Social Network and Industrial Policy: Japan's Camphor Monopoly in Colonial Taiwan

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Industrial Policies in East Asia

- East Asian economies are often described as successful cases of industrial policies (e.g. Amsden ,1989; Wade, 2004; more recently, Lane, 2022)
  - Choose a strategic industry (can be narrowly defined).
  - Determine how funds and resources are allocated between the firms (**policy treatments**).
  - Review performances of firms, and shift the resources towards the **most productive firms** (winners).
- Successful examples: TSMC, Korean *Chaebols*, Japanese conglomerates, China's semiconductor (?).

Industrial Policies in East Asia

- The winners are oftentimes come with strong **political connections**.
- *Embedded Autonomy* by Peter Evans (1995):
  - Connection with business people through a social network facilitates with authority's decision making.
- "Favoritism" towards the efficient.
- But why not favortisim towards connected?

Research Questions

- How do we evaluate the performance of the visible hands **when accounting for the role of connectivities**?
  - Which firms recieve better policy treatments? The efficient or the connected?
  - How are these channels shape the configuration and outcome of industrial policies?
- More fundamentally, how to gague connectivity itself?
- The Camphor Monopoly System during Japanese Colonial Period in Taiwan might provide an answer.

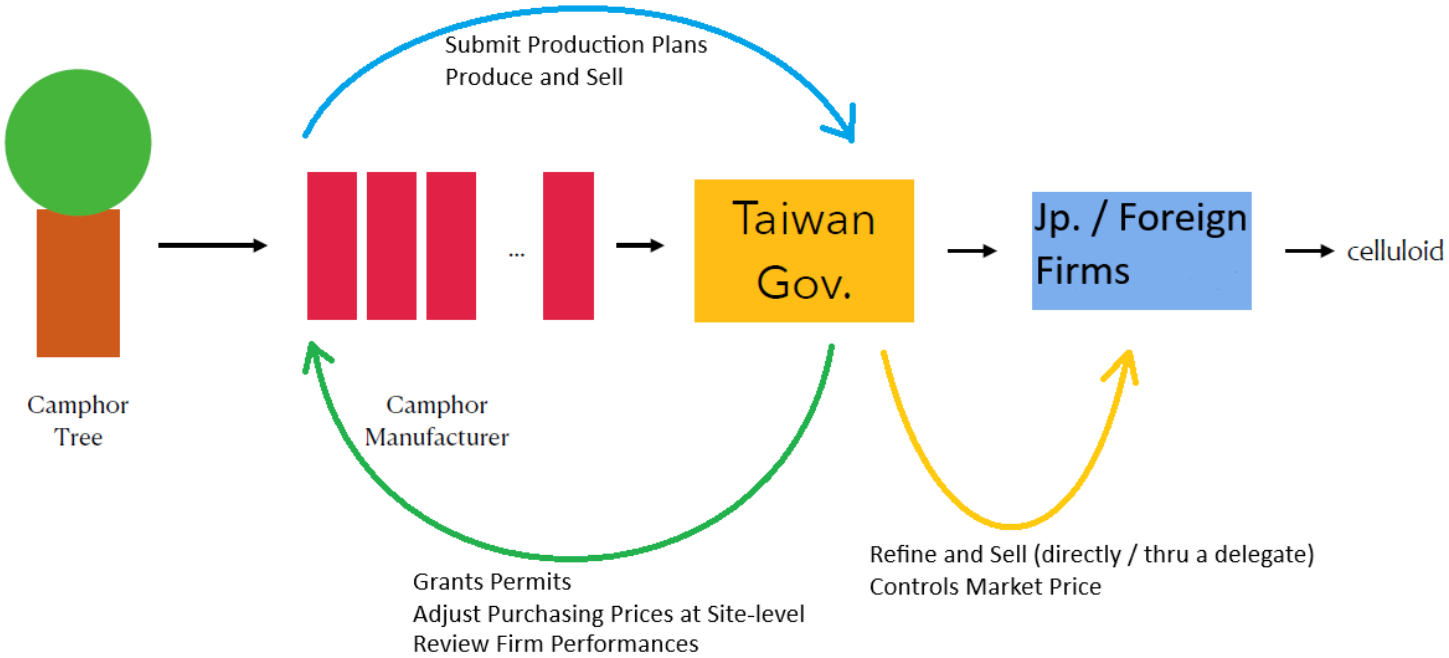
Why Camphor and Why Taiwan

- Camphor was fundamental to produce *celluloid* (nitrocellulose).
- Camphor supply was mostly controlled by Japanese and mostly produced in Taiwan (80% and 60% of world market share, resp.).
  - Natural habitat of camphor trees were mainly under Japanese control.
  - Difficult to plant beyond natural habitat.
  - Artificial synthesis too costly before the end of WWI.
- Just imagine that you have all of the world's *rare earth* in your backyard.

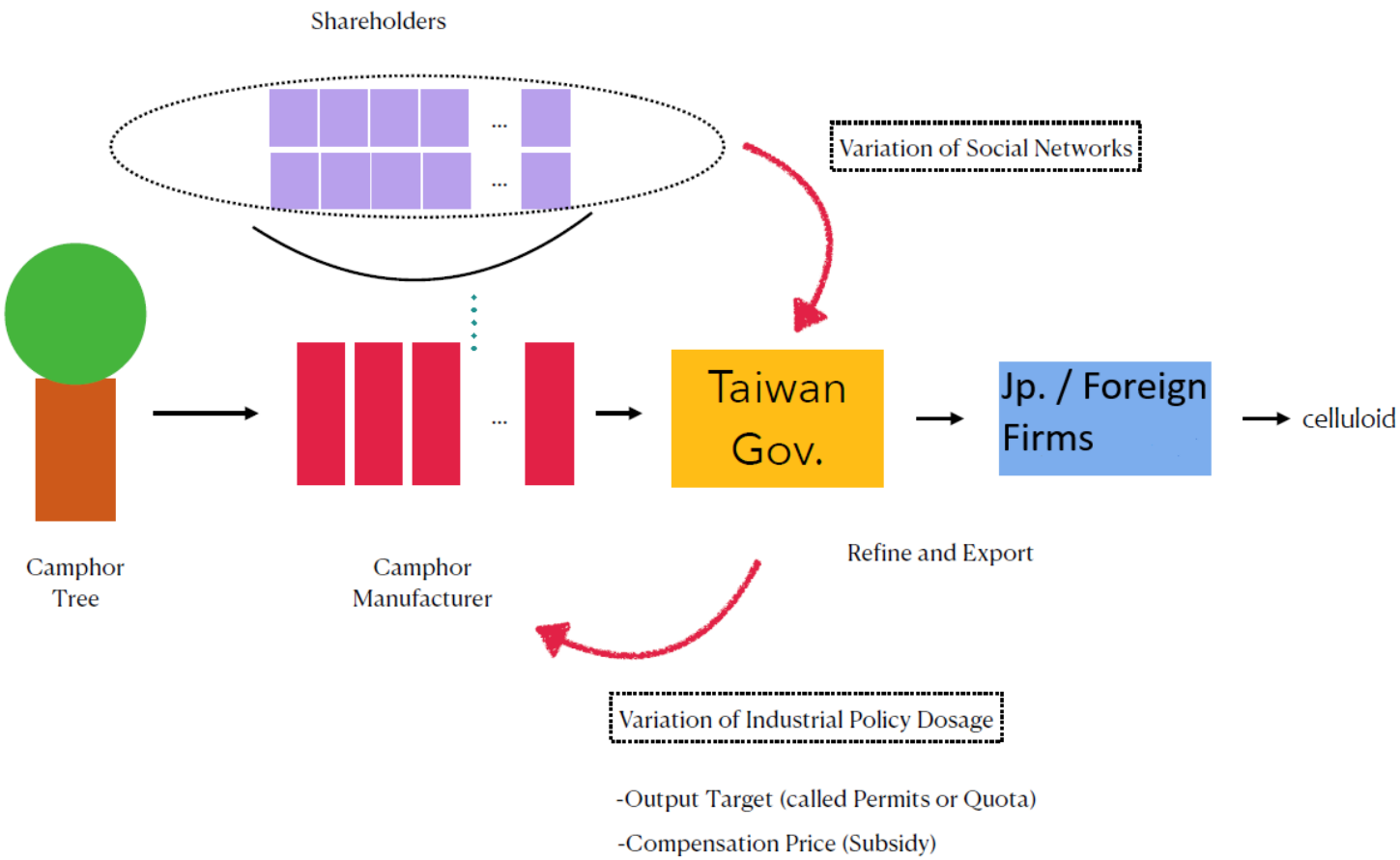
Camphor Monopoly System

- Camphor Monopoly System since 1899.
  - Government intervention to extract the profit.
  - A monopoly aspect for downstreams such as refining and retailing.
  - A **monopsony** aspect for upstream **crude camphor** during 1899-1918.
  - Detailed micro-level data for administration purpose.

