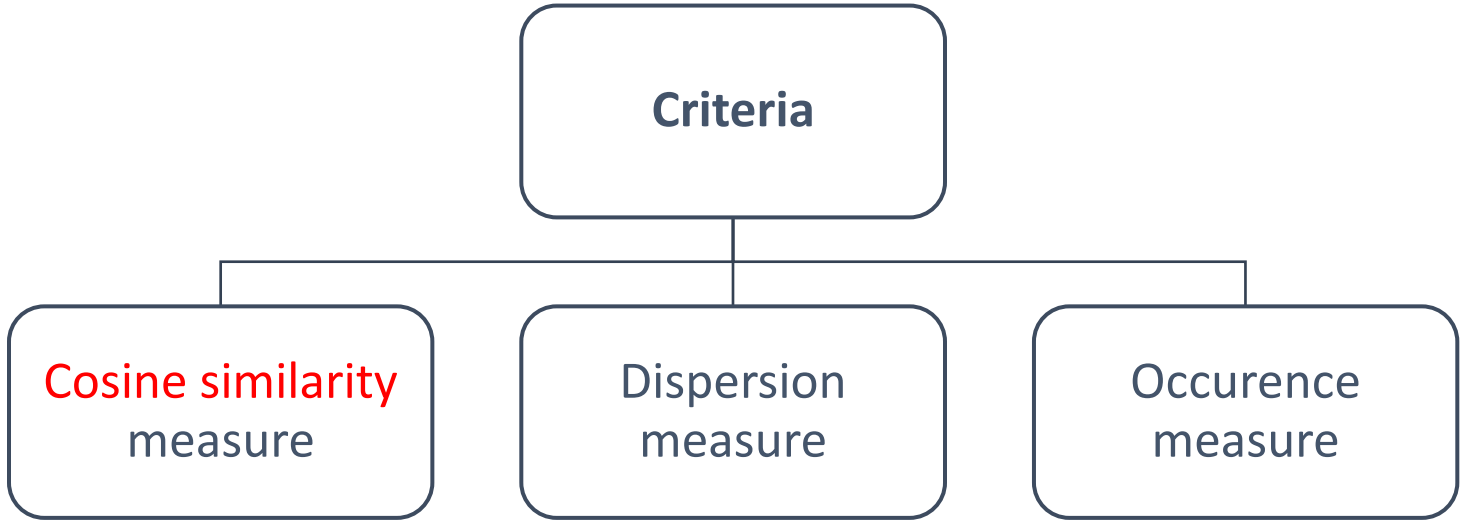
Methodology

Using natural language processing to estimate data/AI intensity

1. Process the text data from the job advertisements
2. Extract skills/tasks that identify the job as involved in data production/related to AI using natural language processing
3. Classify the job based on its link to data entry, database or data analytics activities or AI-related skills
4. Aggregate the jobs to occupation, firm, industry, and economy level (data/AI intensity score per occupation/firm/industry/economy)

Classification and aggregation of data-intensive jobs

- A job is classified as data-intensive (1, else 0) if it passes the following criteria:



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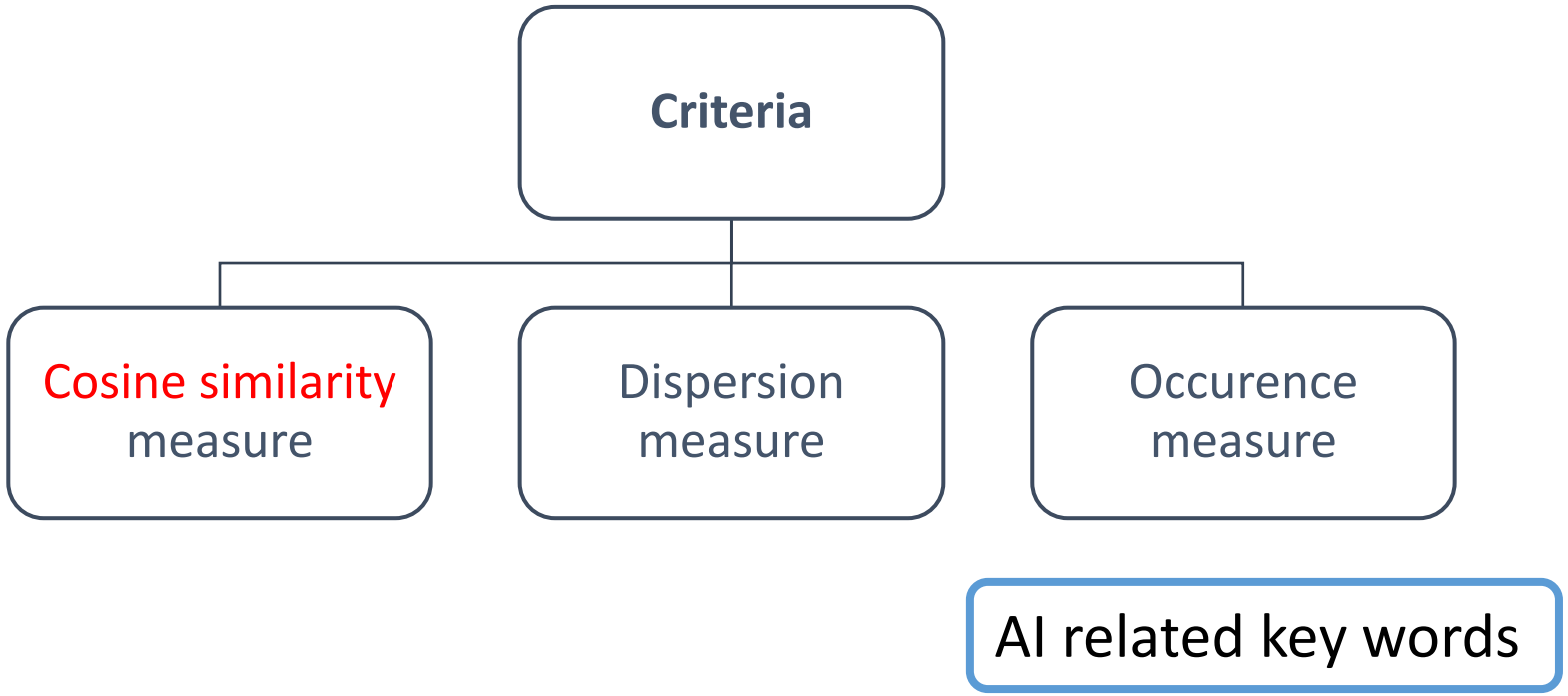
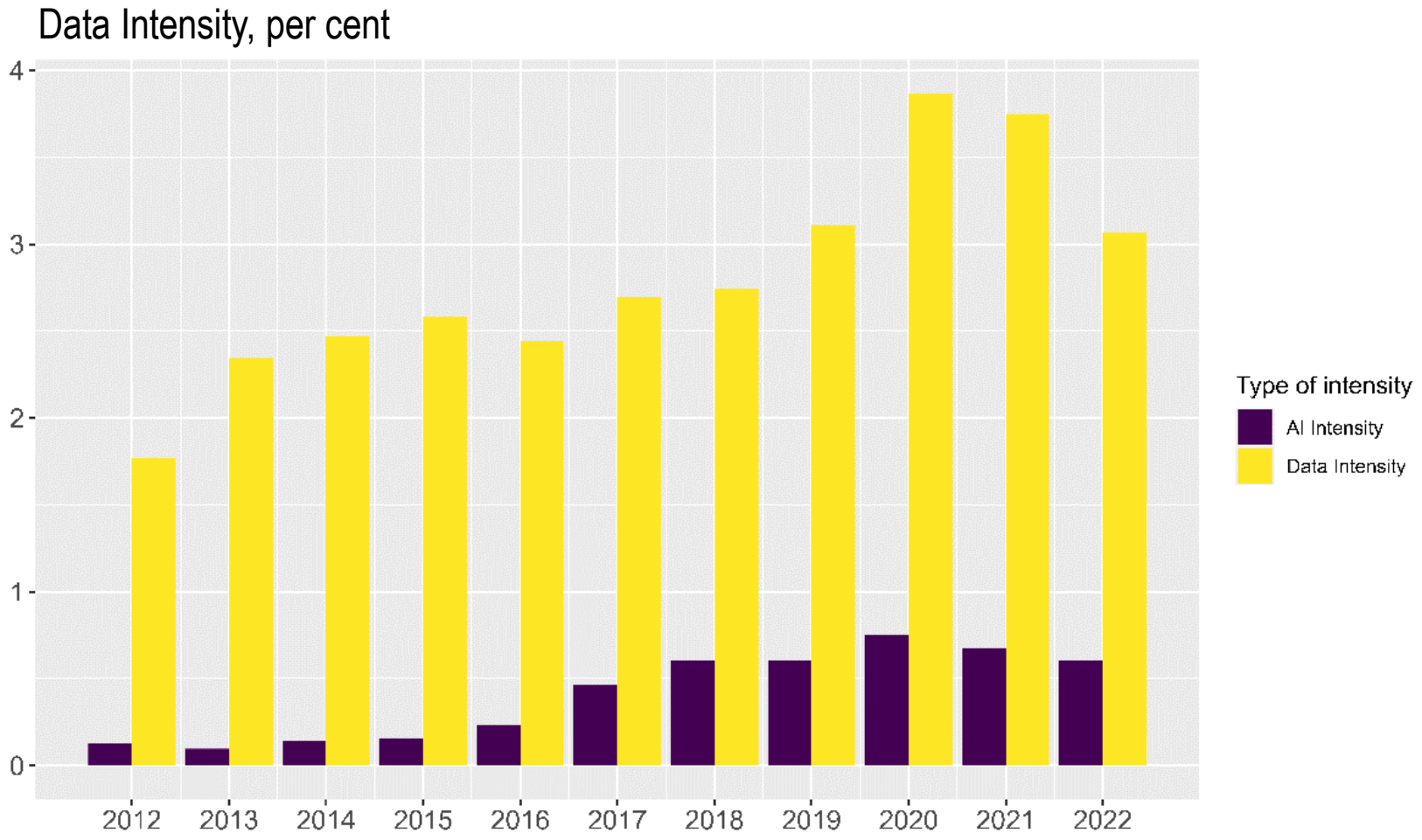


