

AI Diffusion Within Multinationals

Work in Progress

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Making AI work – 26 January 2026

Note: the views expressed here are those of the authors and cannot be attributed to any of the above institutions.

Motivation

- AI adoption and diffusion are highly uneven across firms, and countries. MNEs are big players in the AI revolution.
- We still do not know much about, e.g.,:
 - ▶ AI adoption by MNEs
 - ▶ how AI diffuses within multinational firms
 - ★ how much does distance matter?
- Evidence from previous waves of digitalisation suggests that MNEs were critical as early adopters but also as vectors of cross-country diffusion, of both technologies and best practices across borders.
(Bloom, Sadun and Van Reenen, 2012)

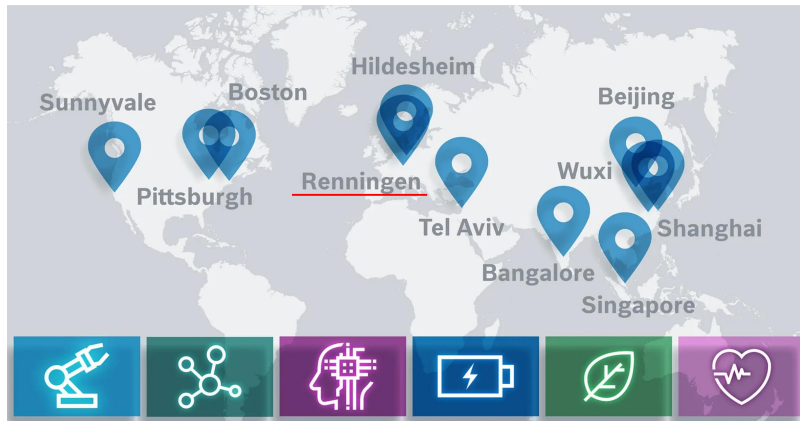
Research questions

- Where do MNEs first adopt AI?
- How does AI then diffuse within MNEs?

Stylised facts on MNEs' AI adoption and diffusion dynamics and which factors can explain adoption and diffusion within MNEs

Anecdotal evidence: The Bosch Case

Bosch's worldwide research and advance engineering locations



Source: <https://www.bosch.com/research/about-bosch-research/research-locations/>

Anecdotal evidence: The Bosch Case

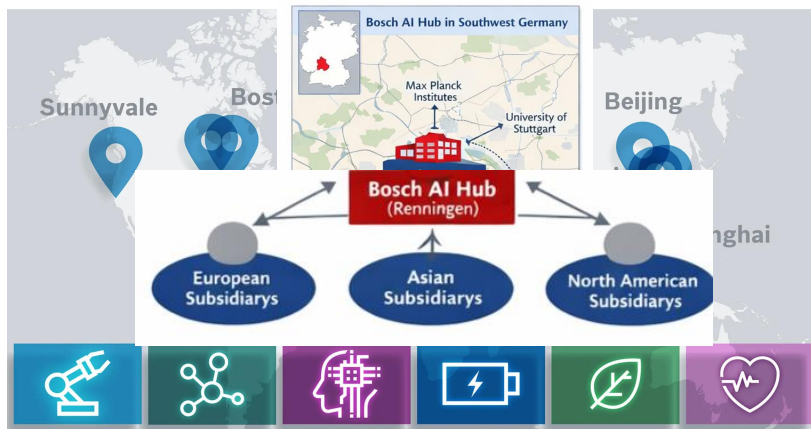
Bosch's Renningen AI Hub



Source: Authors' elaborations based on <https://www.bosch-presse.de/pressportal/de/en/on-the-path-toward-zero-defect-production-with-bosch-ai-225472.html>

Anecdotal evidence: The Bosch Case

Bosch's Roll-out of AI systems



Source: Authors' elaborations based on <https://www.bosch-presse.de/pressportal/de/en/on-the-path-toward-zero-defect-production-with-bosch-ai-225472.html>

Data and Stylised Facts

Data: Spiceworks

- Commercial database (formerly known as Harte Hanks)
- IT usage dummies at establishment level (AI = Machine Learning, Cloud = IaaS, ERP ...), basic financial and location info.
- Widely used in the literature (e.g., Bresnahan, Brynjolfsson, and Hitt (2002); Brynjolfsson and Hitt (2003); De Stefano, Kneller, and Timmis (2018); Cao and Iansiti (2022); Oikonomou, Pierri, and Timmer (2023))
- This work: Balanced panel of establishments and their parent firms (i.e. MNEs) between 2016-2022
- 30 countries (ARG, AUS, AUT, BEL, BRA, CHE, CHN, CZE, DEU, DNK, ESP, FIN, FRA, GBR, HUN, IND, IRL, ITA, JPN, LUX, MEX, NLD, NOR, NZL, POL, PRT, SVK, SWE, THA, USA)
- 30,000 MNEs and their establishments
- Geocoded addresses to measure proximity to “AI science” from OpenAlex [Details](#)

Local AI Research Exposure: OpenAlex Data

OpenAlex (<https://openalex.org/>) open-access bibliographic catalogue covering over **200 million** scholarly works worldwide. Classified into 4,500 topics, **250 sub-fields**. **Focus on sub-fields** :

- Artificial Intelligence (**Our instrument**),
- Veterinary medicine (**Placebo test**).

