Expected Insurance Coverage and Pharmaceutical Innovation: Evidence from China's National Drug Price Negotiation Policy

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Motivation

- The high drug price raises concerns for public health and equity.
- Limiting drug prices, especially those still under patent protection, faces a trade-off:
  - Low prices improve the welfare of consumers who take the existing drug
  - But low prices may reduce firms' incentives to innovate, hurting consumers who might benefit from future innovations

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- The high drug price raises concerns for public health and equity.
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  - But low prices may reduce firms' incentives to innovate, hurting consumers who might benefit from future innovations
- Question: Can the policy be designed to expand access and sustain innovation?

China's National Drug Price Negotiation Policy

- Target: new drugs under patent protection
- The policy bundles two interventions
  1. Negotiation of price: the central government conducts a bilateral negotiation with the drug company.
  2. Successfully-negotiated drugs are covered by the public insurance program.
- Since its implementation in 2016, more than 400 drugs have been included in the public insurance coverage.

This Paper: Evaluation of Policy Impacts on Innovation

- In this paper, we examine the impacts of the negotiation policy on pharmaceutical innovation.
- The impacts are ambiguous ex-ante:
  - Negotiated price lowers firms' profits.
  - Expanded market size due to insurance coverage increases firms' profits.

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- In this paper, we examine the impacts of the negotiation policy on pharmaceutical innovation.
- The impacts are ambiguous ex-ante:
  - Negotiated price lowers firms' profits.
  - Expanded market size due to insurance coverage increases firms' profits.
- We examine the policy impacts on
  1. firm revenues
  2. quantity and quality of new drug innovation
  3. industry dynamics

Our Contribution

- Market size and pharmaceutical innovation
  - Broadly (Acemoglu and Linn, 2004; Blume-Kohout and Sood, 2013; Dubois et al., 2015; Agha, Kim, and Li, 2022), and in China (Zhang and Nie, 2021, and Geng and Shi, 2024).
  - We offer new evidence using a policy targeting novel drugs in China.

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  - We offer new evidence using a policy targeting novel drugs in China.
- Public procurement programs in the health care industry:
  - Competitive bidding for generics (Cao, Yi, and Yu, 2024; Liu, Lu, and Yang, 2025; Zhang et al. 2026) and medical equipment (Ding, Duggan, and Starc, 2025; Ji and Rogers, 2024)
  - **New drugs: price negotiation**
    - Barwick, Swanson, and Xia (2025) examine the impacts on price and (current) consumer welfare
    - We focus on the impacts on innovation.
    - See also a recent NBER WP: Barwick, Xia, and Xia (2026)

Institutional Background

The Pharmaceutical Industry in China

- The pharmaceutical industry in China: many domestic manufacturers, low R&D capabilities (Kanavos, Mills, and Zhang, 2019)
- By 2010, large/medium pharma firms R&D revenue share:
  - China: $< 2\%$
  - Global average: 8%
  - Developed countries: 15%

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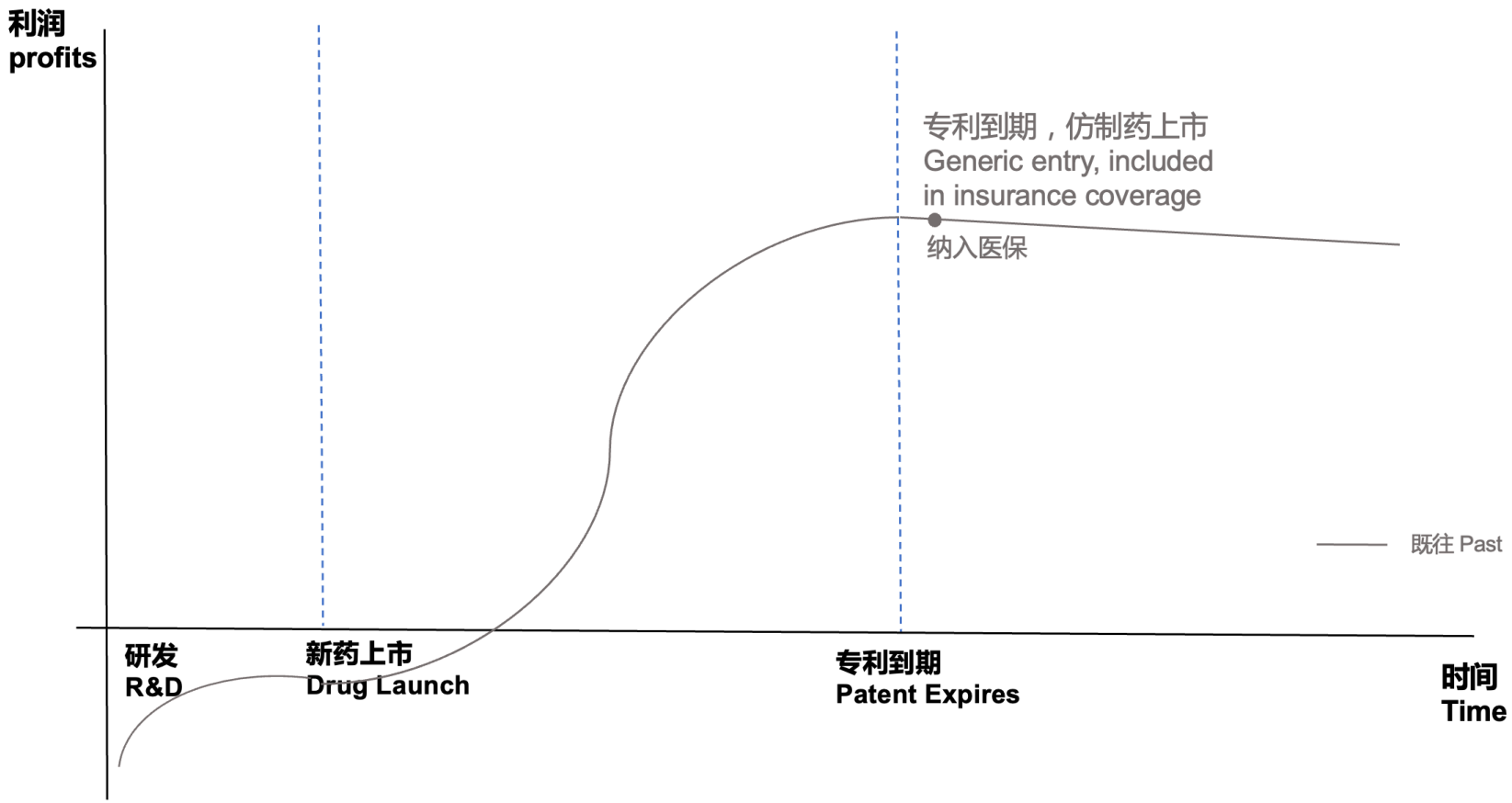
  - Developed countries: 15%
- FDA approved the first China-developed new cancer drug in November 2019 (Tevimbra by BeOne Medicine).

Pre-Reform: Limited Coverage for New Drugs



Implementation of the Drug Price Negotiation Policy

- Target drugs: single-seller drugs under patent protection
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  - Newly developed domestic drugs

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- Successfully negotiated drugs receive:
  - Public insurance coverage through a two-year contract
  - Renegotiation upon contract renewal