Matching Orbis to Lightcast data

- Matched Orbis data for the United Kingdom to Lightcast data
- Applied OpenCorporates OpenRefine Reconciliation API (version 0.4.8) to generate company IDs
- Facilitated matching (matching on ID vs. matching on names)
- Matching rates for 2022: validation via OpenCorporates (retained 77% of original Lightcast firms → 22% when matching to Orbis)

Results

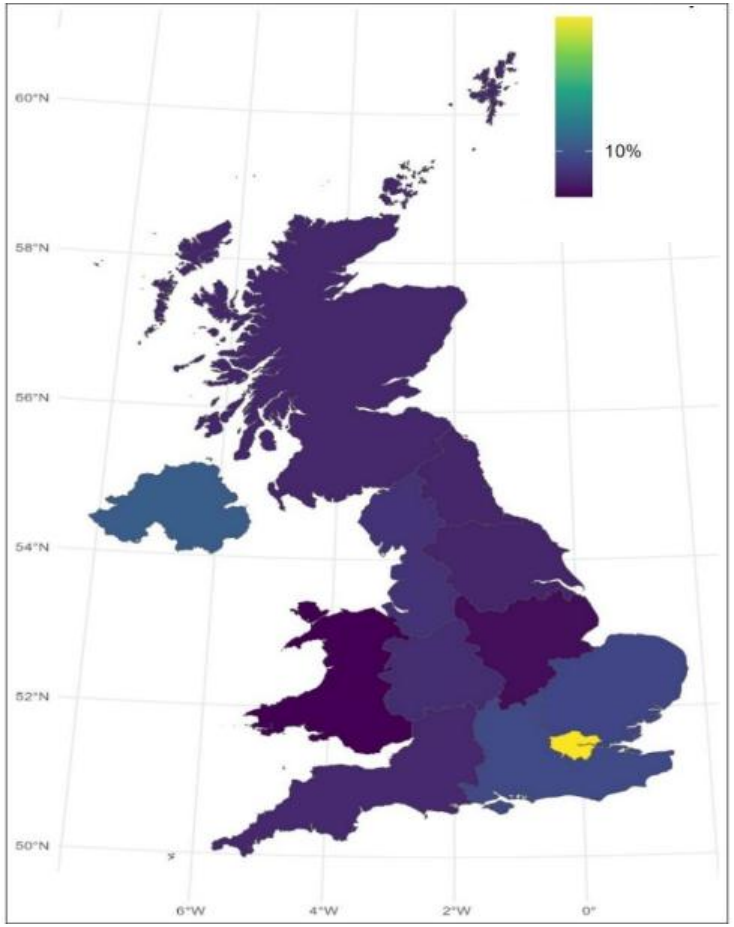
Data and AI-hiring intensity peaked during COVID in the UK



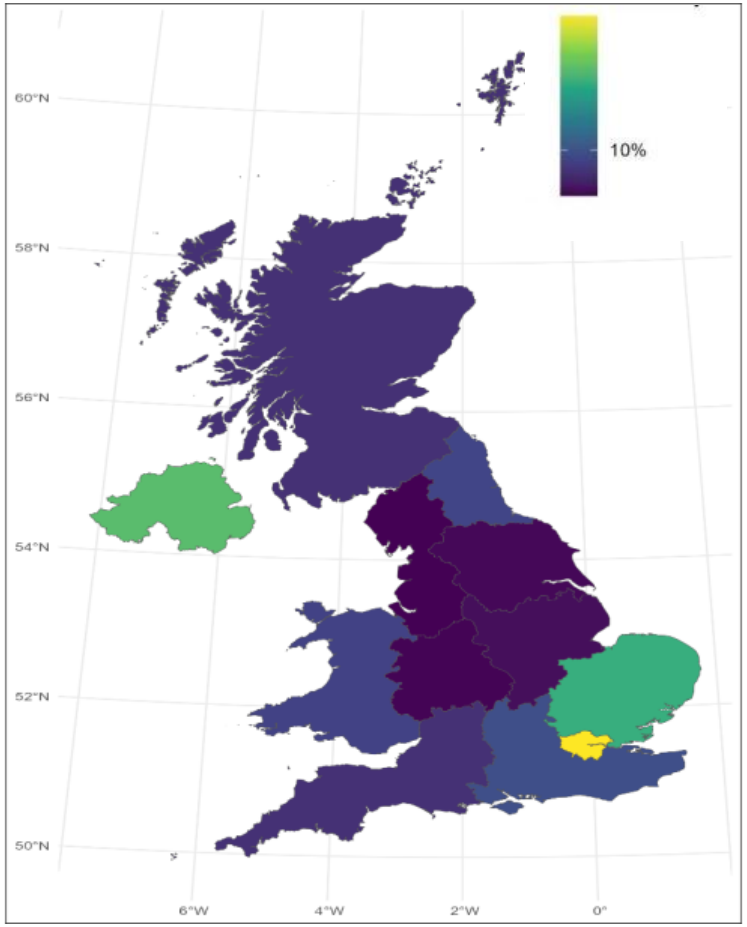
Source: Authors' calculations based on Lightcast data.

