AI Adoption and the Demand for Managerial Expertise

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The Transformative Power of AI (ECB)

Motivation


QuantumBlack
AI by McKinsey
The state of AI: How organizations are rewiring to capture value
March 12, 2025 | Survey
JULY 31, 2023
AI CASE STUDIES
Case Study: How AI is Transforming Procter & Gamble's Global Operations

This Paper

As firms adopt AI, is there a change in the role of managers in organizations?

Literature Gap

- **AI as a General Purpose Technology (GPT):** Klinger et al. (2018), Trajtenberg (2018), Goldfarb et al. (2019), McElheran et al. (2024).
- **AI, wages, and employment:** Alderucci et al. (2019), Felten et al. (2021), Alekseeva et al. (2021), Acemoglu et al. (2022).
- **AI and firm productivity and growth:** Brynjolfsson et al. (2021), Czarnitzki et al. (2023), Babina et al. (2024).
- **AI and worker productivity:** Lebovitz et al. (2022), Dell'Aqua et al. (2023), Toner-Rodgers (2024).
- **AI and Firm Transformation:** Research Gap.
  Dixon et al. (2023) - effect of robots on management.

Literature Gap - AI and Firm Transformation

- As a major technological shock, AI may substantially affect firm organization and managerial roles.
- Studying AI's impact on management helps to understand:
  - How firms reorganize to utilize the AI's potential,
  - Mechanisms of these changes: i.e., complementary skills.
- Prior research on the effect of technologies on managers shows contrasting results:
  - **Increase** in the demand for managers: communication technologies (Bloom et al., 2014);
  - **Decrease** in the demand for managers: information technologies, e.g., ERP (Bloom et al., 2014), digital collaboration tools (Gulati et al., 2023), and robots (Dixon et al. 2023).
- We aim to provide the first evidence into the changing role of managers in firms adopting AI.

Research Question

Big Q: As firms adopt AI, is there a change in the role of managers in organizations?

- Will companies replace managers or make them even more important?
- What skills will managers need when working with AI?
- What are employment and salary effects of AI adoption?

Predictions: Effect of AI on Demand for Managers

- (-) Simplifies task delegation and supervision (Gulati et al., 2023), e.g., by reducing workers' errors (Dixon et al., 2023);
- (-) Automates tasks previously requiring human supervision (Bloom et al., 2014);

- (+) Adds complexity, requiring additional oversight and coordination (Dell'Acqua et al., 2023; Ide and Talamas, 2023);
- (+) Requires additional checks of new outputs to mitigate risks and enhance reputation (Garicano and Wu, 2012; Dell'Acqua et al., 2023);
- (+) Requires workflow restructuring and process re-engineering (Garicano and Wu, 2012).

Main Findings

- AI adoption increases the relative demand for managers:
  - → Requiring a higher number of managerial positions;
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  - → Firms reduce the demand for routine administrative tasks (e.g., scheduling, budgeting) and physical abilities.

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  - → Firms reduce the demand for routine administrative tasks (e.g., scheduling, budgeting) and physical abilities.
- Managerial and non-managerial roles are becoming more valuable with higher AI adoption:
  - → Higher managerial salaries within firms;
  - → Higher non-managerial salaries;
  - → No decrease in non-managerial vacancies in the recent period.

Data

- Nearly universe of online job postings in the U.S., provided by Lightcast (e.g., Alekseeva et al., 2021, Goldfarb et al., 2023; Babina et al., 2024):
  - In 2010-2022: nearly 375 million vacancies;
  - Rich information on vacancies: title, employer, location, experience, salary, occupation code, **list of skills**;
  - Match with Compustat: 2.3k unique companies over multiple years, excluding IT and Professional Services firms.
- Skill-based definition of AI adoption:
  1. Estimate how often each skill co-occurs with unambiguous AI skills in vacancies;
  2. Estimate average co-occurrence ratio at a vacancy level, use 10% cutoff to define an AI vacancy (Babina et al., 2024);
  3. Verify robustness to other cutoffs and the bag-of-words method as in Alekseeva et al. (2021).

How AI-related is Each Skill?