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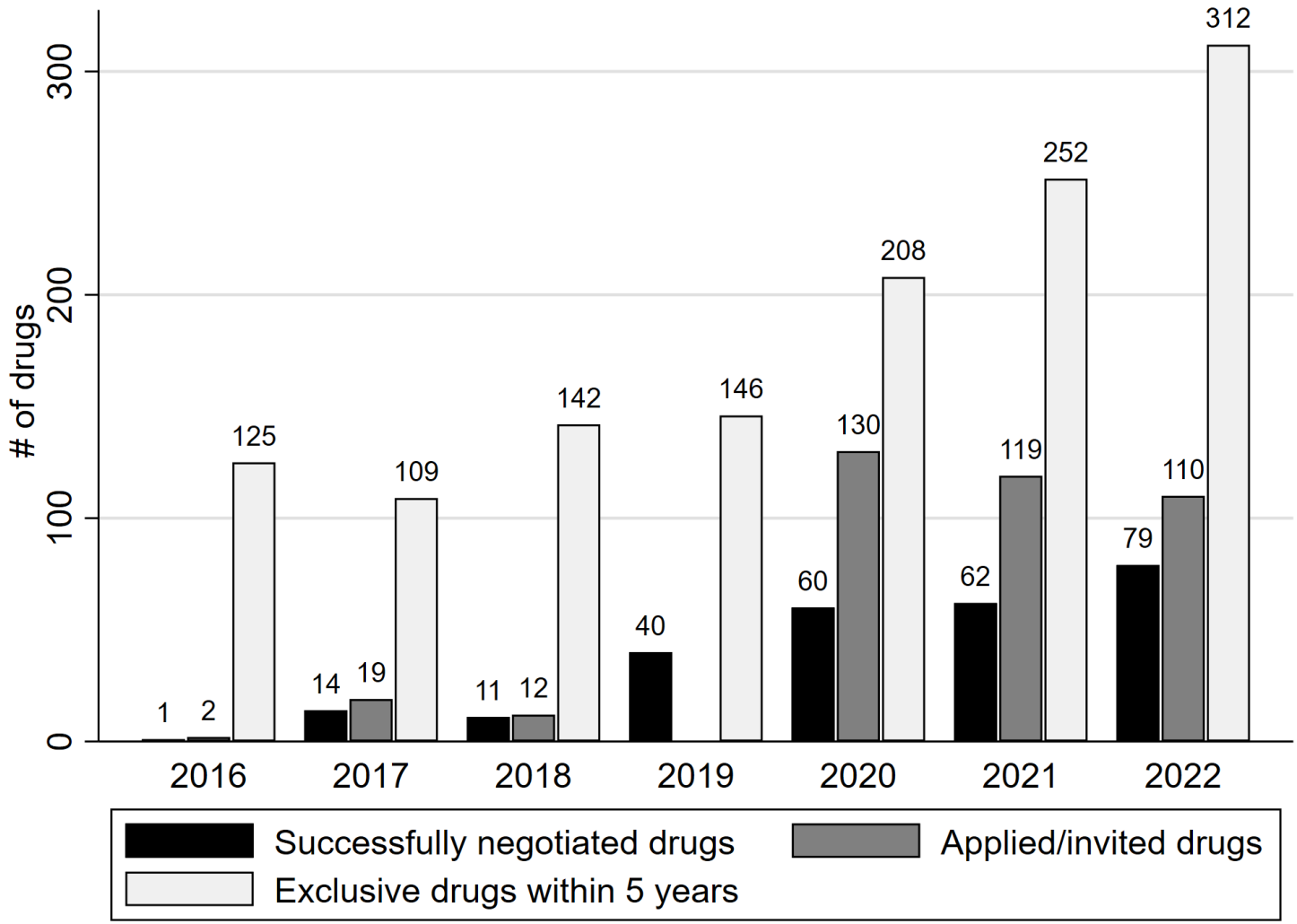
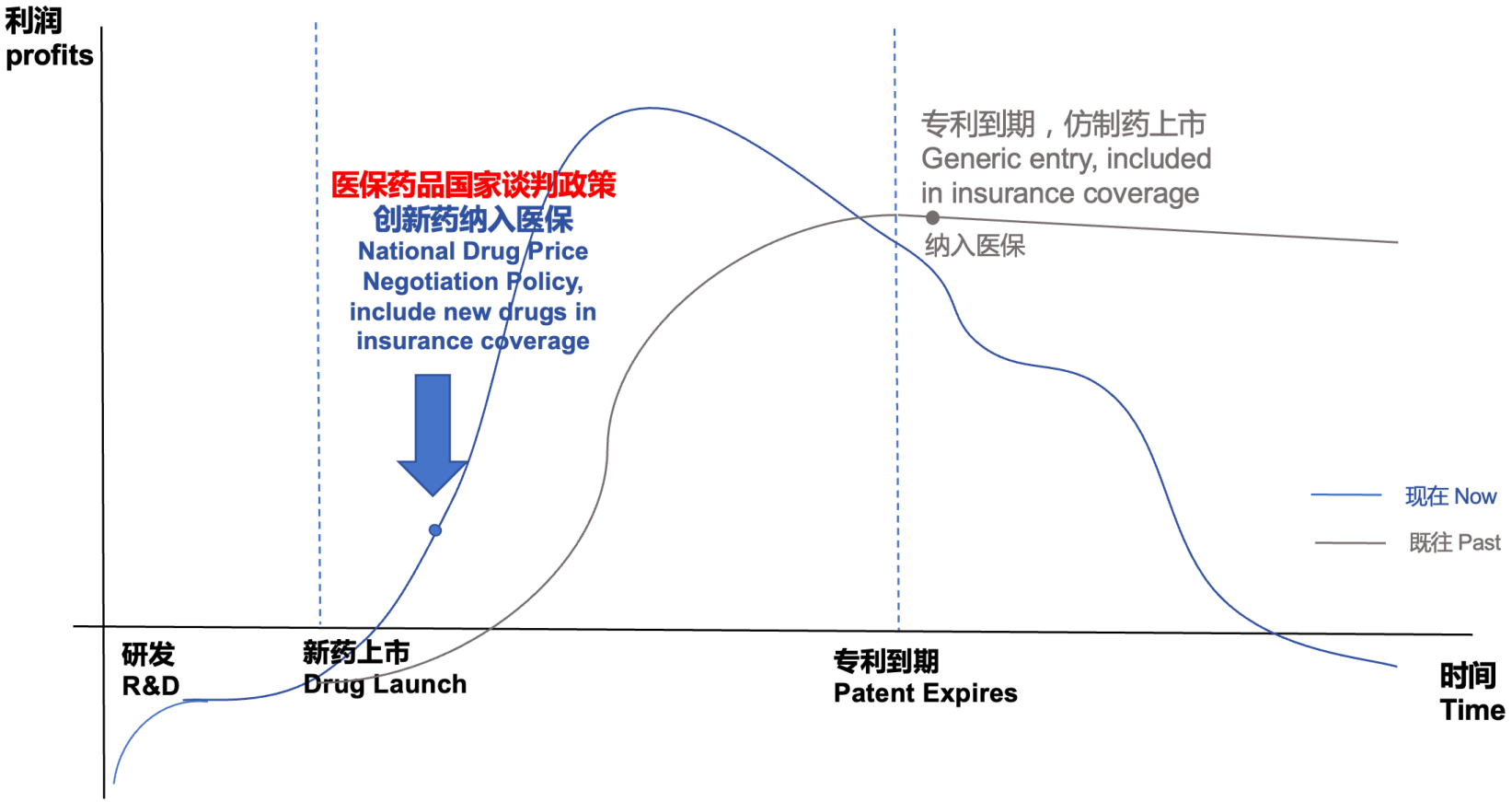
  - Public insurance coverage through a two-year contract
  - Renegotiation upon contract renewal
- The 2018 round focused on cancer drugs; other rounds covered all diseases.

400+ New Drugs Are Covered By Insurance Since 2016

- New drugs marketed within 5 years
  - Drugs invited/applied for negotiation
    - Successfully negotiated drugs



Policy Goal: Expand Market Size



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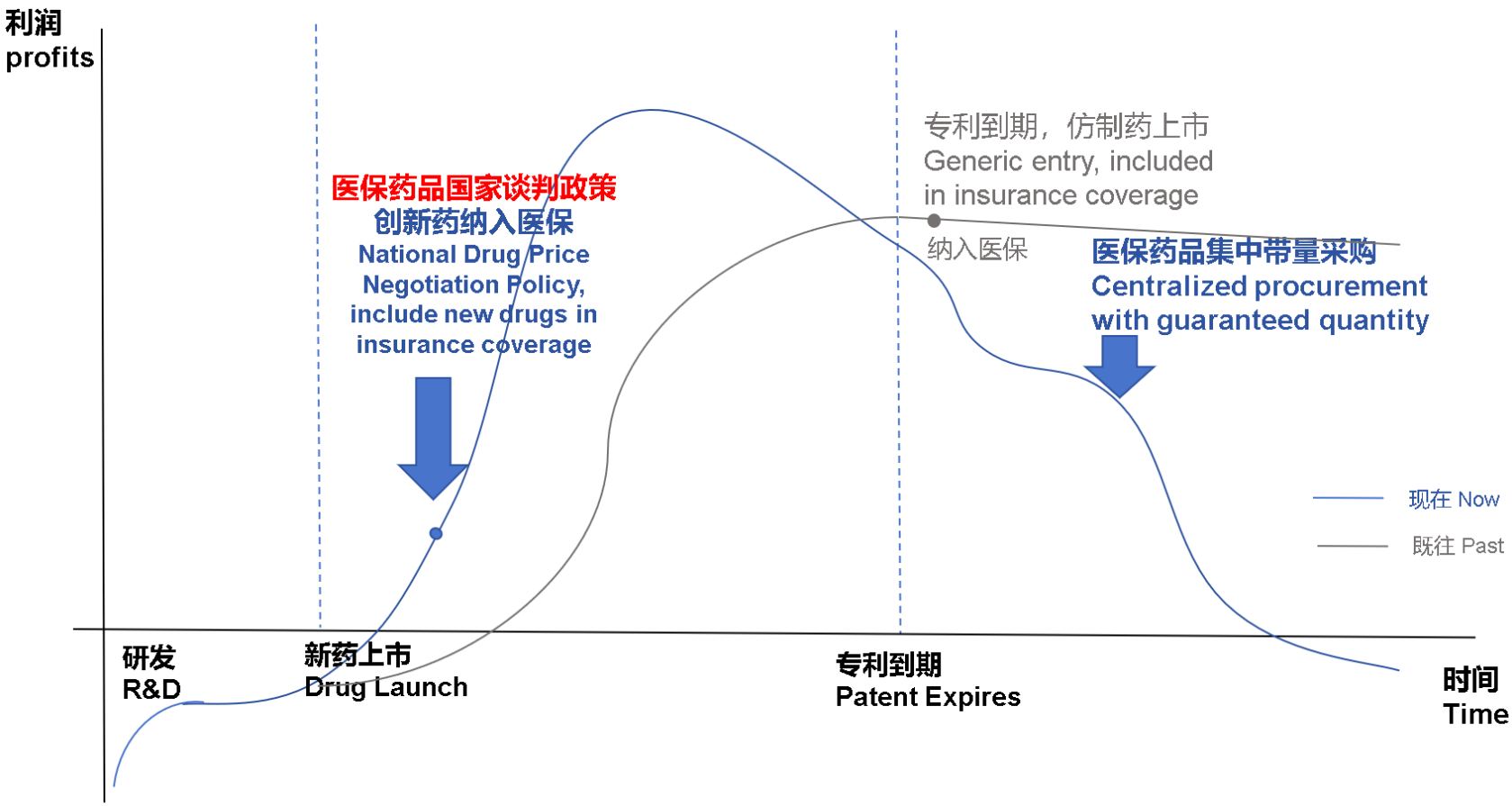