Focus on works before our sample period (2000–2015).

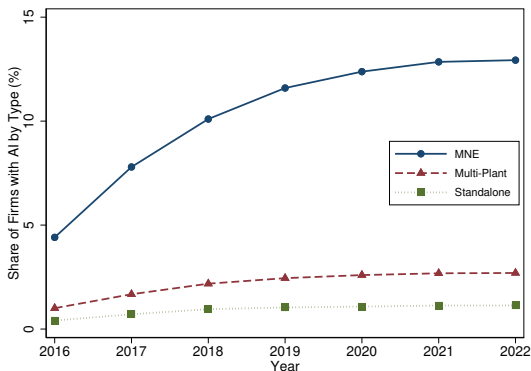
Establishment Proximity to AI Research: Number of AI research institutions located within:

- 0–50 km
- 50–100 km
- 100–200 km

Robust to top quartile institutions, # of publications, citations

Fact 1 – AI (Machine Learning) Use Is More Prevalent Among MNEs Than Among Domestic Multi- and Single-Plant Firms

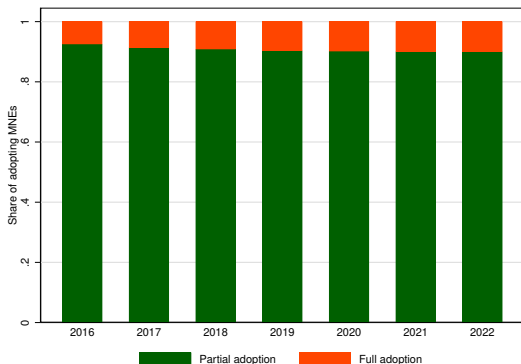
Share of Firms with AI by Firm Type (2016–2022)



Notes: The figure displays the yearly share of firms using AI, distinguishing between firm types: standalone firms (i.e., single-plant), multi-plant domestic firms, and multi-plant multinational firms (MNEs). Each firm is represented

Fact 2 – Within MNEs, adoption is incomplete

Within-MNE AI Adoption (2016-2022): Full vs. Partial

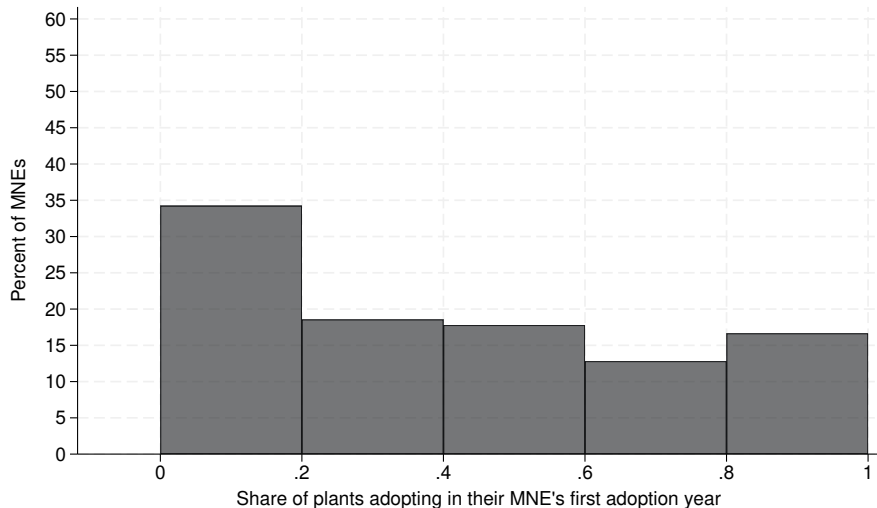


Notes: Among the MNEs using AI, the figure displays the share of firms using AI in all plants (full adoption) as compared to partial use across plants (partial adoption).

Source: Authors' elaboration based on Spiceworks data.