Camphor Monopoly System



Possible Role of Connection



This paper

- Constructs firm-official social network then defines connectivity measurements based on historical news archive.
- Empirically identify the effect of connectivity on policy treatment received by firms.
- Builds a quantitative model that mimics the actual Camphor Monopoly System.
- Inspects the roles of the Peter Evans mechanism and favoritism on the government's financial goal via counterfactual simulation.

Main Findings

- **Empirical:** Firms that better connect with the authority obtain **more favorable compensations**.
- **Simulation:** Peter Evans mechanism and favoritism **coexist**.
  - **Non-monotonic effect** of connection on productivity of firms.
  - Entry and exit of firms tend to improve the performance of the industry in generating government profit.
  - But the six largest firms (mainly Japanese) are assigned with too many locations and come with too low productivity in light of the model.

Establishment-Level Data

- *Yearbook of Taiwan Governor-General Monopoly Bureau* (臺湾総督府専売事業年報)
  - Firm-Location (establishment) level data (we take 1905-18).
  - Initial and final camphor stove, permits, and actual output of camphor by quality.
  - Quantity of material usage and revenue (compensation from authority) received (available after 1907).
  - Owner, prefecture, and list of production sites.
  - Some information in shareholder structure.
- Matsushida (松下芳三郎 1924), *A Gazetter of Taiwan Camphor Monopoly,* (臺湾樟脳専売誌)
  - Provides labor expenditure for most firms during 1911-17.
- Suppliment wage rates and camphor price on downstream markets retreived from *Statistical Abstract of Taiwan Government-General* (台湾総督府統計書).
- PPI compiled by Wu (1996).

(二) 粗製樟腦樟腦油製造許可 其二

廳別	製腦業者	製腦地	腦灶數 原許可	增	減	年度末現在
宜蘭廳	臺灣製腦合名會社	小熕溪、大熕溪、五重溪、紅柴山、拳頭母山、松羅溪右岸、濁水溪左岸、清水溪左岸、大湖、桶山、大元山、小南澳山、舊蓉山、新蓉山、西帽山、東澳嶺、太白山、濁水溪右岸	五五〇	—	—	五五〇
	計		五五〇	—	—	五五〇
	三井合名會社	北勢溪上流、桶後溪上流	五〇	—	—	五〇
	計		六〇〇	—	—	六〇〇
臺北廳	三井合名會社	平廣坑、スガニー、樟樹林、トロンク、ガツトン、阿玉溪、桶後溪下流、北勢溪下流、南勢溪上流、カラモチ山、ララ山、栗仔園、山羊洞	二〇〇	一〇	—	二一〇
	計		二〇〇	一〇	—	二一〇
桃園廳	臺灣救濟團	大嵙崁溪左岸	五〇〇	—	三二	四六八
	萬基公司	石牛山	一〇〇	—	三一	一〇〇
	三井合名會社	竹坑山、雞罩山、熊空山、崙尾寮、三十份按山、五寮山、熊空山南脚、東眠山、金敏仔山、溪州山、ハブン	六五〇	三六〇	—	一、〇一〇
	計		一、二五〇	三六〇	三一	一、五七八

本年度粗製樟腦樟腦油生產見込量目認可高ハ樟腦五百六萬四十斤樟腦油六百九十一萬一千七百斤ニシテ其ノ後增額シタルモノ樟腦三十六萬斤樟腦油五十七萬七千斤ヲ加ヘ結局認可實施額樟腦五百四十二萬四十斤樟腦油七百四十八萬八千七百斤トナリ之ニ對スル製造實行高ハ樟腦四百九十三萬二千七百五十五斤五樟腦油五百九十三萬三千四百六十九斤五ニシテ認可實施額ニ對シ樟腦四十八萬七千二百八十四斤五樟腦油百五十五萬五千二百三十斤五ヲ不足セリ而シテ之ヲ前年度ニ比スレハ認可實施額ニ於テ樟腦十四萬六千四百十五斤樟腦油四十三萬六千七百十五斤製造實行高ニ於テ樟腦十八萬八千二百七十六斤五樟腦油四十九萬二千九百四十四斤ヲ增加セリ其ノ製造許可高、製造高、製腦原料附帶用材使用高等左ノ如シ

