

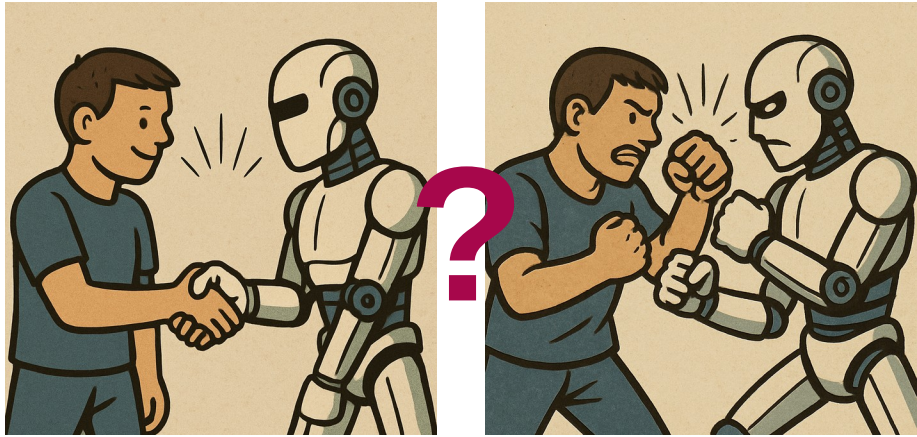
Discussion of Deng, Pluempe, Stegmaier (2025)

“Minimum Wage, Workforce Composition, and Robot Adoption”

Discussant: Christina Brinkmann (Boston University)

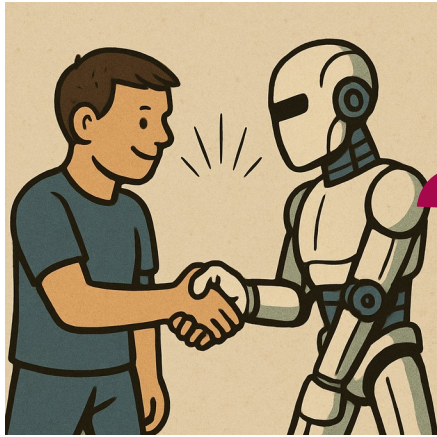
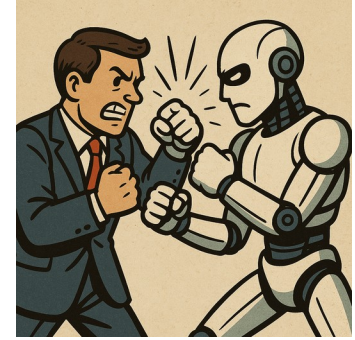
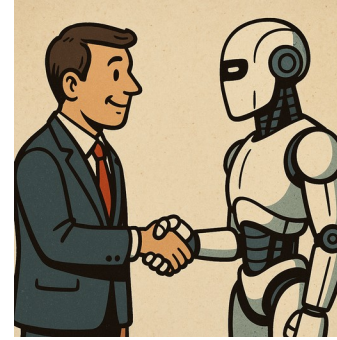
2025 Labor and Finance Group Conference

Debate: Labor vs. capital: substitutes or complements?

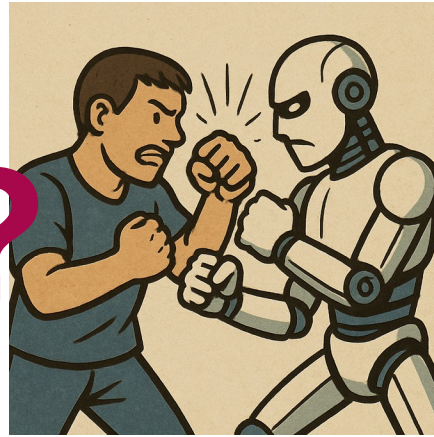


Debate: Labor vs. capital: substitutes or complements? When?