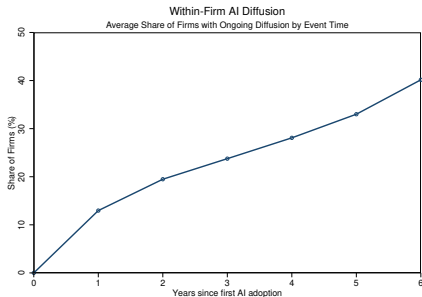
Fact 3 – AI Adoption Is Typically Piloted Within MNEs

Few Establishments Adopt in the First Year of MNE Use

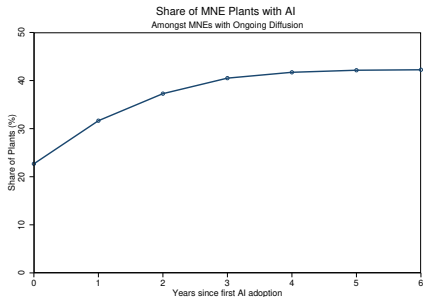


Fact 4 – AI Diffuses Over Time Within MNEs

AI Diffusion within MNEs



A: Share of MNEs displaying diffusion



B: Scale of internal diffusion

Notes: Panel A plots the average share of MNEs with ongoing within-MNE AI diffusion by event time, where event time is defined relative to the first year of AI adoption (event time 0). The sample includes multinational enterprises (MNEs) that adopt AI. At each event time, the share reflects the cumulative fraction of MNEs that have expanded AI use beyond the initially adopting establishments. Averages are computed across adoption cohorts and weighted by cohort size. Panel B displays, for each event period, the cross-MNE average of the cumulative ratio of establishments that have newly adopted up to that event time relative to the initial adopting establishments.

Source: Authors' elaboration based on Spiceworks data.

Drivers of adoption

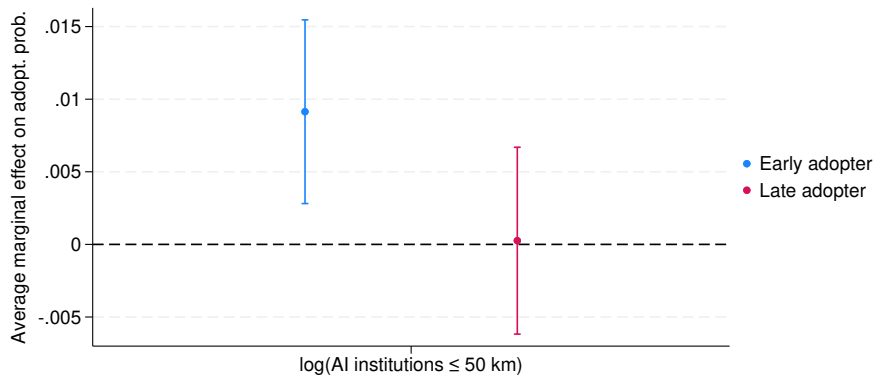
Which establishments adopt earlier?

$$\text{Early Adopter}_i = \beta_1 \log(\text{AI Inst.}_i^{\leq 50\text{km}}) + \beta_2 \text{ERP}_i + \beta_3 \text{Cloud}_i + \mathbf{X}'_i \gamma + \text{FE}_{\text{CS}} + \varepsilon_i$$

	(1)	(2)	(3)	(4)
	Early AI adopter			
log(AI inst. count \leq 50 km)	0.0114*** (0.00173)	0.00877*** (0.00201)	0.0129*** (0.00201)	0.00747*** (0.00198)
ERP		0.377*** (0.0150)		0.382*** (0.0150)
Cloud		0.205*** (0.0105)		0.207*** (0.0103)
Size: 1-9			0.00827 (0.0111)	0.0150 (0.0117)
Size: 50-249			0.0248** (0.0113)	0.00164 (0.00928)
Size: 250+			0.0554*** (0.0119)	-0.0125 (0.0117)
Age: 6-10			0.0753*** (0.0245)	0.0400 (0.0252)
Age: 11+			0.0670** (0.0267)	0.0148 (0.0273)
City distance	No	Yes	Yes	Yes
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

- Notes: Early AI adoption reflects establishments adopting AI in the first year of MNE-level adoption

Proximity to science matters only for early adopters



Notes: Average marginal effects from a multinomial logit model of AI adoption timing within multinational enterprises (MNEs), 2016–2022. Early adopters adopt in the first year of MNE-level adoption; late adopters adopt thereafter. The omitted category is establishments that never adopt. The main regressor is the log number of AI research institutions within 50 km of the establishment. Controls include establishment size and age, ERP and cloud adoption in 2016, distance to the nearest city, and country fixed effects. Standard errors are clustered at the region–sector level. 95% confidence intervals shown.

