AI and Services-Led Growth: Evidence from Indian Job Adverts

Alexander Copestake[1], Max Marczinek[2], Ashley Pople[3], Katherine Stapleton[3]

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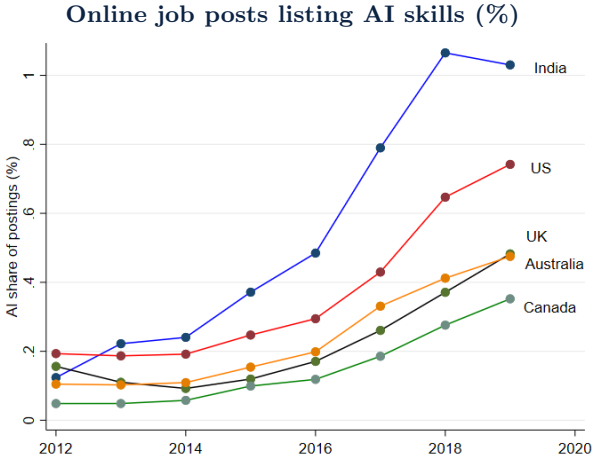
[1]International Monetary Fund
[2]University of Oxford
[3]World Bank

Motivation

- Rapid growth in demand for AI skills across countries since 2015



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- Impact on jobs ambiguous (displacement vs. productivity/new tasks)
  (Brynjolfsson et al. 2017, Acemoglu & Restrepo 2018, Agrawal et al. 2018, Cockburn et al. 2018, Klinger et al. 2018, Goldfarb et al. 2020, Agrawal et al. 2021)
- Limited empirical evidence, focused on high-income countries (adoption)
  (E.g. Acemoglu et al. 2021 in USA, Albanesi et al. 2023 in Europe, Stapleton 2021 in UK)
- Important potential consequences for development (call center vs. chatbot)
  (Susskind & Susskind 2015, Baldwin 2019, Baldwin & Forslid 2020, Korinek & Stiglitz 2021)
- India a key case: archetype of services-led growth; large + young population
  - ⇒ E.g. IT/Business Process Outsourcing employs 4M, 8% of GDP (SESEI 2019)
  - ⇒ 200M ageing into labor market by 2030 (UN 2019)

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How did AI affect labor demand in India's white-collar service sector?

What we do:

⇒ Document demand for AI skills using online job adverts from India's largest jobs site

⇒ Study the impact of establishment-level AI demand on non-AI job adverts, wage offers and tasks using ex-ante exposure to future AI inventions

What we find:

⇒ Demand for AI skills is highly concentrated across firms, industries, cities

⇒ AI adoption has a net negative impact on labor demand within establishments, driven by lower demand for skilled, managerial, non-routine, analytical labor

Clarifications: (i) ML, pre-GenAI, (ii) 'posts/wage offers' not 'hiring/wages', (iii) direct within-establishment effects not GE

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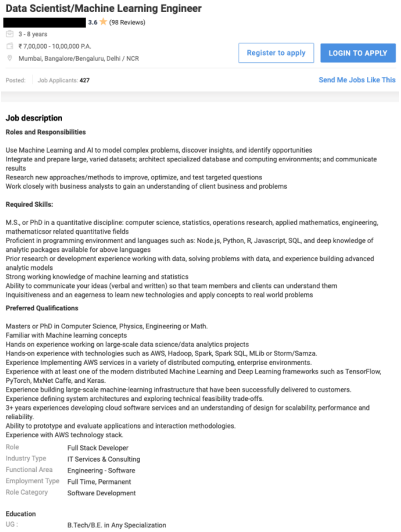
Vacancy data from India's largest online job postings platform

- Platform hosts 60% of online job posts in India, we received 80% random sample across 2010-19
- 150k+ firms posted >1 one vacancy; average of 80 posts per firm
- Includes salary, experience and educational requirements plus detailed job descriptions



Data Scientist/Machine Learning Engineer

[redacted] 3.6 (98 Reviews)

3 - 8 years

₹ 7,00,000 - 10,00,000 P.A.

