Discussion of "How Do Robot Subsidies Affect Aggregate Productivity And Firm Dispersion? Theory And Evidence From China"

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This Paper

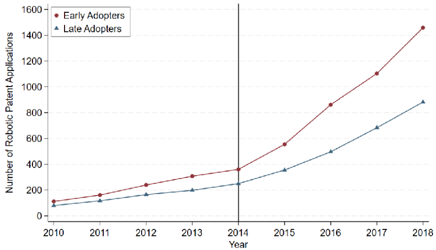
- **Research question**: how do robot subsidies affect the aggregate economy?
- **Key insight**: raise aggregate output and automation but reduce TFP due to increased dispersion in automation levels across firms

$$\gamma\left(J_i\right) = \frac{w}{\left(1-\tau\right) r + \Phi_i}$$

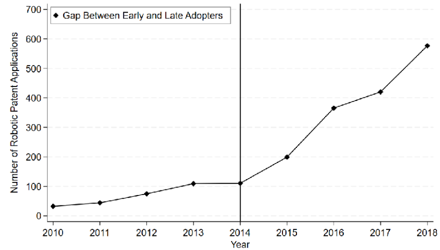
  - municipal-level robot subsidies increase robotics innovation and boost performance among large firms, but discourage new firm entry
  - heterogeneous firm model with endogenous automation and financial frictions
  - rich policy and welfare implications
- **A well-executed and timely paper** that contributes to the literature on automation, industrial policy, and firm heterogeneity

Comment #1: DiD-related Issues

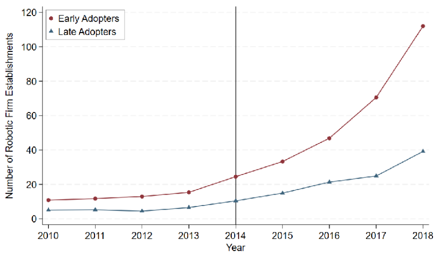
- "key identification assumption of my empirical framework is that the timing of subsidy introduction across municipalities is uncorrelated with the outcomes of interest."



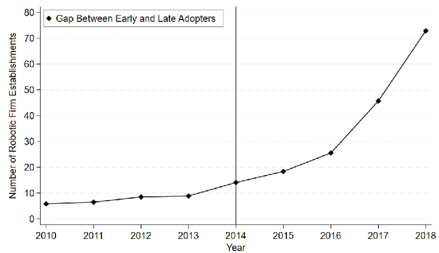
(a) Robotics Patents (Average)



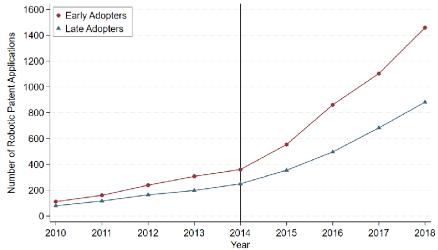
(b) Robotics Patents (Gap)



(c) Robotics Firm Establishments (Average)



(d) Robotics Firm Establishments (Gap)



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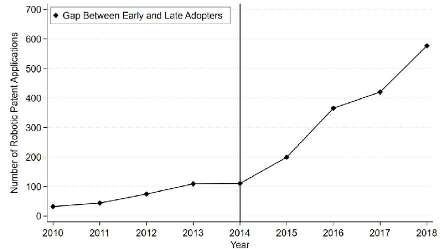
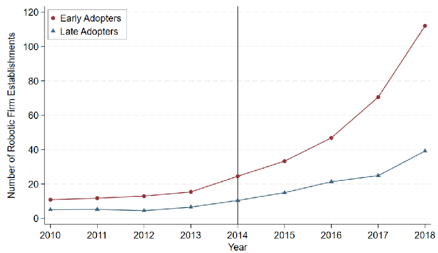
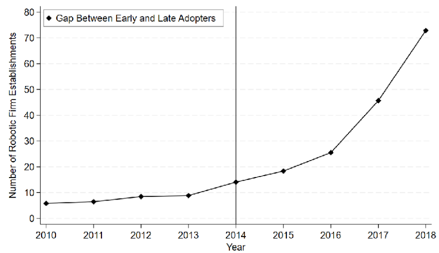