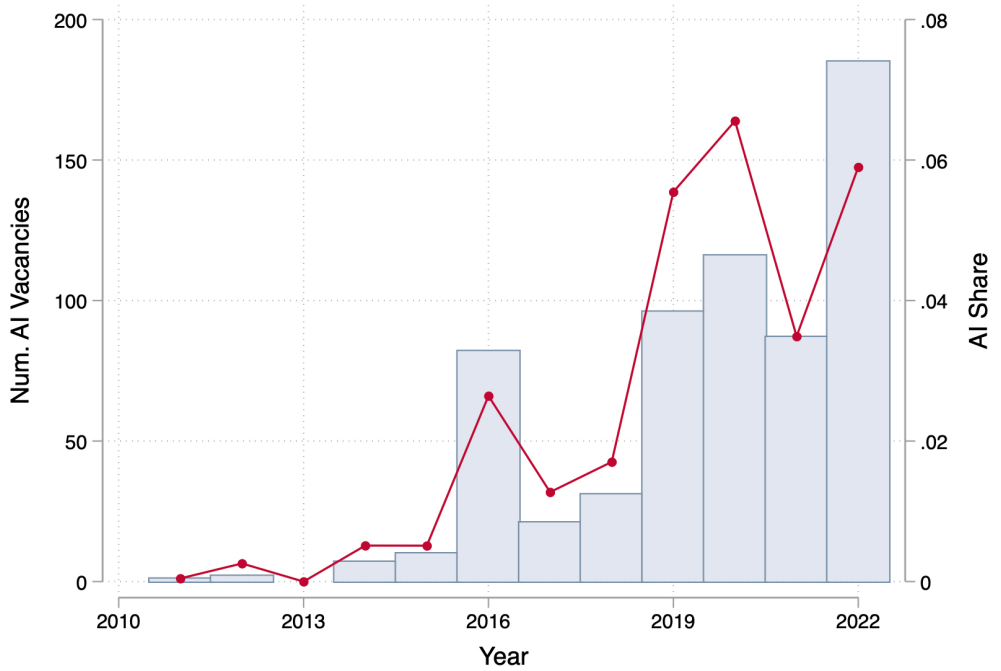
AI Co-occurrence Score	Skill
0.98	Sentiment Classification
0.91	Unsupervised Learning
0.60	Cluster Analysis
0.36	Web Scraping
0.36	Predictive Analytics
0.31	Salesforce Einstein
0.26	Big Data Analytics
0.22	Marketing Mix Modeling
0.17	Data Visualization
0.07	Facebook Insights
0.05	Supply Chain Data Analysis
0.04	Game Development
0.02	Automotive Engineering
0.01	Corporate Performance Measurement
0.01	Social Networking
0.01	Project Management
0.00	Corporate Communications
0.00	Microsoft Powerpoint
0.00	Internal Auditing
0.00	Electrical Engineering
0.00	Sales Goals

How AI-related is a Vacancy?

Final Score	AI-related? (1/0)	Job Title	N. Skills in Vacancy
0.95	1	Machine Learning Engineer	6
0.79	1	Data Scientist	12
0.69	1	Natural Language Processing Scientist	7
0.67	1	Computer Scientist	9
0.66	1	Director of Engineering	10
0.47	1	Principal Data Scientist	13
0.40	1	Product Designer	6
0.33	1	Software Engineering Manager	11
0.15	1	Applications Engineer	14
0.15	1	**Director of Sales**	7
0.11	1	Market Research Analyst	14
0.07	0	Software Development Engineer	15
0.07	0	Healthcare Operations Manager	15
0.07	0	Actuarial Analyst	10
0.03	0	Electrical Engineer	9
0.01	0	Marketing Specialist	6
0.01	0	Security Analyst	15
0.01	0	Laboratory Technician	7
0.01	0	E-Commerce Manager	6
0.00	0	**Director of Sales**	15

