

# AI, firms and wages: Evidence from India

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  - Advances in ML have reduced the cost of the task of ‘prediction’ (Agrawal et al. 2018)
  - Improved prediction could displace workers, but also expand employment through improved productivity or higher quality
  - AI could also create new tasks and new jobs ( $\Rightarrow$  GPT debate) (Brynjolfsson et al. 2017, Cockburn et al. 2018, Klinger et al. 2018, Goldfarb et al. 2020, Agrawal et al. 2021)

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(Acemoglu et al. 2021 in USA, Stapleton 2021 in UK)
- Yet the labour market effects of AI have important ramifications for a services-led development model (Baldwin 2019; Baldwin & Forslid 2020; Korinek & Stiglitz 2021)
- India is archetype of services-led growth  $\Rightarrow$  important context for understanding effects of AI on employment
  - E.g. IT-BPO sector currently employs 4 million people and contributes 8% of India's GDP (SESEI 2019)

# Overview of the paper

- What we do:
  - Investigate impact of AI on white-collar service sector using 15 million online vacancy posts from India's largest jobs website.
  - Measure firm-level demand for AI-related skills and document a rapid take-off in AI demand after 2016.
  - Exploit exogenous variation in exposure to advances in AI technologies to examine the labour market impacts of AI hiring.

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  - Measure firm-level demand for AI-related skills and document a rapid take-off in AI demand after 2016.
  - Exploit exogenous variation in exposure to advances in AI technologies to examine the labour market impacts of AI hiring.
- What we find:
  - 1% increase in the AI vacancy growth rate  $\Rightarrow$  3.6 percentage point decrease in establishment non-AI vacancy growth + 2.6 percentage point decrease in non-AI median wage offers over time.
  - These negative effects on wage growth appear across the wage distribution.

Intro

Data

Descriptives

Empirical Strategy

Results

Conclusion

## Three datasets

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- **Prowess:** Longitudinal balance sheet data on all publicly-listed and many large private Indian firms
- **Nationally-representative labour surveys:** National Sample Survey (2011-12) and Periodic Labour Force Survey (2017-18)

## Construction of the vacancy data

- Over 150,000 unique firms posted at least one vacancy between 2010 and 2019, with an average of 80 posts per firm



## Construction of the vacancy data

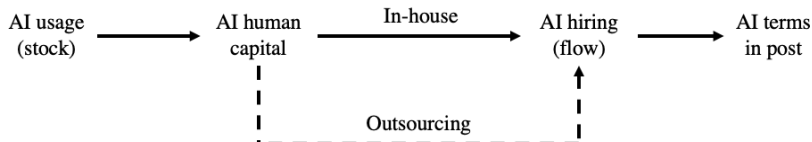
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- All posts include text data on the job title, industry, role category, location, skills required, salary and experience ranges and educational requirements
- We manually map roles and industries onto the 2004 National Classification of Occupations and 2008 National Industrial Classification, and locations to cities and districts

# Measuring AI demand

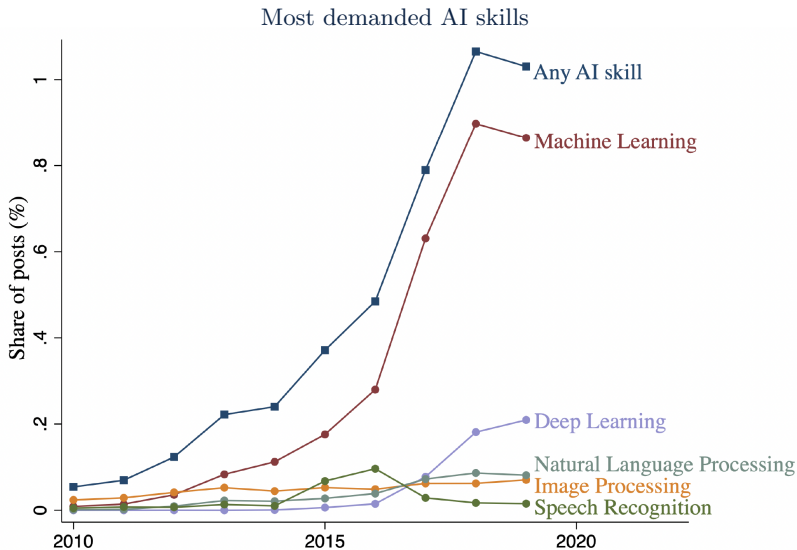
- Use AI hiring to proxy for AI usage  
(Rock 2019, Benzell et al. 2019, Acemoglu et al. 2021, Stapleton 2021)
- Exploit that primary method for sourcing AI capabilities is external hiring (McKinsey Global Institute 2019)
- Classify a post as an AI vacancy if it includes words from list of specific AI terms (Acemoglu & Restrepo 2018)