Diffusion dynamics within MNEs

VERY PRELIMINARY

Within-MNE Dynamics –preliminary

- Second Stage:

$$\Delta AI_j = \beta_1 \text{Early Adopter}_i + \beta_2 \text{ERP}_j + \beta_3 \text{Cloud}_j + X_j' \beta + FE_{cs} + \varepsilon_j$$

- IV First Stage for Early Adopter (see previous slide)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	ΔAI_j		ΔAI_j		ΔAI_j		ΔAI_j	
	OLS	IV	OLS	IV	OLS	IV	OLS	IV
Early Adopter _i	0.361*** (0.006)	0.732*** (0.066)	0.382*** (0.007)	0.710*** (0.070)	0.252*** (0.006)	0.660*** (0.074)	0.237*** (0.010)	0.632*** (0.072)
× Same Industry _{ij}	0.109*** (0.010)	-0.051 (0.180)						
× Same Country _{ij}			0.060*** (0.008)	0.030 (0.122)				
× Both Cloud _{ij}					0.457*** (0.009)	0.077 (0.118)		
× Both Cloud&Same Vendor _{ij}							0.593*** (0.013)	0.251** (0.117)
Kleibergen–Paap F Statistic	N/A	2446.2	N/A	2076.2	N/A	2007.6	N/A	2294.3
Observations	18,880,618	18,880,618	18,880,618	18,880,618	18,880,618	18,880,618	18,880,618	18,880,618

- Notes: All regressions include City Distance, Age & Size, Cloud & ERP controls as well as country-sector fixed effects for both sending and receiving establishments.

Conclusions and implications

Preliminary Discussion and conclusions

- AI is first piloted in a few establishments and partially diffused to the rest of the MNE
- Early adopters are **close to AI knowledge & have pre-existing complementary technologies**
 - ▶ Importance of proximity to external "frontier" AI knowledge
- Closeness to AI knowledge does not correlate with later diffusion of AI within MNEs
 - ▶ MNEs as "bridges" for technology diffusion to non-frontier locations
- Importance of complementarities
 - ▶ ERP & Cloud

Appendix

Appendix – Descriptives

Establishment Characteristics	
	Mean
ΔAI_i	0.05
$\Delta \bar{AI}_{-i}$ (all peers)	0.05
$\log(\text{AllInst}_{r(j)}^{\leq 50\text{km}})_{-i}$ (all peers)	4.41
Number of peers	11.32
Number of countries	3.45
Number of industries (3-digit)	3.74
Cloud	0.18
ERP	0.15
Age (years)	21.85
Employment	102.19

Placebo test - proximity to veterinary medicine research

	(1) ΔAI_i	(2) ΔAI_i	(3) ΔAI_i
log(AI inst. count \leq 50 km)	0.00275*** (0.000227)		0.00334*** (0.000465)
log(VM inst. count \leq 50 km)		0.00245*** (0.000229)	-0.000730 (0.000474)
Obs.	505658	505569	505569
R-squared	0.161	0.161	0.161
FE c \times s	Yes	Yes	Yes
City distance	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs
i	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022

Appendix — Excluding 2016 Cohort

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00276** (0.00129)	0.00279*** (0.000890)	0.00651*** (0.00110)	0.00355*** (0.000907)
1{ERP = 1}		0.309*** (0.0192)		0.306*** (0.0192)
1{Cloud = 1}		0.149*** (0.0208)		0.147*** (0.0204)
Size: 1-9			0.0119 (0.0225)	-0.000137 (0.0105)
Size: 50-249			0.0248 (0.0194)	-0.000684 (0.0147)
Size: 250+			0.0613** (0.0260)	-0.00414 (0.0321)
Age: 6-10			0.00263 (0.00325)	-0.00364 (0.00294)
Age: 11+			0.00869 (0.00775)	-0.00250 (0.00565)
Obs.	546460	546460	546460	546460
R-squared	0.146	0.352	0.160	0.353
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2017-2022	2017-2022	2017-2022	2017-2022

Clustered standard errors at the c \times s level

Weighting

Distance Measures

Publications

Citations

Placebo Tests

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Appendix — Weighting Scheme (No Weighting)

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00294*** (0.000210)	0.00316*** (0.000191)	0.00640*** (0.000216)	0.00391*** (0.000191)
1{ERP = 1}		0.305*** (0.00126)		0.302*** (0.00127)
1{Cloud = 1}		0.133*** (0.00120)		0.130*** (0.00120)
Size: 1–9			0.00712*** (0.00150)	-0.00116 (0.00130)
Size: 50–249			-0.00132 (0.00141)	-0.0146*** (0.00128)
Size: 250+			0.0279*** (0.00208)	-0.0227*** (0.00190)
Age: 6–10			0.00421** (0.00184)	-0.00224 (0.00168)
Age: 11+			0.0152*** (0.00151)	0.00192 (0.00138)
Obs.	505658	505658	505658	505658
R-squared	0.148	0.341	0.163	0.343
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