(b) Robotics Patents (Gap)



(c) Robotics Firm Establishments (Average)



(d) Robotics Firm Establishments (Gap)

- Early adopters (2014-2016) and Late adopters (2016-2018)
  - increasing gap even before 2014
  - upward trend for late adopters during 2014-2016
  - stronger divergence after 2016

Comment #1: DiD-related Issues

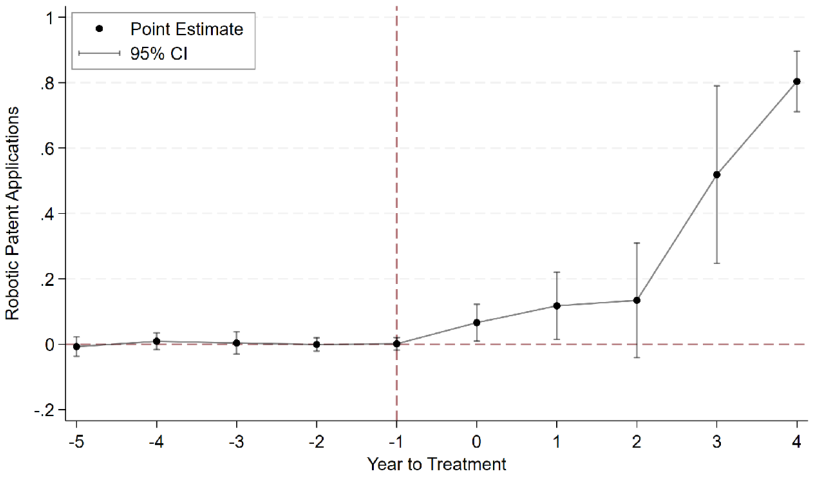


Figure 5: Dynamic Impact on the Number of Robotics Patents

- In DiD, the base year typically does not have its own confidence interval
- Which year is the base year?

COMMENT #1: DID-RELATED ISSUES

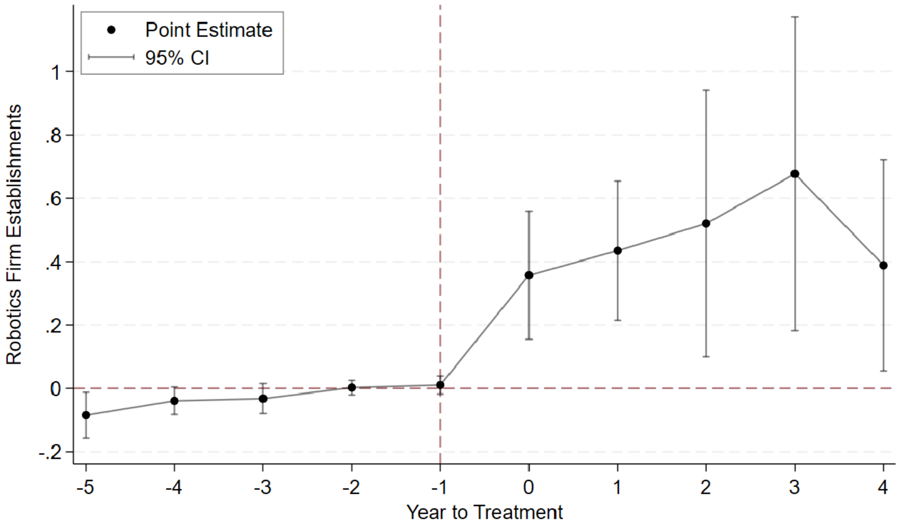


Figure 6: Dynamic Impact on Robotics Firm Establishment

- In DiD, the base year typically does not have its own confidence interval
- Which year is the base year?

