A Thirst for Silver:

Trade Shock, Taxation, and Local Unrest in Nineteenth-Century China

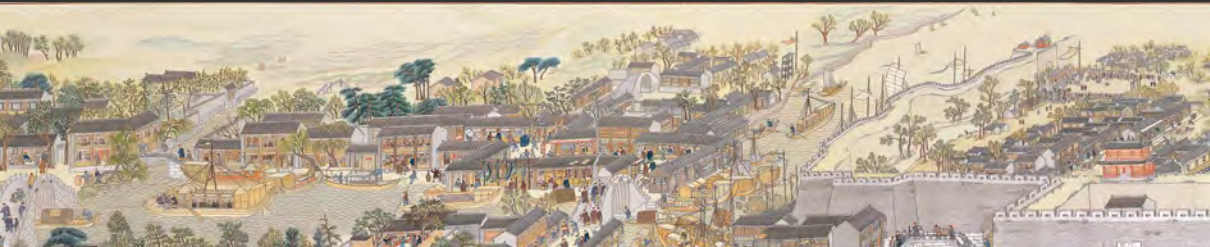
Ting Chen
HKBU

Jianan Li
Xiamen U

Chong Pang
UPF

Yuan Zi
Geneva Graduate Institute

CUHK
August, 2026



This Paper

- Question: Under what conditions can globalization become a source of state fragility?

- Context: early 19th century Imperial China

Motivation

19th century: a major turning point in Chinese history

- Western powers made China open in 1840s
- But internal crises had already set the stage in 1810s (the "Daoguang Depression").

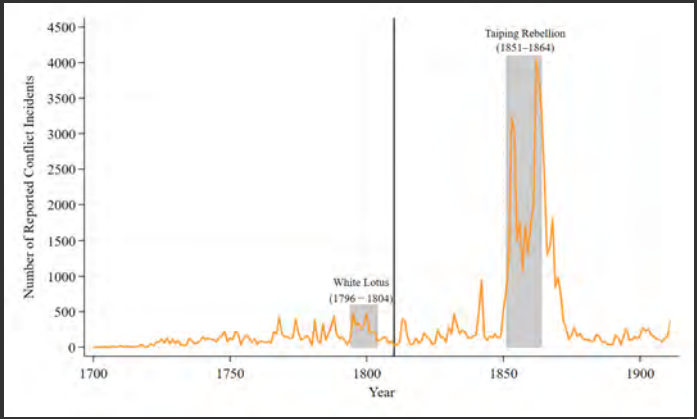


Figure: Annual Conflict Frequency

Motivation

The silver shortage issue

- No accurate record on total silver supply
- Measure of silver shortage: silver price (relative to copper)

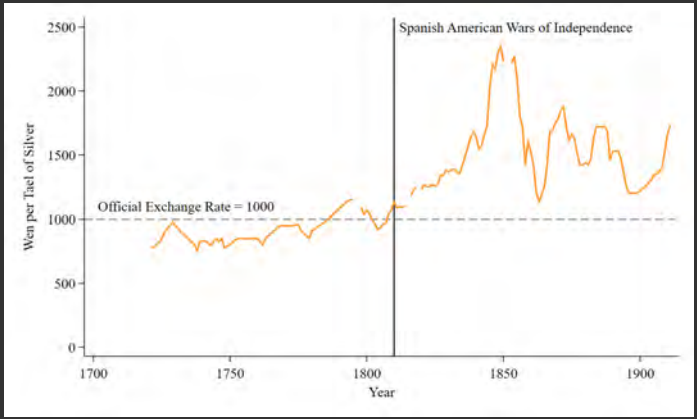


Figure: Silver Price Fluctuations

Motivation

- How did the Qing monetary system work?

Figure: Qing Dynasty (1644–1911) Coinage

Motivation

Historical narrative and literature link China's social instability in the early 19th century to rising silver price

"而国用未充，民生罕裕，情势积渐，一岁非一岁之比。"
"Yet the state's finances remained strained, and the people seldom enjoyed prosperity; the situation deteriorated gradually, with each year worse than the last."

— 1838, Huang Juezhi, in a discussion on the rising silver price issue

Motivation

The puzzle:

- Why did silver shortage affect social stability in a largely agrarian economy?