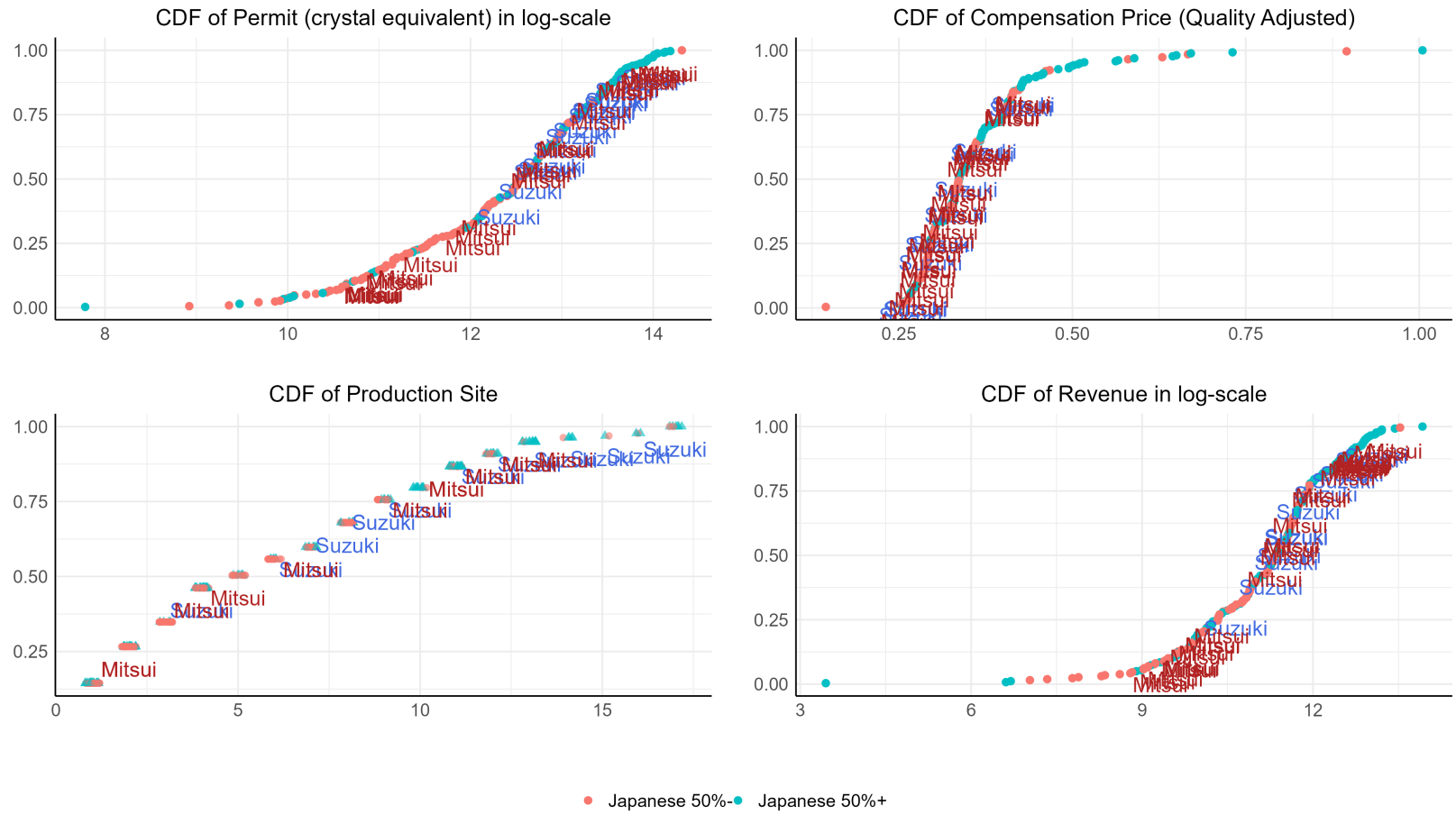
(一)　粗製樟腦、樟腦油製造認可高

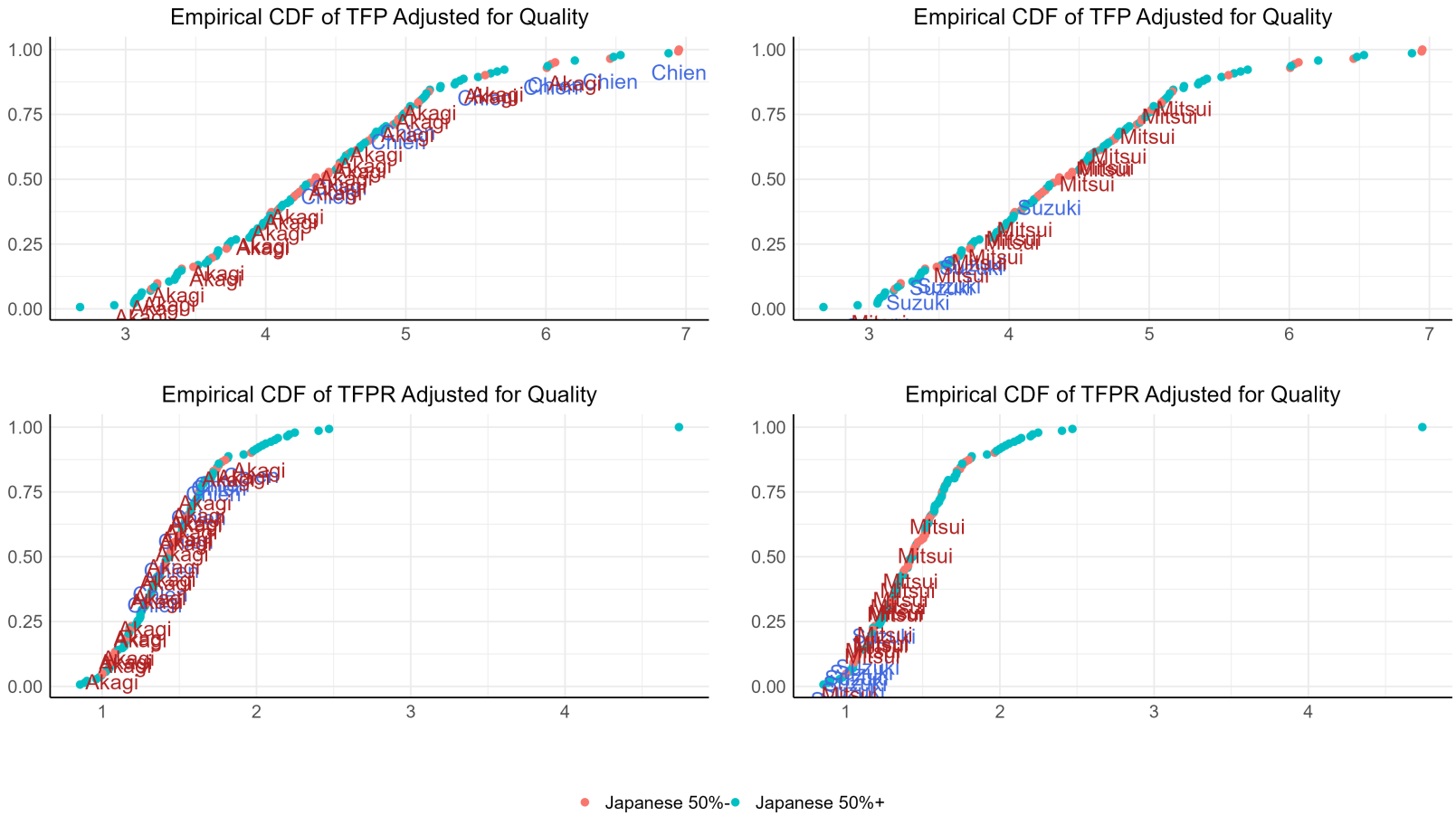
廳別	製腦業者	原許可額 樟腦	原許可額 樟腦油	增額 樟腦	增額 樟腦油	減額 樟腦	減額 樟腦油	廢業 樟腦	廢業 樟腦油	實施額 樟腦	實施額 樟腦油
宜蘭廳	臺灣製腦合名會社	五〇〇、〇〇〇斤	四〇〇、〇〇〇斤	八〇、〇〇〇斤	五〇、〇〇〇斤					五〇〇、〇〇〇斤	四〇〇、〇〇〇斤
	臺灣救濟團	三〇〇、〇〇〇	二四〇、〇〇〇							三八〇、〇〇〇	二九〇、〇〇〇
	簡阿牛	四三、〇〇〇	九〇、〇〇〇							四三、〇〇〇	九〇、〇〇〇
	計	八四三、〇〇〇	七三〇、〇〇〇	八〇、〇〇〇	五〇、〇〇〇					九二三、〇〇〇	七八〇、〇〇〇
臺北廳	三井合名會社	三六、〇〇〇	四三、〇〇〇							三六、〇〇〇	四三、〇〇〇
桃園	三井合名會社	九〇〇、〇〇〇	七二〇、〇〇〇							九〇〇、〇〇〇	七二〇、〇〇〇
	波多野岩次郎外一名	三〇〇、〇〇〇	二七〇、〇〇〇							三〇〇、〇〇〇	二七〇、〇〇〇
	萬基公司	二〇〇、〇〇〇	二〇〇、〇〇〇							二〇〇、〇〇〇	二〇〇、〇〇〇

計			五七〇	—	—	五七〇
阿緱廳	櫻井貞次郎	內英羅是壽山、外英紅仔寮山、東篩仔霧山、西篩仔霧山	六五〇	—	二三	六二七
	計		六五〇	—	二三	六二七
花蓮港廳	臺東拓殖製糖株式會社	木瓜山、馬里勿山、長漢山、清水山、卓溪山、六十針塱山、廸佳山、巴林妹軟山、崙天山、石山	六五〇	—	三三	六一七
	計		六五〇	—	三三	六一七
合計			六、五一四	四三五	二二一	六、七二八