Clustered standard errors at the c \times s level

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Appendix — Distance Measures

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00504*** (0.00171)	0.00273* (0.00146)	0.00850*** (0.00196)	0.00379** (0.00152)
log(50 km < AI inst. count \leq 100 km)	-0.00140 (0.00104)	0.000652 (0.000858)	0.000203 (0.000989)	0.000916 (0.000805)
log(100 km < AI inst. count \leq 200 km)	-0.00144 (0.00177)	0.000356 (0.00153)	-0.000243 (0.00191)	0.0000315 (0.00163)
1{ERP = 1}		0.359*** (0.0190)		0.354*** (0.0180)
1{Cloud = 1}		0.185*** (0.0296)		0.183*** (0.0280)
Size: 1-9			-0.0293* (0.0166)	-0.0338* (0.0198)
Size: 50-249			0.00853 (0.0270)	-0.0215 (0.0274)
Size: 250+			0.0573 (0.0448)	-0.0218 (0.0507)
Age: 6-10			0.0102 (0.00732)	-0.00383 (0.00338)
Age: 11+			0.00678 (0.0112)	-0.00680 (0.00819)
Obs.	614088	614088	614088	614088
R-squared	0.198	0.428	0.218	0.431
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

Clustered standard errors at the c \times s level

Appendix — Publications

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI publ. sum \leq 50 km)	0.00275** (0.00107)	0.00255*** (0.000763)	0.00615*** (0.00117)	0.00328*** (0.000794)
1{ERP = 1}		0.359*** (0.0190)		0.354*** (0.0180)
1{Cloud = 1}		0.185*** (0.0295)		0.183*** (0.0280)
Size: 1–9			-0.0290* (0.0166)	-0.0336* (0.0198)
Size: 50–249			0.00832 (0.0269)	-0.0215 (0.0274)
Size: 250+			0.0575 (0.0447)	-0.0218 (0.0506)
Age: 6–10			0.0101 (0.00727)	-0.00383 (0.00338)
Age: 11+			0.00656 (0.0112)	-0.00688 (0.00818)
Obs.	614088	614088	614088	614088
R-squared	0.198	0.428	0.218	0.431
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016–2022	2016–2022	2016–2022	2016–2022

Clustered standard errors at the c \times s level

Appendix — Citations

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI cit. sum \leq 50 km)	0.00195** (0.000881)	0.00197*** (0.000610)	0.00456*** (0.000961)	0.00251*** (0.000632)
1{ERP = 1}		0.359*** (0.0190)		0.354*** (0.0180)
1{Cloud = 1}		0.185*** (0.0295)		0.183*** (0.0279)
Size: 1–9			-0.0288* (0.0166)	-0.0334* (0.0198)
Size: 50–249			0.00821 (0.0269)	-0.0216 (0.0273)
Size: 250+			0.0577 (0.0447)	-0.0217 (0.0506)
Age: 6–10			0.0101 (0.00724)	-0.00385 (0.00337)
Age: 11+			0.00641 (0.0111)	-0.00694 (0.00817)
Obs.	614088	614088	614088	614088
R-squared	0.198	0.428	0.217	0.431
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016–2022	2016–2022	2016–2022	2016–2022

Clustered standard errors at the c \times s level

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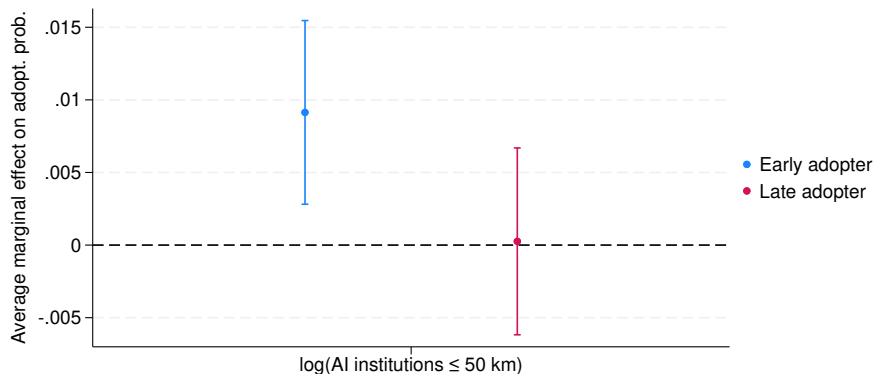
Appendix — Placebo Tests

	(1)	(2)	(3)
	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00420*** (0.00102)		0.00617*** (0.00193)
log(VM inst. count \leq 50 km)		0.00384*** (0.00107)	-0.00246 (0.00190)
Obs.	614088	613991	613991
R-squared	0.431	0.431	0.431
FE c \times s	Yes	Yes	Yes
City distance	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs
i	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022
controls	Yes	Yes	Yes

Clustered standard errors at the c \times s level

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Appendix — Multinomial Logit, main AME



Notes: Average marginal effects from a multinomial logit model of AI adoption timing within multinational enterprises (MNEs), 2016–2022.