Data/AI intensive jobs are concentrated in London

UK regions, demand for data skills, 2022



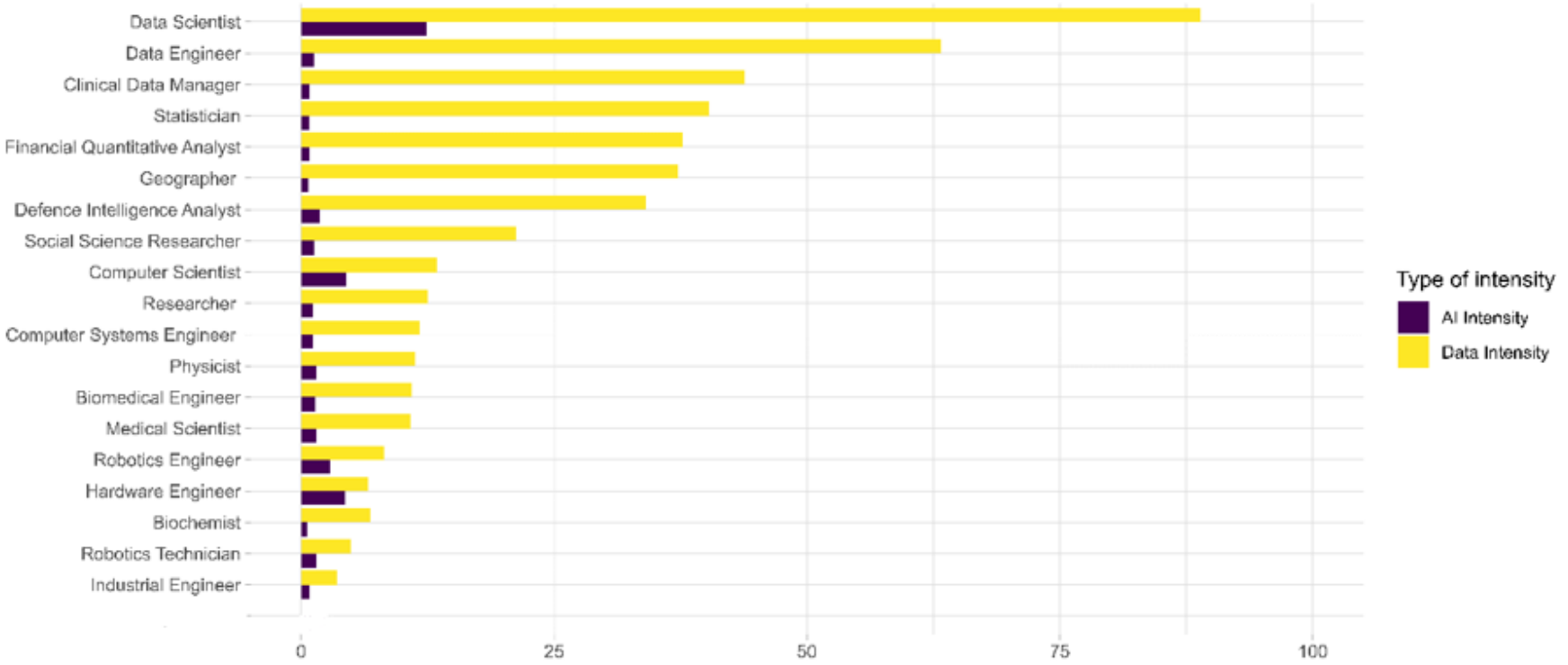
UK regions, demand for AI skills, 2022



Source: Authors' calculations based on Lightcast data.

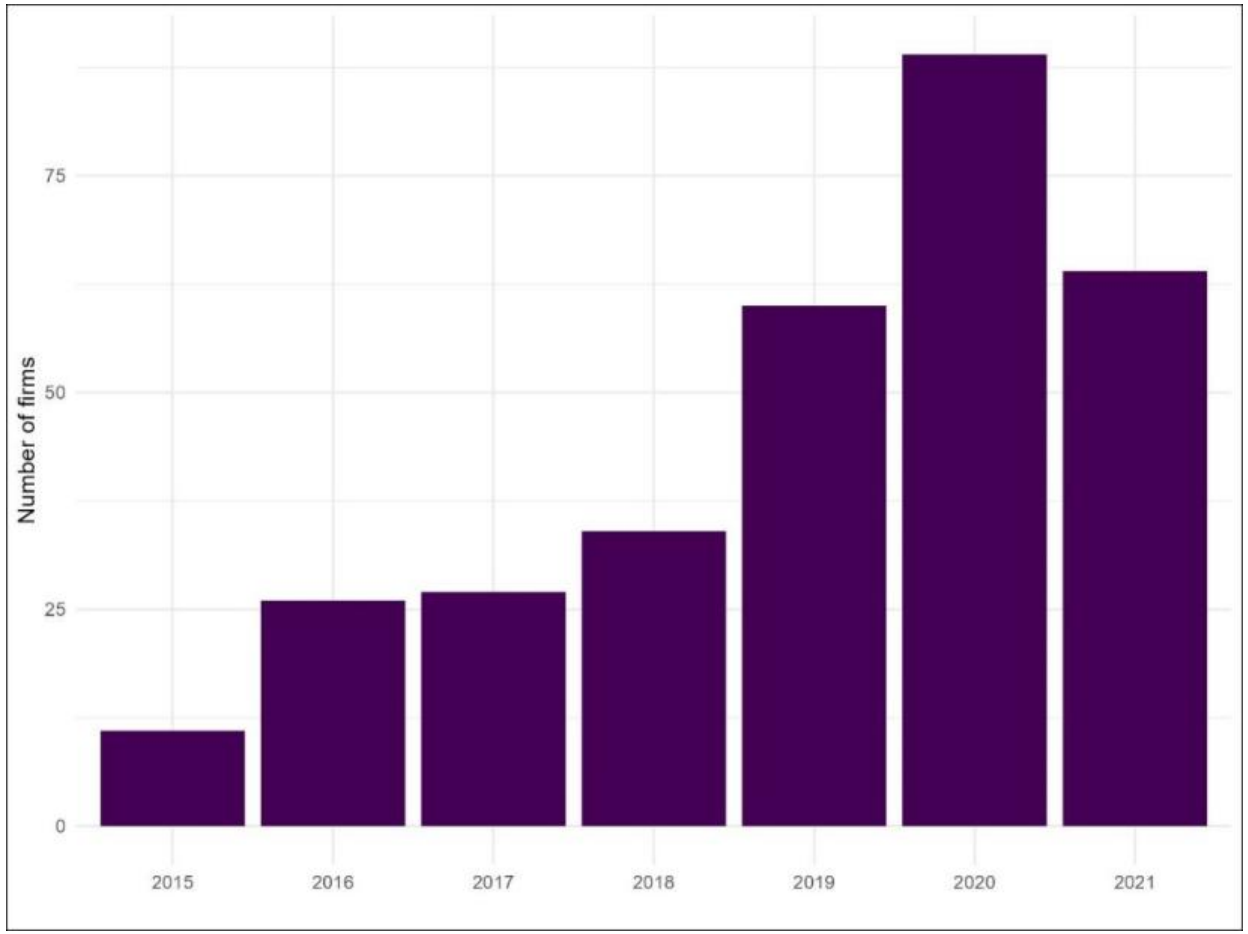
Demand for data/AI skills by occupation differs

Data and AI-hiring intensity in per cent, 2022



Source: Authors' calculations based on Lightcast data.