## Five descriptive findings

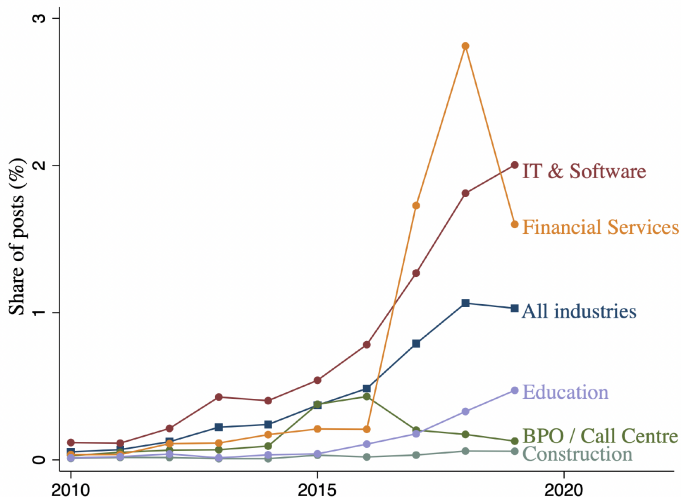
1. AI demand increased rapidly after 2016, particularly in the IT, finance, education and professional services sectors
2. AI roles require more education, but offer substantially higher wages than other white-collar services jobs
3. AI roles are highly concentrated in a few key technology clusters, particularly Bangalore
4. AI roles are highly concentrated in the largest 'superstar' firms
5. AI adoption can spur local AI diffusion, over and above industry and region trends, particularly in the IT sector

# AI demand increased rapidly after 2016



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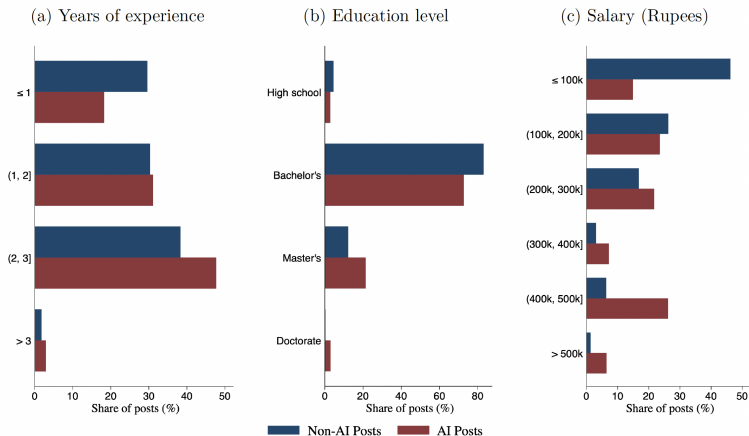
AI share of total posts, by industry



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



⇒ AI posts pay a 13% salary premium, even after controlling for education, experience, and detailed fixed effects (industry-region, industry-year, region-year, firm, occupation).