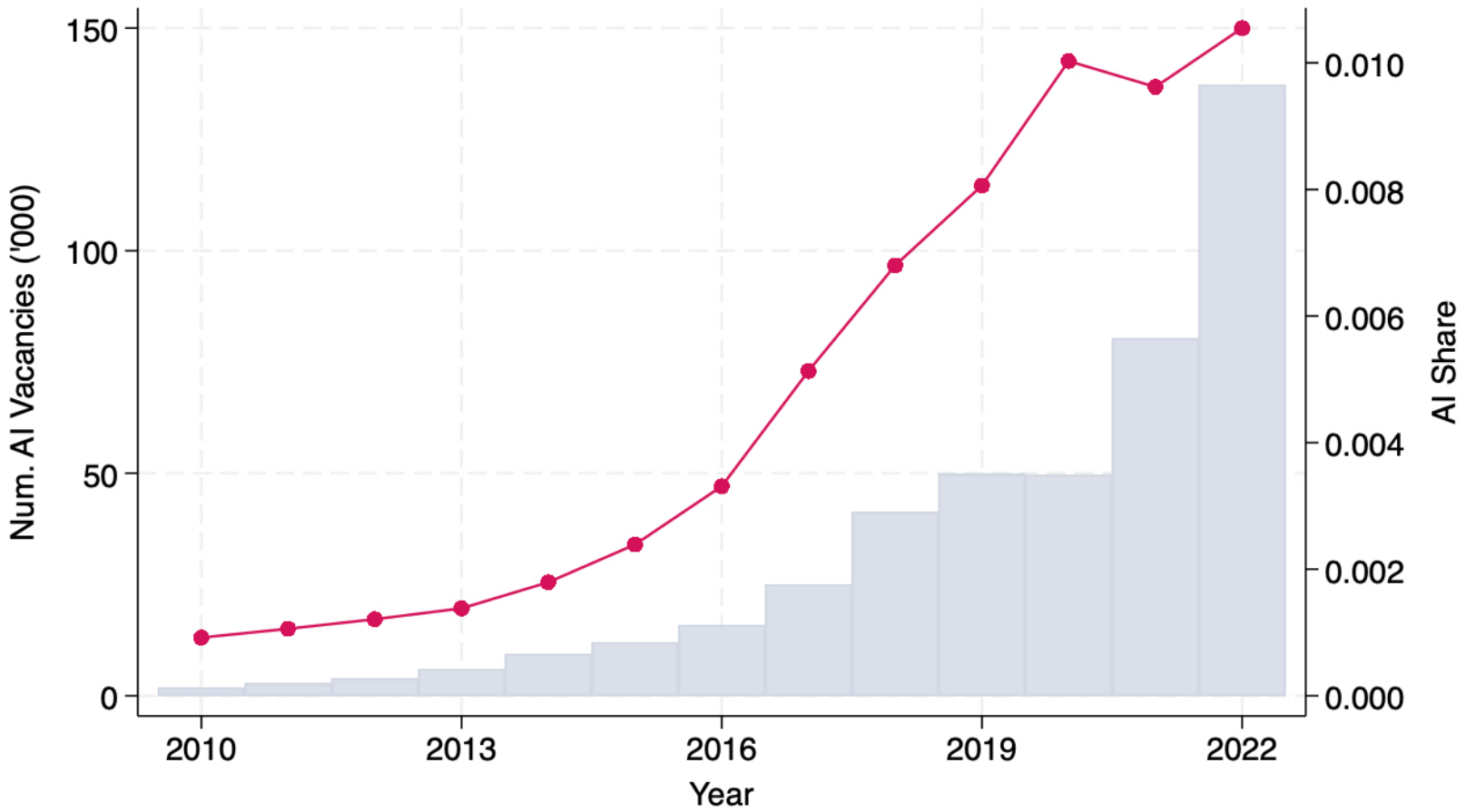
Firm-level Measure of AI Adoption - AI Share

Figure: **PROCTER & GAMBLE CO.: AI Hiring.**



$$\text{AI Share}_{i,t} = \frac{\text{Number of AI-related Job Postings}_{i,t}}{\text{Total Number of Job Postings}_{i,t}}$$

Average Demand for AI Vacancies in the Sample



▸ Keywords-based AI Share

Firm-level Measures of Managerial Intensity and Skills

$$\text{Managers Share}_{i,t} = \frac{\text{Num. Job Postings in Management Occupation}_{i,t}}{\text{Total Num. Job Postings}_{i,t}}$$

$$\text{Man. Skill } j \text{ Share}_{i,t} = \frac{\text{Num. Job Postings in Management Requiring Skill } j_{i,t}}{\text{Total Num. Job Postings in Management}_{i,t}}$$