Mumbai, Bangalore/Bengaluru, Delhi / NCR

Register to apply | LOGIN TO APPLY

Posted: Job Applicants: 427

Send Me Jobs Like This

Job description

Roles and Responsibilities

Use Machine Learning and AI to model complex problems, discover insights, and identify opportunities
Integrate and prepare large, varied datasets; architect specialized database and computing environments; and communicate results
Research new approaches/methods to improve, optimize, and test targeted questions
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Experience Implementing AWS services in a variety of distributed computing, enterprise environments.
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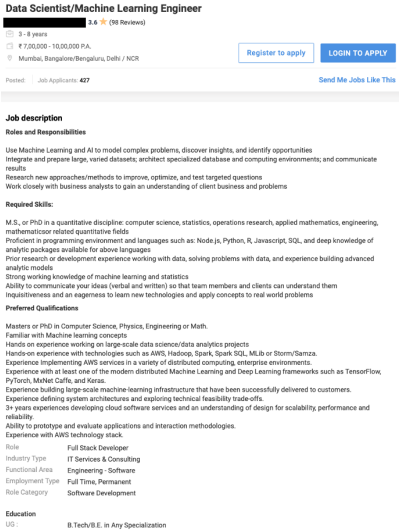

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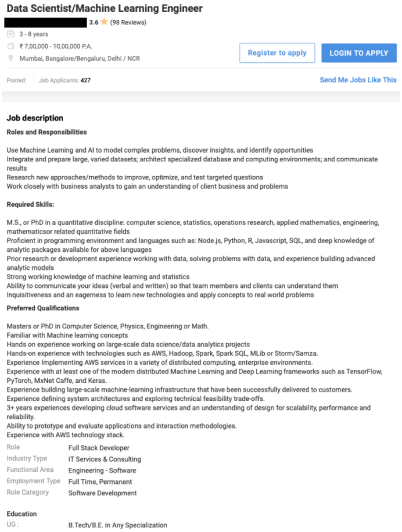

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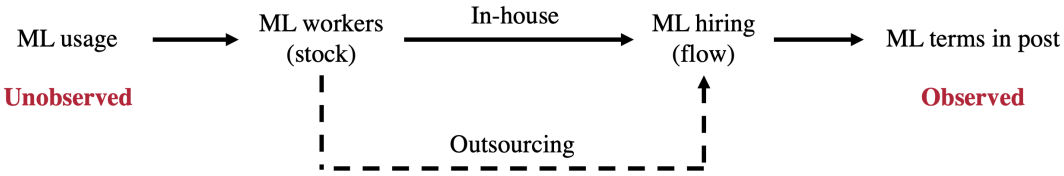

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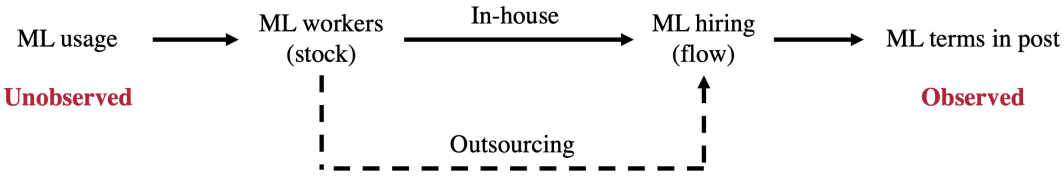
Measuring demand for machine learning skills



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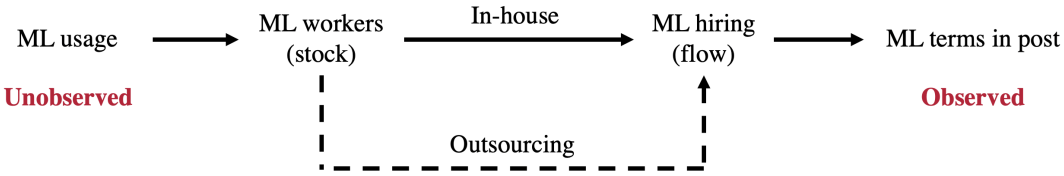