Early adopters adopt in the first year of MNE-level adoption; late adopters adopt thereafter. The omitted category is establishments that never adopt.

The main regressor is the log number of AI research institutions within 50 km of the establishment.

Controls include establishment size and age, ERP and cloud adoption in 2016, distance to the nearest city, and country fixed effects.

Standard errors are clustered at the region–sector level. 95% confidence intervals shown.

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Appendix — Weighting Scheme

	(1)	(2)	(3)	(4)
	Early AI adopt.	Early AI adopt.	Early AI adopt.	Early AI adopt.
log(AI inst. count \leq 50 km)	0.0115*** (0.00175)	0.00885*** (0.00207)	0.0129*** (0.00207)	0.00763*** (0.00207)
1{ERP = 1}		0.375*** (0.0142)		0.379*** (0.0144)
1{Cloud = 1}		0.205*** (0.0107)		0.207*** (0.0105)
Size: 1-9			0.00835 (0.0107)	0.0116 (0.0117)
Size: 50-249			0.0220* (0.0113)	-0.00223 (0.00906)
Size: 250+			0.0537*** (0.0117)	-0.0148 (0.0112)
Age: 6-10			0.0720*** (0.0245)	0.0404 (0.0251)
Age: 11+			0.0702** (0.0273)	0.0193 (0.0279)
Obs.	390799	390799	390799	390799
R-squared	0.074	0.303	0.078	0.304
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

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Appendix — Distance Measures

	(1)	(2)	(3)	(4)
	Early AI adopt.	Early AI adopt.	Early AI adopt.	Early AI adopt.
log(AI inst. count \leq 50 km)	0.00549*** (0.00174)	0.00382** (0.00163)	0.00852*** (0.00196)	0.00478*** (0.00163)
log(50 km < AI inst. count \leq 100 km)	-0.00189** (0.000941)	-0.000893 (0.000817)	-0.00113 (0.000833)	-0.000798 (0.000768)
log(100 km < AI inst. count \leq 200 km)	-0.00224 (0.00164)	-0.000140 (0.00110)	-0.00159 (0.00134)	-0.000430 (0.00103)
1{ERP = 1}		0.319*** (0.0307)		0.319*** (0.0292)
1{Cloud = 1}		0.178*** (0.0255)		0.178*** (0.0249)
Size: 1–9			-0.0154 (0.0156)	-0.0221 (0.0208)
Size: 50–249			-0.0442 (0.0387)	-0.0674* (0.0400)
Size: 250+			-0.0346 (0.0554)	-0.102 (0.0687)
Age: 6–10			0.0306** (0.0131)	0.0124* (0.00700)
Age: 11+			0.0198 (0.0202)	0.00554 (0.0182)
Obs.	390799	390799	390799	390799
R-squared	0.143	0.341	0.153	0.346
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample i				
Adoption between period	Plant 2016-2022	Plant 2016-2022	Plant 2016-2022	Plant 2016-2022

Clustered standard errors at the c \times s level

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Appendix — Publications

	(1)	(2)	(3)	(4)
	Early AI adopt.	Early AI adopt.	Early AI adopt.	Early AI adopt.
log(AI publ. sum \leq 50 km)	0.00321*** (0.00110)	0.00304** (0.00125)	0.00586*** (0.00134)	0.00367*** (0.00123)
1{ERP = 1}		0.319*** (0.0307)		0.319*** (0.0292)
1{Cloud = 1}		0.178*** (0.0255)		0.178*** (0.0249)
Size: 1-9			-0.0152 (0.0155)	-0.0220 (0.0207)
Size: 50-249			-0.0444 (0.0387)	-0.0674* (0.0400)
Size: 250+			-0.0345 (0.0554)	-0.102 (0.0686)
Age: 6-10			0.0306** (0.0131)	0.0124* (0.00700)
Age: 11+			0.0199 (0.0201)	0.00562 (0.0182)
Obs.	390799	390799	390799	390799
R-squared	0.143	0.341	0.153	0.346
FE c \times s	No	Yes	Yes	Yes
City distance	Yes	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