Qing China had:

- Limited market integration
- Predominantly self-sufficient rural households
- Silver used mainly for long-distance transfers

Motivation

This paper: What caused the silver shortage, and how did it drive social instability?

- Novel historical data $\rightarrow$ Causal evidence + Quantitative trade model
- Our answer: *one global shock meets two rigid domestic institutions*
  - Global shock: Spanish American Wars of Independence
  - Institutional rigidities: Canton system (一口通商) + silver-denominated fixed taxes

One Global Shock

Spanish American Wars of Independence (1810s-1830s, following Spain's defeat in Napoleonic Wars)

- Spanish American produces most silver (>%80) in the world
- Circulation of silver: Spanish American produces → European Merchants transports → China imports
- Wars severely disrupted the system
- China was hit particularly hard, due to its heavy reliance on imported silver.

Carlos IV Coin | Relevance

Two Institutional Rigidities

Canton system + silver-denominated fixed taxes

- Canton System (1757–1842): all Western trade funneled through a single southern port
  - Remote regions saw sharper silver shortage during decrease in external silver supply
- Qing Fiscal System (∼1741)
  - Land-based tax quota collected in silver, frozen at 1710 figures (70% of fiscal revenue)
  - Rigid spending hierarchy & extractive: military payroll (*60%*) + official salaries (*30%*) → silver-denominated fixed debt
- Agrarian economy with little surplus ⇒ real tax burdens ↑ → uprisings and conflict ↑

This Paper

1. Systematic empirical evidence from novel data on historical commercial routes:
   - Regions with higher trade costs to Canton saw larger silver price increases and were more prone to uprisings.
   - Uprisings were more frequent in regions with heavier tax burdens.

2. A quantitative spatial model with monetized trade for analytical insight:
   - Builds on Boehm and Chaney (2024), incorporating endogenous fixed trade costs (Arkolakis, 2010), silver trade and taxation.
   - Global production decline $\rightarrow$ less silver inflow to China, especially in distant regions $\rightarrow$ higher silver prices and real tax burdens.
   - In an agrarian economy with little surplus $\rightarrow$ uprisings and conflict.

3. Quantification:
   - Welfare loss: –1.16%, mainly from higher taxes.
   - Opening more ports modestly mitigates welfare loss and conflict incidence; fiscal reform is the key policy lever.

Literature

- Transportation networks and local outcomes
  - Fogel, 1964, Donaldson and Hornbeck, 2016, Hornbeck and Rotemberg, 2024; Donaldson, 2018; Nagy, 2023; Pascali, 2017; Redding and Sturm, 2008; Ahlfeldt et al., 2015; Juhász, 2018
- Real effects of money in historical settings
  - Palma, 2022; Brzezinski et al., 2024a; Brzezinski et al., 2024b
- Trade and conflict
  - Martin et al., 2008; Berman et al., 2017; Couttenier et al., 2024; Cao and Chen, 2022; Dell et al., 2019; Vicard, 2012
- China's early nineteenth-century recession and turmoil
  - Climate shocks (Cao et al., 2012; Li, 2015), Malthusian pressures (Huang, 1990; Jones and Kuhn, 1978), dynastic economic cycles (von Glahn, 2018), and silver shortages (Lin, 2020; Wang, 1997; Ma, 2012)
- This paper: Institutions as choke points.

Data and Empirics

Data

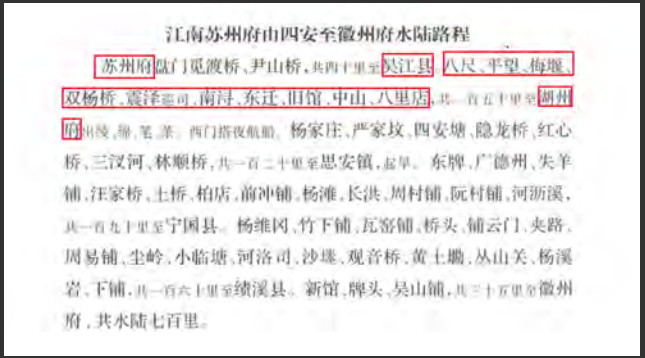
- Time & scope: 1801–1840; 1,515 counties in 18 Han China (China Proper)
- Silver prices: Lin (2020) for time series (expl.); Hu (2021) for provincial panel (dep.)
- Conflicts: annual incidences by county from Qing Shilu (uprisings, bandits, disturbances, tax resistance)
- Taxation: total collection by county, from Guo (2022)
- Controls:
  - Natural disasters: annual incidences from Zhang (2013)
  - Political/military importance of a county*: Liu (1993) (冲繁疲难)
  - Social norms*: *Comprehensive Catalogue of Chinese Genealogies* (count in 1750)
  - County-specific geographic factors*
  - India's annual opium export to China: Richards (2002)