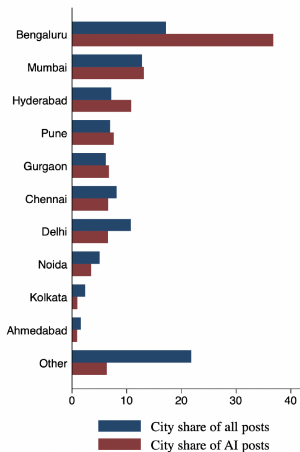


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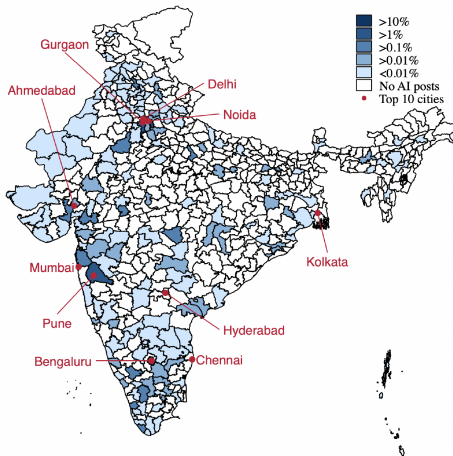
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# AI roles are highly concentrated in a few key technology clusters, particularly Bangalore

(a) Shares of posts across cities



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

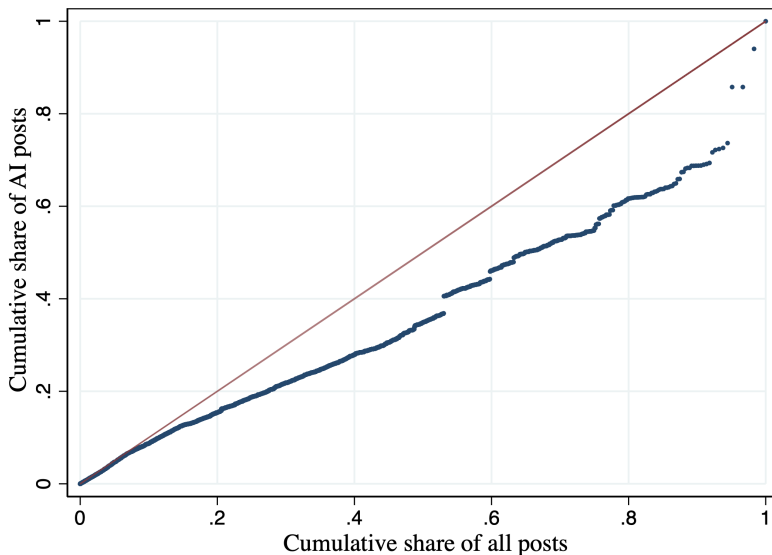


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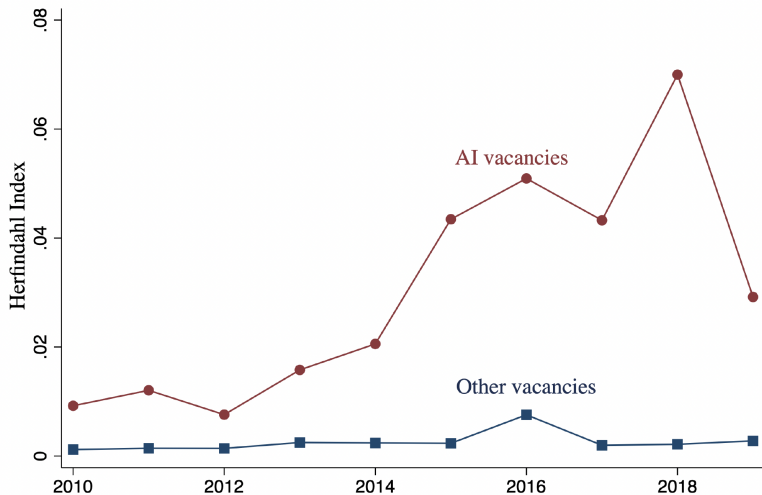
# AI roles are highly concentrated in the largest ‘superstar’ firms