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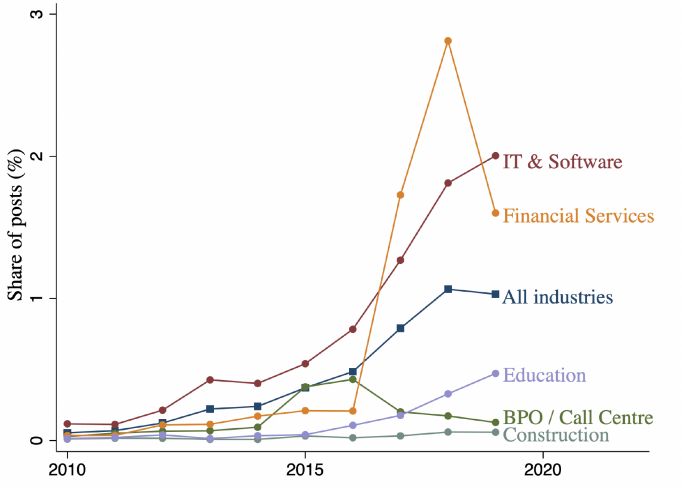
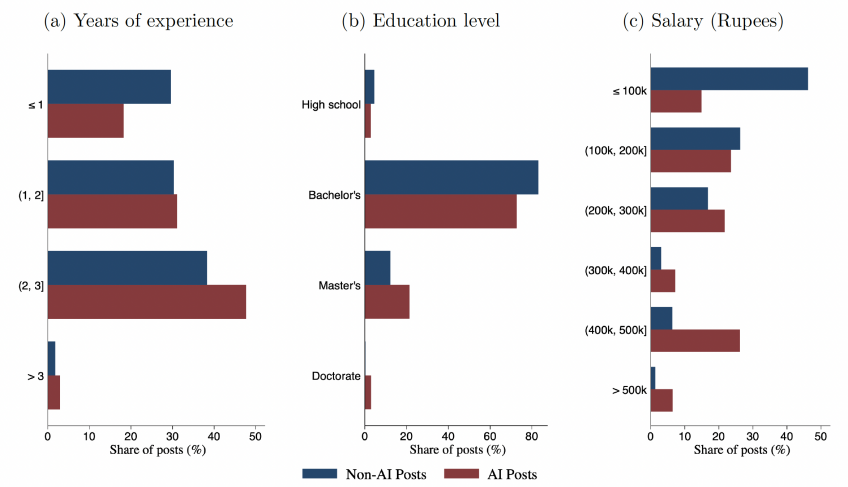


2. AI roles require more education, but offer substantially higher wages than other white-collar services jobs



⇒ AI posts offer 13% salary premium, even after controlling for education, experience, and detailed fixed effects (ir, it, rt, firm, occupation).

Further descriptives

LD: *AI adoption ⇒ #posts + wage offers*

Changes from 2010-12 to 2017-19 for 25k establishments (2M vacancies)

First stage:

$$AdoptsAI_{fr,t-t_0} = \gamma \cdot Exposure_{fr,t_0} + \alpha_r + \alpha_i + \alpha_{f10} + \epsilon_{fr,t-t_0}$$

- Combine establishments' ex-ante occupation shares with Webb (2020) measure of overlap between patents and occupations' task descriptions

Second stage:

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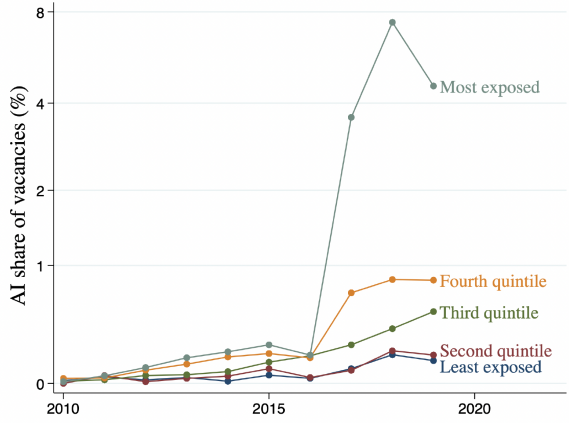

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Second stage: AI lowers growth in non-AI postings...