Policy Impacts on Firm Revenues

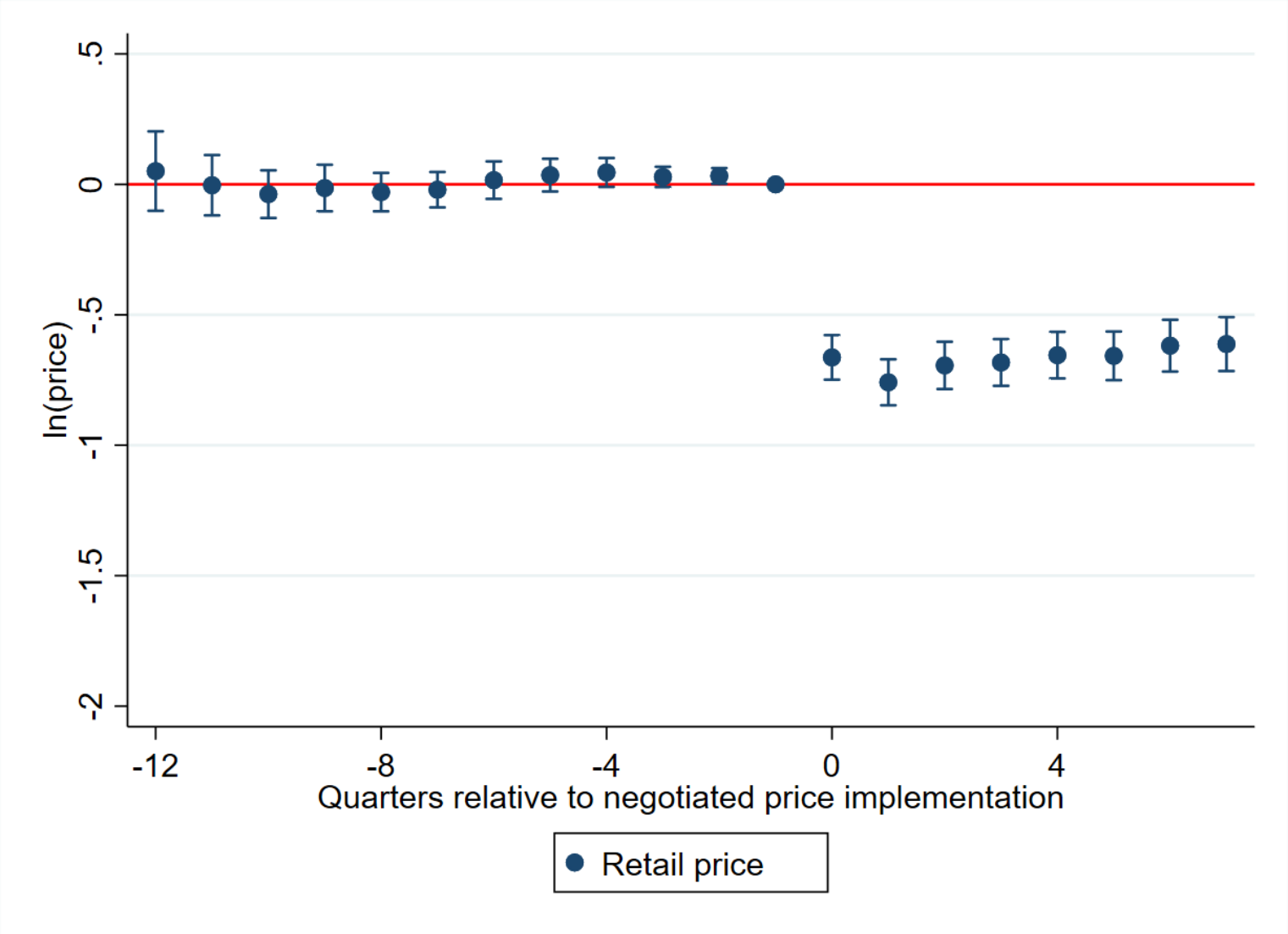
Empirical Design: Drug-Level DiD

- First empirical exercise: Does successful negotiation increase firm revenues?
- A staggered DiD design:

$$y_{it} = \sum_{k \neq -1} \beta_k treat_i \times 1(t - \tau_i = k) + \gamma_i + \lambda_t + \varepsilon_{it},$$

  - $treat_i = 1$: successfully negotiated drugs
  - Two types of control groups: Details
    - Eligible drugs: single-seller drugs launched within 5 years
    - Applied/selected but not successfully negotiated drugs
  - Estimated using rolling sample method and drug sales data from public hospitals from 2013 to 2021.

Successful Negotiation Leads to Price Reduction



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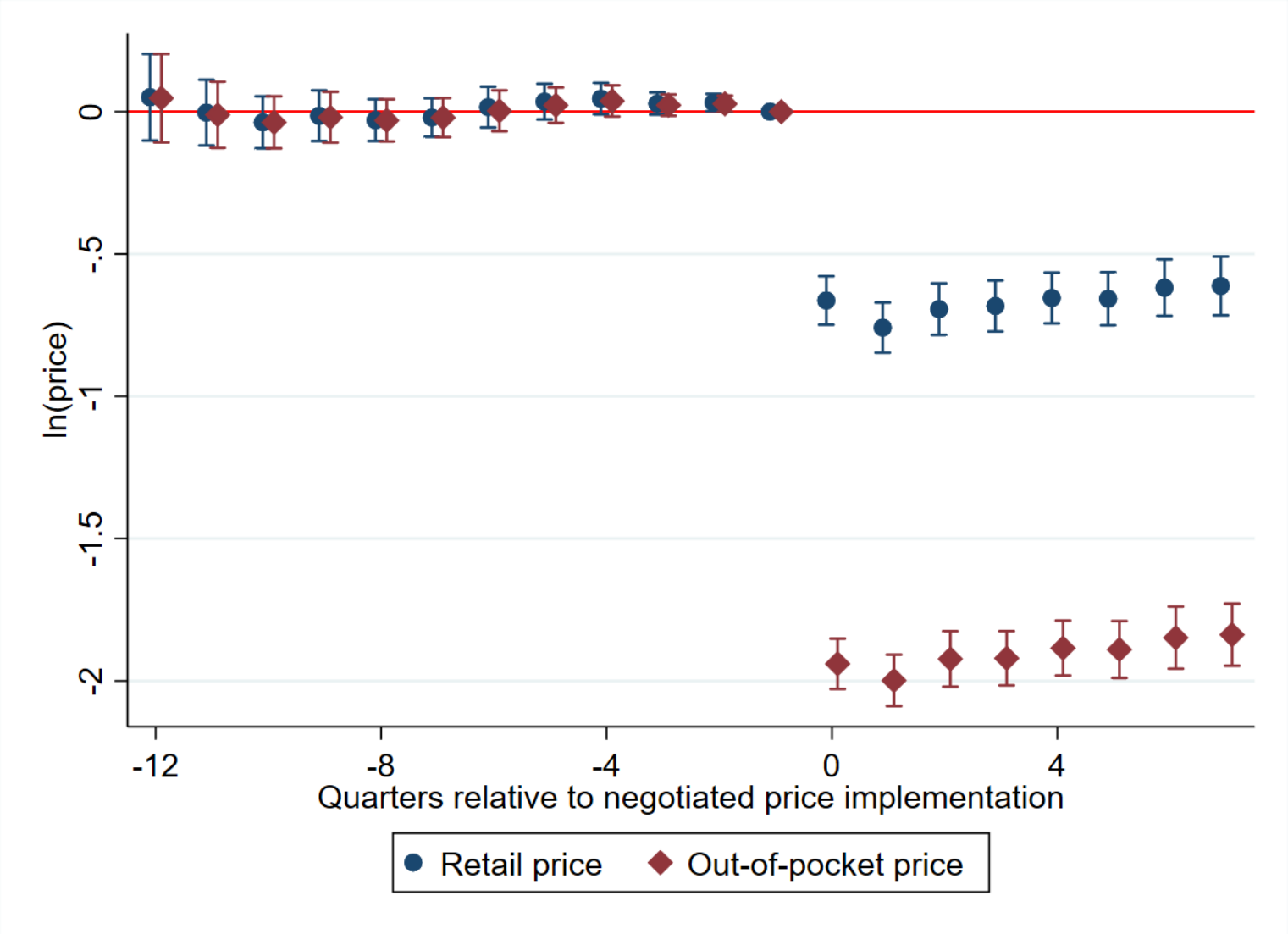
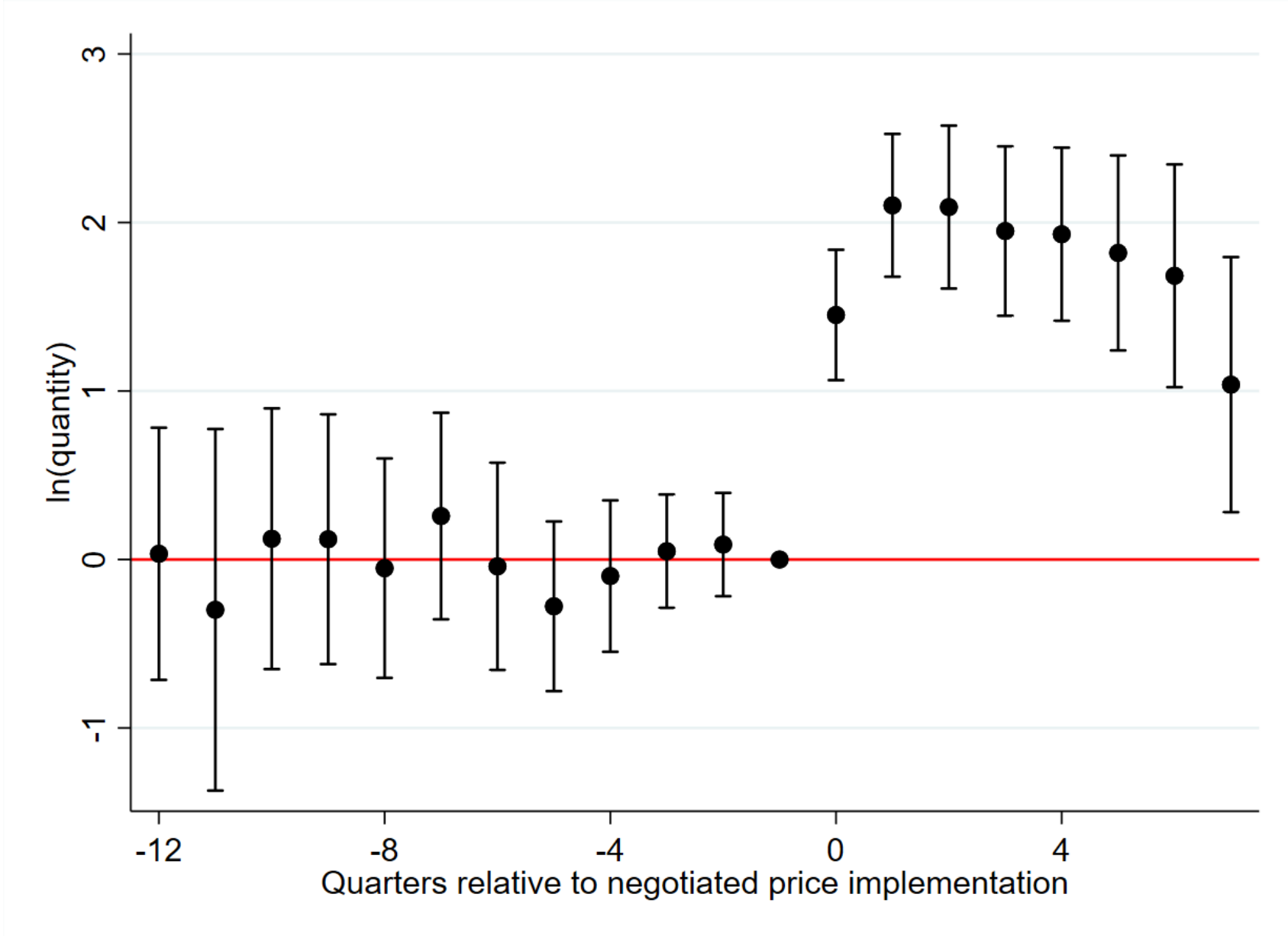
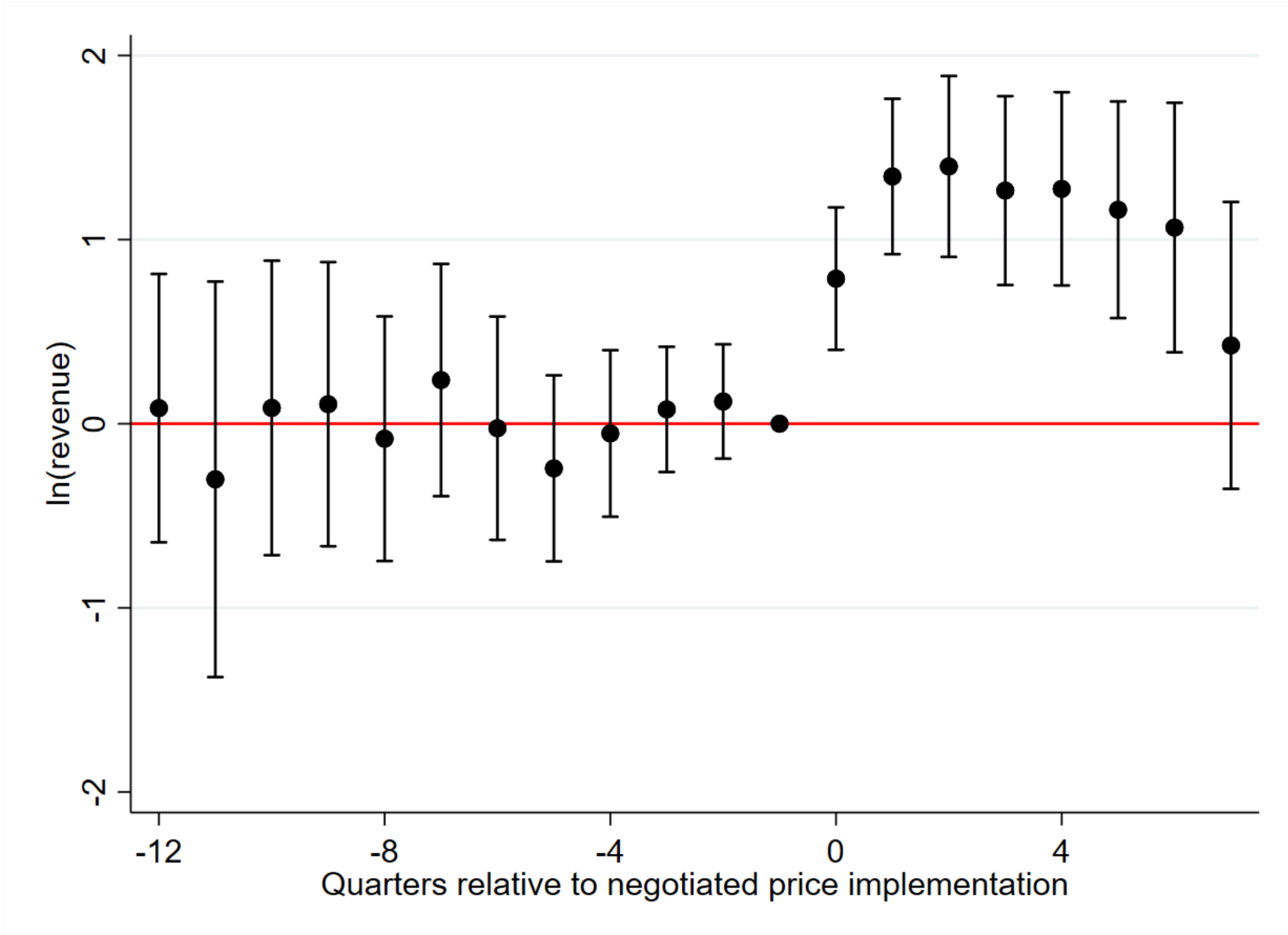