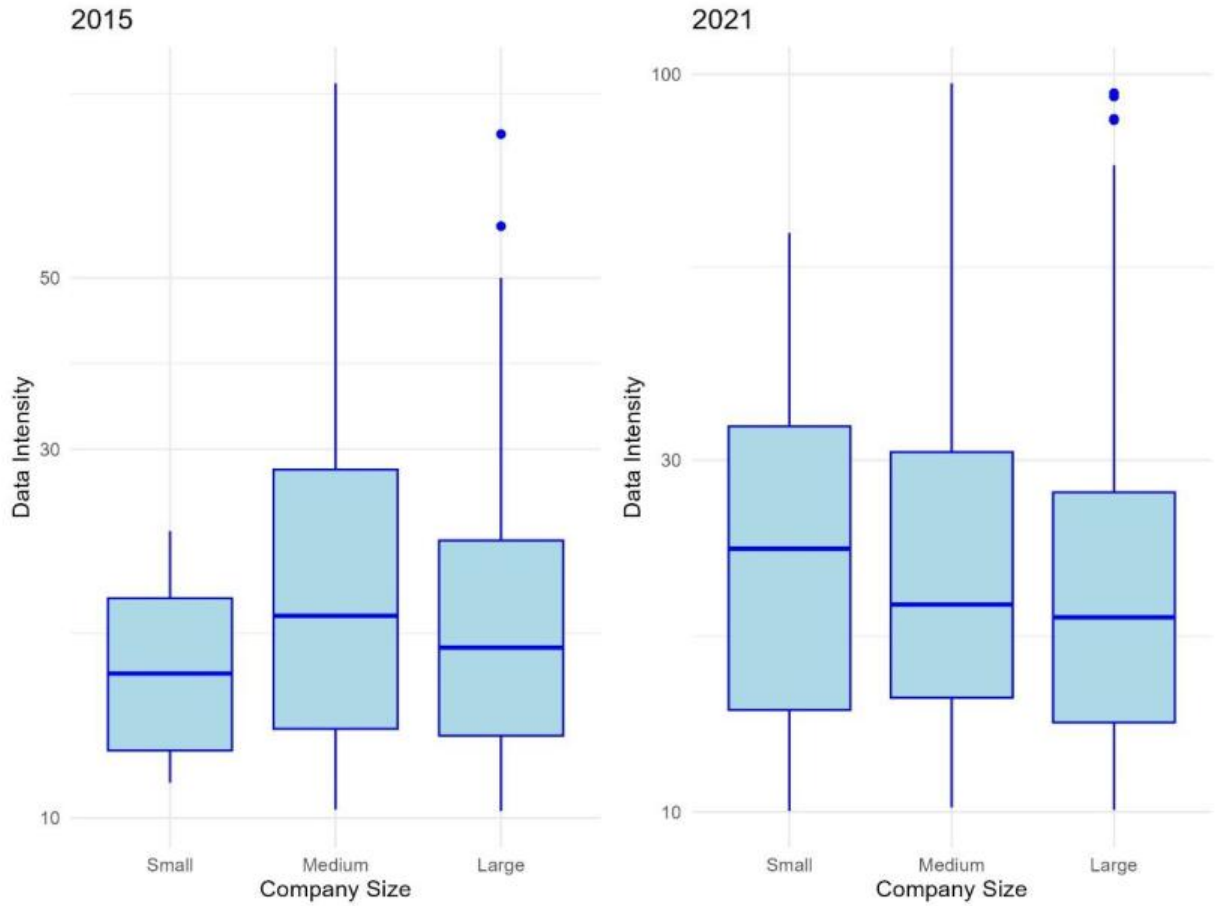
Number of highly data intensive firms increased



Source: Authors' calculations based on Lightcast data.

The group of data-intensive firms is heterogenous

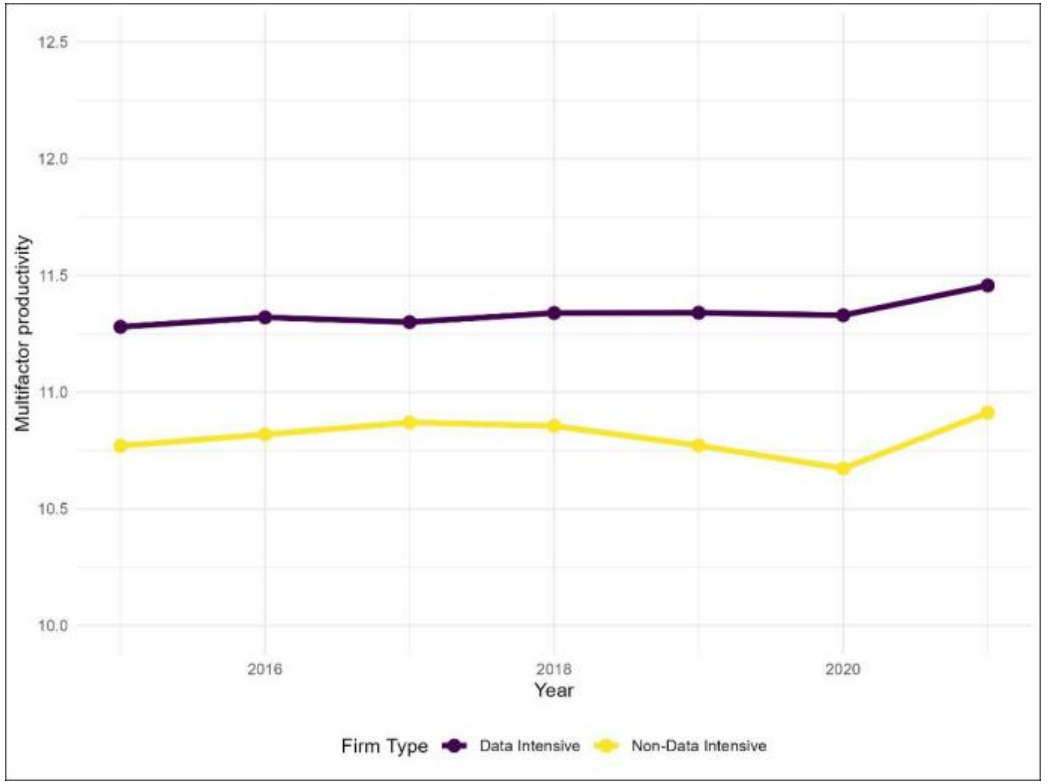
Data intensity in per cent



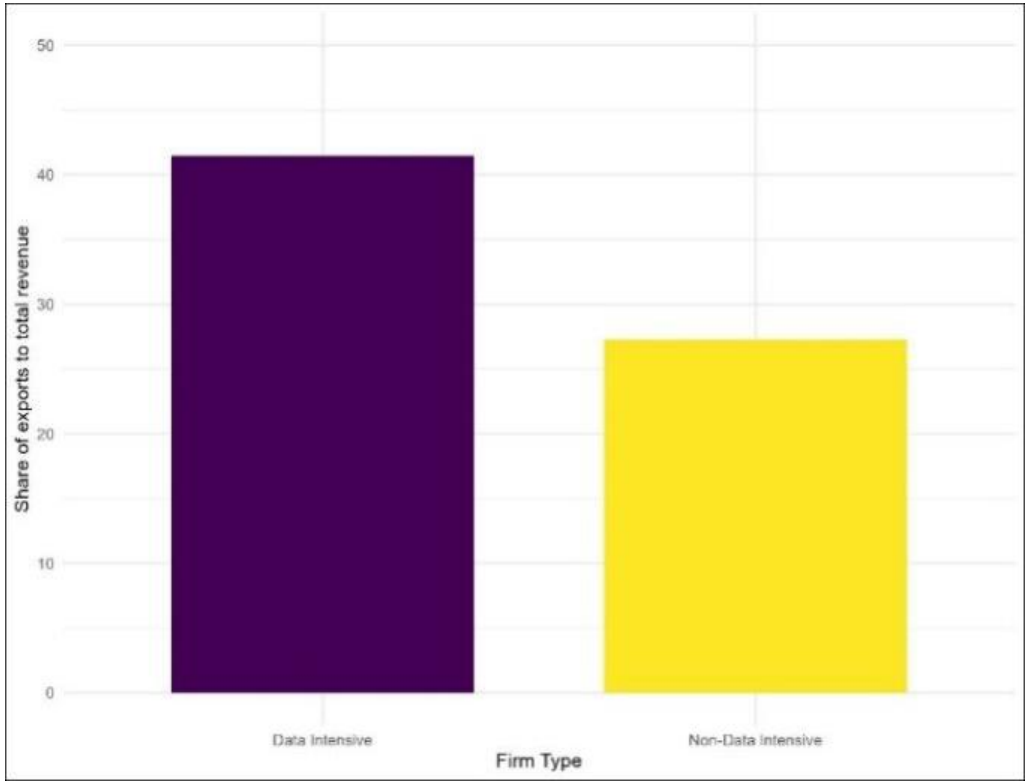
Source: Authors' calculations based on Lightcast and Orbis data.