	Growth in Non-AI Vacancies			Growth in Total Vacancies		
	(1)	(2)	(3)	(4)	(5)	(6)
Adoption of AI	-7.975***	-12.90***	-8.064***	-7.737***	-12.47***	-7.840***
	(2.350)	(3.092)	(2.282)	(2.245)	(2.959)	(2.181)
Fixed Effects:						
– Region	✓	✓	✓	✓	✓	✓
– Industry	✓		✓	✓		✓
– Firm Decile		✓	✓		✓	✓
First Stage F-Stat	43.7	41.58	45.43	44.06	41.83	45.62
Observations	22,244	22,244	22,244	22,251	22,251	22,251

1% increase in the predicted probability of adopting AI ⇒ 8.1pp decrease in the growth rate of non-AI vacancies between 2010-12 and 2017-19

Second stage: AI lowers growth in non-AI postings & total postings

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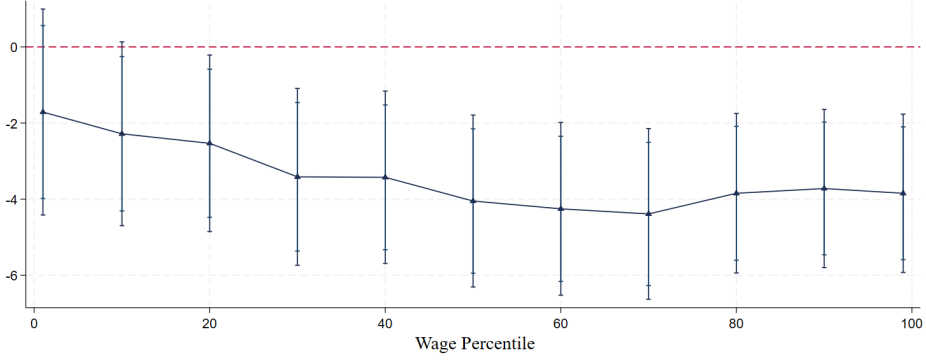
– Region	✓	✓	✓	✓	✓	✓
– Industry	✓		✓	✓		✓
– Firm Decile		✓	✓		✓	✓
First Stage F-Stat	43.7	41.58	45.43	44.06	41.83	45.62
Observations	22,244	22,244	22,244	22,251	22,251	22,251

There is a similarly-sized decrease of 7.8pp in the growth of total vacancies ⇒ the negative impact on non-AI vacancies far outweighs the rise in AI vacancies

The wage offer distribution falls...

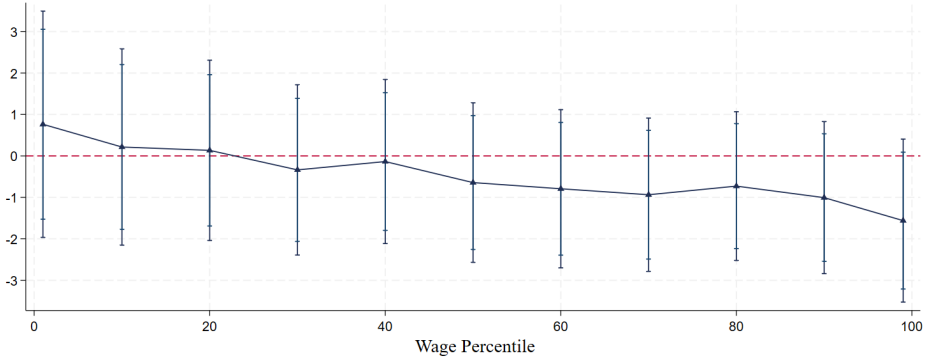
Impact of 1% higher predicted probability of AI adoption on growth in non-AI wage offers (pp)



1% increase in the predicted probability of adopting AI $\Rightarrow$ 4pp decrease in the growth rate of median wage offers

The wage offer distribution falls, driven by occupational composition

Impact of 1% higher predicted probability of AI adoption on growth in non-AI wage offers (pp)



Control for changes in shares of each occupational group ⇒ composition effects main driver

Lower demand hits higher-skilled occupations...