Average Demand for Managers in the Sample

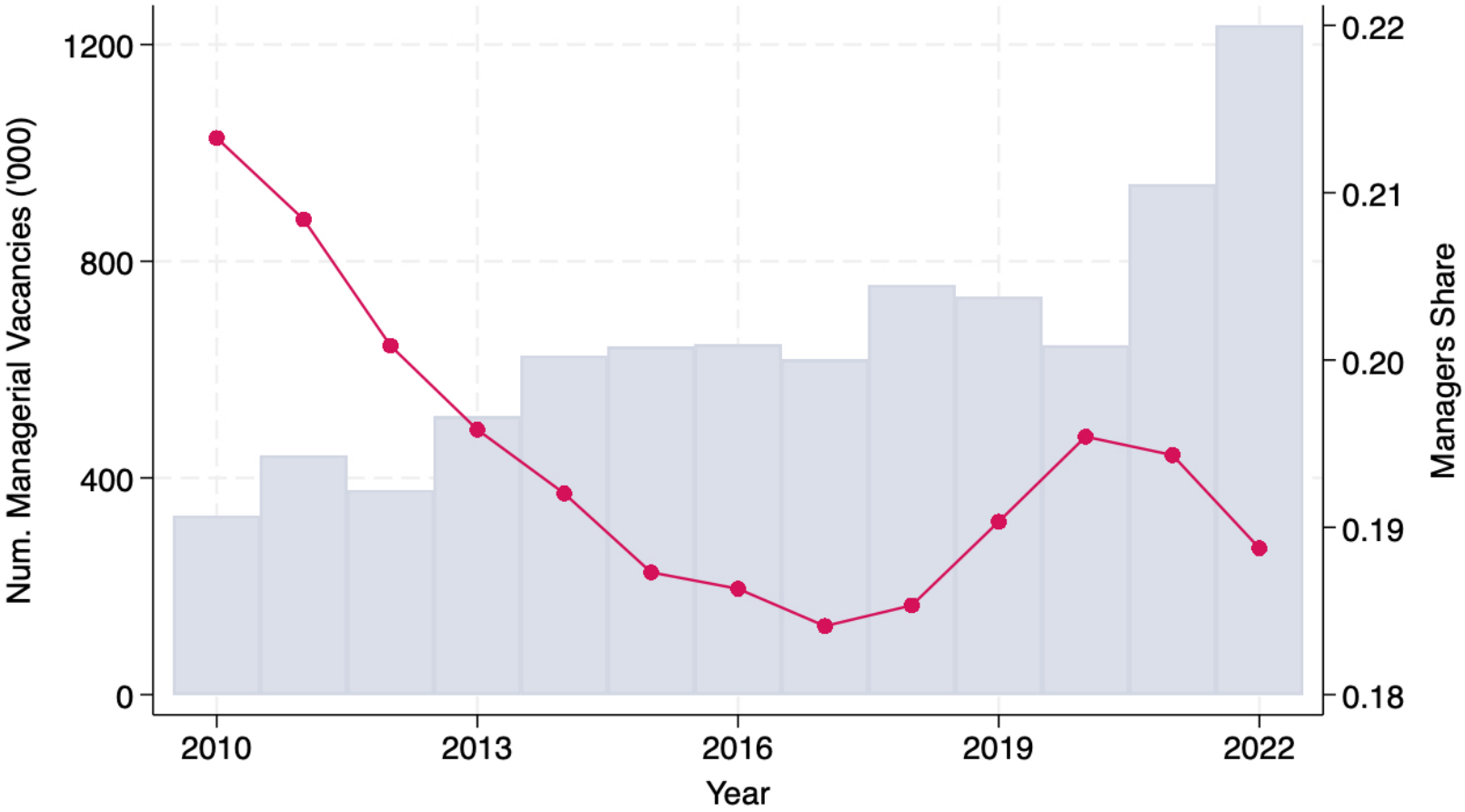


Table: **Summary statistics.**

	N co.	N obs.	Mean	SD	p(5)	p(95)
Vacancy-based Characteristics:						
AI Share	2,322	16,021	0.5%	1.3%	0.0%	2.6%
AI Vacancies	2,322	16,021	27	288	0	72
N Vacancies	2,322	16,021	4,001	12,977	149	16,513
Managers Share	2,322	16,021	19.1%	11.6%	4.3%	42.2%
N Managerial vacancies	2,322	16,021	510	1,567	35	2,017
Skill Shares within Managerial vacancies:						
Communication Skills	2,322	16,021	49.6%	20.9%	11.6%	84.1%
Budgeting	2,322	16,021	29.7%	17.5%	4.1%	62.6%
Planning	2,322	16,021	27.8%	15.6%	3.2%	55.6%
Teamwork / Collaboration	2,322	16,021	27.6%	19.2%	1.8%	64.1%
Project Management	2,322	16,021	22.3%	14.8%	1.1%	48.8%
Scheduling	2,322	16,021	18.4%	15.2%	1.6%	49.7%
Problem Solving	2,322	16,021	23.0%	16.3%	1.6%	54.3%
Microsoft Excel	2,322	16,021	23.5%	17.1%	2.3%	58.0%
Organizational Skills	2,322	16,021	19.1%	14.9%	2.1%	49.3%
Microsoft Office	2,322	16,021	19.4%	17.1%	0.9%	49.3%
Control Variables:						
Software Share	2,322	16,021	29.0%	20.0%	2.1%	65.8%
Sales (in thousand USD)	2,322	16,021	12,211	31,417	173	53,270
Employment (in thousand emp)	2,322	16,021	30.86	88.45	0.48	125.10
Cash/Assets	2,322	16,021	13.9%	16.9%	0.6%	53.6%
R&D/Sales	2,322	16,021	13.7%	82.9%	0.0%	28.0%

Estimation Strategy

$$\text{Managers Share}_{i,t} = \beta \text{AI Share}_{i,t} + \gamma X_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t}. \quad (1)$$

Managers Share$_{it}$ - share of managerial vacancies in a firm, *AI Share*$_{it}$ - main variable of interest, X_{it} is a vector of controls for company financial and operational characteristics, and δ_i and θ_t are firm and year fixed effects.

$$\text{Managerial Skill } j \text{ Share}_{i,t} = \beta \text{AI Share}_{i,t} + \gamma X_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t}. \quad (2)$$

Managerial Skill Share$_{it}$ - share of managerial vacancies requiring one of the top-100 managerial skills.

