

# Re-Innovation Nation:

## Explaining Technology Transfer Policy in Rising China

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Massachusetts Institute of Technology

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# Motivation

## Importance of Technology Transfer Policies in China:

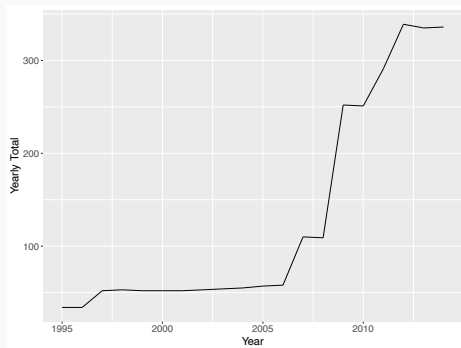
- 1 Helped fuel China's rise
- 2 Central to U.S.-China trade war and technology competition

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## Tech Transfer Policies in China, 1995-2015



Sources: PKU Laws and Regulations Database

# Puzzle: The Dogs That Did Not Bark

Aircraft Engines



Renewable Energy



High-Speed Rail



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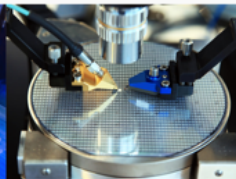
Batteries



Navigation Equip.



Semiconductors



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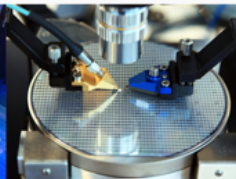
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What explains variation in China's use of tech transfer policies?

# Contributions

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  - Joint venture (JV) requirements, local content requirements, preferential government procurement
- 3 **Findings:**
  - Strategic industries account for >85% of the 6.6x growth in use of technology extractors after WTO entry
  - China is 2.4x less likely to use these policies when it sits in the middle of global value chains in an industry

# Theory: Argument in Brief

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But China's **bargaining power** over foreign firms constrains the use of technology extractors, even in highly strategic industries.

China's bargaining power rests on central state **enforcement capacity** and China's position in **global value chains (GVCs)** in an industry.

# Theory: Breaking Down Bargaining Power

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- 3 Medium- and Long-Term Program, 2006

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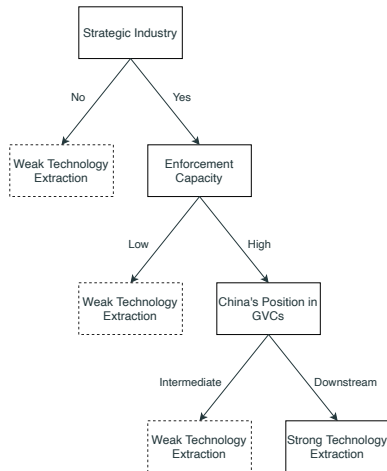
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## Determinants of Tech Extraction



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- 1 China primarily introduces tech extractors in strategic industries.
- 2 The use of tech extractors increases with the growth of central enforcement capacity, particularly after launch of the Medium- and Long-Term Program (MLP).
- 3 China seldom introduces tech extractors in strategic industries in which it occupies an intermediate position in GVCs.

# Research Design

## Quantitative Analysis:

- **DV:** Technology extractors by industry-year, 1995-2015
- **IV:** Interaction of industry strategic status and bargaining power
- **Controls:** Concentration, SOE share, year FE, industry FE (2-digit)
- **Strategy:** Poisson regression with cluster-robust standard errors
- **Robustness:** OLS, negative binomial, zero-inflated poisson, lagged DVs, alternative measures of DV and IV

## Qualitative Case Studies:

- ① Wind turbine technology
- ② Semiconductor design and fabrication



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- ① **FDI Ownership Restrictions:** FDI Guidance Catalogue
- ② **Local Content Requirements:** PKU Laws and Regulations Database
- ③ **Preferential Govt. Procurement:** Indigenous Innovation Catalogue