Successful Negotiation Leads to Expanded Market Size



Successful Negotiation Increases Firm Revenues



Policy Impacts on Innovation

Empirical Design: Measures of Innovation

- We use clinical trials to measure innovation (Finkelstein, 2004; Yin, 2008; Blume-Kohout and Sood, 2016; Geng and Shi, 2024).
- Data: 2013-2023 clinical trials registered with the government-mandated platform.
- We exclude clinical trials
  - for generics, i.e., bio-equivalence tests
  - for drugs already marketed elsewhere
  - for COVID-19

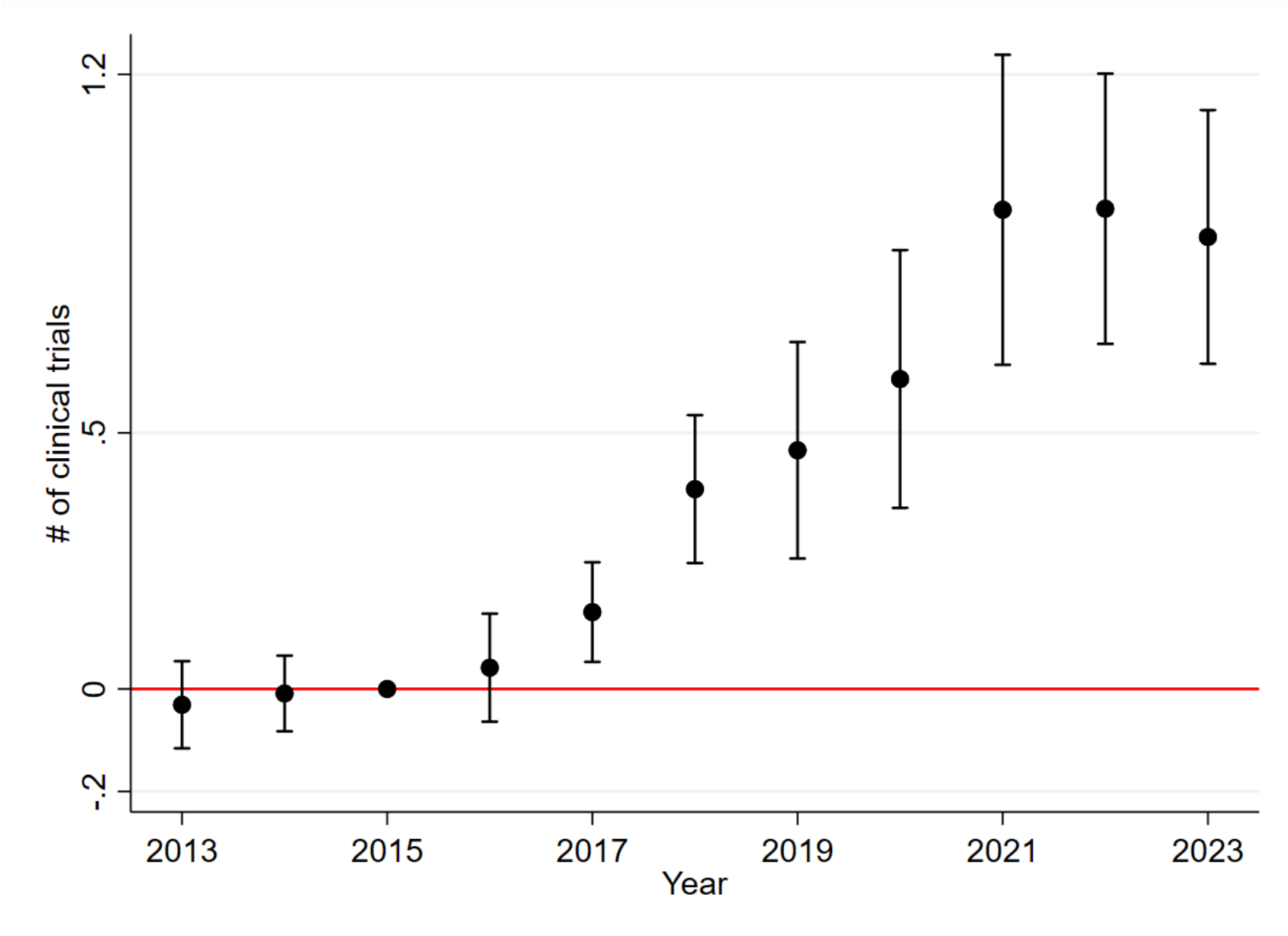
Empirical Design: Disease-Level DiD

- We employ a DiD design comparing innovation for drugs and preventive vaccines
  - Vaccines are not eligible for the policy
  - Other shocks/policy may affect drugs and vaccines R&D simultaneously
- We construct ICD-10 disease categories and interact with drugs/vaccines ICD-10

$$y_{it} = \beta\, drug_i \times post_t + \lambda_i + \gamma_t + \varepsilon_{it}.$$

  - $drug_i = 1$ for drugs and 0 for vaccines
  - $post_t = 1$ when $t \geq 2016$
  - y_{it} is the number of drug/vaccine clinical trials for a disease