Identification Strategy

The IV measures the firm's exogenous exposure to AI adoption, based on the expected AI adoption by companies surrounding the focal firm.

$$B_{i,m,t} = \sum_{s=1}^{S} w_{m,s,0} \text{AI Share}_{s,t},$$

where $w_{s,m,0}$ is the pre-period (2010) share of industry s's employment in commuting zone m; $AI\ Share_{s,t}$ is the country-wide *AI Share* in industry sector s and time t (industry is 3-digit NAICS).

Result 1: Demand for Managers

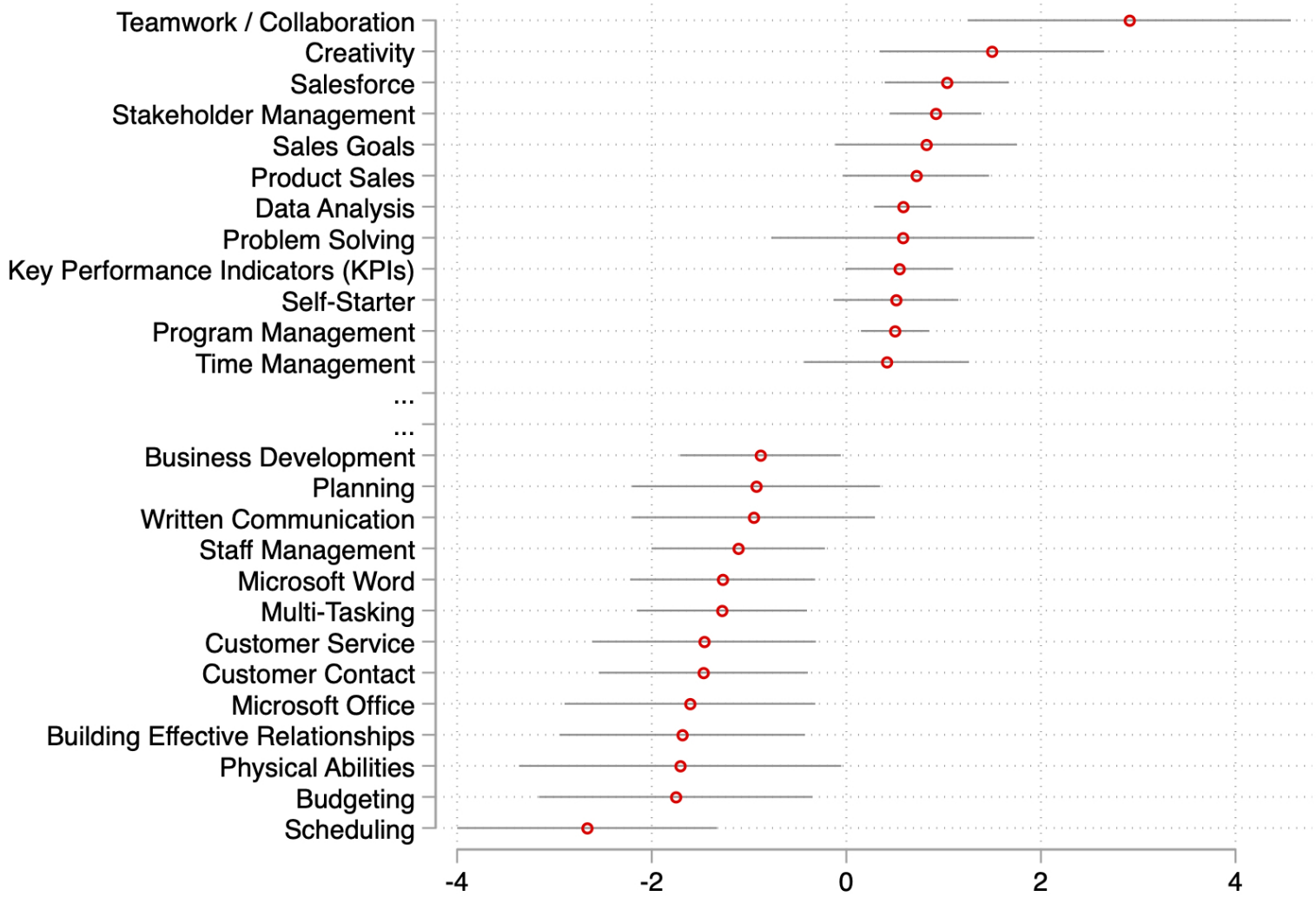
	Ln(Managerial vacancies)		Managers Share	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
AI Share	0.024***	0.072***	0.004***	0.014***
	(0.004)	(0.021)	(0.001)	(0.004)
Software Skills Share	0.629***	0.558***	0.074***	0.057***
	(0.057)	(0.072)	(0.010)	(0.013)
Ln(Sales)	0.054***	0.089***	0.007**	0.010***
	(0.012)	(0.019)	(0.003)	(0.004)
Ln(Employment)	0.105***	0.087***	0.012***	0.010**
	(0.021)	(0.025)	(0.004)	(0.005)
Cash/Assets	0.044	0.032	0.005	0.008
	(0.056)	(0.071)	(0.010)	(0.013)
R&D/Sales	0.018***	0.029	0.001	0.001
	(0.007)	(0.019)	(0.002)	(0.004)
Ln(Vacancies)	-0.019***	-0.039***	-0.003***	-0.005***
	(0.049)	(0.053)	(0.009)	(0.009)
Observations	15,977	13,331	15,977	13,331
R-squared	0.953		0.829	
F-stat for weak IV		87.10		87.10
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