Wage and Prices

*Variables marked with * are interacted with Mexico silver production or $\Delta Silver_t$ as controls.*

Data: Trade Route to Canton

- The associated spatial variation in trade costs to Canton? → Combing geospatial models with 75 major trade routes from *A Convenient Handbook for Merchants* (商贾便览)
- Step 1: Identify geographical names recorded in *A Convenient Handbook for Merchants* and match to coordinates



江南苏州府由四安至徽州府水陆路程

苏州府盘门觅渡桥、尹山桥，共四十里至吴江县。八尺、平望、梅堰、双杨桥、震泽塞司、南浔、东迁、旧馆、中山、八里店，共一百五十里至湖州府。出陵、绿、笔、漾。西门搭夜航船。杨家庄、严家坟、四安塘、隐龙桥、红心桥、三汊河、林顺桥，共一百二十里至思安镇，起旱。东牌、广德州、失羊铺、汪家桥、土桥、柏店、前冲铺、杨滩、长洪、周村铺、阮村铺、河沥溪，共一百九十里至宁国县。杨维冈、竹下铺、瓦窑铺、桥头、铺云门、夹路、周易铺、尘岭、小临塘、河洛司、沙堰、观音桥、黄土墩、从山关、杨溪岩、下铺，共一百六十里至绩溪县。新馆、牌头、吴山铺，共三十五里至徽州府，共水陆七百里。

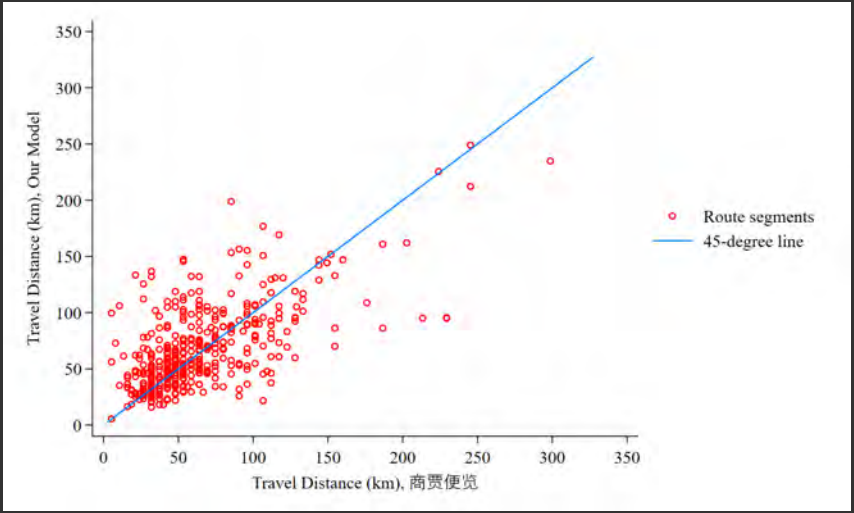
Example: Route from Suzhou to Huizhou, via Si'an

Data: Trade Route to Canton

- The associated spatial variation in trade costs to Canton? → Combing geospatial models with 75 major trade routes from *A Convenient Handbook for Merchants (商贾便览)*
- Step 1: Identify nodes recorded in *A Convenient Handbook for Merchants* and match to coordinates
- Step 2: recover paths connecting different nodes, assumption:
  - Paths minimzing travel cost between nodes
  - Different travel cost multiplier of waterways and mountainous regions