（三）粗製樟腦樟腦油製造高（△ハ減）

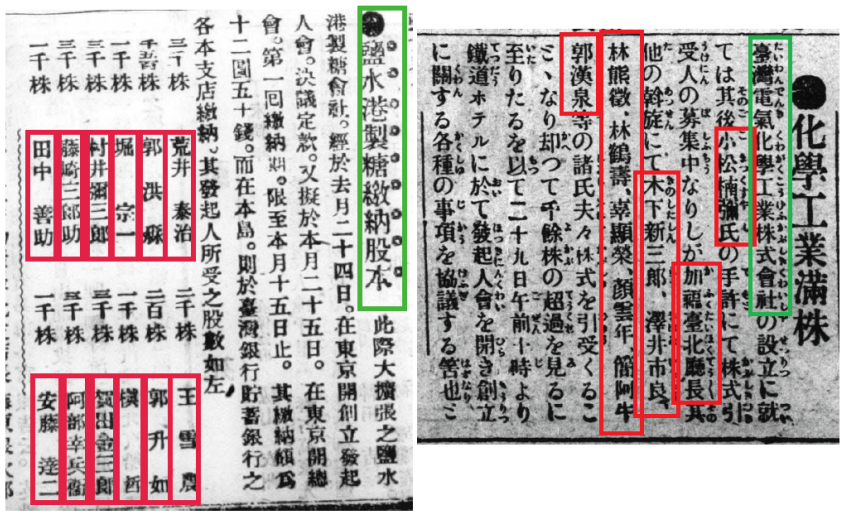
廳別	製腦業者	製造許可高 樟腦	製造許可高 樟腦油	製造高 樟腦	製造高 樟腦油	許可高ニ對スル製造高比較增減 樟腦	許可高ニ對スル製造高比較增減 樟腦油
		斤	斤	斤	斤	斤	斤
宜蘭廳	臺灣製腦合資會社	五七〇、〇〇〇	四五六、〇〇〇	四四五、二四三	四一一、七五八	△一二四、七五七	△四四、二四二
	三井合名會社	三〇、〇〇〇	五四、〇〇〇	三一、〇九三	六〇、九〇三	一、〇九三	六、九〇三
	計	六〇〇、〇〇〇	五一〇、〇〇〇	四七六、三三六	四七二、六六一	△一二三、六六四	△三七、三三九
臺北廳	三井合名會社	一三〇、〇〇〇	一一一、〇〇〇	七四、四四一	六九、四六三	△五五、五五九	△四一、五三七
	計	一三〇、〇〇〇	一一一、〇〇〇	七四、四四一	六九、四六三	△五五、五五九	△四一、五三七
桃園廳	三井合名會社	一、〇二〇、〇〇〇	八〇七、〇〇〇	九九七、一二二	五五六、六三六	△二二、八七八	△二五〇、三六四
	臺灣救濟團	三五〇、〇〇〇	二四五、〇〇〇	二五六、二八六	一一八、一九〇	△九三、七一四	△一二六、八一〇
	萬華公司	二五、〇〇〇	二〇、〇〇〇	三八、二一九	二七、二六〇	一三、二一九	七、二六〇
	計	一、三九五、〇〇〇	一、〇七二、〇〇〇	一、二九一、六二七	七〇二、〇八六	△一〇三、三七三	△三六九、九一四


CDF of Permit (crystal equivalent) in log-scale
CDF of Compensation Price (Quality Adjusted)
CDF of Production Site
CDF of Revenue in log-scale
Japanese 50%-
Japanese 50%+


Empirical CDF of TFP Adjusted for Quality
Empirical CDF of TFP Adjusted for Quality
Empirical CDF of TFPR Adjusted for Quality
Empirical CDF of TFPR Adjusted for Quality
Japanese 50%-
Japanese 50%+

Hanzhen Taiwan Daily News Archive (漢珍版台灣日日新報)

- Digital scan of *Taiwan Daily News* during 1898-1944, the *Chinese Language Edition* during 1905-11, and *Taiwan News* during 1896-97.
- Official gazette (think of CNA and Xinhua) and largely captures official opinion.
- News including activities of officials, entrepreneurs and VIPs, business and economy activities, government announcements, announcements from enterprises, interviews, and entertainment.
- Biased towards Japanese, but still a good amount of news about Taiwanese.



Other Data Sources

- Biographies for various information such as nobility titles, shareholding status, and interactions:
  - *Including Japan Who's Who (人事興信録), Biographies of Gentries in Taiwan (台灣列紳傳), Biographies of Entrepreneurs in Taiwan (台湾實業家名鑑)*, and *Hanzhen Biographies of People of Taiwan (漢珍台灣人物誌).*
- *Staff List of Taiwan Government-General (台湾総督府職員録)* digitalized by Academia Sinica.
  - List of officials in the colonial government, from Governor-General to street-level officers.

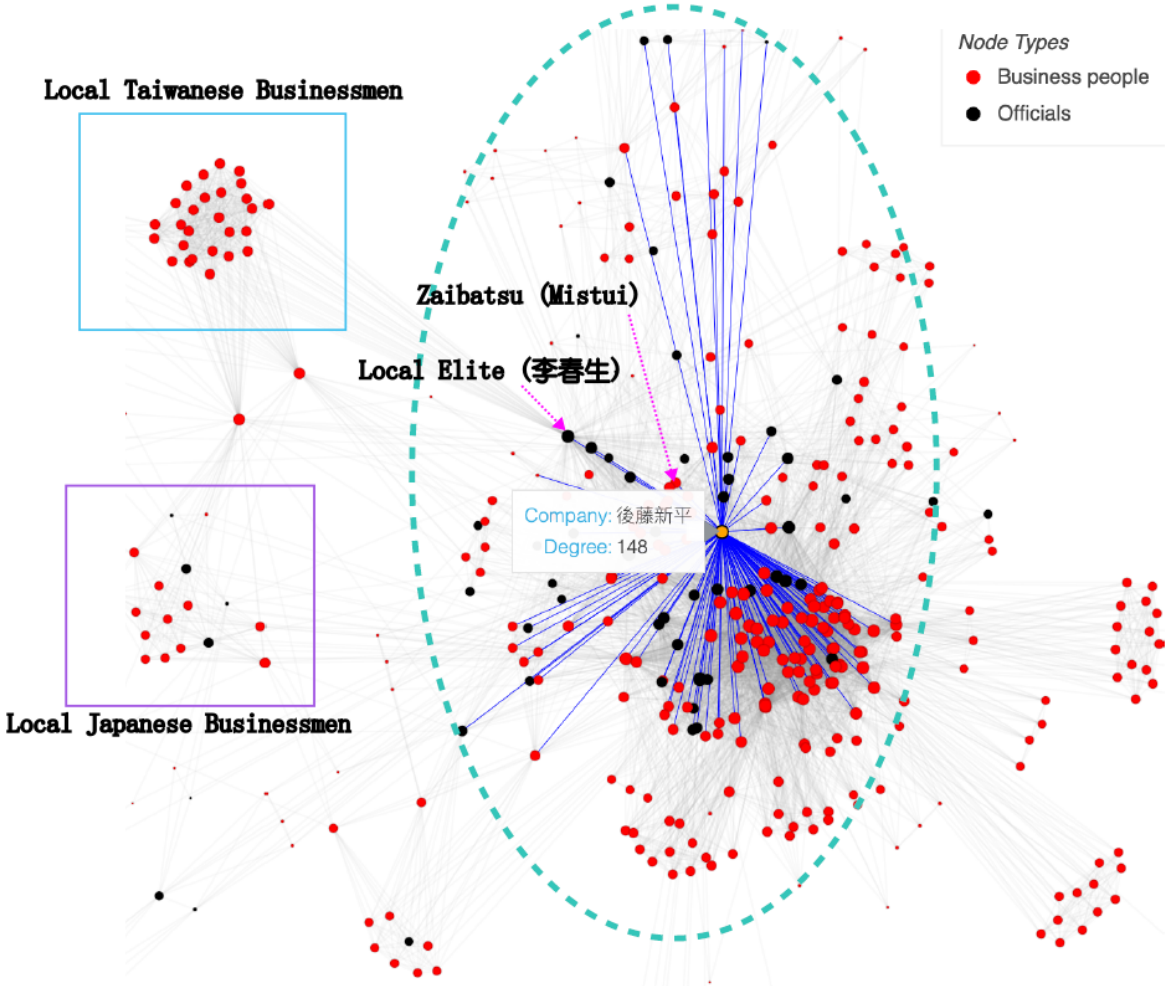
Network and Social Distance

Idea to construct network:

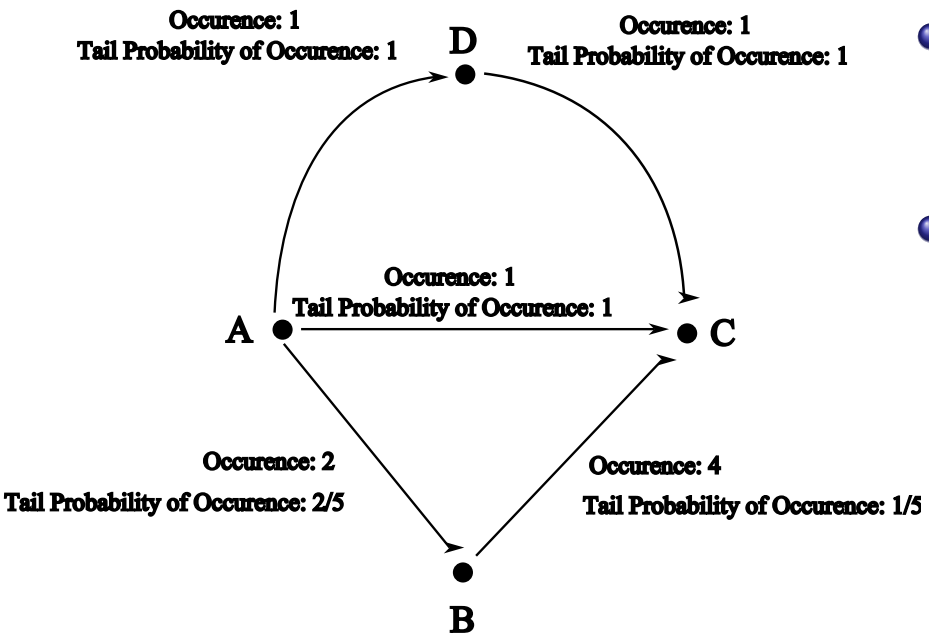
1. Search the News Archive by names to retrieve news.
2. Consider all agents involved in the same news to be mutually connected in the same subnetwork.
3. Join the subnetworks and accumulate year by year.

- 2700 unique news reports during 1896-1918 and about 700 are used; end up with about 2531 entities as of 1918.

Example: Network in 1899



Network Distance Weighted by Occurrence



- But **frequency of common exposure matters!**
- Weight by the right-tail probability of frequency of edges.
  - Tail probability for $\overline{AB}$ is $2/5$ since only two edges ($\overline{AB}$ and $\overline{BC}$) in the network of 5 edges occur for at least twice.
  - Distance from A to C given by $\overline{ABC} = 2/5 + 1/5 = 3/5$.
- What we use to construct social distance.

Identification Strategy

- Official turnover is exogenous, but individuals could react against it due to private information.
- Identification strategy:
  - Classify individuals into **identity groups** by pre-determined ethnicity-nobility composition.
  - Look at how an **average individual** in an identity group link to an **average official** of a rank.
  - Firm heterogeneity determined by share of identity group.

Identification Strategy

- Shift-share-like construction with shock design
  - Rate of change in firm i's social distance to official group g in year t defined as

$$\dot{d}^g_{i,t} \equiv \sum_e \underbrace{\omega_{i,e}}_{\text{share}} \underbrace{\frac{d^g_{e,t+1} - d^g_{e,t}}{d^g_{e,t}}}_{\text{shift}}.$$

  - d^g_e is the social distance between identity group e and official rank g; $\omega_{i,e}$ is the fraction of group e in firm i.
  - The shift part eliminates linear time-invariant factors.
  - Variations in the shift part come from **turnover** of officials, and are largely irrelevant to firms and businessmen.

Identification Strategy

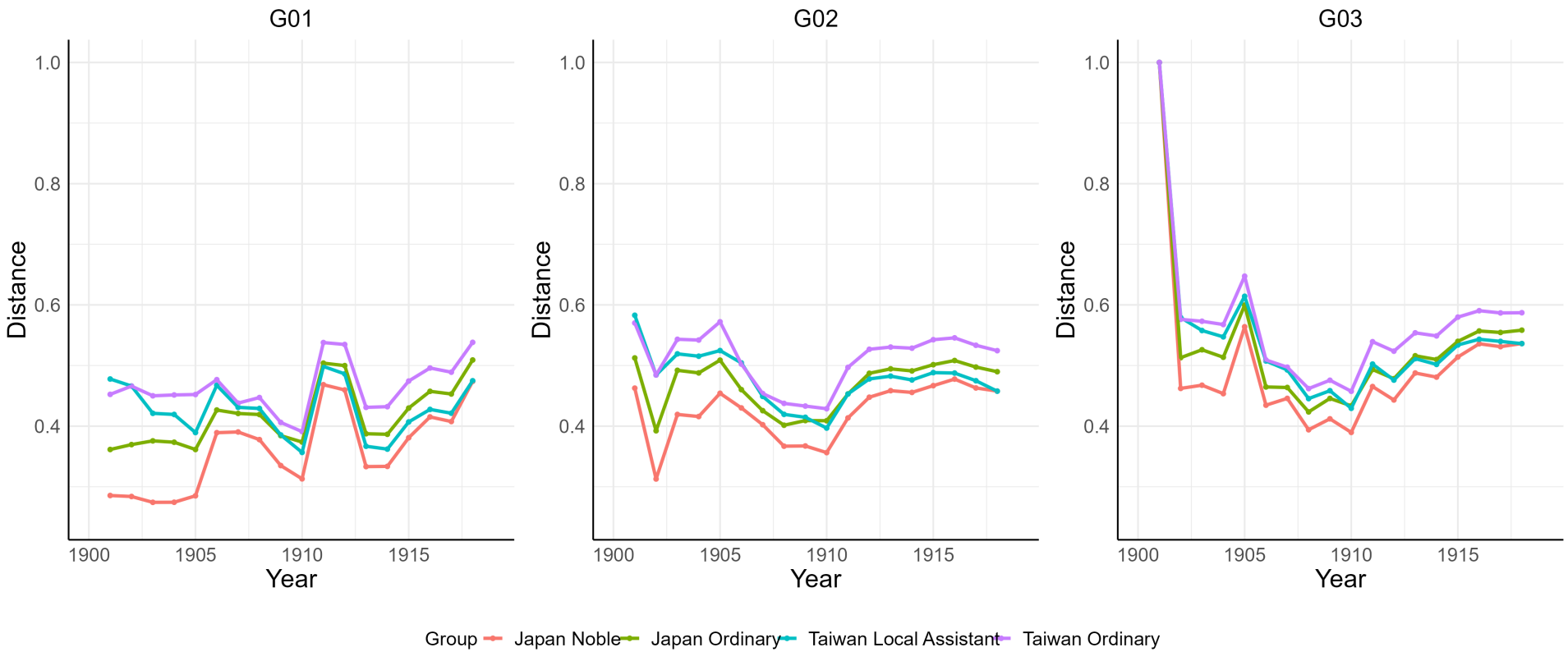
Four identity groups:

1. Japanese Nobilities: Shizoku, Kazouku, Royal Family, etc. Basically Samurai's offsprings.
2. Ordinary Japanese.
3. Local Taiwanese Assistants (LTA): Taiwanese who obtained councilors (參事) or local heads (街庄區長) positions from Japanese **before 1904**.
   - Japanese entitle influential local elites with previlledges to counter organized resistance (1895-1902) in earlier years.
   - Influence of local elites come from their history and is irrelevant to Japan's arrival.
   - **More about given than earned**.
4. Ordinary Taiwanese.

Identification Strategy

- Classify officials in the **Government-General** into **three groups** by referring to the List of Staffs
  - *G*01: Governor-General (總督), Director of Internal Affair (民政部/局長) or equivalent.
  - *G*02: Secretaries of Government-General (總督府官房秘書), Directors of Sections under the Department of Internal Affairs (1896–1901), Directors of Agencies under the Bureau of Internal Affairs (1902–1918), Directors of Camphor Monopoly Bureau, Salt Monopoly Bureau (1900–1901), Director of Monopoly Bureau (專賣局長, 1902–1918), and Directors of their Sections and Branches or equivalent.
  - *G*03: Managers of Sections under the Bureau of Internal Affairs and its agencies (1902–1918).

Identification Strategy



Identification Strategy: Recenter

- **Systematic effect** due to non-random treatments between groups?
  - A firm composed of more Japanese noblemen may still receive better treatment than the other firm with the same $\dot{d}^{g}_{i,t}$.
  - If yes, these firms still secure good treatments even if officials are randomly replaced.
- Tackle with the Recentered Shift-Share approach by Borusyak and Hull (2023).