Comment #1: DiD-related Issues

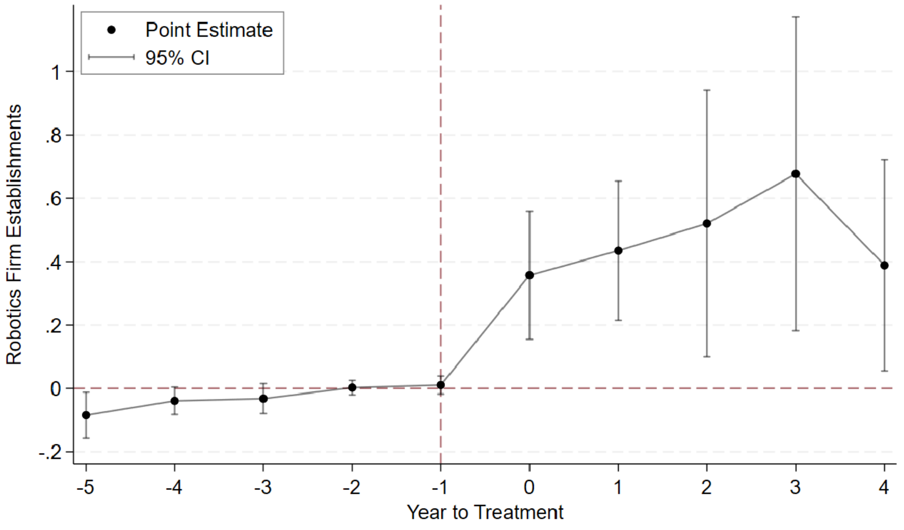


Figure 6: Dynamic Impact on Robotics Firm Establishment

- The assumption of no pre-trends may not be valid for certain investigations
- More discussions are necessary

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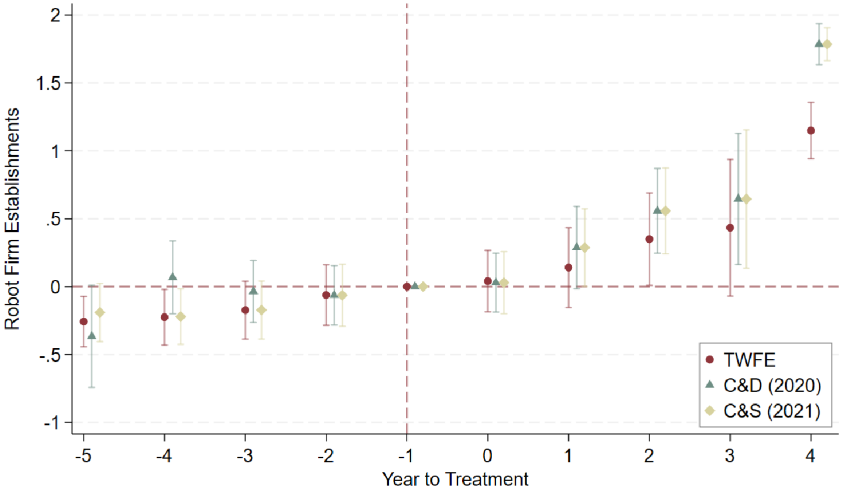

Figure 8: Event Study Robustness Check - Robot Firm Establishments

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Comment #1: DiD-related Issues

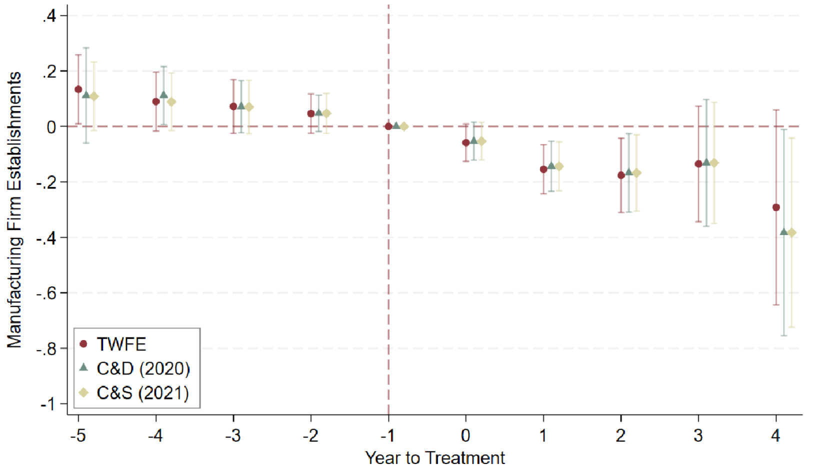

Figure 13: Event Study Robustness Check - Manufacturing Firm Establishments

- The assumption of no pre-trends may not be valid for certain investigations
- More discussions are necessary