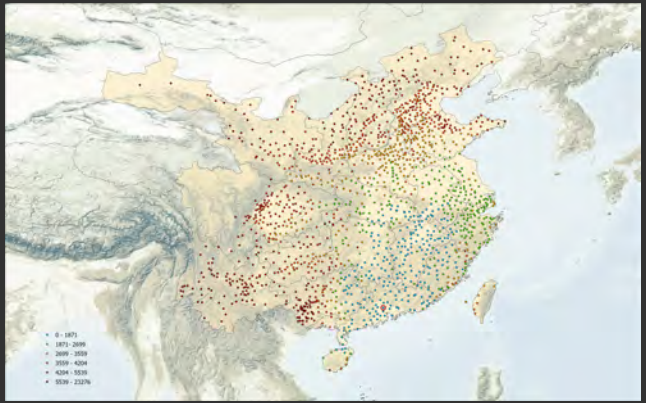
Data: Estimated Trade Network

Validating Travel Distance



Trade Costs to Canton

- Assumption: travel outside the existing trade network is 6 times as costly as within the network
- Empirical results are not sensitive to changing out-network travel cost multiplier



Fact #1: Trade Cost to Canton Amplifies Silver Price Fluctuations

$$\Delta Silver_{pt} = \beta\,(TradeCanton_p \times MexicoSilver_t) + \gamma\,(Distance_p \times MexicoSilver_t) + \alpha_p + \lambda_t + \varepsilon_{pt}$$

- $\Delta Silver_{pt}$: silver price growth rate in province p, year t, measure of silver shortage
- $TradeCanton_p$: province p's travel cost to Canton
- $MexicoSilver_t$: Mexico's silver production in year t, measure of foreign silver supply
- $Distance_p$: province p's staright line distance to Canton
- α_p: province FE; λ_t: year FE

Fact #1: Trade Cost to Canton Amplifies Silver Price Fluctuations

	$\Delta Silver_{pt}$		
	(1)	(2)	(3)
$TradeCanton_p \times MexicoSilver_t$	-0.0774*	-0.1396**	-0.1427**
	(0.0434)	(0.0642)	(0.0650)
Baseline Controls	No	No	Yes
$Distance_p \times MexicoSilver_t$	No	Yes	Yes
Province FE, Year FE	Yes	Yes	Yes
Observations	185	185	185
R-squared	0.413	0.421	0.445

Notes: The dependent variable is the log change in provincial silver prices relative to copper, calculated based on Hu (2021). The data sample is an unbalanced panel and includes 18 Han-inhabited provinces of China Proper, covering the years 1801 to 1840. $TradeCanton_p$ represents the average of the log travel cost from each province to Canton; $MexicoSilver_t$ represents the log of Mexico's silver production, calculated based on Borah (1949); $Distance_p$ represents the average of the log straight line distance to Canton. Coefficients are estimated using OLS, with robust standard errors reported in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Fact #2: Trade Cost to Canton Heightens Conflict Incidence

$$Conflicts_{it} = \beta\,(TradeCanton_i \times \Delta Silver_t) + \gamma\,(Distance_i \times \Delta Silver_t) + \alpha_i + \lambda_t + \mathbf{X}'_{it}\theta + \varepsilon_{it}$$

- $Conflicts_{it}$: conflict frequency in county i, year t
- $TradeCanton_i$: county i's travel cost to Canton
- $\Delta Silver_t$: national level silver price growth rate in year t
- $Distance_i$: county i's staright line distance to Canton
- α_i: county FE; λ_t: year FE

Fact #2: Trade Cost to Canton Heightens Conflict Incidence

	$Conflicts_{it}$		
	(1)	(2)	(3)
$TradeCanton_i \times \Delta Silver_t$	2.5129	4.9070**	10.3170***
	(2.0418)	(2.2490)	(3.6192)
Baseline Controls	No	No	Yes
$Distance_i \times \Delta Silver_t$	No	Yes	Yes
County FE, Year FE	Yes	Yes	Yes
Observations	36180	36180	36180
Pseudo R-squared	0.359	0.359	0.361

Notes: The dependent variable is the number of conflicts for a given county and year. The sample covers 1,515 counties within the 18 Han-inhabited provinces of China Proper from 1801 to 1840. $TradeCanton_i$ represents the log of the travel cost from each county to Canton; $\Delta Silver_t$ represents the log change in silver prices relative to copper, calculated based on Yan (2016). $Distance_i$ represents the log of the straight line distance to Canton. Coefficients are estimated using a pseudo-Poisson model, with standard errors clustered at the prefecture level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Fact #2: Deal with Endogenity

$\Delta Silver_t$:

- Concern: silver price is endogenously determined.
- Solution: use $MexicoSilver_t$ and progress of Latin American Independence War to instrument for $\Delta Silver_t$.