▸ Subperiods ▸ Balanced Sample ▸ Exclude Top 5%

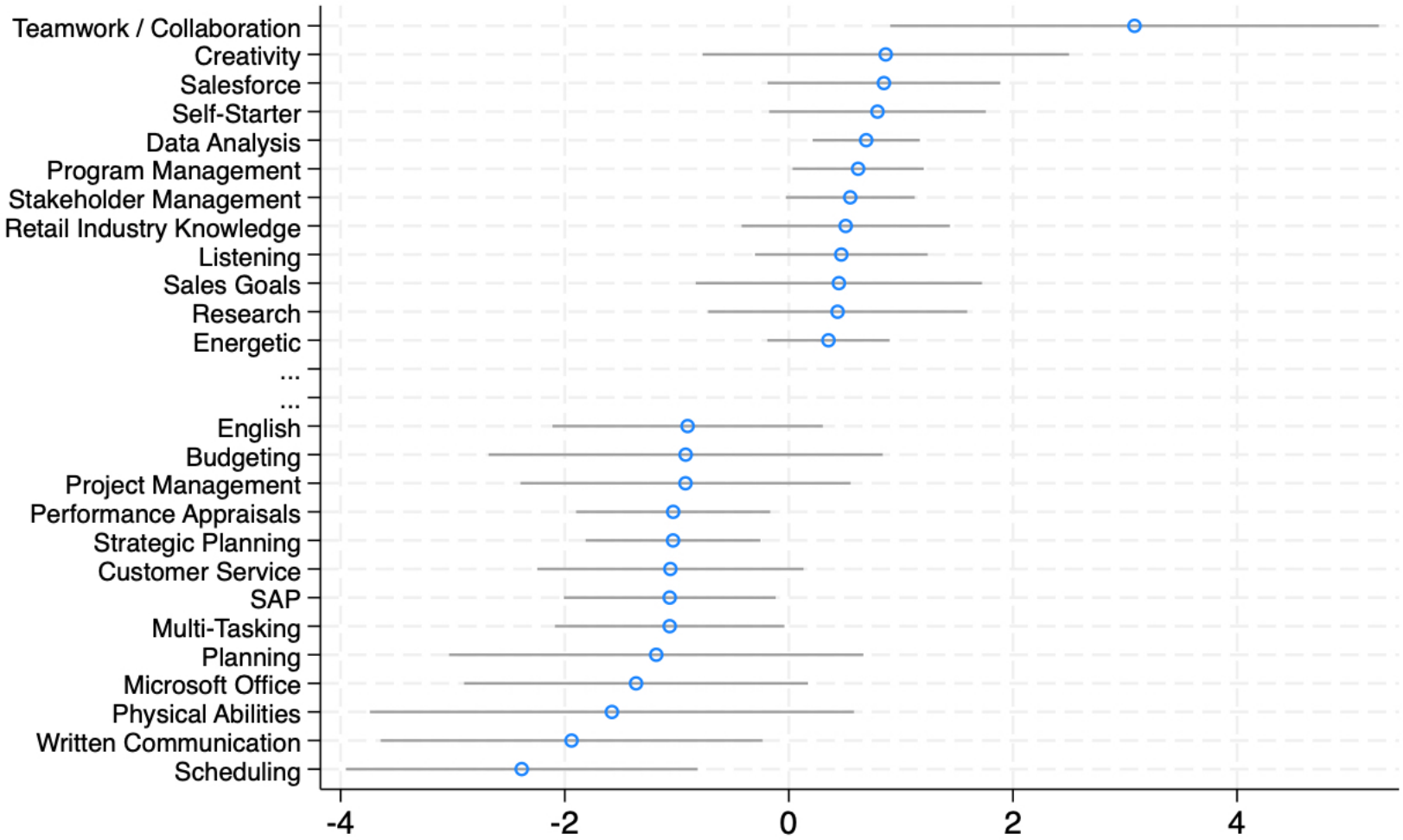
Result 1: Demand for Managers - Sectors

	Managers Share							
	Manufacturing		Finance		Retail & Wholesale Trade		Other	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
AI Share	0.005***	0.025***	0.002	0.009	0.002	-0.005	0.005***	0.014
	(0.001)	(0.007)	(0.002)	(0.010)	(0.002)	(0.010)	(0.002)	(0.014)
Observations	7,290	6,026	3,179	2,723	1,832	1,511	3,676	3,071
R-squared	0.855		0.758		0.775		0.783	
F-stat for weakIV		40		26.53		5.395		11.85
Controls	✓	✓	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓	✓	✓

Result 2: Demand for Managerial Skills



Result 2: Demand for Managerial Skills - Manufacturing



Result 3: Managerial Wages

	Log(Mgt Salary)		Ratio of Mgt to Non-Mgt Salaries (Professional Occ.)	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
AI Share	0.012**	0.068**	0.004	-0.017
	(0.005)	(0.029)	(0.010)	(0.049)
Observations	11,112	9,091	10,752	8,787
R-squared	0.450		0.281	
F-stat for weak IV		92.91		80.43
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

Result 3: Overall Demand for Labor (2011-2022)