Distribution of AI posts across all firms, 2010-2019



# AI roles are highly concentrated in the largest ‘superstar’ firms

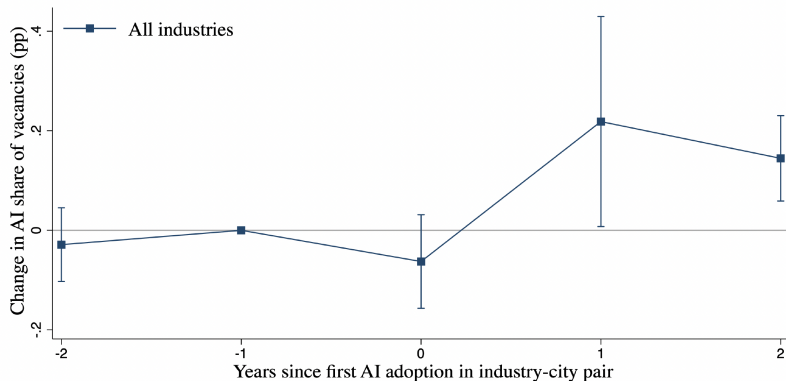
Firm concentration of AI posts, 2010-19



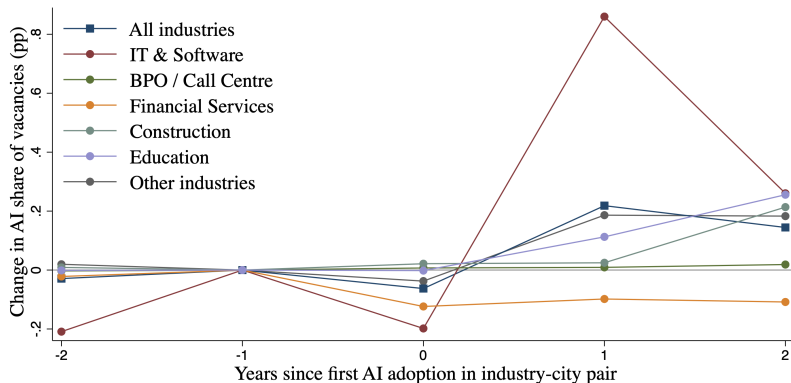
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## 2SLS with AI exposure as an instrument

$$\Delta y_{fr,t-t_0} = \beta \cdot \Delta Adoption_{fr,t-t_0} + \alpha_r + \alpha_i + \alpha_{f10} + \epsilon_{fr,t-t_0} \quad (1)$$

- Increasing the growth rate of AI demand by 1% between 2010-12 and 2017-19 causes a  $\beta$  **percentage point rise in the growth rate** of the outcome variable across the same time period.
- Our primary unit of analysis are **firm-city pairs** ('establishments') and we cluster standard errors at the firm level.
- Our main estimates therefore use 25,000 incumbent establishments posting 2 million vacancies.

## 2SLS with AI exposure as an instrument

$$\Delta Adoption_{fr,t-t_0} = \gamma \cdot Exposure_{fr,t_0} + \alpha_r + \alpha_i + \alpha_{f10} + \epsilon_{fr,t-t_0} \quad (2)$$

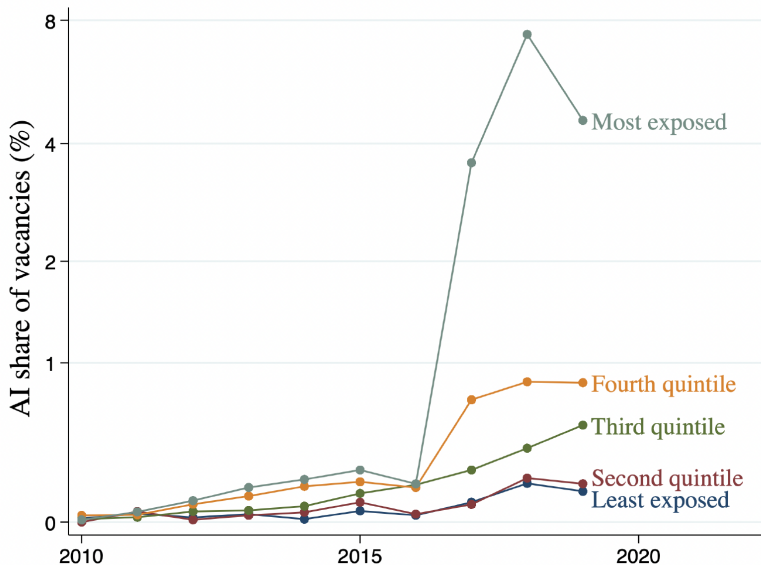
- We instrument AI demand by ‘AI exposure’ that captures plausibly exogenous improvements in the AI technological frontier.
- The Webb (2020) AI exposure measure captures the degree of overlap between workers’ tasks and tasks that can be performed by patented AI technologies.
- Occupations comprising more AI-automatable tasks are assigned a higher exposure measure.
- We use publicly-available crosswalks to map the Webb (2020) measure to 2004 NCO and aggregate to the establishment level.