$TradeCanton_i$:

- Concern: $TradeCanton_i$ is correlated with confounding factors (culture, internal trade, political importance...)
- Solution: Falsification test:
  - replace Canton by other major ports/Beijing/Nanjing
  - use sample period prior to the Canton System period

Robustness: IV Results

	$Conflicts_{it}$			
	(1)	(2)	(3)	(4)
	First Stage			
$TradeCanton_i \times MexicoSilver_t$	-0.0042***	-0.0042***		
	(0.0000)	(0.0000)		
$TradeCanton_i \times I(1810 \leq t \leq 1821)$			0.0267***	0.0268***
			(0.0019)	(0.0019)
$TradeCanton_i \times I(t > 1821)$			0.0219***	0.0220***
			(0.0013)	(0.0013)
	Second Stage			
$TradeCanton_i \times \Delta Silver_t$	13.0938**	12.1541**	2.3631***	2.1602**
	(5.6266)	(5.7632)	(0.8912)	(0.9011)
Baseline FEs and Controls	Yes	Yes	Yes	Yes
$ExportGoods_i \times MexicoSilver_t$	No	Yes	No	No
$ExportGoods_i \times I(1821 \geq t \geq 1810)$	No	No	No	Yes
$ExportGoods_i \times I(t > 1821)$	No	No	No	Yes
Observations	54540	54540	54540	54540
F Statistics	36.78	35.74	1220	1207

Notes: This table revisits the estimation in Table 2, column (3) using an IV specification. Columns (1)–(2) use the interaction between $TradeCanton_i$ and the log of Mexico′ s silver production as the instrument, while columns (3)–(4) use the interaction between $TradeCanton_i$ and wartime dummies. Column (2) also controls the interactions between three export indicators (silk, tea, ceramics) and the log of Mexico′ s silver output; column (4) includes similar controls interacted with wartime dummies. Standard errors clustered at the prefecture level are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Back

Robustness: Falsification

	$Conflicts_{it}$			
	Placebo Ports	Beijing	Nanjing	Placebo Period
		1801-1840		1721-1757
	(1)	(2)	(3)	(4)
$TradeCost_i \times \Delta Silver_t$	-4.5283	-0.3272	-3.4014	
	(5.0719)	(3.9141)	(3.5295)	
$TradeCanton_i \times \Delta Silver_t$	10.6928**	9.6620**	11.6374***	-1.1313
	(5.0719)	(4.2041)	(4.1679)	(1.8079)
Baseline FEs and Controls	Yes	Yes	Yes	Yes
Observations	36180	36180	36180	27540
Pseudo R-squared	0.362	0.361	0.361	0.300

Notes: This table replicates the regression from Table 2, column (3), with placebo tests. In columns (1)–(3), the log trade costs to Canton are replaced with alternative measures. Column (1) uses the log of the average travel cost to three other port cities opened for a period after the return of Taiwan (Zhangzhou, Songjiang, and Ningbo; opened 1684–1757). Columns (2) and (3) use log trade costs to political centers —Beijing and Nanjing, respectively. These regressions also control for the interaction between log trade costs to Canton and log silver price changes. Column (4) conducts a placebo test using the pre-sample period (1722–1757). Coefficients are estimated using a pseudo-Poisson model, with standard errors clustered at the prefecture level reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

IV Results | Robustness: Additional Controls | Robustness: Alternative Travel Costs | Indirect Evidence - Domestic Silver Production