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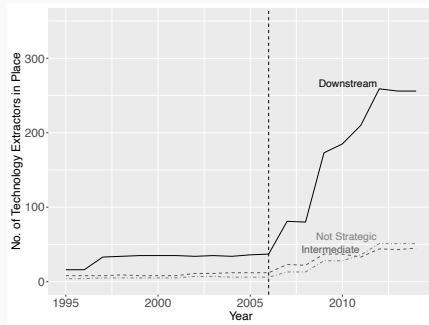
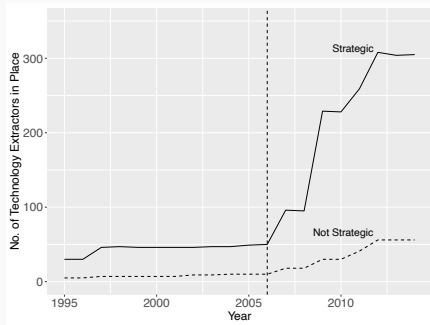
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## Controls

- 1 Geographic Concentration: Herfindahl–Hirschman Index
- 2 Vested Interests: State-owned enterprise share of industrial output

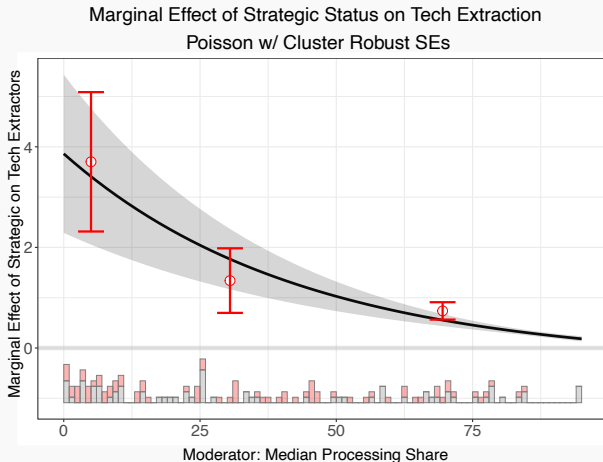
# Results: Tech Extraction Before and After MLP Launched

## Total Technology Extractors in Place, 1995-2015



**Key:** Tech extractors concentrated in strategic industries in which most Chinese imports are consumed in China

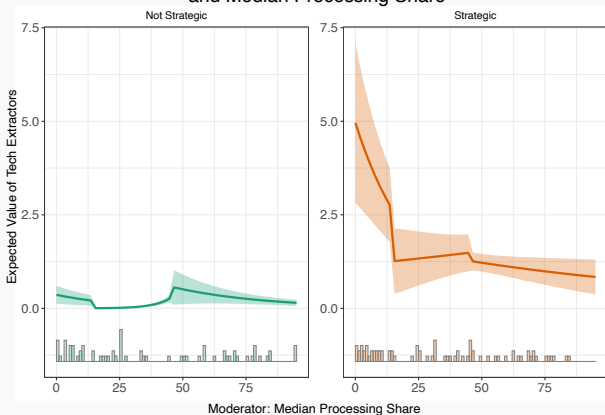
# Results: Impact of Strategic Status Declines in GVC Position



**Key:** Marginal effect of strategic status on the use of tech extractors conditional on processing trade dependence

# Results: Impact of Strategic Status Declines in GVC Position

Expected No. of Tech Extractors by Strategic Status and Median Processing Share



**Key:** China 2.4x more likely to introduce tech extractors in strategic industries in which it is downstream of GVCs

# Conclusion

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**Summary:** Top-down strategic interests shape technology transfer policy in China, but their impact is conditional on institutional capacity and where China sits in global value chains.

# Conclusion

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[www.johndminnich.com](http://www.johndminnich.com)

# Appendix

Theory: Strategic Interests

Theory: Enforcement Capacity

Theory: GVC Position

Case Selection

Wind, Part One

Wind, Part Two

Semiconductors

Alternative Explanations

China's Processing Trade Dependence

Alt. Measure of Strategic Industries

Technology Extractors by Type

Lagged Outcome Variable Models

Negative Binomial Regression

# Appendix: Theory – Strategic Interests

## Existing Approaches

- Vested economic interests
  - **Problem:** Aggressive tech extraction in infant industries
- Bureaucratic fragmentation
  - **Problem:** Rise of tech extractors follows institutional consolidation

## My Argument

- Rising great power, late modernizer, performance legitimacy
- Leninist political structure
- Public and private speech evidence from senior Chinese leaders