# First stage: AI exposure predicts AI demand

## Impact of AI exposure on establishment AI demand

	Growth in AI Vacancies		
	(1)	(2)	(3)
Establishment AI Exposure	0.0170*** (5.13)	0.0193*** (5.21)	0.00607** (2.05)
<i>Fixed Effects:</i>			
– Region	✓	✓	✓
– Firm Decile	✓	✓	
– Industry		✓	
– Firm			✓
R <sup>2</sup>	.0341	.049	.3774
Observations	22,251	22,251	19,383

## First stage: AI share by exposure quintile



## Second stage: AI demand lowers growth in non-AI demand

	Growth in Non-AI Vacancies			Growth in Total Vacancies		
	(1)	(2)	(3)	(4)	(5)	(6)
Growth in AI Vacancies	-5.942*** (-3.66)	-3.605*** (-3.16)	-9.944* (-1.84)	-5.909*** (-3.64)	-3.566*** (-3.14)	-9.923* (-1.84)
<i>Fixed Effects:</i>						
– Region	✓	✓	✓	✓	✓	✓
– Firm Decile	✓	✓		✓	✓	
– Industry		✓			✓	
– Firm			✓			✓
First Stage F-Stat	26.31	27.17	4.185	26.31	27.17	4.185
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## Second stage: AI demand lowers non-AI wage growth

	Growth in Non-AI Median Wage			Growth in Overall Median Wage		
	(1)	(2)	(3)	(4)	(5)	(6)
Growth in AI Vacancies	-3.101*** (-3.47)	-2.599*** (-3.43)	-5.973* (-1.83)	-3.017*** (-3.50)	-2.527*** (-3.46)	-5.696* (-1.87)
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– Industry		✓			✓	
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First Stage F-Stat	25.64	26.39	4.294	26.84	27.71	4.602
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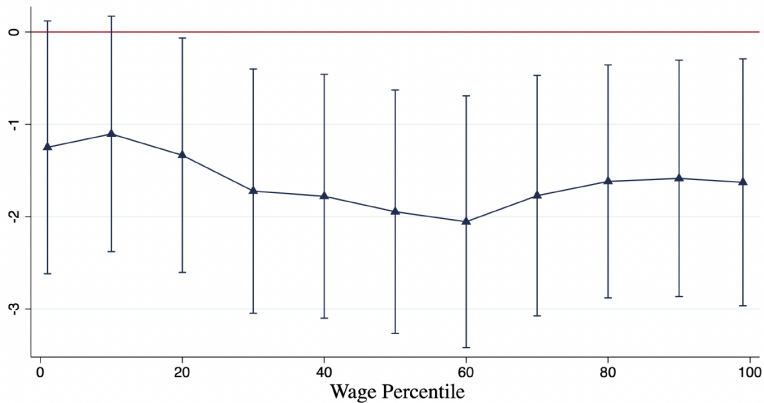
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✓ Robust to controlling for changes in education and experience (-1.933\*\*\*)

✓ Robust to mean wages

## Second stage: AI demand lowers non-AI wage growth



## Results are robust to:

1. Alternative exposure measures ✓
2. Weighting by baseline establishment size ✓
3. Alternative data sources ✓

# Conclusion

- Evidence that AI is a ‘double-edged sword’ for Indian white-collar services workers:
  - AI jobs pay a substantial wage premium, but are highly concentrated in certain industries, cities and ‘superstar’ firms.
  - Within incumbent establishments, AI adoption reduces the number of other job opportunities and the available salaries.  
(A 1% increase in the AI vacancy growth rate  $\Rightarrow$  3.6 percentage point decrease in establishment non-AI vacancy growth + 2.6 percentage point decrease in non-AI median wage offers over 2010-2019.)
- Further research: offsetting effects elsewhere?
  - New tasks? New firms?
  - Overall ‘creation’ > ‘destruction’?