The Policy Induces More Clinical Trials

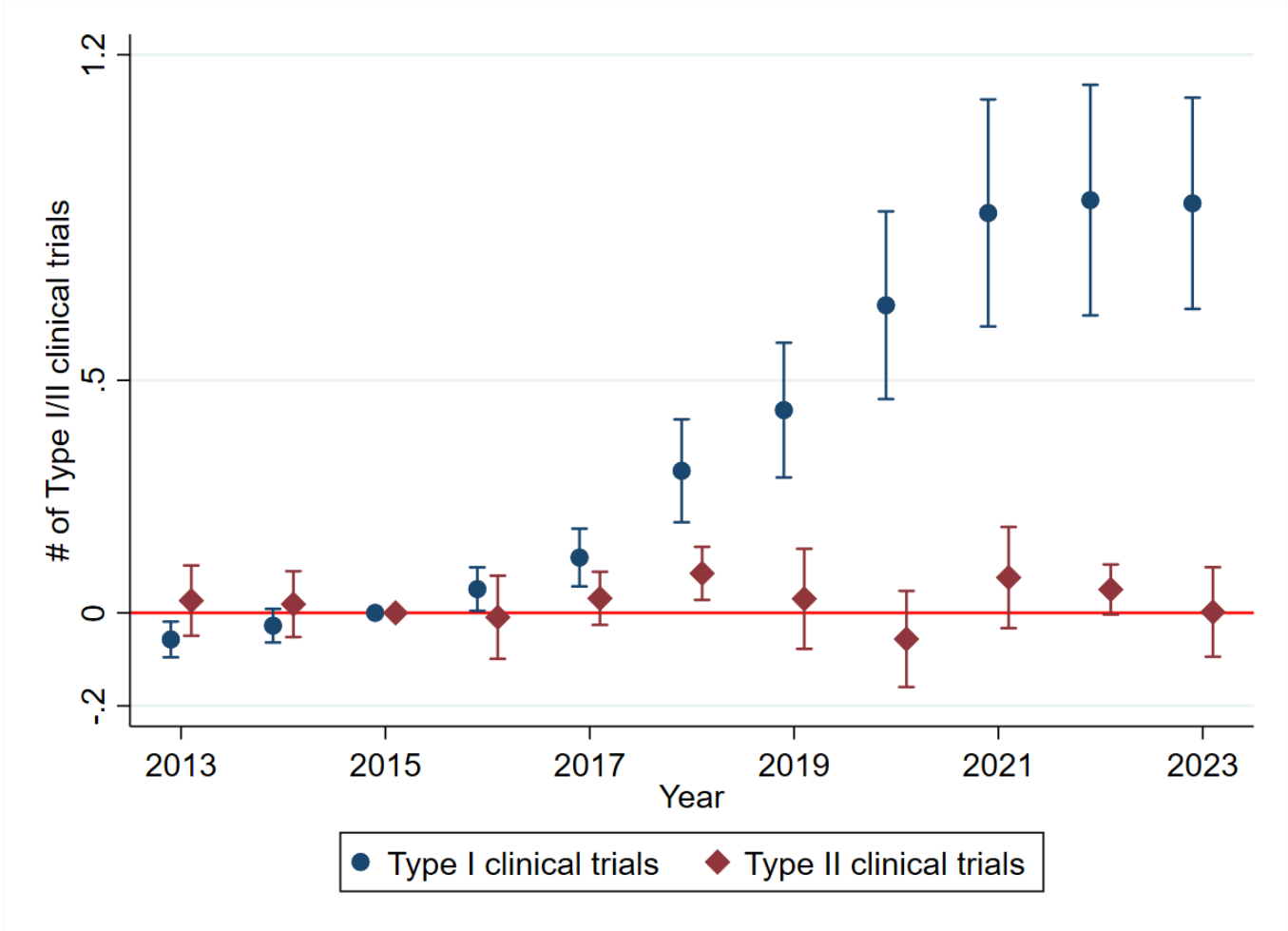


Robustness Checks and Alternative Research Designs

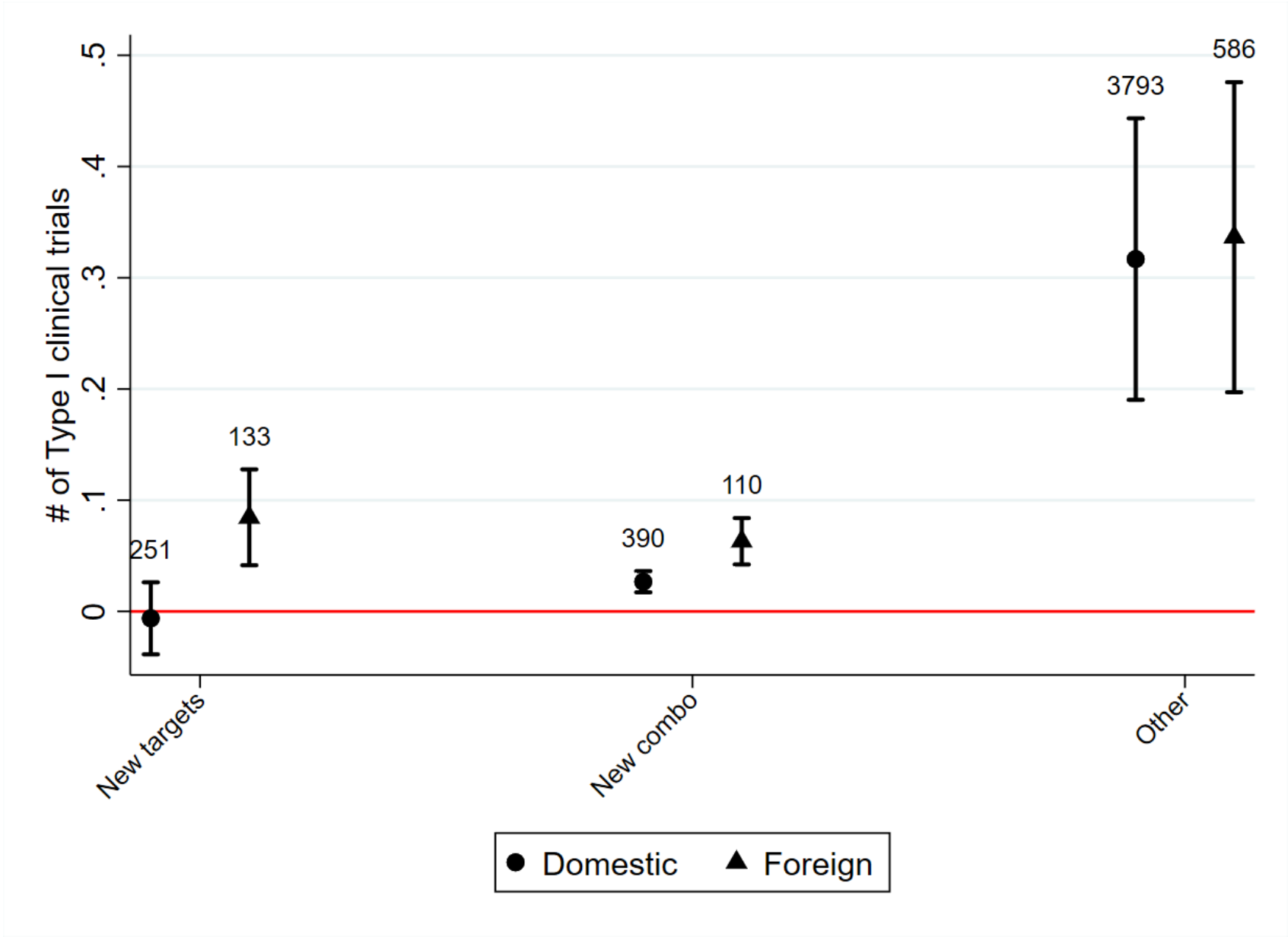
- Confounding policies MAH Pilot
- Comparability between vaccine and drugs Drug Type
- Alternative design based on the variation in negotiation status: a greater increase after a successful negotiation
  - Firm-level Firm
  - Disease-level Disease
- Other robustness checks: Any Trial Poisson Trial Phases

How About Innovation Quality?

- Clinical trial classification
  - Type I new drugs (new molecules)
  - Type II new drugs (improved existing molecules, less novel)
- Effects Are Driven By Type I Innovations:



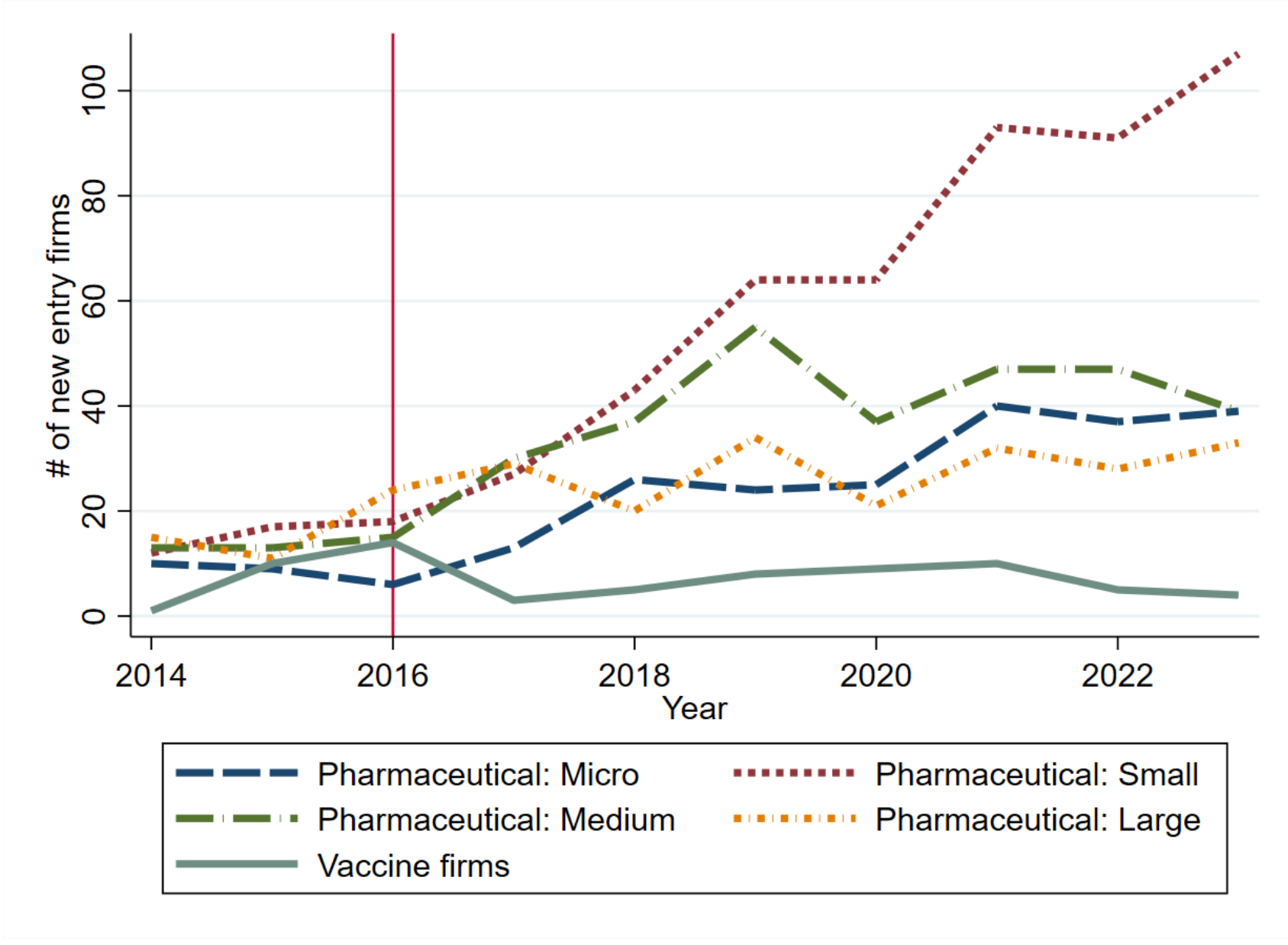
Most Trials Interact with Existing Targets[1]