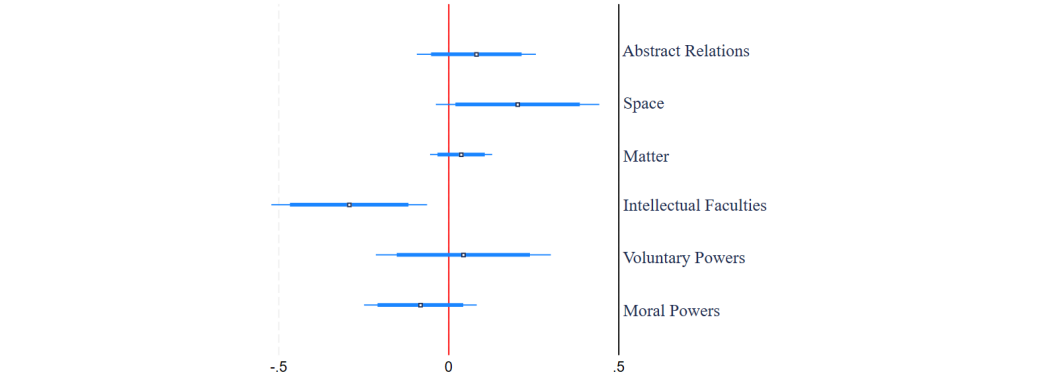
	Change in Non-AI Vacancy Shares				
	Personal, Sales & Security	Clerks	Associate Professionals	Professionals	Managers
Adoption of AI	2.074***	1.324***	10.46***	-3.637***	-10.59***
	(0.385)	(0.272)	(1.718)	(0.717)	(1.709)
Fixed Effects:					
– Region	✓	✓	✓	✓	✓
– Industry	✓	✓	✓	✓	✓
– Firm Decile	✓	✓	✓	✓	✓
First Stage F-Stat	45.43	45.43	45.43	45.43	45.43
Observations	22,244	22,244	22,244	22,244	22,244

...with negative impacts largest for corporate managers

	Change in Non-AI Vacancy Shares					
	Engineering Professionals	Health Professionals	Teaching Professionals	Other Professionals	Corporate Managers	General Managers
Adoption of AI	-2.689***	0.130	0.212***	-1.290***	-9.964***	-0.626**
	(0.494)	(0.120)	(0.0748)	(0.409)	(1.589)	(0.299)
Fixed Effects:						
– Region	✓	✓	✓	✓	✓	✓
– Industry	✓	✓	✓	✓	✓	✓
– Firm Decile	✓	✓	✓	✓	✓	✓
First Stage F-Stat	45.43	45.43	45.43	45.43	45.43	45.43
Observations	22,244	22,244	22,244	22,244	22,244	22,244

AI reduces demand for intellectual tasks...

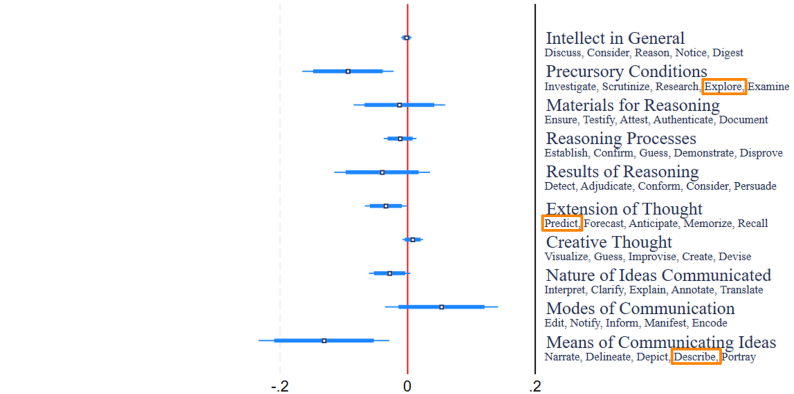
Impact of 1% higher predicted probability of AI adoption on change in verb shares



Classify verbs in job descriptions by meaning based on Roget's Thesaurus, following Michaels, Rauch and Redding (2018), then construct establishment-level shares