**Key:** China pursues technology extraction in strategic industries

## Appendix: Theory – Enforcement Capacity

### Three-Step Process:

- 1 Administrative restructuring and consolidation, 1998-2003
  - Eliminates 3/4 of industrial line ministries
- 2 Rise of National Development and Reform Commission, 2003-2005
  - NDRC gains approval authority over large-scale FDI in China
- 3 Launch of the Medium- and Long-Term Program, 2006
  - Improves inter-agency coordination, facilitating expansion of tech extraction beyond core NDRC policy domains

**Key:** Improved enforcement capacity enables more aggressive tech extraction in strategic industries

## Appendix: Theory – GVC Position and Credible Threats

Interest	China	Foreign Firms
Short-Term	Present Security (Exports)	Present Sales (Market Access)
Long-Term	Future Security (Get Technology)	Future Sales (Protect Technology)

**China Intermediate to GVCs:** Firms can more credibly threaten China's short-term interest in exports and employment than China can threaten theirs in present sales

**China Downstream of GVCs:** China can more credibly threaten firms' short-term interest in present sales than firms can threaten China's in exports and employment

**Key:** China will refrain from imposing tech extractors in strategic industries in which it is intermediate to value chains

# Appendix: Case Selection

## Detailed Industry Case Studies:

- Wind turbine technology: “less likely”
- Semiconductor design and fabrication: “most likely”

## Case Selection Criteria:

- 1 Variation on DV
- 2 Variation on GVC position
- 3 Substantive Importance and diversity

## Method:

- Within-case: “Before & after” gains in enforcement capacity
- Cross-case: Variation in GVC position

**Evidence:** Interviews (n = 22), primary documents, secondary sources

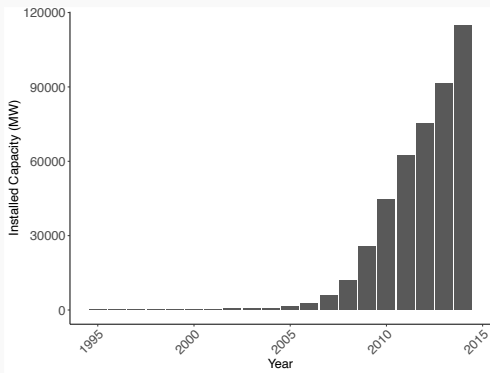
# Appendix: Case Study # 1 – Wind Turbine Technology (Part 1)

## Before Admin. Restructuring

- Bureaucratic competition
- Policy redundancy
- Soft Inducements: Tech transfer “encouraged”
- Limited efficacy: Installed capacity low; Goldwind opened first facility in 2002

**Key:** Enforcement cap. limited tech extraction before ~2003

Installed Wind Power Capacity in China (MW), 1995-2015



Source: Global Wind Energy Council



## Appendix: Case Study #1 – Wind Turbine Technology (Part 2)

### After Admin. Restructuring

- NDRC takes control
  - ① 2004: Wind Concessions
  - ② 2005: Expands 70% req.
  - ③ 2007: Imposes JV req.
  - ④ 2009: Govt. procurement
- Hard localization mandates
- Improved efficacy: Installed capacity rises 100x, domestic share from <25% to >90%

**Key:** Increased enforcement cap. spurs tech extraction after ~2003

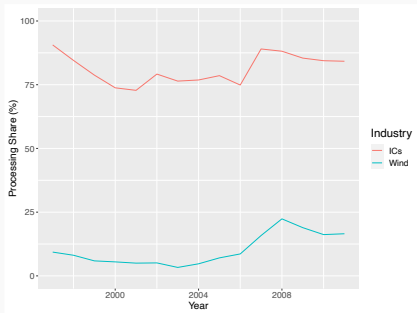
“[T]he Chinese government bet correctly that...Rather than fight, Gamesa and the other leading multinational wind turbine makers [would opt] to open factories in China and train local suppliers to meet the 70 percent threshold.”

“Within weeks...Gamesa sent dozens of Spanish engineers to Tianjin. The engineers...fanned out to Chinese local Chinese companies and began teaching them how to make a multitude of steel forgings and castings, and a range of complex electronic controls.”