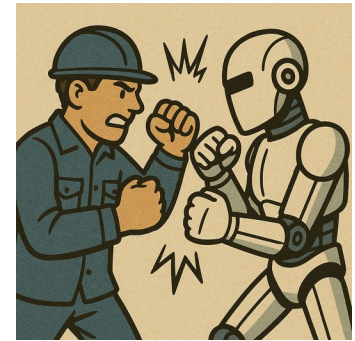
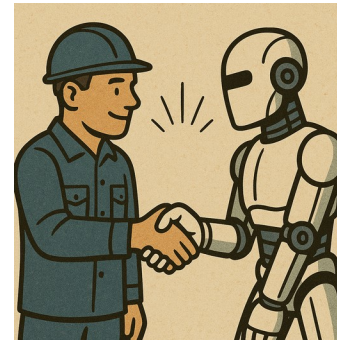
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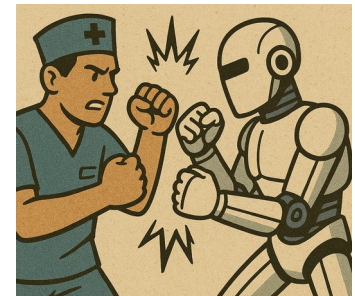
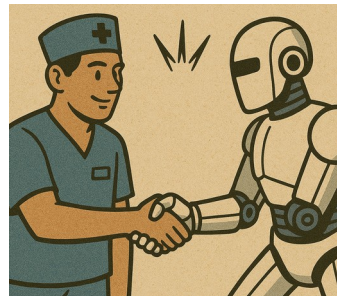
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Motivation: Increase in labor costs vs. decrease in capital costs?

- When are labor and capital complements vs. substitutes?
 - How does it depend on the
 - type of labor?
 - type of capital investments?
 - type of technology?
- Acemoglu and Restrepo (AER, 2018): relative factor prices shape firm's technology choices
- Change in relative factor prices can come from
 - Increase in the cost of labor vs
 - Decrease in the cost of capital?
- Still empirically an open question!
- Curtis, Garrett, Ohn, Roberts and Suarez Serrato (2022):
Tax policies that incentivize capital investment do not lead manufacturing plants in the U.S. to replace workers with machines
- This paper:
studies the effect an increase in cost of simple manual labor on capital investments in robots

Recap

Question:

What effect do minimum wage policies have on automation (here: robot adoption)?

Methodology

- Exploit differential plant-level exposure to the 2015 introduction of minimum wage in Germany
- DiD design comparing plants w/ vs. wo/ employees with hourly wage below 8.50 EUR in 2013
- Outcome variable: robot adoption between 2014-2018 as provided in survey responses of the 2019 wave of IAB Establishment Panel

Main Findings

- Higher exposure to the minimum wage introduction incentivized robot adoption
- Do not find employment effects, but evidence points towards change in the workforce composition

Plan for Discussion

- 1 Several ways to motivate the paper
- 2 Catch-up story?
- 3 Role of size – why not a size-adjusted measure?
- 4 Who is paid below the minimum wage beyond simple manual labor?
- 5 Upscaling with new technology?
- 6 Change in workforce composition

1 Several ways to motivate the paper

- Currently:
Connect to literature on the effects of the introduction of the minimum wage (Dustmann et al., 2021; Bossler and Schank, 2023)

Food for thought #1:

- Speak to the broader question of labor vs. capital as inputs to production? (as motivation here)
 - Use introduction of minimum wage in Germany as a shock to the cost of labor for certain tasks
- Lean more into workforce composition (more on that later)
- Curious to see a binscatter at the industry-level (even within-manufacturing):
 - Share of plants with robot adoption vs
 - Share of workers for whom the minimum wage introduction had bite

2 Catch-up story? Automation does not start with robots

- Plenty of scope for automation before robots
- Plant that has invested in the past in labor-augmenting capital likely
 - Has a higher labor productivity → higher wages → less likely below minimum wage
 - Decreasing returns to automation → less likely to further automate
- Worry: Catch-up story (or even leap-frogging story) at play in the background

Table 1: Summary Statistics

	Treatment Group (<i>N</i> = 2, 728)	Control Group (<i>N</i> = 4, 260)
# Robot Users in 2014	128	141
# Robot Users in 2018	203	214
Average Employment	216.0	90.3
Average Hourly Wage	15.3	18.4
Median Labor Productivity (in € 1,000)	43.2	57.7
<i>Occupational Composition (in %)</i>		
Share of Simple Manual Workers	14.2	14.2
Share of Qualified Manual Workers	14.3	15.0
Share of Technicians/Engineers	6.3	7.7
Share of Managers	3.3	3.9
Share of Service and Administrative Workers	48.1	44.0