Data-intensive companies are more productive and export

Average multifactor productivity levels, index

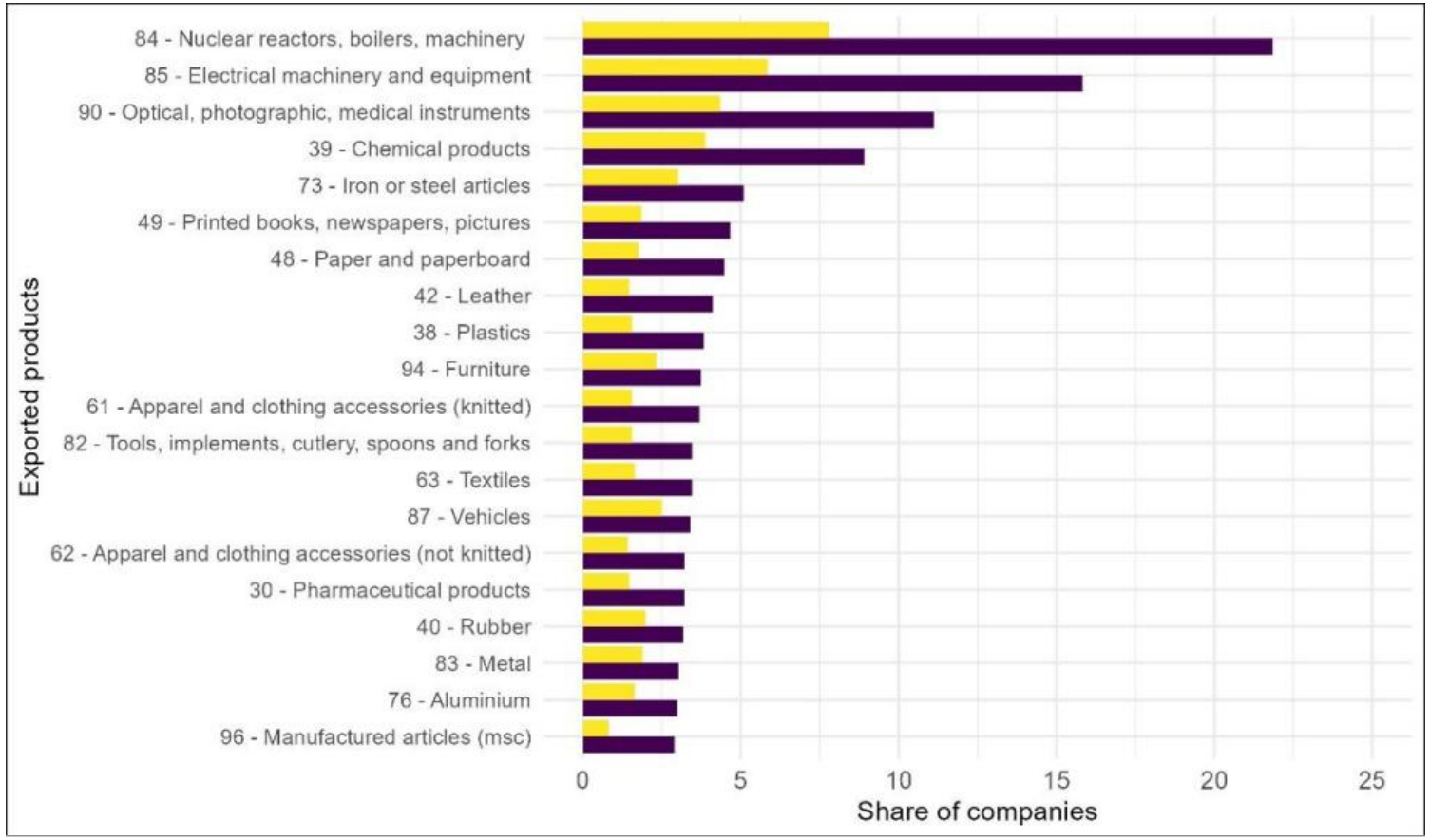


Share of exports/total revenue, per cent, average 2015-2022



Source: Authors' calculations based on Lightcast and Orbis data.

Data and non-data firms differ in the types of products traded



Source: Authors' calculations based on Lightcast/Orbis data and the UK trader dataset.

Take aways and new ideas

Contribution of our work

- Flexible NLP algorithm that can be extended across countries and time series; to 66 languages, as well as beyond digital skills (e.g. green skills)
- Disaggregated insights into digital skills on labour markets (data as well as AI skills)
- Combine several data sources (online job advertisements, and two-firm-level databases)
- Provide a new methodology on how to match ORBIS with Lightcast data

Future work

- Extend the work to trade in services
- Expand the matching exercise to additional countries (ongoing at the OECD)

Questions?

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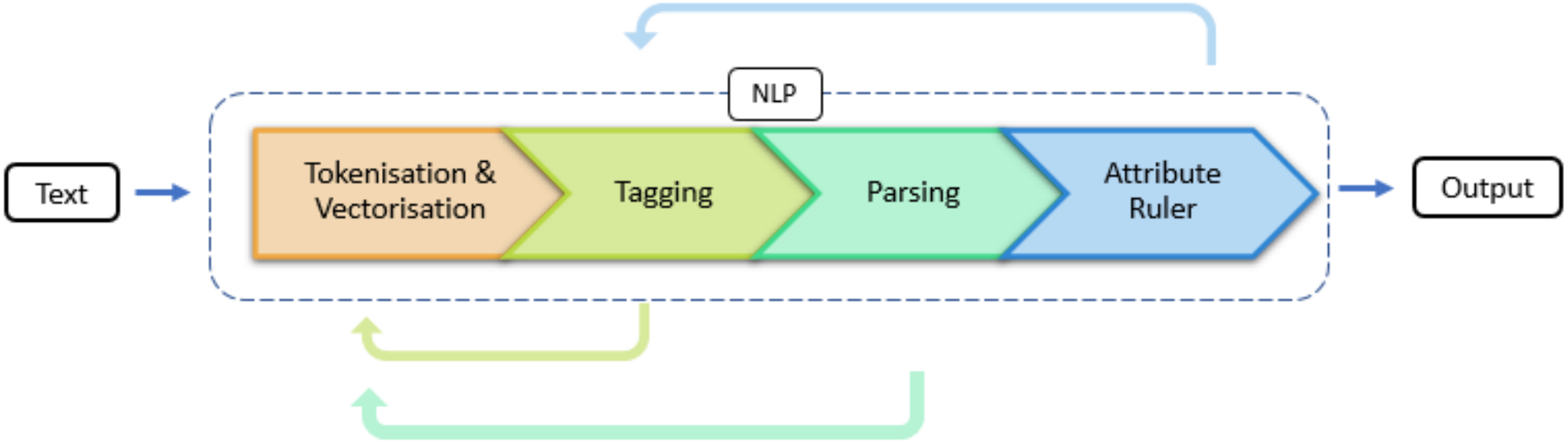
Process the online job advertisements

- NLP captures the **meaning and structure of** a word/sentence in different contexts



Source: Authors' illustration based on (spaCy, 2022[43])

Tokenising and vectorising online job advertisements

Tokenisation

"A data scientist is a high-skilled professional who uses analytical, statistical and programming knowledge skills to analyse large datasets."