	Ln(Vacancies)		Ln(Non-AI Vacancies)		Ln(Non-AI & Non-Mgt Vacancies)	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
AI Share	-0.019*	-0.076*	-0.032***	-0.090**	-0.042***	-0.119***
	(0.010)	(0.041)	(0.010)	(0.041)	(0.010)	(0.044)
Observations	15,977	13,331	15,977	13,331	15,977	13,331
R-squared	0.890		0.890		0.89	
F-stat for weak IV		89.03		89.03		89.03
Controls	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓

▸ Period 2016-2022

Summary of Results and Implications

- **Increase in demand for managerial roles**:
  - $\rightarrow$ Increase in the number and share of managerial positions.
- **Change in skill requirements**:
  - $\rightarrow$ Increase in the demand for cognitive and interpersonal skills;
  - $\rightarrow$ Reduced demand for routine administrative tasks.
- Managerial and non-managerial **salaries rise with AI adoption**.

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- **Change in skill requirements**:
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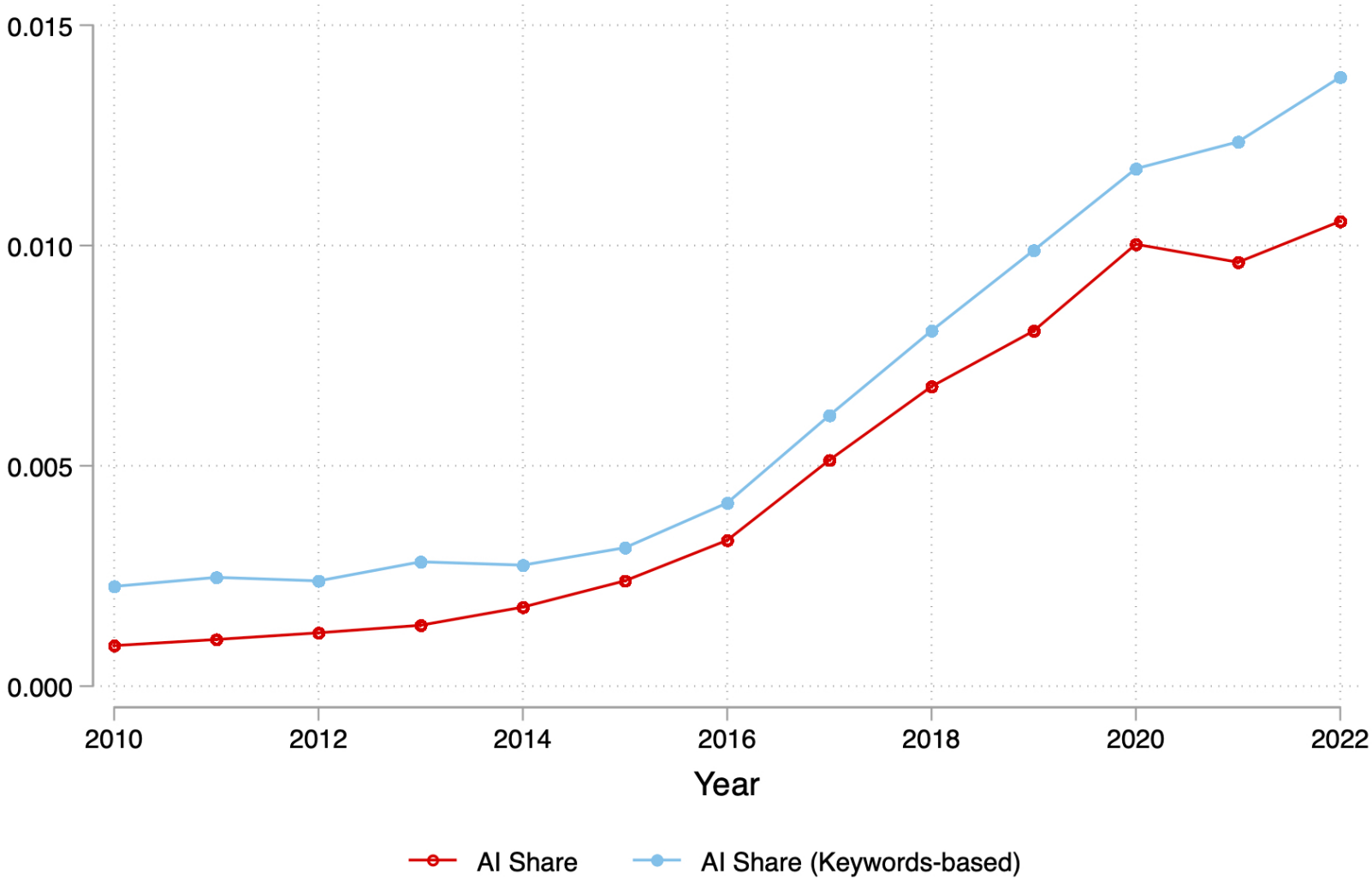
- Managerial and non-managerial **salaries rise with AI adoption**.
- AI adoption is not just a technology project, it is also a management challenge.