- Key empirical challenge in the setup:
 - Data on robot adoption starts in 2014 and thus does not allow to study pre-trends

Suggestion #1:

- Look at pre-trends regarding capital investment more broadly

3 Role of size – why not a size-adjusted measure?

- Authors consider different treatment measures:
 - Treated (baseline): one worker with 2013-wage below the minimum wage floor
 - Treated (versions): three/ five ...
 - Gap: potential increase in a plant's total daily wage bill if all workers earning below 8.50 EUR were raised to that threshold
- A larger firm:
 - More likely to have at least one worker below the minimum wage threshold
 - More likely to automate
- Authors include another term in the D-i-D: Size in 2013 interacted with the Post-Dummy

3 Role of size – why not a size-adjusted measure?

Table 3: Minimum Wage and Robot Adoption: Binary Treatment

Dependent variable	Robot-use Dummy		Number of Robots			
	w/o 2014 users		w/o 2014 users		w/ 2014 users	
	(1)	(2)	(3)	(4)	(5)	(6)
	Panel A: $T = 1$ if at Least 1 Worker Affected ($Bite \geq 1$)					
T×Post	0.0068*** (0.0024)	0.0038 (0.0025)	0.0084*** (0.0032)	0.0042 (0.0032)	0.0111*** (0.0036)	0.0043 (0.0035)
log(Emp)×Post		0.0064*** (0.0012)		0.0093*** (0.0018)		0.0143*** (0.0020)
	Panel B: $T = 1$ if at Least 3 Workers Affected ($Bite \geq 3$)					
T×Post	0.0097** (0.0041)	0.0065 (0.0041)	0.0141** (0.0058)	0.0095* (0.0056)	0.0188*** (0.0062)	0.0114* (0.0060)
log(Emp)×Post		0.0064*** (0.0012)		0.0092*** (0.0017)		0.0141*** (0.0019)
	Panel C: $T = 1$ if at Least 5 Workers Affected ($Bite \geq 5$)					
T×Post	0.0136** (0.0055)	0.0104* (0.0055)	0.0194** (0.0081)	0.0147* (0.0079)	0.0222*** (0.0083)	0.0149* (0.0081)
log(Emp)×Post		0.0064*** (0.0012)		0.0092*** (0.0017)		0.0142*** (0.0019)
N	33595	33595	33588	33588	34933	34933

- Unclear to me what this buys beyond a validation that size is highly correlated with treatment (Firms in treatment/control under the bite_5 vs bite_1 measure likely more similar in size?)

Suggestion #2:

- Use a size-adjusted exposure measure as baseline
- Heterogeneity analysis of the effect
 - e.g., include interaction term of Treatment x Post based on size e.g. above-median

4 Who is paid below min wage beyond simple manual labor?

- Authors differentiate between workers affected by the minimum wage who
 - are performing simple manual tasks (by requirement) vs.
 - are in other occupations

Table 5: The Role of Occupational Composition: Binary Treatment

Dependent variable Sample	Robot-use Dummy		Number of Robots			
	w/o 2014 users		w/o 2014 users		w/ 2014 users	
	(1)	(2)	(3)	(4)	(5)	(6)
$T^{\text{sm}} \times \text{Post}$	0.0325*** (0.0076)	0.0300*** (0.0075)	0.0416*** (0.0107)	0.0380*** (0.0105)	0.0582*** (0.0111)	0.0517*** (0.0107)
$T^{\text{oth}} \times \text{Post}$	0.0005 (0.0022)	-0.0026 (0.0023)	0.0003 (0.0028)	-0.0042 (0.0029)	-0.0014 (0.0031)	-0.0083** (0.0033)
$\log(\text{Emp}) \times \text{Post}$		0.0066*** (0.0012)		0.0095*** (0.0018)		0.0144*** (0.0020)
N	33595	33595	33588	33588	34933	34933