- data scientist
- high-skilled professional
- analytical statistical programming knowledge skills
- analyse large datasets

Vectorisation

```
Data analysis    = [1.5, -0.4, 7.2, 19.6, 3.1, ..., 20.2]
Data analytics   = [1.5, -0.4, 7.2, 19.5, 3.2, ..., 20.8]
your information = [7.5, -1.0, 7.2, 14.8, 2.8, ..., 19.0]
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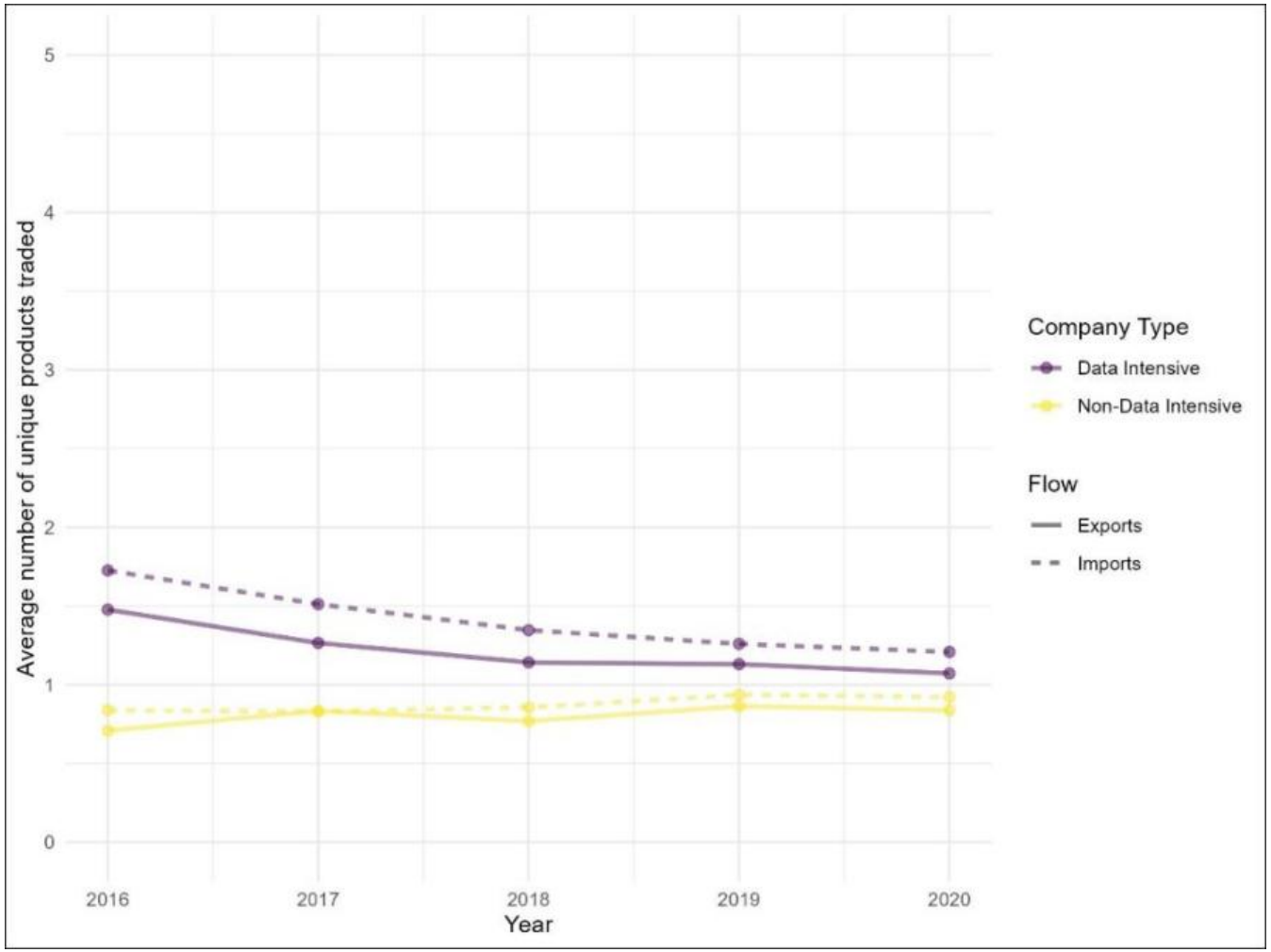
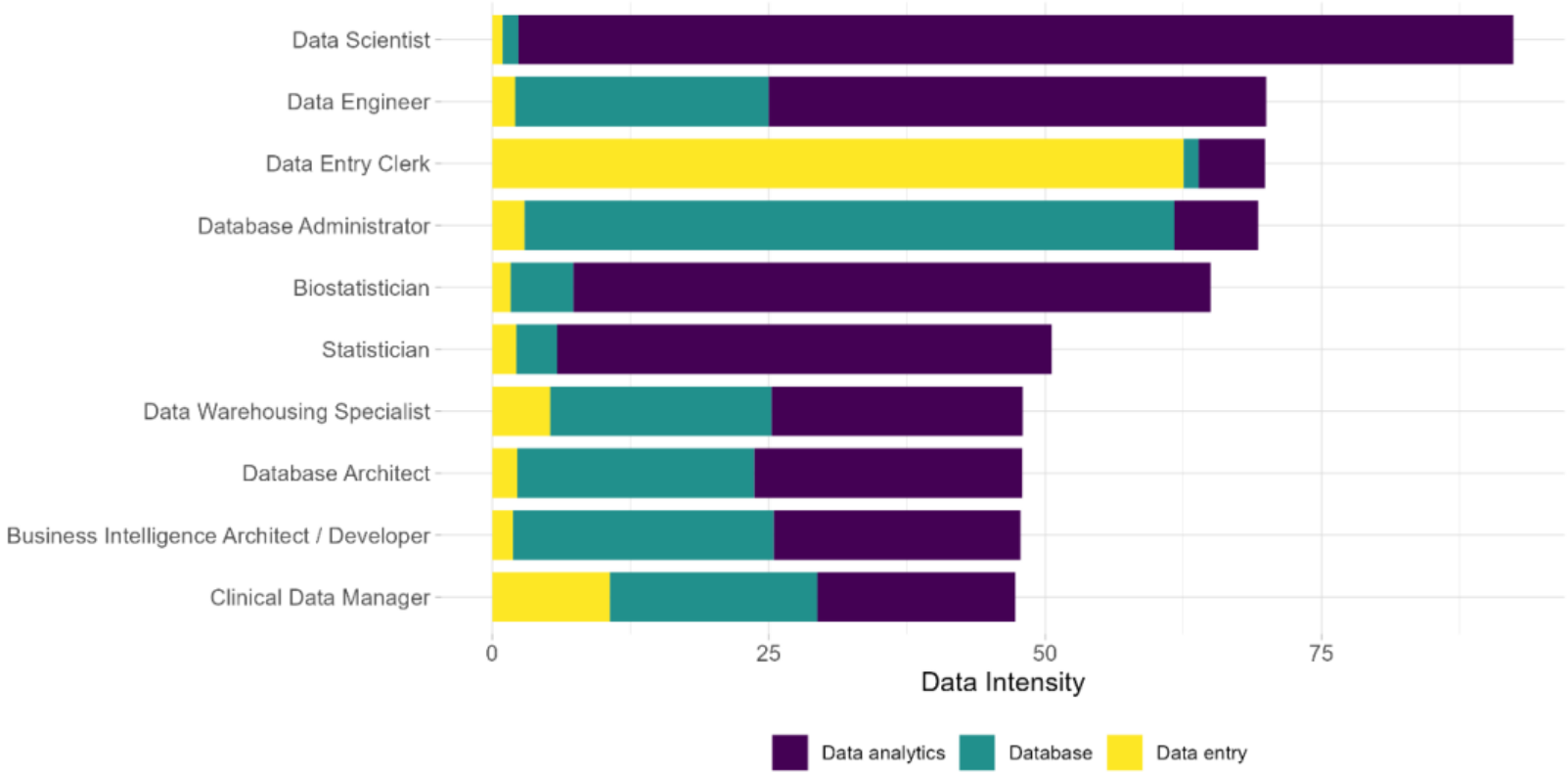
The average number of products traded are similar across firms