Comment #1: DiD-related Issues

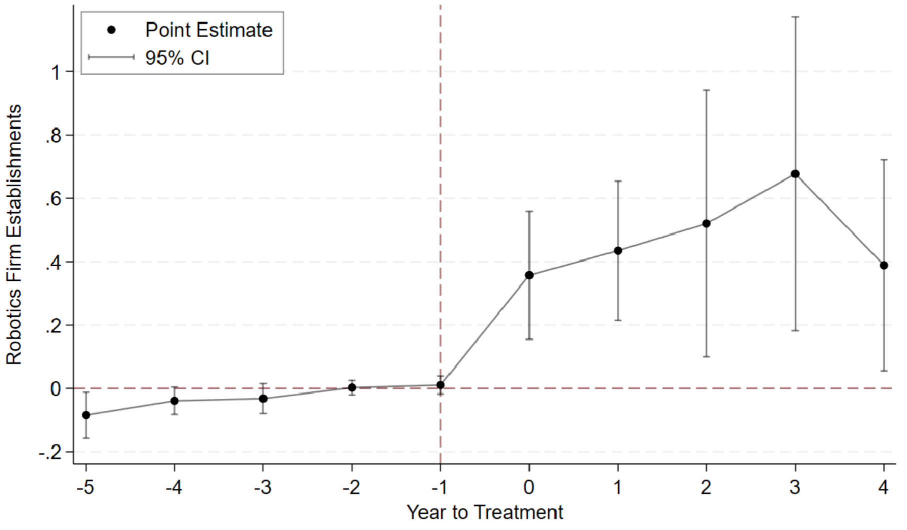

Figure 6: Dynamic Impact on Robotics Firm Establishment

Table 3: Descriptive Statistics

	Treated	Controls	Δ(T-C)	C/T
Panel A: Robotics Patent Application (2010-2018)				
All Patents	19,045.53	2,720.50	16,324.83	14.28%
Robot Patents	279.74	29.20	250.54	10.44%
Robot Module Patents	117.41	24.86	92.55	21.17%
Robotics Patents	483.24	67.27	415.97	13.92%
Panel B: Number of Newly-Established Robotics Enterprises (2010-2018)				
Manufacturing	26.18	2.55	23.63	9.74%
Machinery	12.88	1.26	11.62	9.78%
Electronic	2.63	0.16	2.47	6.08%
Electric	1.95	0.19	1.76	9.74%
Panel C: Number of Newly-Established Manufacturing Enterprises (2010-2019)				
All Firms	73,060.91	24,053.46	49,007.45	32.92%
Tertiary Sector	59,268.34	18,731.00	40,537.34	31.60%
Manufacturing	5,438.92	1,426.14	4,012.78	26.22%
Machinery	682.71	119.11	563.60	17.45%
Automobile	112.05	25.92	86.13	23.13%
Electronic	187.05	15.55	171.50	8.31%
Electric	246.94	31.79	215.15	12.87%
Panel C: Number of Newly-Established Manufacturing Enterprises (2011-2020)				
Counts	2.81	0.83	1.98	29.54%
Turnovers	798.19	232.39	565.80	29.11%
Total Assets	761.33	219.27	542.06	28.80%
Employments	901.83	209.46	692.37	23.23%
Number of Municipalities	63	219		

- Early adopters (2014-2016) and Late adopters (2016-2018)
- Data for the later years is unavailable

Comment #2: Tighten the Empirics-Theory Link

- The model yields several important implications:
  - Differences in financial access at the firm level have a significant impact on outcomes
  - Aggregate TFP decreases following the introduction of subsidy policies
  - ...
- Currently, empirical findings indicate that robotics innovation and firm performance are boosted among large firms, but new firm entry is discouraged.
- Do “large firms” refer to financially unconstrained or efficient firms? Does the lack of new firm entry lead to aggregate TFP losses?
- Additional empirical evidence is needed to further substantiate the conclusions and clarify the proposed underlying mechanism.