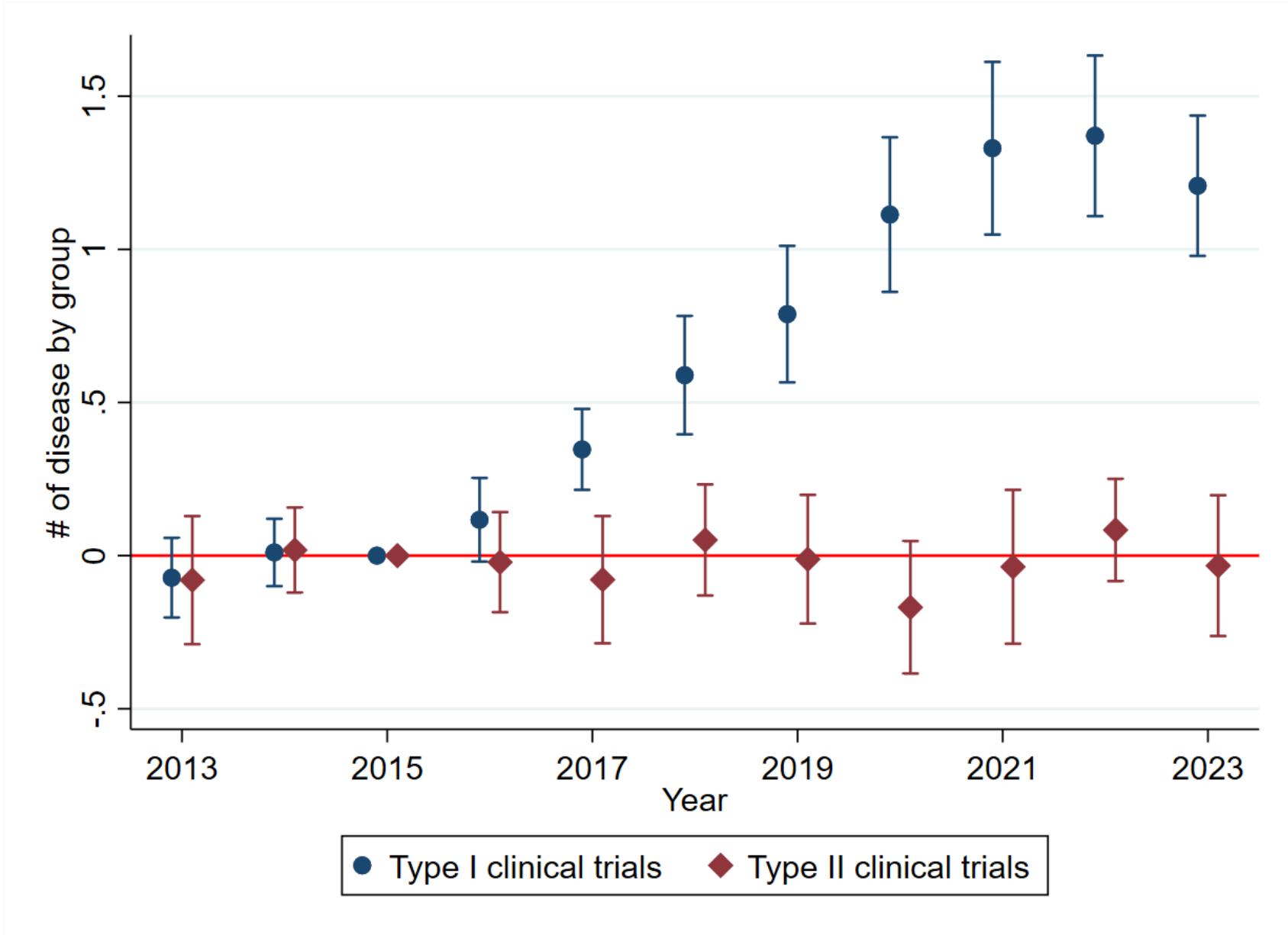
[1]Numbers on top of the bar show the sample count in that category.

Policy Impacts on Industry Dynamics

More (Small) Firms Entering the Market



Incumbent Firms Expanding Disease Scopes



Initial Policy Effects Are Driven By Firm Collaboration

Three collaborative models for clinical trials:

1. In-house: one single firm
2. Collaboration: the licensing firm conducts trials with others
3. Outsourcing: licensing and trial firms are different

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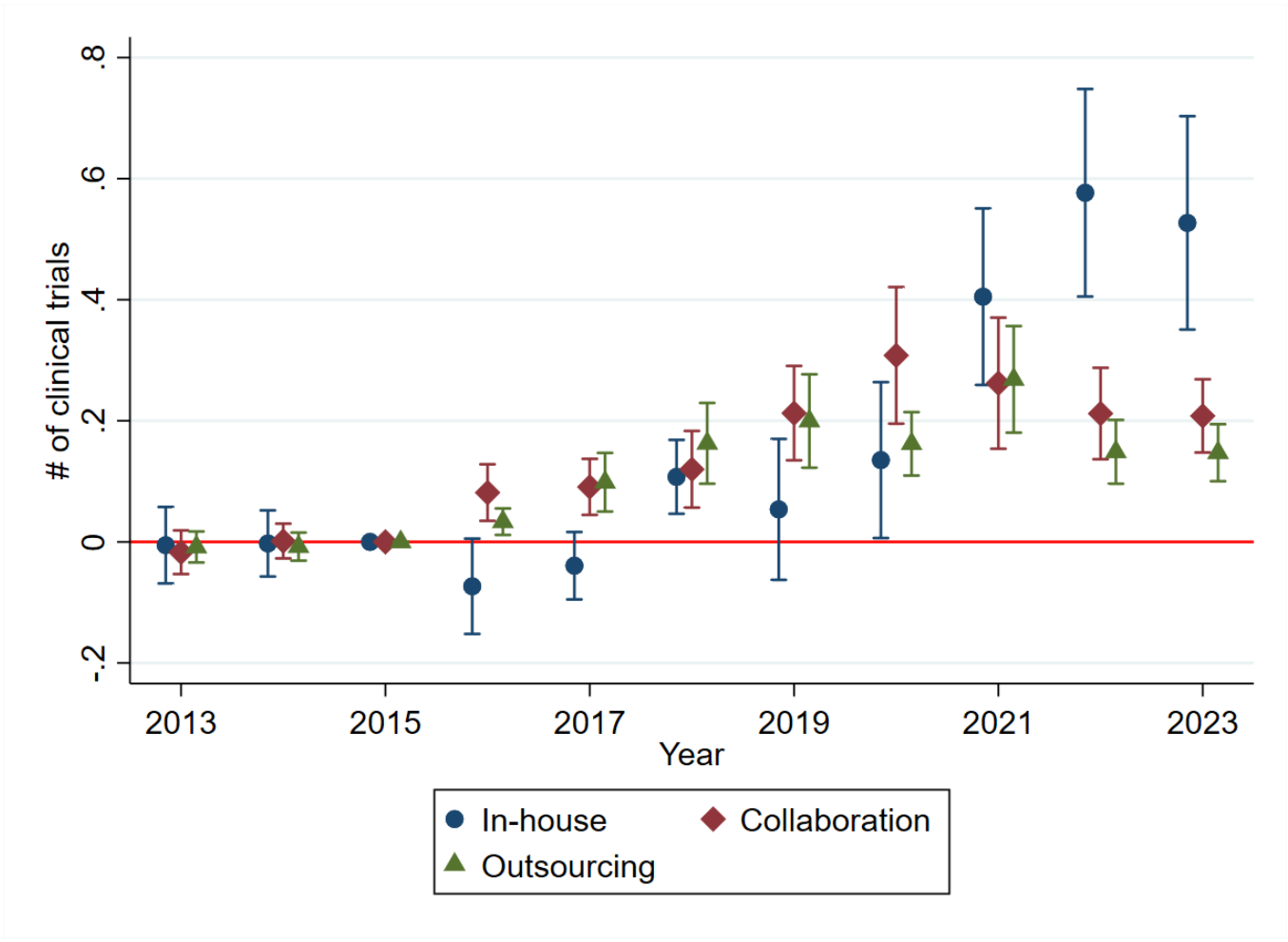


Discussion

- By combining insurance coverage with price bargaining, China's drug price negotiation policy can successfully achieve
  - price reduction
  - increase in firm revenues
  - more pharmaceutical innovations
- The policy induces
  - More new drugs developed **for** Chinese households
  - More new drugs developed **by** Chinese firms
- Welfare implications?

Appendix

Successfully Negotiated Drugs Are Similar To Others

	Treatment group	Control group		Robustness check	
	(1)	(2)	(3)	(4)	(5)
	Negotiated drugs	Exclusive drugs	Difference	Invited/applied drugs	Difference
ln(revenue)	10.751	10.467	0.285	11.549	-0.798*
	(2.019)	(2.358)	(0.30)	(2.404)	(0.44)
First launch year	2017.257	2014.609	2.648***	2016.892	0.365
	(2.144)	(3.285)	(0.38)	(3.332)	(0.59)
1(Domestic drug)	0.352	0.382	-0.029	0.351	0.001
	(0.480)	(0.488)	(0.07)	(0.484)	(0.09)
N	105	110	215	37	142

Back

Methodology: Staggered DID

- We use the rolling sample method to estimate the staggered diff-in-diff model (Cengiz et al. 2019; Deshpande and Li 2019).
- Divide the sample into groups G_1, G_2, $\cdots$, G_n based on the policy treatment at T_1, T_2, $\cdots$, T_n, along with a control group C that never receives the treatment.
- For G_1, we set treatment time as T_1 and construct control group including:
  - Observations from G_2, $\cdots$, G_n that occur at and before the time they are treated and
  - all of the control group C.