– *The New York Times* (2010)

## Appendix: Case Study #2 – Semiconductors

Import Processing Share  
ICs vs. Wind Turbines, 1997-2011



Source: China Customs Data

“Other industries – rail, wind, aircraft – are **closed loop**, which gives [China] **incredible leverage**...In semiconductors, for much of the 2000s...the vast majority of consumption by companies in China was for manufacture and export to international customers.”  
– *Interview with SIA executive (2021)*

“Much of the market was for re-export processing...**so not strong leverage** to impose JVs...[Instead] China had to offer **sweetheart deals to lure investment**.”  
– *Correspondence with China-based industry expert (2022)*

# Appendix: Alternative Explanations

## Motives:

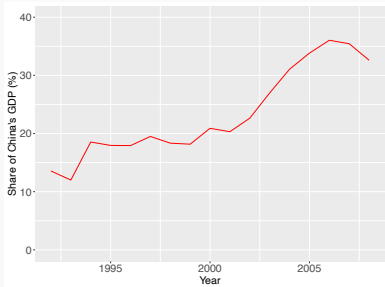
- 1 Economic interest groups
- 2 Bureaucratic fragmentation

## Absence in Strategic Industries:

- 1 Technological complexity
- 2 Rates of innovation
- 3 International concentration

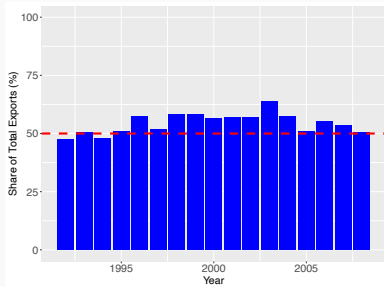
# Appendix: The Stakes of Processing Trade for China

Exports as a Share of China's GDP, 1992-2008



Source: World Bank

Processing Trade as a Share of China's Exports, 1992-2008



Source: National Bureau of Statistics

- Exports from processing trade account for 19.8% of China's GDP in 2006
- Foreign firms account for >80% of process. trade in China from 1995-2009
- Export-related employment heavily concentrated in coastal cities

# Appendix: Data – Coding Technology Extractors

**外商投资产业指导目录 (2015年版)**

**鼓励外商投资产业目录**

一、农、林、牧、渔业

1. 林木良种选育、栽培加工及林产品的初加工等, 包括:

2. 绿色、有机蔬菜 (含食用菌、蔬菜类)、干鲜果品

农产品

3. 猪肉、牛肉、禽蛋等动物源性食品技术开发及生产

4. 无公害农产品及绿色食品的研发、经营

5. 蔬菜、食用菌、豆制品、粮油等制品

6. 中药种植、养殖

7. 非生物转基因及非转基因动物、植物遗传资源的开发

8. 水产苗种繁育 (不含国家特有的珍贵经济品种)

9. 动物源性化妆品及天然植物源性化妆品原料研发

10. 水产品养殖、深加工及销售, 工厂化水产养殖、加工

二、采矿业

11. **石油、天然气** 地质普查、勘探、开发气、油田气、开发页岩气及天然气 (限于合资、合作)

12. 煤炭地质普查 (不含地质普查方式) 及地质勘探工程

13. 地质、钻探、测井、录井、录井技术服务及测井工程

14. 煤炭矿、金属矿、非金属矿的地质普查及勘探工程及工程

15. 金属矿产勘探 (除稀土、稀有矿产) 的勘探、工程

三、制造业

(一) **装备制造制造业**

16. 绿色及节能材料及其制品开发

17. 农产品加工、其他农产品加工、海产品保鲜及加工

18. 蔬菜、干鲜果品、禽蛋产品加工

3

代码	名称	备注
1310	石油和天然气开采业	131001 原油开采
1320	煤炭开采和洗选业	132001 烟煤开采
1330	黑色金属矿采选业	133001 铁矿采选
1340	有色金属矿采选业	134001 铜矿采选
1350	非金属矿采选业	135001 石墨采选
1360	其他采矿业	136001 其他金属矿采选
1370	地质普查和地质勘探业	137001 地质普查
1380	地质钻探	138001 地质钻探
1390	测井	139001 测井
1400	录井	140001 录井
1410	录井技术服务	141001 录井技术服务
1420	测井工程	142001 测井工程
1430	测井工程技术服务	143001 测井工程技术服务
1440	录井工程	144001 录井工程
1450	录井工程技术服务	145001 录井工程技术服务
1460	录井工程技术服务	146001 录井工程技术服务
1470	录井工程技术服务	147001 录井工程技术服务
1480	录井工程技术服务	148001 录井工程技术服务
1490	录井工程技术服务	149001 录井工程技术服务
1500	录井工程技术服务	150001 录井工程技术服务