Source: Authors' calculations based on Lightcast/Orbis data and the UK trader dataset.

High data-intensive professions are linked to data analytics

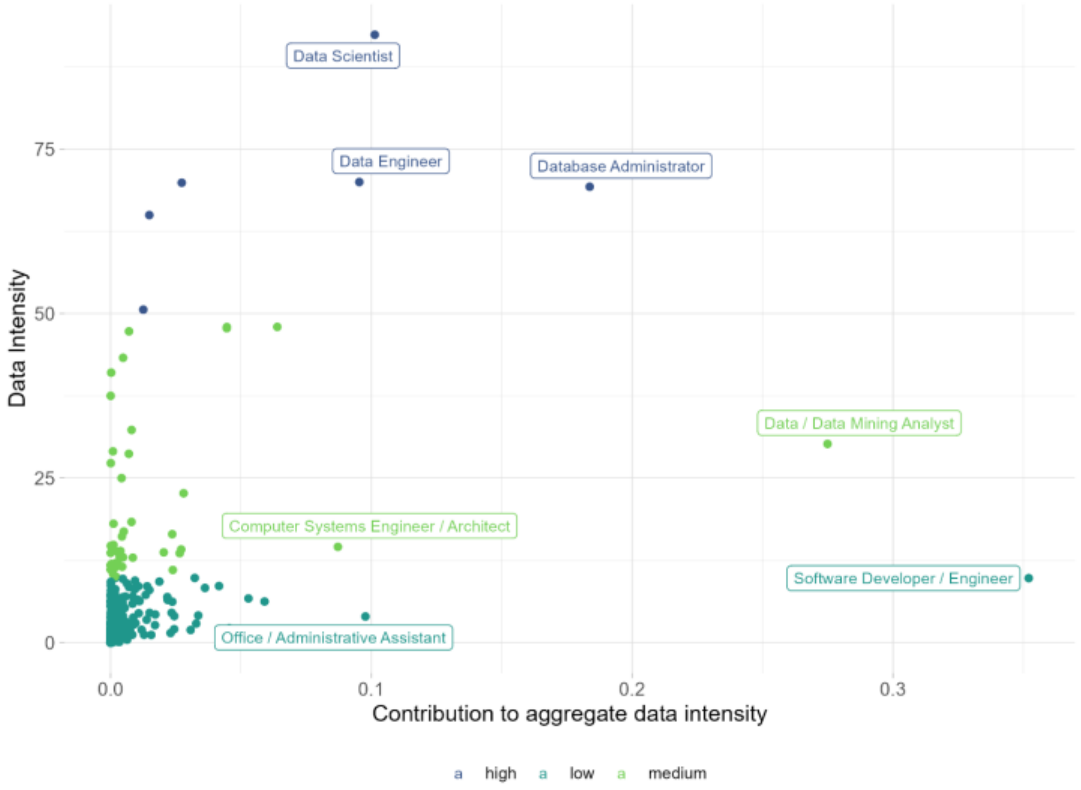
Top 10 data-intensive occupations in the United Kingdom, per cent, 2020



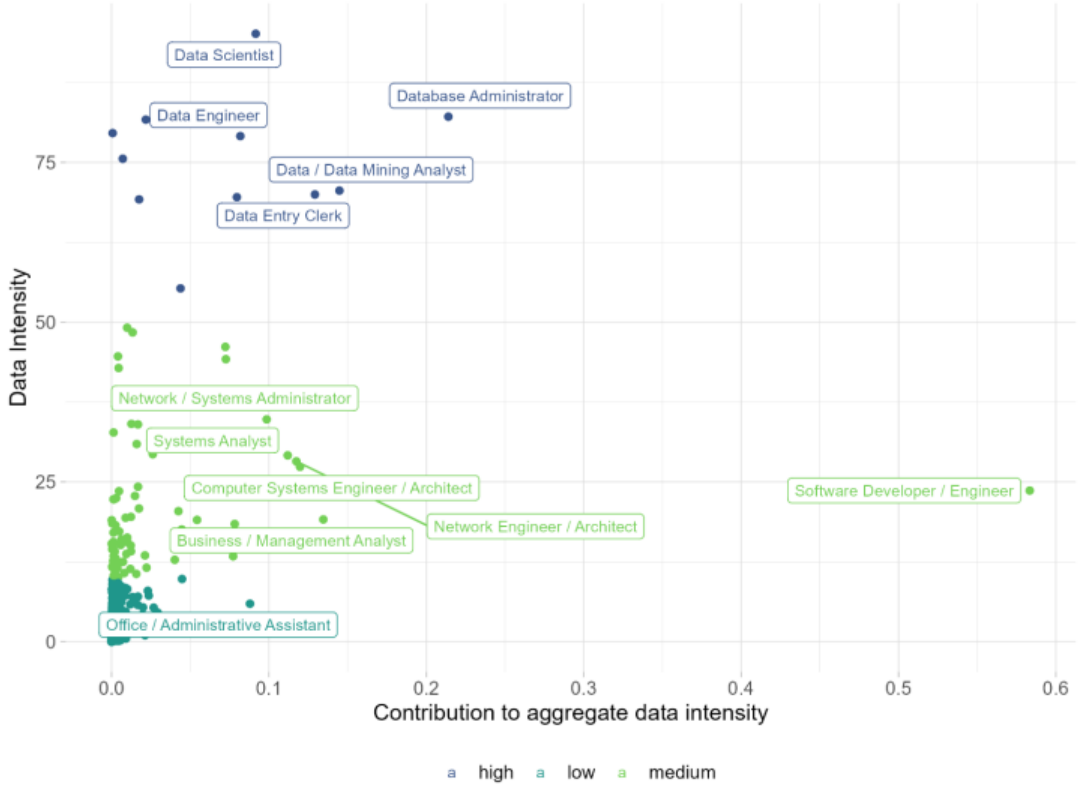
Source: Authors' calculation based on LightCast data.

The distribution of data professions is highly unequal

A - United Kingdom, per cent, 2020



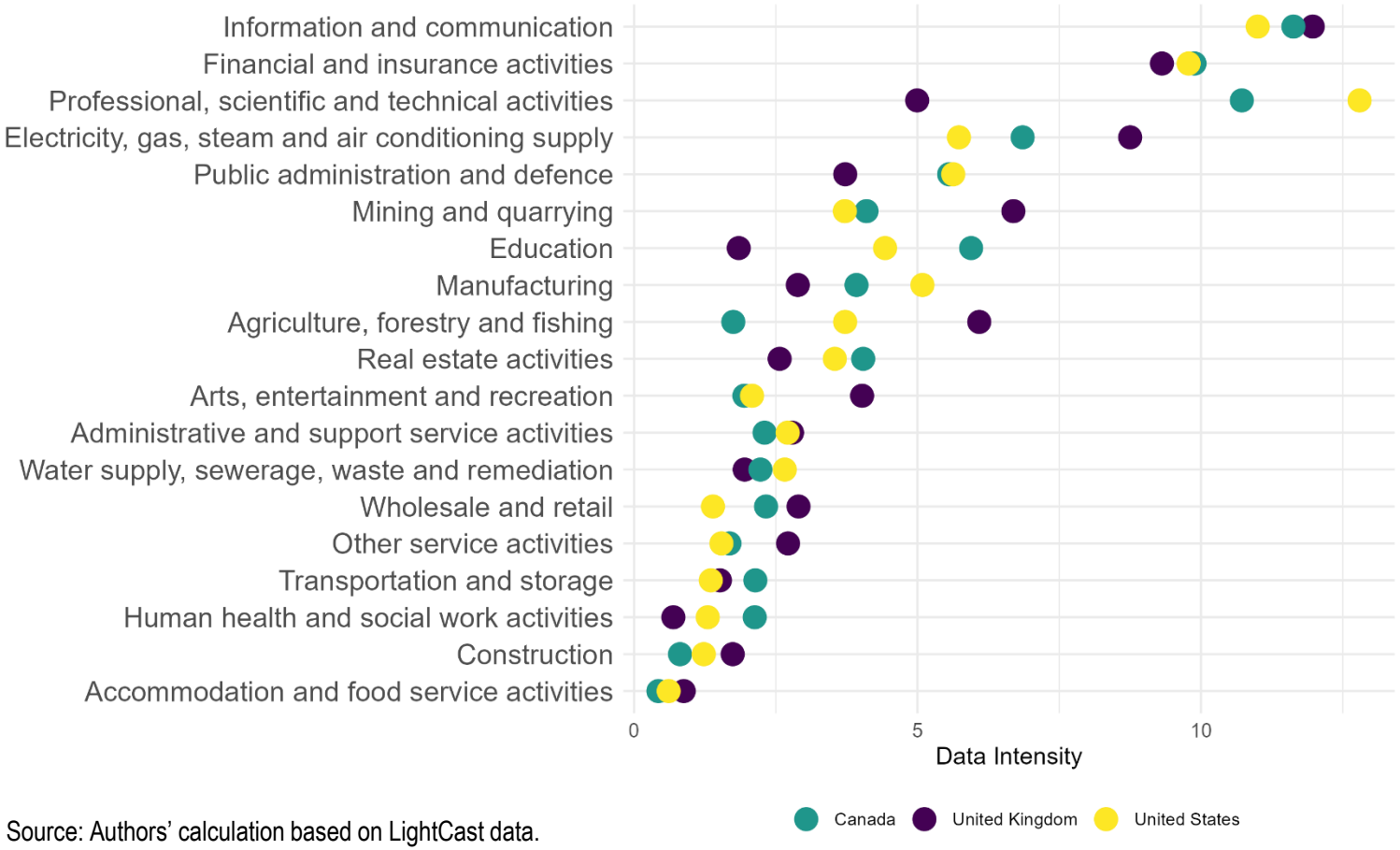
B- United States, per cent, 2020



Source: Authors' calculation based on LightCast data.