...especially analytical tasks involving description and prediction

Impact of 1% higher predicted probability of AI adoption on change in verb shares



Within 'Intellectual Faculties', significant declines for categories including 'explore', 'predict', 'describe'

Robustness & extensions

Baseline results robust to:

- ✓ Controls for baseline shares of software engineers and sales & admin. professionals
- ✓ Later baseline (2013-15) with larger sample
- ✓ Weighting by baseline establishment size
- ✓ Number of AI posts instead of binary adoption
- ✓ Alternative exposure measure (Felten et al. 2018)
- ✓ Shift-share tests following Goldsmith-Pinkham et al., (2020)
- ✓ Adjusted standard errors (Adão et al., 2019)
- ✓ Event-study approach

Wider effects, beyond establishment level:

- ✓ Firm-level
- ✗ District-level (by 2020)

Conclusion

- AI jobs offer a substantial wage premium, but are highly concentrated in certain industries, cities and firms
- AI adoption has a net negative impact on labor demand within incumbent Indian white-collar services firms
  - ⇒ Stark contrast to literatures on computerization and industrial robotics
  - ⇒ Driven by lower demand for skilled, managerial, non-routine, analytical labor
- Key open question: to what extent does AI enable new tasks and firms, and how do the overall 'creative' vs. 'destructive' effects compare?

AI and Services-Led Growth: Evidence from Indian Job Adverts

Alexander Copestake[1], Max Marczinek[2], Ashley Pople[3], Katherine Stapleton[3]

October 17, 2024

[1]International Monetary Fund
[2]University of Oxford
[3]World Bank

Classifying AI posts

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Posts are categorised as AI-related if any of the following terms appear in either the 'job description' or 'skills required' fields:

Machine Learning, Computer Vision, Machine Vision, Deep Learning, Virtual Agents, Image Recognition, Natural Language Processing, Speech Recognition, Pattern Recognition, Object Recognition, Neural Networks, AI ChatBot, Supervised Learning, Text Mining, Support Vector Machines, Unsupervised Learning, Image Processing, Mahout, Recommender Systems, Support Vector Machines (SVM), Random Forests, Latent Semantic Analysis, Sentiment Analysis / Opinion Mining, Latent Dirichlet Allocation, Predictive Models, Kernel Methods, Keras, Gradient boosting, OpenCV, Xgboost, Libsvm, Word2Vec, Chatbot, Machine Translation and Sentiment Classification

(Acemoglu et al. 2021)

3. AI roles are highly concentrated in a few key technology clusters, particularly Bangalore

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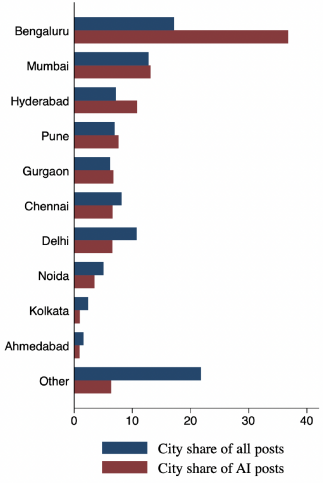
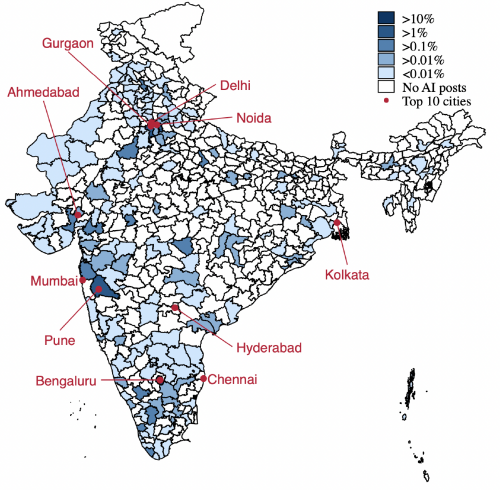
(a) Shares of posts across cities



(b) Share of all AI posts, by city, 2010-2019



4. AI roles are highly concentrated in the largest firms

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