Specification

- Regression

$$\dot{p}_{i,l,t} = \begin{cases} \beta_0 + \sum_g \beta_g \dot{d}^g_{i,t} + \gamma \mathbf{X} + Year_t + Prefecture_l & \text{original} \\ \beta_0 + \sum_g \beta_g \dot{d}^{g,rc}_{i,t} + \mu^g_{i,t} + \gamma \mathbf{X} + Year_t + Prefecture_l & \text{recentered} \end{cases}$$

- $\dot{p}_{i,l,t}$ is firm-location-year (i, l, t) compensation price.
  - Also inspect effects on quota and productivity in the paper...
- Change in social distance $\dot{d}^g_{i,t}$ is at firm-year level.
- $\mathbf{X}$ is a vector of firm-year-level current year controls: fraction of Japanese shareholders, dummies for officially owned firms, private-owned firm based in Japan mainland, subcontractor of Monopoly Bureau.

Estimation Results: Compensation Price

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\dot{d}_{i,t}^{G01}$ / $\dot{d}_{i,t}^{G01,rc}$	-0.018	-0.025	-0.011	-0.001	-3.877***	-3.818***	-3.823***	-3.733***
	(0.043)	(0.041)	(0.043)	(0.046)	(0.898)	(0.884)	(0.947)	(0.872)
$\mu_{i,t}^{G01}$					-0.087*	-0.094**	-0.094**	-0.083**
					(0.045)	(0.041)	(0.038)	(0.042)
$\dot{d}_{i,t}^{G02}$ / $\dot{d}_{i,t}^{G02,rc}$	-0.740***	-0.756***	-0.835***	-0.810***	9.814	9.670	12.456	12.062
	(0.157)	(0.154)	(0.163)	(0.164)	(9.496)	(9.768)	(10.007)	(11.095)
$\mu_{i,t}^{G02}$					-0.780***	-0.798***	-0.893***	-0.867***
					(0.156)	(0.154)	(0.170)	(0.170)
$\dot{d}_{i,t}^{G03}$ / $\dot{d}_{i,t}^{G03,rc}$	-0.360**	-0.364***	-0.354***	-0.346**	-0.802	-0.815	-7.147	-7.430
	(0.141)	(0.137)	(0.130)	(0.134)	(6.821)	(7.080)	(7.961)	(8.260)
$\mu_{i,t}^{G03}$					-0.356*	-0.360*	-0.286	-0.275
					(0.188)	(0.186)	(0.173)	(0.184)
X		Yes	Yes	Yes		Yes	Yes	Yes
Time Trend			Yes	Yes			Yes	Yes
Prefecture FE				Yes				Yes
Observations	207	207	207	207	207	207	207	207

HC3 robust standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Takeaway

- Better connected firms gets higher compensation prices:
  - An increase in connectivity to $G01$ ($\dot{d}_{i,t}^{G01,rc}$) by one s.d. (1.2%) leads to a growth in compensation price by $1.2\% \times 3.733 \approx 4.480\%$.
  - Including all connectivity variables still yields similar results.
- (Not presented) Connection leads to higher quota via the systematic component, but no obvious effect on productivity.

Model Outline

What we want to capture in the reality:

1. Monopoly to the final market.
2. Monopoly Bureau assigns firms to production sites.
3. Monopoly Bureau buys intermediate goods from firms at the compensation prices.
4. Firms are heterogeneous in production efficiency and connectivity.
5. Monopoly Bureau is supposed to maximizes its profit by selecting suitable firms as claimed.

Model Outline

1. A firm's connection determines authority's **bargaining power** β_i against it.
   - The authority gets $\beta\pi$ while the firm gets $(1-\beta)\,\pi$, $\beta \in (0,1)$.
   - π is the profit by charging a monopolistic price to the downstream.
2. A firm exerts **efforts** φ_0 **in improving productivity**.
   - Depends on β, and affects π.
   - Realized productivity depends on **effort** and **luck**.
3. Given $\{\beta, \varphi_0\}$ the authority chooses the firm that yields the highest $\beta\pi$.
   - Discrete choice model, yields the **winning rates** r **for each firm**.
   - **Government profit** rate ι can also be computed.

Model Outline

- In reality the total rent π is distributed as

$$\pi_i = \underbrace{(p - p_{m,i})\, q_i}_{\text{government}} + \underbrace{p_{m,i} q_i - k(q_i)}_{\text{firm}}.$$

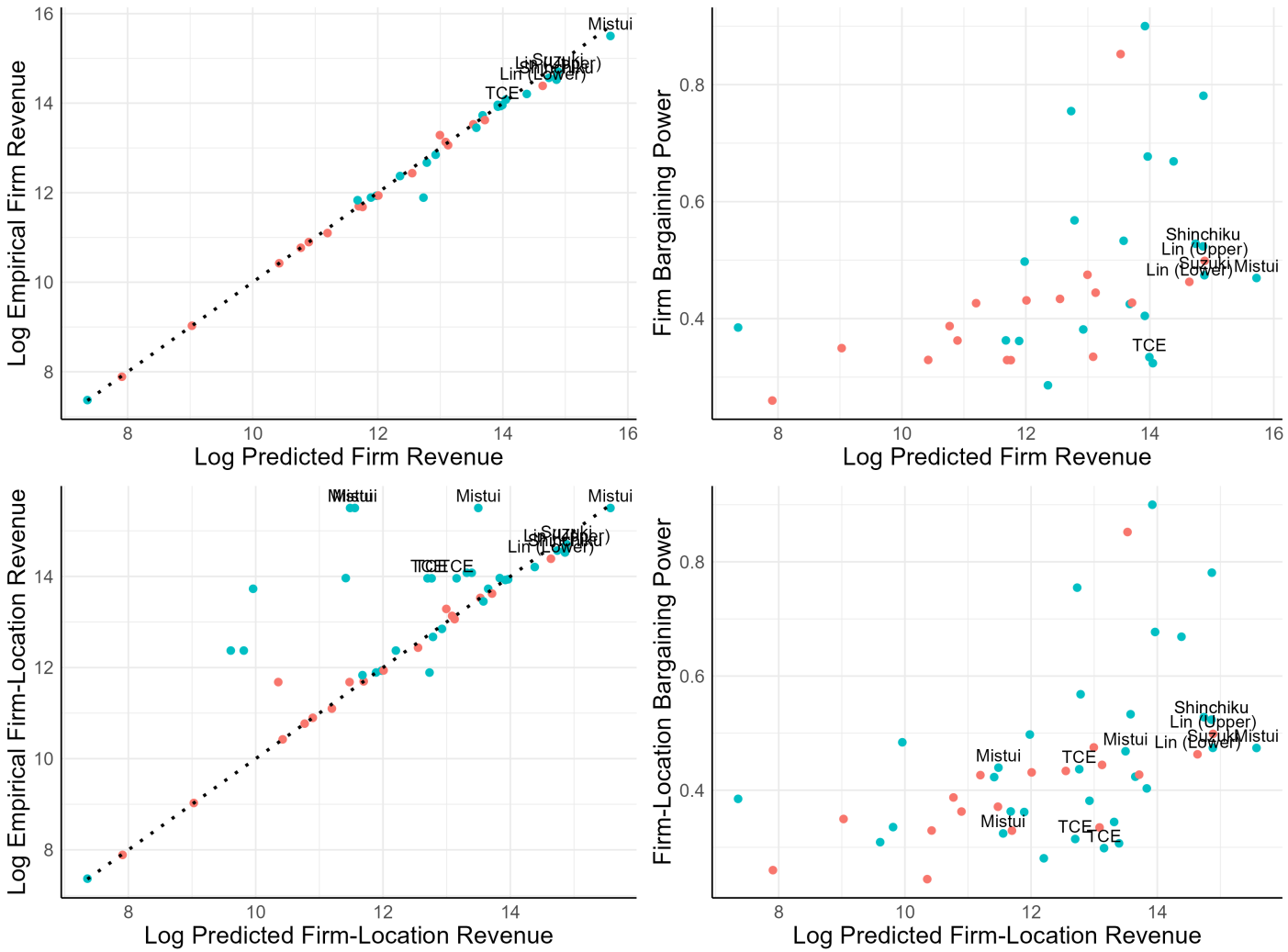
- Our approach approximates the reality by having