  Repeat for other $G_2, ..., G_n$ as treated group.
- The Staggered DID model becomes:

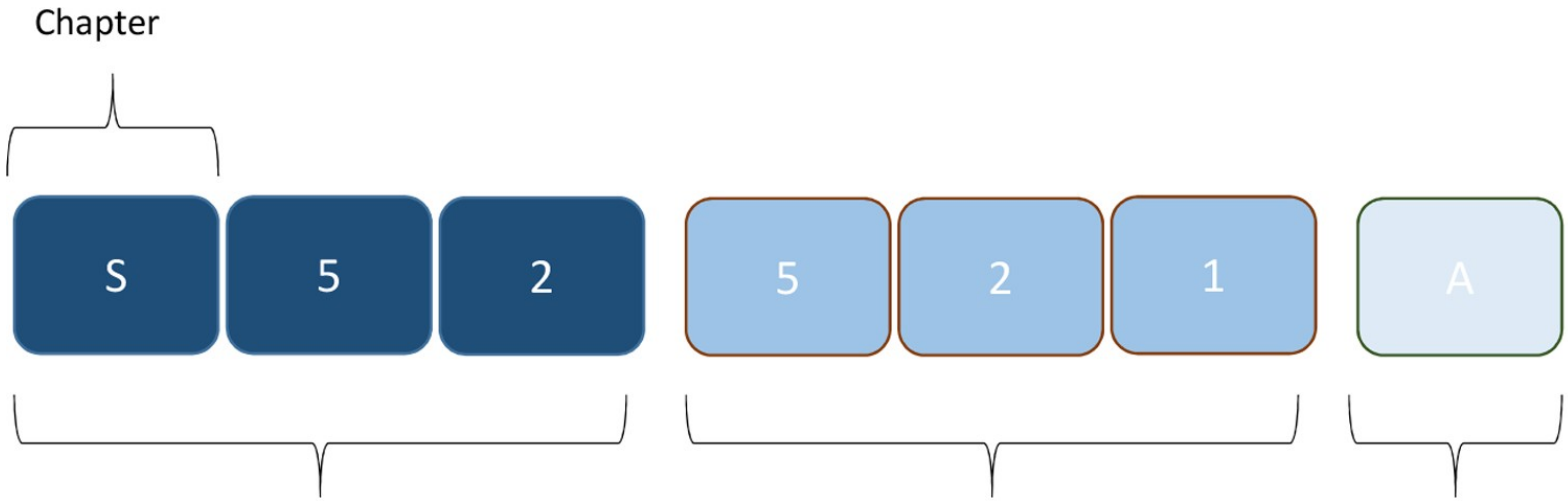
$$y_{ist} = \beta treat_{is} \times post_{st} + \lambda_{is} + \mu_{st} + \epsilon_{ist}$$

where s refers to the subsample.

Back

National Clinical Version 2.0 of Disease Classification

- Compiled based on the international ICD-10 codes
- Coding Structure

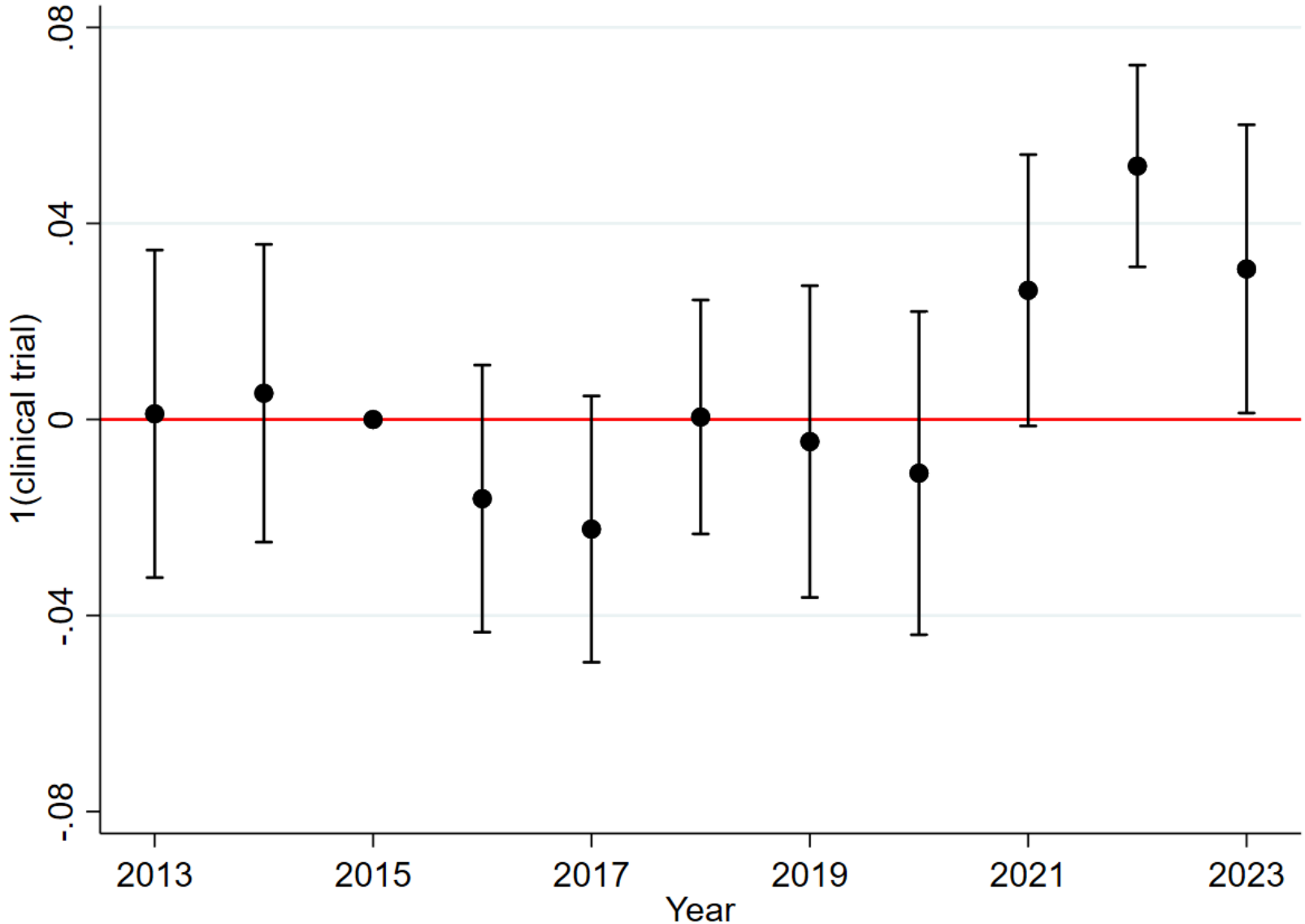


S52 Fracture of forearm
S52.5 Fracture of lower end of radius
S52.52 Torus fracture of lower end of radius
S52.521 Torus fracture of lower end of ***right*** radius
S52.521A Torus fracture of lower end of ***right*** radius, ***initial encounter,*** closed fracture

- We define diseases at the ICD-10 Category level.

Back

Policy Makes Clinical Trials More Likely To Happen



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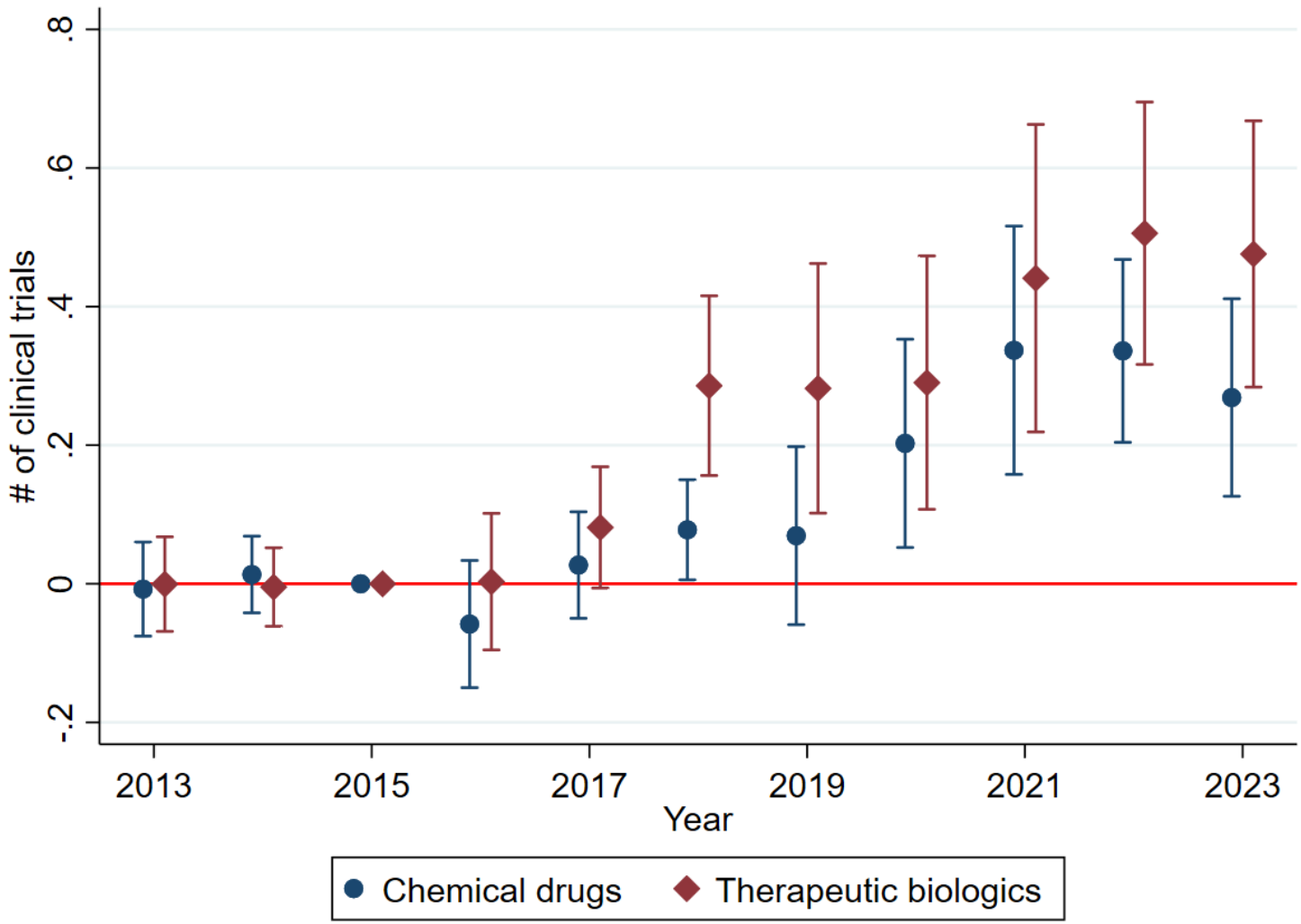
Robustness Check: Chemical vs Biologics



Back

Robustness Check: Poisson Regression

- Use Poisson regression when the dependent variables are the number of clinical trials

	(1) All	(2) Type I	(3) Type II
treat × post	0.521***	0.812*	-0.083
	(0.153)	(0.442)	(0.140)
Observations	5830	4686	3982
Mean of Dep. Var.	4.565	4.443	1.455
SD of Dep. Var.	15.108	14.153	3.635

Back

Robustness Check: Alternative Dependent Variable

- Use the number of clinical trial projects as the dependent variable

	# of clinical projects		
	(1)	(2)	(3)
	All	Type I	Type II
treat × post	0.278***	0.300***	-0.022
	(0.057)	(0.045)	(0.022)
Observations	40568	40568	40568
Mean of Dep. Var.	0.367	0.294	0.073
SD of Dep. Var.	3.134	2.759	0.507
Adj. R^2	0.637	0.589	0.663
Within R^2	0.000	0.000	0.000