Appendix

Average AI Share in the Sample



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Result 1: Robustness to Excluding AI Managers

	Ln(Managerial vacancies)		Managers Share	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
AI Share	0.017***	0.063***	0.002***	0.013***
	(0.004)	(0.022)	(0.001)	(0.004)
Observations	15,977	13,331	15,977	13,331
R-squared	0.952		0.829	
F-stat for weak IV		87.10		87.10
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

▸ Back

Result 1: Robustness to Excluding Top-5% by AI Share

	Ln(Managerial vacancies)		Managers Share	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
AI Share	0.046***	0.156***	0.008***	0.033***
	(0.008)	(0.051)	(0.001)	(0.010)
Observations	15,145	12,676	15,145	12,676
R-squared	0.951		0.832	
F-stat for weak IV		114		114
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

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Result 1: Robustness to Keeping a Balanced Sample

	Ln(Managerial vacancies)		Managers Share	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
AI Share	0.024***	0.061***	0.003***	0.010**
	(0.006)	(0.023)	(0.001)	(0.004)
Observations	6,288	6,264	6,288	6,264
R-squared	0.954		0.796	
F-stat for weak IV		63.31		63.31
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

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Result 1: Demand for Managers - Subperiods

	Ln(Managerial vacancies)		Managers Share	
	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)
Panel A: 2011-2015 period				
AI Share	0.040**	0.357**	0.006*	0.045*
	(0.017)	(0.147)	(0.003)	(0.026)
Observations	5,613	5,345	5,613	5,345
R-squared	0.964		0.846	
F-stat for weak IV		32.49		32.49
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓
Panel B: 2016-2022 period				
AI Share	0.015***	0.101***	0.002***	0.023***
	(0.005)	(0.033)	(0.001)	(0.006)
Observations	10,049	9,213	10,049	9,213
R-squared	0.965		0.882	
F-stat for weak IV		62.96		62.96
Controls	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓
Year FE	✓	✓	✓	✓

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Result 3: Demand for Labor (2016-2022)

	Ln(Vacancies)		Ln(Non-AI Vacancies)		Ln(Non-AI or Non-Mgt Vacancies)	
	OLS	IV	OLS	IV	OLS	IV
	(1)	(2)	(3)	(4)	(5)	(6)
AI Share	0.024**	0.073	0.012	0.061	0.005	0.024
	(0.010)	(0.055)	(0.010)	(0.055)	(0.010)	(0.060)
Observations	10,049	9,213	10,049	9,213	10,049	9,213
R-squared	0.927		0.927		0.928	
F-stat for weak IV		63.33		63.33		63.33
Controls	✓	✓	✓	✓	✓	✓
Firm FE	✓	✓	✓	✓	✓	✓
Year FE	✓	✓	✓	✓	✓	✓

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