Fact #3: Tax Burden Matters

	$Conflicts_{it}$		
	Tax Rate	Tax Per Farmland	Tax Per Capita
	(1)	(2)	(3)
$TradeCanton_i \times \Delta Silver_t \times Tax_i$	0.2126*	0.2258**	0.3144**
	(0.1107)	(0.0894)	(0.1488)
$TradeCanton_i \times \Delta Silver_t$	12.5979***	11.8978***	9.2929***
	(3.8910)	(3.7526)	(3.5506)
Baseline Controls	Yes	Yes	Yes
$Distance_i \times \Delta Silver_t$	Yes	Yes	Yes
County FE, Year FE	Yes	Yes	Yes
Observations	35496	32040	35208
Pseudo R-squared	0.365	0.315	0.352

Notes: This table reports results using three alternative tax burden measures: prefecture-level tax rate (total taxes divided by silver-measured historical agricultural potential); county-level taxation per acre of farmland; and prefecture-level per capita taxation (based on 1776 population). Controls follow those in Table 2, column (3). All tax measures are logged. Standard errors, clustered at the prefecture level, are in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Qing Government's Response to the Silver Shortage?

	I(Exemption$_{it}$ + Relief$_{it}$)	log(Gov. Income$_t$)	log(Gov. Expenditure$_t$)	log(Exemp.$_t$ + Relief$_t$)
	(1)	(2)	(3)	(4)
TradeCanton$_i \times \Delta$Silver$_t$	1.2597***			
	(0.2651)			
Silver$_t$		-0.3884***	-0.2420***	-2.8765***
		(0.1066)	(0.0787)	(0.3383)
Baseline controls	Yes	No	No	No
Distance$_i \times \Delta$Silver$_t$	Yes	No	No	No
County FE, Year FE	Yes	No	No	No
Observations	54540	79	79	178
R^2	0.247	0.116	0.059	0.329

Notes: Column (1) replicates Table 2, column (3), but uses an indicator for receiving relief from the central government or being granted a tax exemption as the dependent variable. Columns (2)–(4) use a time-series dataset to examine the relationship between the silver price and the Qing government' s logged income and expenditures, as well as the logged annual frequency of relief and tax exemptions. Coefficients are estimated using an OLS model; standard errors, clustered at the prefecture level, are reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Model and Quantification

Model: Production and Trade

- N Chinese regions ($i = 1, \ldots, N$) and RoW ($i = 0$)
- Immobile labor L_i in each location with CES preferences over goods
- Each Chinese region produces a single differentiated variety with linear production function $A_i L_i$; RoW produces only silver (numeraire, exogenous amount S_0 every period)
- One intermediary in each region, trading goods i to region n with:
  - Iceberg costs τ_{in}
  - Variable fixed costs of reaching a fraction f_{in} of consumers in region n $M(f_{in}) = \frac{1-(1-f_{in})^{1-1/\lambda}}{1-1/\lambda}$ à la Arkolakis (2010)
- Producer& intermediary behavior:

$$X_{in} = \underbrace{\left(1 - \left[\frac{X_n}{\sigma}\left(\frac{\tau_{in} p_i}{P_n}\right)^{1-\sigma}\right]^{-\lambda}\right)}_{f_{in}} \left(\frac{\tau_{in} p_i}{P_n}\right)^{1-\sigma} X_n; \quad p_i = \frac{\sigma}{\sigma - 1} w_i / A_i.$$

- $\tau_{i0} \to i$'s trade cost to Canton

Model: Intertemporal Setup

- Money in utility (suppress the subscript i):

$$\sum_{t=0}^{\infty} \beta^t \left[\ln c_t + \gamma \ln \frac{m_{t+1}}{P_t} \right]$$

  - t_1: Endowed with m_t units of silver
  - t_2: δ fraction of saved silver is lost; M_t fresh silver is minted
  - t_3: Produce and sell goods, and pay silver-denominated taxes T_t in terms of output (government spending implicitly assumed to be local)