Back

Robustness Check: Clinical Trial Time

- Clinical trial date:
  - Benchmark: the date of first patient enrollment
  - Robustness check: the IRB committee's first approval date as the trial start date

	(1) Any	(2) Type I	(3) Type II
treat × post	0.017*	0.032***	-0.005
	(0.010)	(0.008)	(0.009)
Observations	40568	40568	40568
Mean of Dep. Var.	0.074	0.059	0.042
SD of Dep. Var.	0.262	0.235	0.200
Adj. R^2	0.651	0.644	0.548

	(1) All	(2) Type I	(3) Type II
treat × post	0.722***	0.659***	0.062**
	(0.119)	(0.096)	(0.031)
Observations	40568	40568	40568
Mean of Dep. Var.	0.757	0.600	0.157
SD of Dep. Var.	6.885	5.850	1.313
Adj. R^2	0.665	0.630	0.598

Back

Robustness Check: Excluding the MAH Pilot Program

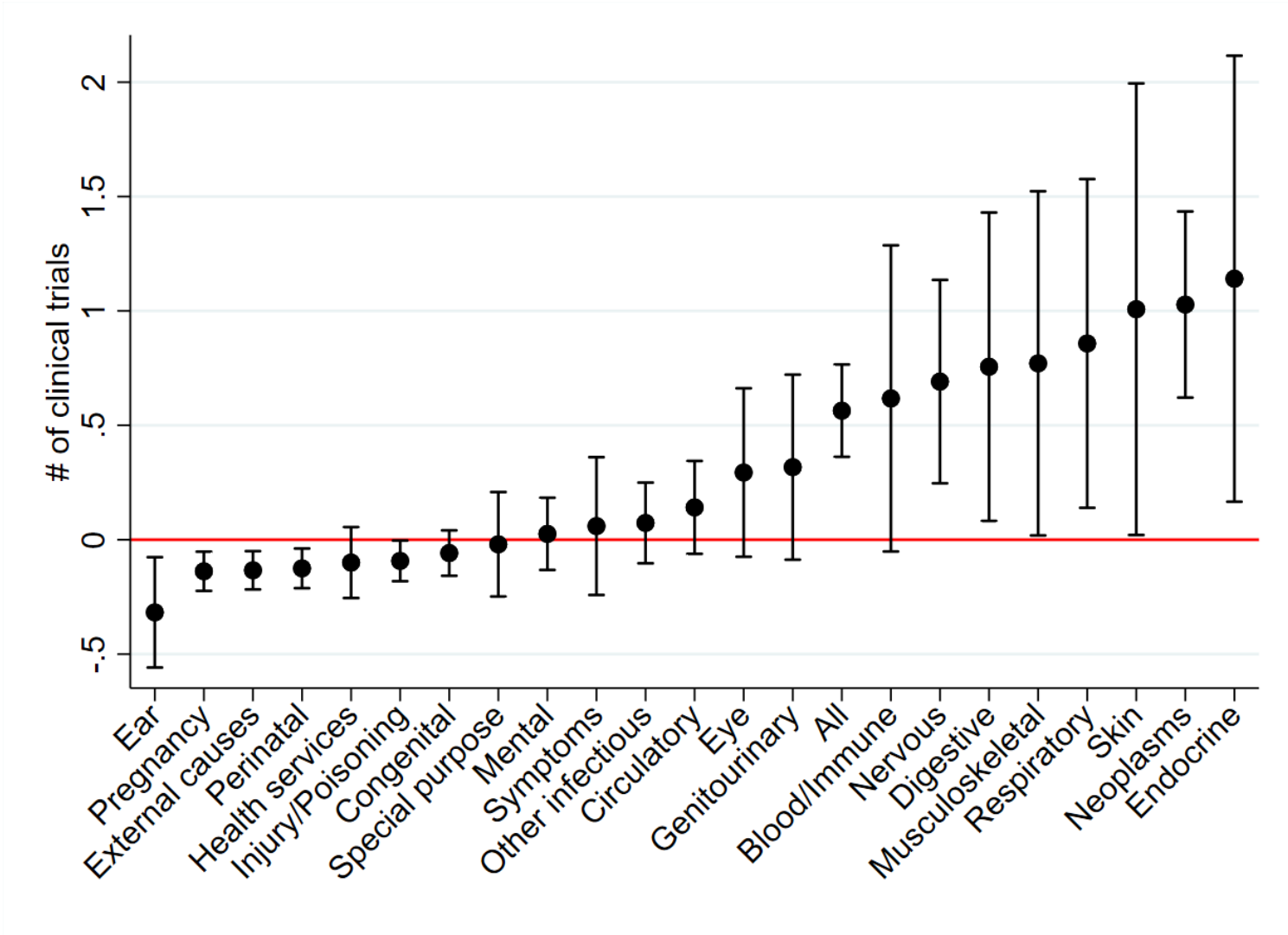
- To avoid confounding from the 2015 MAH pilot which excluded vaccines, we drop trials led by MAHs in pilot provinces and restrict the sample to 2013–2019, before the nationwide rollout.

	(1) All	(2) Type I	(3) Type II
treat × post	0.064***	0.014*	0.051***
	(0.020)	(0.008)	(0.016)
Observations	25816	25816	25816
Mean of Dep. Var.	0.082	0.022	0.060
SD of Dep. Var.	0.799	0.258	0.653
Adj. R^2	0.547	0.410	0.512
Within R^2	0.000	0.000	0.000

Back

Heterogeneity: Diseases

- We group diseases by ICD-10 Chapters



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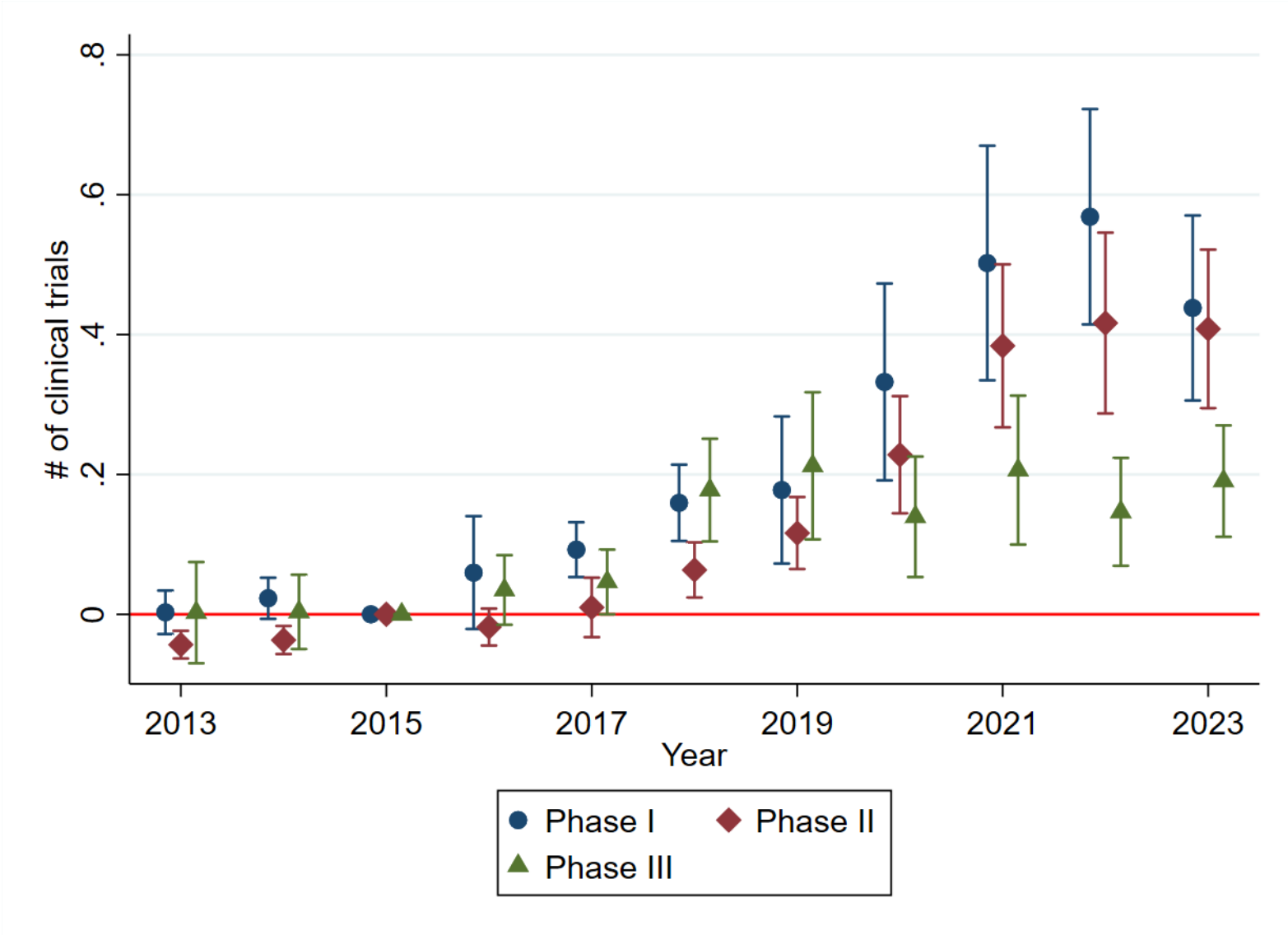
Heterogeneity: Clinical Trial Phases

- The impacts for different trial phases



Back

Empirical Design: Firm-Level Analysis

- For overall effect, we use DID model with all firms:

$$y_{jt} = \beta_1 policy_{jt} + \lambda_j + \gamma_t + \varepsilon_{jt},$$

- For income shock effect, we estimate a staggered treatment timing DID model using the rolling sample method with applied/invited firms:

$$y_{jt} = \beta_2 nego_{jt} + \lambda_j + \gamma_t + \varepsilon_{jt},$$

  - y_{jt}: the number of clinical trials in year t
  - $policy_{jt} = 1$ for pharmaceutical firms after 2016
  - $nego_{jt} = 1$ for successfully negotiated firms after the negotiation

Results: Number of Clinical Trials

- Column (1): Overall effect
- Column (2): Income shock effect

	(1) All	(2) All
policy	0.188*	
	(0.110)	
nego		1.957***
		(0.730)
Observations	18132	12156
Mean of Dep. Var.	0.594	1.194
SD of Dep. Var.	2.171	3.993
Adj. R^2	0.559	0.615

Back