Clustered standard errors at the c \times s level

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Appendix — Citations

	(1)	(2)	(3)	(4)
	Early AI adopt.	Early AI adopt.	Early AI adopt.	Early AI adopt.
log(AI cit. sum \leq 50 km)	0.00252*** (0.000798)	0.00243*** (0.000925)	0.00449*** (0.000941)	0.00289*** (0.000882)
1{ERP = 1}		0.319*** (0.0307)		0.319*** (0.0292)
1{Cloud = 1}		0.178*** (0.0255)		0.178*** (0.0249)
Size: 1–9			-0.0150 (0.0155)	-0.0218 (0.0207)
Size: 50–249			-0.0444 (0.0386)	-0.0675* (0.0400)
Size: 250+			-0.0343 (0.0554)	-0.102 (0.0686)
Age: 6–10			0.0306** (0.0130)	0.0124* (0.00699)
Age: 11+			0.0198 (0.0201)	0.00562 (0.0182)
Obs.	390799	390799	390799	390799
R-squared	0.143	0.341	0.153	0.346
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022	2016-2022

Clustered standard errors at the c \times s level

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Appendix — Placebo Tests

	(1)	(2)	(3)
	Early AI adopt.	Early AI adopt.	Early AI adopt.
log(AI inst. count \leq 50 km)	0.00432*** (0.00166)		0.00533** (0.00239)
log(VM inst. count \leq 50 km)		0.00438** (0.00193)	-0.00132 (0.00238)
Obs.	390799	390748	390748
R-squared	0.346	0.346	0.346
FE c \times s	Yes	Yes	Yes
City distance	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs
i	Plant	Plant	Plant
Adoption between	2016-2022	2016-2022	2016-2022
controls	Yes	Yes	Yes

Clustered standard errors at the c \times s level

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Appendix — No Weighting Scheme

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00372*** (0.000367)	0.00245*** (0.000351)	0.00490*** (0.000503)	0.00271*** (0.000401)
1{ERP = 1}		0.165*** (0.00717)		0.160*** (0.00654)
1{Cloud = 1}		0.0730*** (0.00440)		0.0716*** (0.00423)
Size: 1–9			-0.00444* (0.00238)	-0.000199 (0.00177)
Size: 50–249			0.0160*** (0.00354)	0.00525* (0.00268)
Size: 250+			0.0496*** (0.00692)	0.0183*** (0.00459)
Age: 6–10			-0.00154 (0.00243)	-0.00462* (0.00260)
Age: 11+			-0.00331* (0.00187)	-0.00816*** (0.00290)
Obs.	546460	546460	546460	546460
R-squared	0.053	0.158	0.065	0.161
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2017-2022	2017-2022	2017-2022	2017-2022

Clustered standard errors at the c \times s level

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Appendix — Distance Measures

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00339** (0.00169)	0.00219 (0.00141)	0.00614*** (0.00172)	0.00300** (0.00143)
log(50 km < AI inst. count \leq 100 km)	-0.000974 (0.000986)	0.000780 (0.000832)	0.000397 (0.000927)	0.000950 (0.000784)
log(100 km < AI inst. count \leq 200 km)	-0.000438 (0.00166)	0.000753 (0.00172)	0.000578 (0.00198)	0.000373 (0.00177)
1{ERP = 1}		0.309*** (0.0192)		0.306*** (0.0192)
1{Cloud = 1}		0.149*** (0.0208)		0.147*** (0.0204)
Size: 1–9			0.0118 (0.0225)	-0.000198 (0.0105)
Size: 50–249			0.0247 (0.0194)	-0.000699 (0.0147)
Size: 250+			0.0613** (0.0260)	-0.00417 (0.0321)
Age: 6–10			0.00262 (0.00326)	-0.00366 (0.00294)
Age: 11+			0.00870 (0.00773)	-0.00247 (0.00564)
Obs.	546460	546460	546460	546460
R-squared	0.146	0.352	0.160	0.353
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2017–2022	2017–2022	2017–2022	2017–2022

Clustered standard errors at the c \times s level

Appendix — Publications

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI publ. sum \leq 50 km)	0.00193*	0.00227***	0.00475***	0.00281***
	(0.00101)	(0.000652)	(0.000873)	(0.000660)
1{ERP = 1}		0.310***		0.306***
		(0.0192)		(0.0192)
1{Cloud = 1}		0.149***		0.147***
		(0.0208)		(0.0203)
Size: 1–9			0.0121	0.0000184
			(0.0225)	(0.0105)
Size: 50–249			0.0246	-0.000749
			(0.0194)	(0.0147)
Size: 250+			0.0615**	-0.00409
			(0.0260)	(0.0321)
Age: 6–10			0.00260	-0.00365
			(0.00325)	(0.00294)
Age: 11+			0.00852	-0.00255
			(0.00772)	(0.00562)
Obs.	546460	546460	546460	546460
R-squared	0.146	0.352	0.159	0.353
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	Yes	Yes	Yes
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2017–2022	2017–2022	2017–2022	2017–2022