代码	名称	备注
1012	原油的开采	
1013	天然气的开采	
1014	其他石油和天然气的开采	
1015	其他石油和天然气的开采	
1016	其他石油和天然气的开采	
1017	其他石油和天然气的开采	
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FDI Catalogue  
“Oil, natural gas”

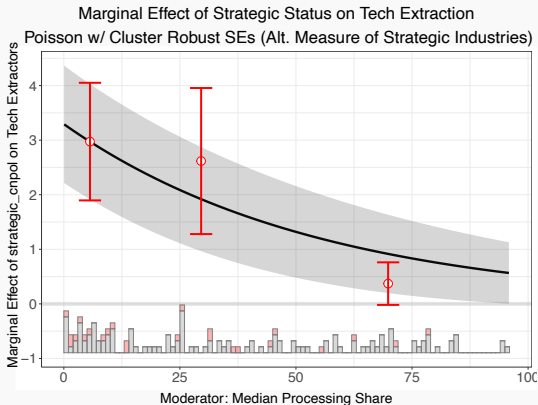


CSIC Industry Code  
“Oil and n.g. extraction”



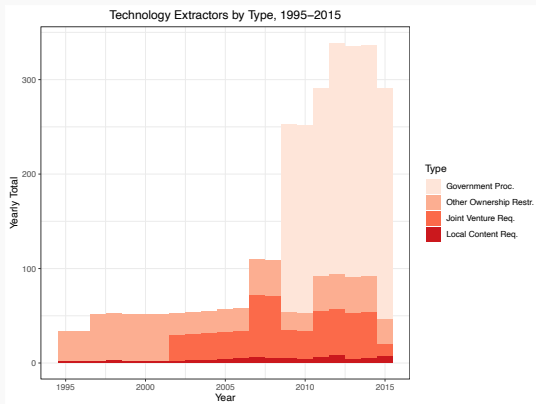
From CSIC to ISIC  
“Natural gas extraction”

# Appendix: Alternative Measure of Strategic Industries



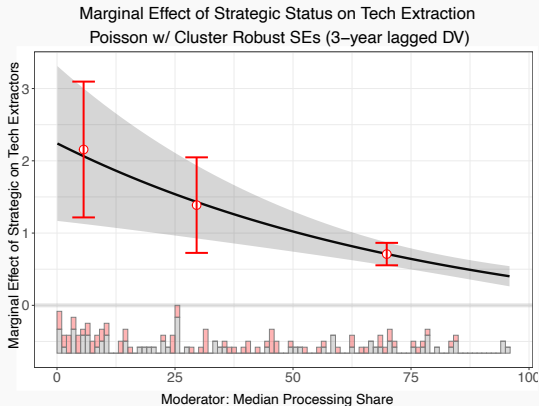
**Key:** Varying measures of strategic industry does not affect the results

# Appendix: Technology Extractors by Type



**Key:** Results hold with each type set as outcome

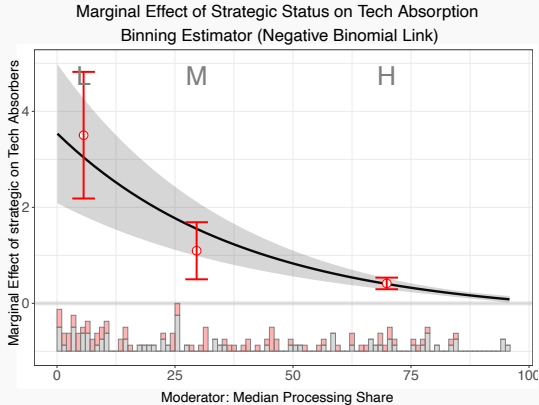
## Appendix: Lagged Outcome Variable Models



**Key:** Including a lagged outcome variable does not affect results



# Appendix: Negative Binomial Regression



Key: Alternating modeling strategies does not affect results