- Intertemporal budget constraint:

$$P_t c_t + m_{t+1} \leq (1-\delta) m_t + w_t L_t + M_t - T_t, \quad \forall t$$

Equilibrium Systems

$$w_i = \frac{\Delta m_i[\frac{1-(1-\delta)\beta}{\delta\gamma} + 1] + M_i[\frac{1-(1-\delta)\beta}{\delta\gamma}] + T_i}{L_i}, \tag{1}$$

$$X_i = \frac{1-(1-\delta)\beta}{\delta\gamma}(\Delta m_i + M_i), \tag{2}$$

$$\Delta m_i = \frac{\sigma-1}{\sigma}(X_{i0} + \sum_{j=1}^{N} X_{ij}) - \sum_{j=1}^{N} X_{ji}, \tag{3}$$

$$X_{i0} = \left(1 - \left[\frac{S_0}{\sigma}\left(\frac{\frac{\sigma}{\sigma-1}\frac{\tau_{i0}w_i}{A_i}}{P_0}\right)^{(1-\sigma)}\right]^{-\lambda}\right)\left(\frac{\frac{\sigma}{\sigma-1}\frac{\tau_{i0}w_i}{A_i}}{P_0}\right)^{(1-\sigma)} S_0 \quad for \quad j=0, \tag{4}$$

$$X_{in} = \left(1 - \left[\frac{X_n}{\sigma}\left(\frac{\frac{\sigma}{\sigma-1}\frac{\tau_{in}w_i}{A_i}}{P_n}\right)^{(1-\sigma)}\right]^{-\lambda}\right)\left(\frac{\frac{\sigma}{\sigma-1}\frac{\tau_{in}w_i}{A_i}}{P_n}\right)^{(1-\sigma)} X_n \quad for \quad n=1,...,N. \tag{5}$$

Given equations (4), (5), equations (1)- (3) yield $3 \times N$ equations in $3 \times N$ unknowns $\{w_i, \Delta m_i, X_i\}_{i \in N}$; the system is exactly identified.

The Aftermath of Silver Disruption

A simplified model with merchants hoarding their silver profits, abstract domestic minting, and no domestic trade

1. *Heterogenous effect of silver shock with respect to τ_{i0}:*

$$\Delta m_i = \frac{\sigma-1}{\sigma} X_{i0} = \underbrace{\left(1 - \left[\frac{S_0}{\sigma}\left(\frac{\tau_{i0} p_i}{P_0}\right)^{1-\sigma}\right]^{-\lambda}\right)\left(\frac{\pi_{i0} p_i}{P_0}\right)^{1-\sigma}}_{\text{extensive margin}, \propto f_{i0}} \underbrace{S_0}_{\text{intensive margin}}$$

$\Rightarrow \quad \frac{\partial^2 \ln \Delta m_i}{\partial \ln S_0 \partial \ln \tau_{i0}} > 0$: When $S_0 \downarrow$, trade drops more in regions with high trade cost to Canton.

Intuition:

- f_{i0} is more sensitive to S_0 in regions with higher τ_{i0}.
- Regions with low trade cost to Canton:
  export decrease only in intensive margin.
- Regions with high trade cost to Canton:
  export decrease in both intensive and extensive margin.

2. Price Index and Welfare Elasticities (asm.: larger welfare decline → higher unrest frequency):

$$\frac{\partial \ln P_i}{\partial \ln \Delta m_i} = \frac{k\Delta m_i}{k\Delta m_i + T_i}; \qquad \frac{\partial \ln \omega_i}{\partial \ln \Delta m_i} = (1+\gamma)\left(1 - \frac{k\Delta m_i}{k\Delta m_i + T_i}\right)$$

$\Rightarrow$ Silver supply disruption ($\Delta m_i \downarrow$) $\rightarrow$ silver appreciation and welfare declines.

The Aftermath of Silver Disruption

3. Role of Taxation:

$$\frac{\partial \ln \omega_i}{\partial \ln \Delta m_i} = (1+\gamma)\left(1 - \frac{k\Delta m_i}{k\Delta m_i + T_i}\right)$$

$\Rightarrow \frac{\partial \ln \omega_i}{\partial \ln \Delta m_i} = 0$ when $T = 0$: Silver decline has only nominal effects without silver taxation.

$\Rightarrow \frac{\partial \ln \omega_i}{\partial \ln \Delta m_i} \uparrow$ in T_i when $T > 0$: Silver appreciation raises the real tax burden; higher T leads to larger welfare losses.

- Early 19th century Chinese economy experienced something akin to Fisherian debt deflation — with spatial variation driven by the Canton system's trade constraint.