Notes: (i) This table reports the OLS estimates based on Equation (3). (ii) The dependent variable is the dummy of robot use in Columns (1) and (2) and the number of robots with IHS transformation in Columns (3)–(6). (iii) The regression sample consists of the plants that did not use robots in 2014 without the incumbent 2014 robot users for Columns (1)–(4) and with the 2014 users for Columns (5) and (6). (iv) The binary treatment $T^{\text{sm}} = 1$ if a plant has at least one worker in a simple manual occupation that is affected by the minimum wage and zero otherwise; $T^{\text{oth}} = 1$ if a plant is affected by the minimum wage but none of the workers affected are in simple manual occupations and zero otherwise. The post dummy $\text{Post} = 1$ if year $t \geq 2015$. (v) $\log(\text{Emp})$ is the total number of workers in log at the plant level in 2013. (vi) Both plant and calendar year fixed effects are included. (vii) Standard errors clustered at the plant level are reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

4 Who is paid below min wage beyond simple manual labor?

- Question:
 - What are occupations beyond simple manual tasks that pay below the minimum wage threshold?
 - Is the fact that there are very few firms with such occupations behind the result in Table 5?

Suggestion #3:

- Some summary statistics on other occupations paying below the minimum wage threshold
- Alternatively a heterogeneity analysis:
 - include an interaction term based on whether majority of affected workers are in other occupp
- Potentially focus on this aspect?
 - “Sudden increase in the cost of labor for simple manual tasks”

5 Upscaling with modern technology?

Table 7: Minimum Wage and Robot Adoption: Employment and Productivity Effects

Dependent Variable	Total Emp.	Employment Share by Occupation Group (%)					Labor Prod.
		simple manual	qualified manual	engineer technician	manager	service admin	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Minimum Wage Exposed Plants ($T = 1$) vs Other Plants							
T×Post	-0.0048 (0.0067)	0.0891 (0.1156)	-0.2132* (0.1204)	0.1631** (0.0727)	0.0833 (0.0601)	-0.1351 (0.1589)	0.0067 (0.0168)
<i>N</i>	47747	47747	47747	47747	47747	47747	16637
Robot Adopting Plants ($Robot = 1$) vs Non-adopting Plants							
Robot×Post	0.0010 (0.0307)	-0.8268 (0.6026)	0.2266 (0.4898)	0.8040** (0.3334)	0.0807 (0.2250)	-0.0832 (0.5733)	0.0965* (0.0582)
<i>N</i>	17941	17941	17941	17941	17941	17941	6386

- Points toward shift in the workforce and productivity gains ...

5 Upscaling with modern technology?

- How about the following story?
 - Those firms that automated also grew!
 - Firms expanded new production facilities with modern technology (robots)
 - Would square with the findings on the workforce: Did not let go of anyone, but hired technicians
- What is the hypothesis?
 - A Increased usage of robots per worker in existing production lines?
 - B Increased incentive to use robots in expansions of production?
 - Then the per-output relevance of simple manual labor may have gone down nonetheless

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- What is the hypothesis?
 - A Increased usage of robots per worker in existing production lines?
 - B Increased incentive to use robots in expansions of production?
 - Then the per-output relevance of simple manual labor may have gone down nonetheless
- Unless there is an increase in output, the following story would be puzzling:
 - Firm invest in capital.
 - Firms do not let go of cheap labor but instead hire more expensive labor.



Suggestion #4:

- Can you also examine changes in output/ scaling?

6 Change in the workforce composition

- Would be fascinating to look at the change in the workforce in more detail!

Suggestion #5:

- Examine who firms hire/fire after robot-adoption:
 - Do workers in simple manual tasks stay at the firm?
 - Whom do firms hire?
 - Which occupations?
 - From whom?
- Does this imply a reshuffling in the labor market?

Final Thoughts

- Thought-provoking paper on the effect of minimum wages (higher labor costs for simple manual tasks) on the introduction of robots

Punchline:

- Yes, the introduction of a minimum wage in Germany incentivized robot adoption

A few suggestions for future iterations:

- Consider different positioning
- Catch-up story in the background?
- Increases in output?
- More on hiring/firing pattern post robot-adoption

A few questions prompted by the paper for future research:

- Is AI similar to robots? Why? Why not?

Very much looking forward to the next version!