$$\beta_i \equiv \frac{(p - p_{m,i})\, q_i}{p q_i - k(q_i)} \in (0, 1),$$

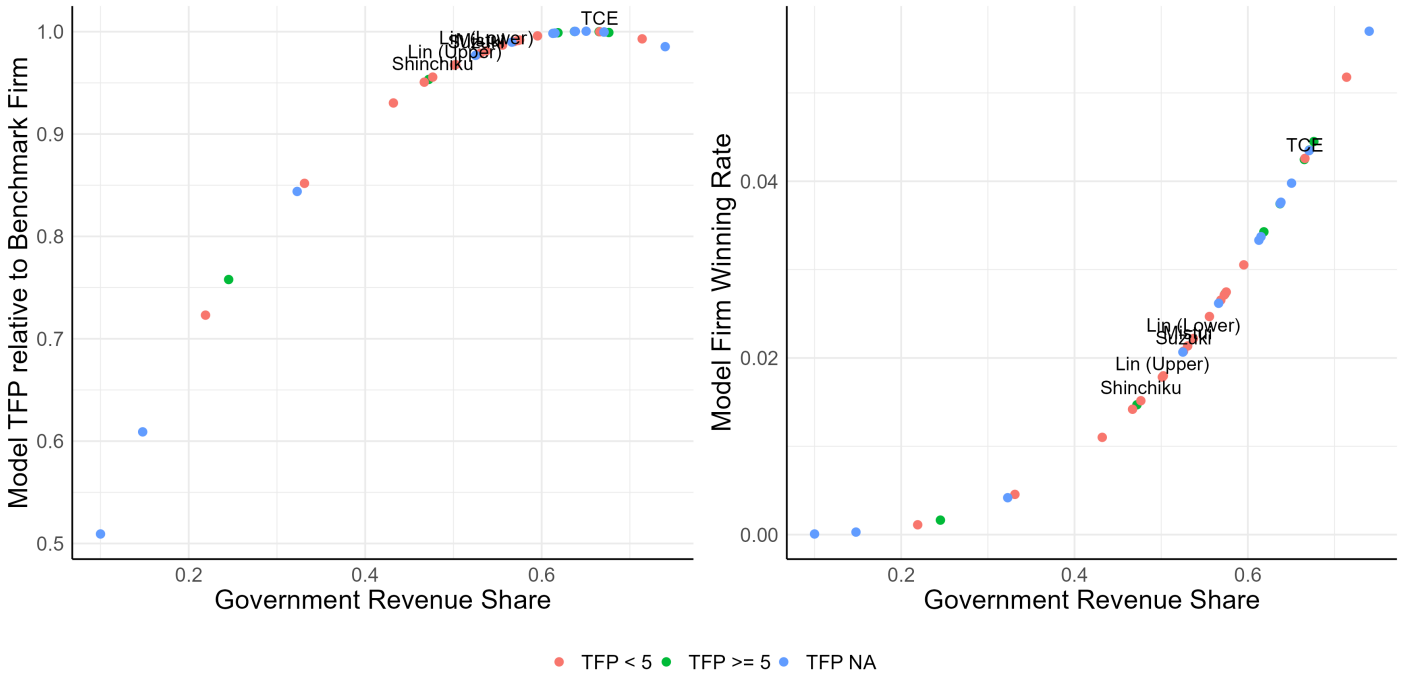
  thus **better connection ensues profits shifted to firms**

- β_i can be calibrated using the **estimated connectivity effect on compensation price.**