Differences across countries are bigger at industry level

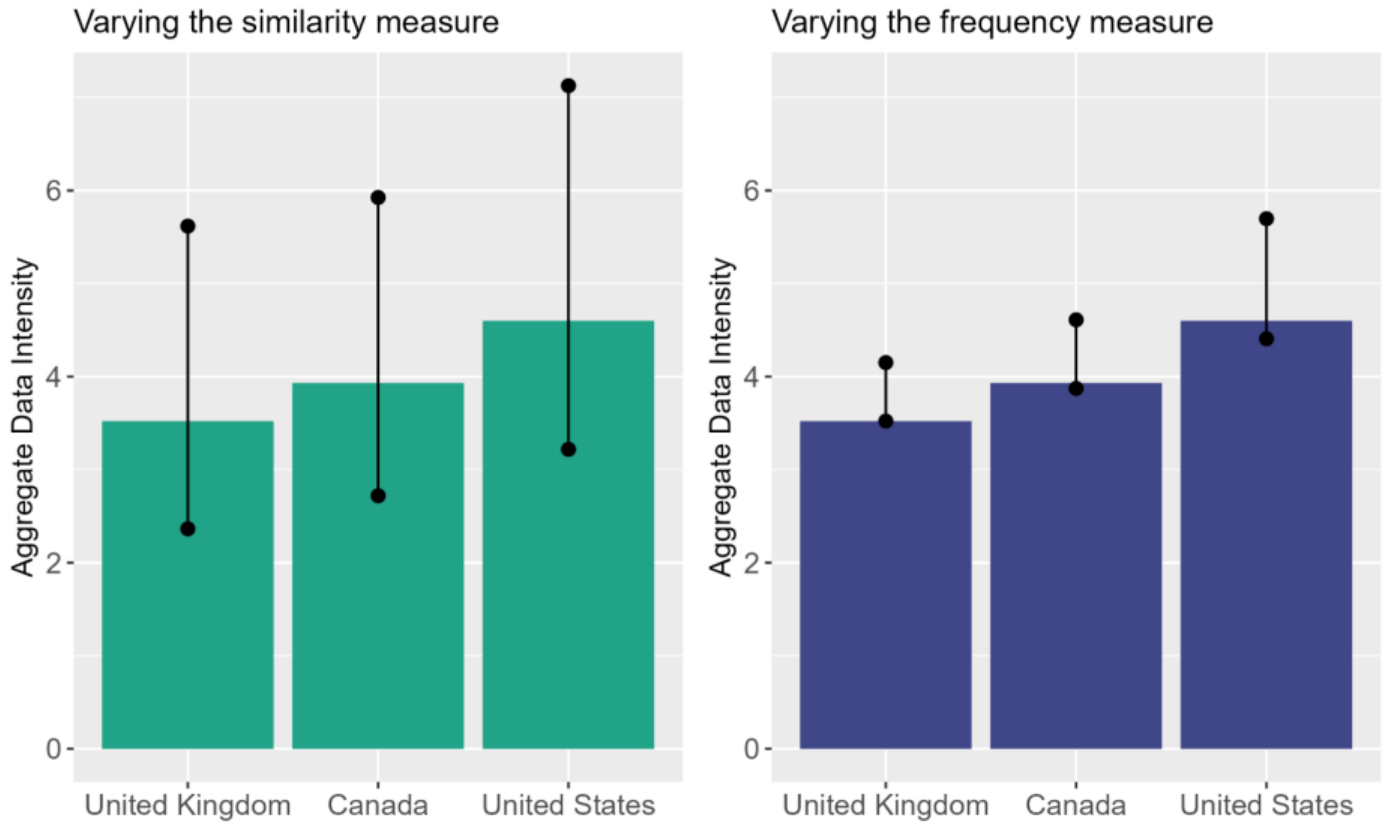
Data intensity at industry level, per cent, 2020



Source: Authors' calculation based on LightCast data.

Results at aggregate level are sensitive to changes in the classification rule

- Careful calibration of classification rule
- Order of magnitude of results remains stable
- Results vary larger for changes in similarity measure, but with the same magnitude across countries



Source: Authors' calculation based on LightCast data.