COMMENT #3: m V.S. k

- In the full model, the authors distinguish between physical capital and machines
- This is a great approach!

$$
\begin{aligned}
\pi_{i,t} = \max_{\{y_{i,t},k_{i,t},l_{i,t},m_{i,t},J_{i,t}\}} \quad & p_{i,t}y_{i,t} - w_t l_{i,t} - [(1+\Phi(a_{i,t}))r_t + \delta]k_{i,t} - [(1+\Phi(a_{i,t}) - \tau_t)r_t^m + \delta]m_{i,t} + T_{i,t}^F, \\
s.t. \quad & p_{i,t} = y_t^{\frac{1}{\sigma}} y_{i,t}^{-\frac{1}{\sigma}}, \\
& kl_{i,t} = k_{i,t}^{\alpha} l_{i,t}^{1-\alpha}, \\
& y_{i,t} = z_i \left\{ J_{i,t}^{\frac{1}{\rho}} m_{i,t}^{\frac{\rho-1}{\rho}} + \left[\int_{J_{i,t}}^{1} \gamma(x)^{\rho-1} dx\right]^{\frac{1}{\rho}} kl_{i,t}^{\frac{\rho-1}{\rho}} \right\}^{\frac{\rho}{\rho-1}},
\end{aligned}
\tag{12}
$$

COMMENT #3: m V.S. k

- However, after the model setup, it is unclear how the authors treat these two types of capital differently:
  - no market clearance condition specified for machines
  - borrowing cost terms are the same and estimated using physical capital data

In practice, I estimate the structure of the borrowing cost term Φ with the following non-linear regression:

$$\log(\frac{k_i}{wl_i}) = \gamma + log(1 + \beta a_i^{\omega}) + \mu_s + \epsilon_i. \quad (17)$$

Comment #3: m v.s. k

- More importantly, the interpretation of $\Phi(a_i)$ for machines remains unclear
- One possible interpretation is that $\Phi(a_i)$ reflects the additional purchase expenses
- But "approximately 82% of subsidies offer financial support exceeding 10% of the purchase price or rental fee of industrial robot equipment"
- Then, $(1 + \Phi(a_{i,t}) - \tau_t)r_t^m$ or $(1 + \Phi(a_{i,t}))\,(1 - \tau_t)\,r_t^m$?

COMMENT #4: CORR(z_i, Φ_i)

- **Whether productive firms face stronger financial frictions is critical for the final welfare implications**
- This aspect is not discussed in the current draft.
- In the full model, the financial friction term is given by $\Phi(a_{i,t}) = \beta a_i^{\omega}$, where $\omega = -0.8$
- However, the productivity process follows a mean-reverting process

$$d\log(z_{i,t}) = \theta_z \left[\mu_z - \log z_{i,t}\right] dt + \sigma_z dW_{i,t}$$

- **Wealthier firms may face more negative shocks in the future due to this process**
- How much of the negative impact of subsidy on TFP is driven by this setup?

Minor Comments

1. The introduction is too China-specific; consider reframing for broader applicability.
2. Model parameters are mainly taken from the literature without matching moments; at least provide targeted validation where feasible.
3. The model only simulates uniform robot subsidies; consider testing targeted subsidies for small or financially constrained firms and explore if alternative designs reduce dispersion while maintaining output gains.
4. Demand-side subsidy policies often reflect local preferences; this is interesting but not explored in the current model.
5. Footnotes are excessive; integrate key content into the main text.
6. Several minor typos and formatting inconsistencies remain; please proofread carefully.

Summary

- **An excellent paper**: solid empirical execution, careful modeling, and high policy relevance.
- I appreciate the integration of micro heterogeneity and macro efficiency concerns.
- The paper raises important follow-up questions on optimal policy design and firm dynamics.
- **Congratulations on the great work—and best of luck with publication!**