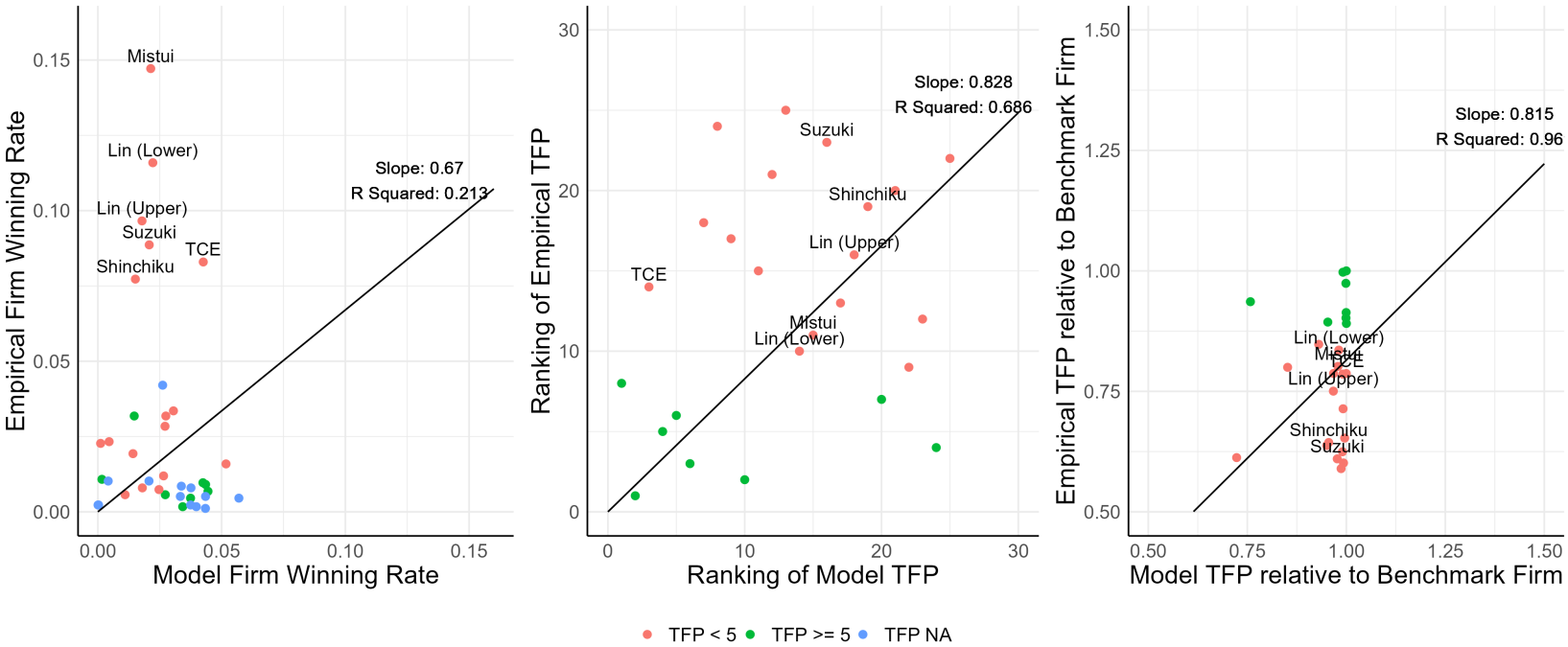
Revenue and Bargaining Power



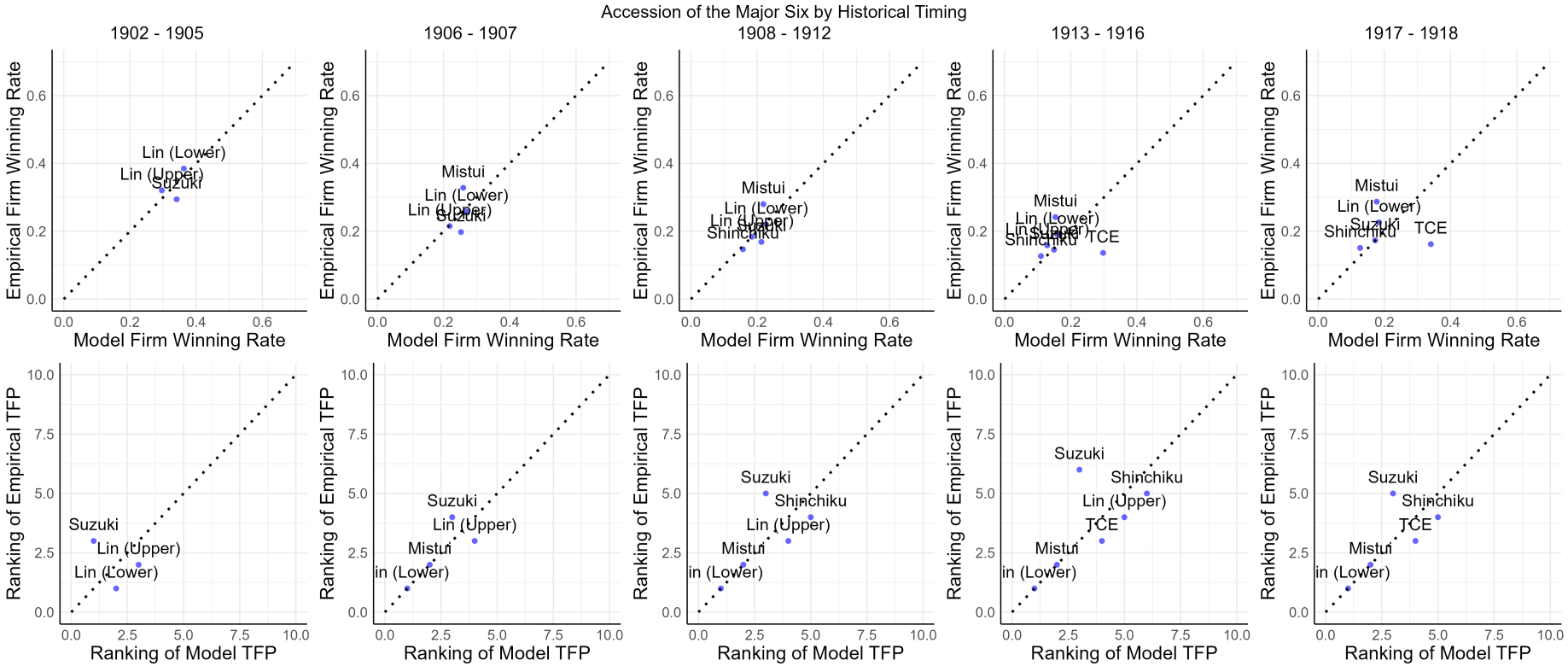
Pooled Simulations



Pooled Simulations



Role of Major Six



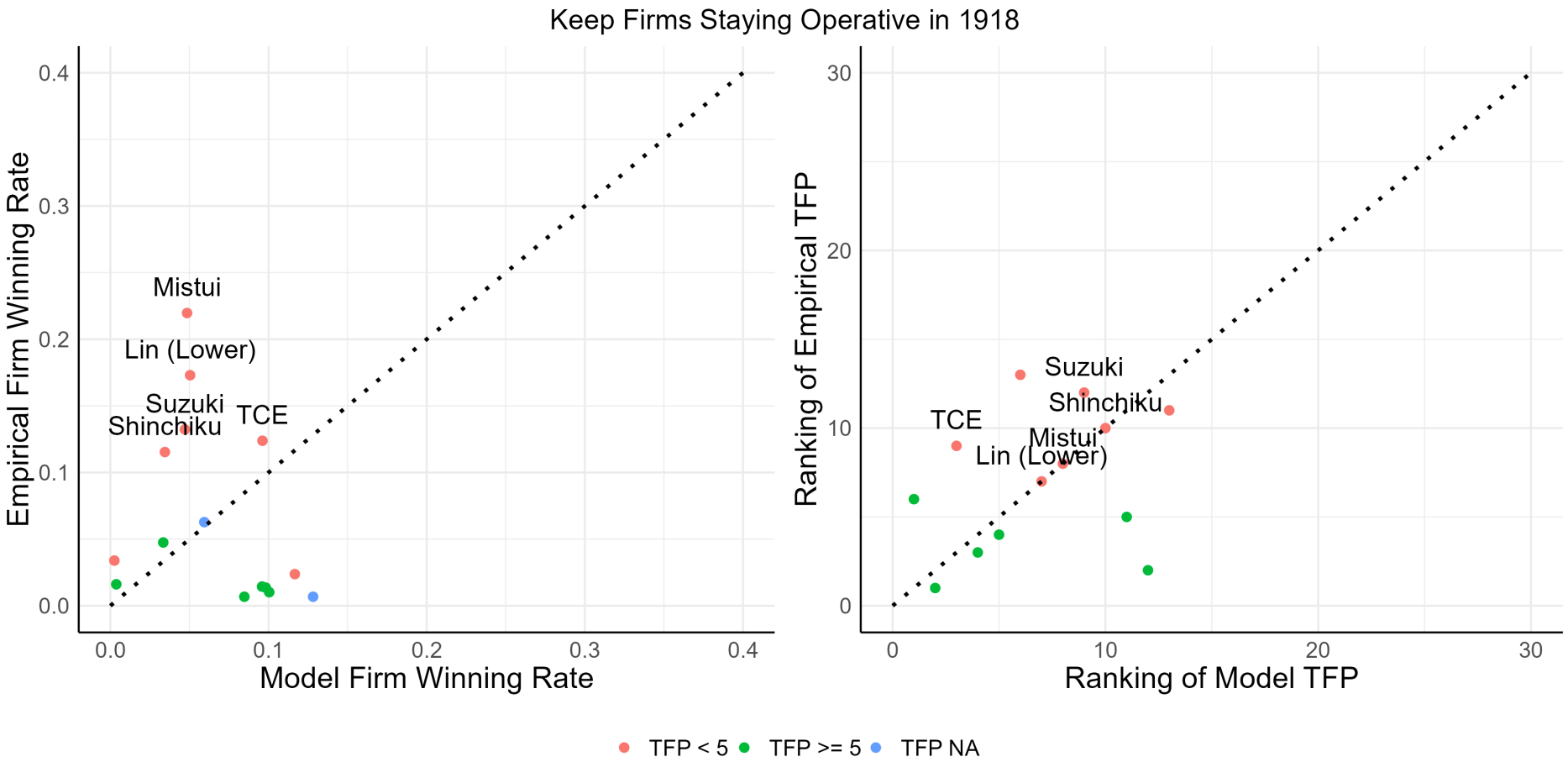
Role of Major Six

- Allocations highly aligned with empirical observation.
- Profit rates are highly similar to reality (35%) and almost always improve by entry and exit of firms.
  - Accession by Mitsui in 1906 raised the profit rate from 37% to 37.2%
  - Accession by Shinchiku Camphor Manufacturing (the least efficient firm) in 1908 reduces the profit rate to 36.6%.
  - Akaji Hatsutaro boosts the profit rate to 39.2%.
  - Akaji's merger to Upper Lin Clan raises the profit rate further up to 39.8%.
- **Keep the efficient even among the more favored firms**.

Performance after 1918

- Monopoly Bureau merged all surviving firms in 1918 into one single private-owned enterprise (Taiwan Camphor Joint-Stock Company 臺灣製腦株式会社).
  - Claims to improve production efficiency against increased market challenges such as synthetic camphor.
  - Ownership determined by operation size prior to the merger.
  - Akaji Hatsutaro becomes the main decision maker until the fully nationalization event in 1933.

Performance after 1918



Performance after 1918

- Compared with the pooled simulation:
  - The least efficient firms are kicked out.
  - Profit rate increased from 42% to 44%.
- The authority had good taste in selecting firms, but not very efficient in allocating resources among the selected.

Summarizing Simulations

- Adherence to industrial / financial goal
  - Allocation positively associates with performance.
  - Entry and exit (controlled by the authority) raise the authority's profit rate.
- Favoritism
  - Major Six is taking too much in terms of allocation.
  - Profit rate similar to the real world implies that the system is mostly about the Major Six.

Concluding Remarks

- Role of intersectoral linkages
  - Possibly explains the prioritization towards the Major Six.
  - Micro-level data for downstream markets *might* be available from Monopoly Bureau's Korea branch and Japan headquarter.
  - Tradeflow of camphor and related intermediate and final products.
  - Need International IO Tables way before Leontief.
  - But then the model should generate even **higher** profit rate than empirically observed.
- China's rare earth industry may be the modern counterpart.