Clustered standard errors at the c \times s level

Appendix — Citations

	(1)	(2)	(3)	(4)
	AI adopt.	AI adopt.	AI adopt.	AI adopt.
log(AI cit. sum \leq 50 km)	0.00131 (0.000860)	0.00175*** (0.000529)	0.00352*** (0.000742)	0.00217*** (0.000526)
1{ERP = 1}		0.310*** (0.0192)		0.306*** (0.0192)
1{Cloud = 1}		0.149*** (0.0208)		0.147*** (0.0203)
Size: 1–9			0.0123 (0.0225)	0.000128 (0.0105)
Size: 50–249			0.0245 (0.0194)	-0.000790 (0.0147)
Size: 250+			0.0616** (0.0260)	-0.00401 (0.0320)
Age: 6–10			0.00256 (0.00325)	-0.00366 (0.00294)
Age: 11+			0.00840 (0.00771)	-0.00260 (0.00561)
Obs.	546460	546460	546460	546460
R-squared	0.146	0.352	0.159	0.353
FE c \times s	Yes	Yes	Yes	Yes
City distance	No	No	No	No
Sample	MNEs	MNEs	MNEs	MNEs
i	Plant	Plant	Plant	Plant
Adoption between	2017–2022	2017–2022	2017–2022	2017–2022

Clustered standard errors at the c \times s level

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Appendix — Placebo Tests

	(1)	(2)	(3)
	AI adopt.	AI adopt.	AI adopt.
log(AI inst. count \leq 50 km)	0.00355*** (0.000907)		0.00593*** (0.00200)
log(VM inst. count \leq 50 km)		0.00305*** (0.000922)	-0.00296 (0.00204)
Obs.	546460	546370	546370
R-squared	0.353	0.353	0.353
FE c \times s	Yes	Yes	Yes
City distance	No	No	No
Sample	MNEs	MNEs	MNEs
i	Plant	Plant	Plant
Adoption between	2017-2022	2017-2022	2017-2022
Controls	Yes	Yes	Yes

Clustered standard errors at the c \times s level

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OpenAlex (<https://openalex.org/>) is an open-access bibliographic catalogue covering over **200 million** scholarly works worldwide. It provides detailed information on:

- Scholarly works, authors, institutions, topics and sub-fields,
- Citation counts (forward citations),
- Institutional affiliations and identifiers.

OpenAlex data are widely used in the scientific literature, including studies on AI-related research.

Institutions in OpenAlex include universities and other research entities. Each institution is assigned a **ROR (Research Organization Registry)** identifier, which provides standardized identification and geographical information (latitude and longitude).

Works are classified into approximately **4,500 topics**, grouped into about **250 sub-fields**. Topic classification is performed using a large language model based on titles, abstracts, sources, and citations.

More about the instrument (3): Data Retrieval, Cleaning, and Variables

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Data retrieval was conducted in September 2025, focusing on two sub-fields:

- Artificial Intelligence (AI),
- Veterinary medicine.

Relevant variables. Institution-level indicators (counts) are constructed using a **fractional counting** approach:

- Each work is equally split across authors,
- Each author's share is equally split across their institutions.

Focus: indicators computed over the 2000–2015 time period.

We construct establishment-level measures of proximity to AI scientific activity.

- **AI institutions:** Number of AI research institutions located within:
 - ▶ 0–50 km
 - ▶ 50–100 km
 - ▶ 100–200 km

All measures are constructed at the establishment level using geodesic distances computed from establishments' and institutions' latitudes and longitudes. Indicators are expressed in logs.

We complement baseline measures with additional robustness indicators.

- **Alternative AI exposure measures:**

- ▶ Number of AI institutions in the top quartile of the national AI publication distribution located near the establishment.
- ▶ Number of AI publications within each distance band.
- ▶ Sum of AI citations within each distance band.

- **Distance to AI hubs:**

- ▶ Minimum distance to the nearest AI hub and top AI hub.
- ▶ Hubs identified via a k -means clustering algorithm applied to the spatial distribution of AI research activity within each country.

- **Placebo exposure:**

- ▶ Number of *veterinary medicine* institutions, publications, and citations within identical distance bands as the main specification.