- In an agrarian economy with little surplus $\rightarrow$ uprisings and conflict.

Taking the Model to Data

Calibrated parameters

Table: Model Parametrization

Variable	Definition	Value	Source
$\sigma - 1$	Trade elasticity	4	Simonovska and Waugh (2014)
β	Discount factor	Annual rate 0.96	Kydland and Prescott (1982)
δ	Silver depreciation	Annual rate 1.7%	Boehm and Chaney (2024)
λ	Cost parameter related to reaching buyers	1	Between Arkolakis (2010) (0.915) and Eaton et al. (2011) (1.1)
γ	Preference parameter related to holding money	0.01	–

Taking the Model to Data

Regional characteristics (baseline year = 1810)

Variable	Definition	Estimated parameter value	Data source
S_0	Total silver inflow from RoW to China	5,737,000	Lee (2010)
L_i	Labor endowment	1820 data	Cao (2001)
T_i	Taxation	1820 data	Guo (2022)
A_i	Productivity	$\ln A_i = \kappa_2 \ln L_i + \kappa_3 \ln(\text{Land productivity}) + \mathbf{D}_{\text{silk, tea, ceramic}}$	Galor and Özak (2016) and county gazetteers
τ_{ij}	Trade costs	$\ln \tau_{ij} = \kappa_0^{F,H} + \kappa_1^{F,H} \ln(\text{TravelCost}_{ij})$; $\tau_{ii} = 1$	–
M_i	Silver minting	$M_i = D_{i,\text{mine}} \bar{M} / \sum_i D_{i,\text{mine}}$	Wei (1983)
P_i^{crop}	Crop price	Calculated from Qing grain prices	MHDB, Modern History Databases

Taking the Model to Data: Estimation

Table: Determinants of Trade Costs and Technology

	ln Trade Cost		ln Technology		Model Fit	
	International	Domestic				
ln Travel Cost	0.23	0.11	ln Population	-0.92	$\ln P_i^{model}$	1.07^{**}
Constant		0.16	ln Agri. Yield	0.01		(0.51)
			Production: Tea	0.02		
			Production: Silk	0.09	R-squared	0.83
			Production: Ceramic	0.04	Observations	247

Notes: Parameters are estimated by minimizing the within-province sum of squared deviations between $\ln P_i^{grain}$ and $\ln P_i^{model}(\kappa)$. The Model Fit column reports the coefficient from regressing $\ln P_i^{grain}$ on $\ln P_i^{model}$ with province fixed effects. Standard errors in parentheses. ** $p < 0.05$.

Taking the Model to Data: Validation

Table: Regional Variation in Silver Prices

	Untargeted Margins				Replicate Fact 1	
	Data		Model		Model (1800, 1810, 1840)	
	(1)	(2)	(3)	(4)	(5)	(7)
	$\ln Silver_{1810}$	$d\ln Silver_{1810-1840}$	$\ln Silver_{1810}$	$d\ln Silver_{1810-1840}$	$\Delta Silver_{it}$	$\Delta Silver_{it}$
$TradeCanton_p$	0.06**	0.03	0.06***	0.0004***	0.0104***	0.0341***
	(0.03)	(0.02)	(0.00)	(0.0001)	(0.0022)	(0.0029)
$TradeCanton_p \times MexicoSilver_t$					-0.0006***	-0.0020***
					(0.0001)	(0.0002)
$MexicoSilver_t$					-0.5853***	-0.5897***
					(0.0011)	(0.0011)
Baseline Controls					No	Yes
Observations	17	14	249	249	498	498
R-squared	0.27	0.18	0.84	0.04	1.00	1.00

Notes: This table presents regression results examining the relationship between trade with Canton and silver prices across different specifications. Columns (1)-(2) show results using raw data, columns (3)-(4) present model-based estimates, and columns (5) and (7) replicate the empirical findings for the period 1800-1840. Column (7) includes baseline controls. Standard errors are reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The Thirst for Silver: Welfare, Prices, and Tax Burden

	Pop.wt. Mean	SD	Max	Min
Panel A: Percentage Changes in Aggregate Outcomes				
Welfare	−1.16	0.82	−0.001	−4.11
Silver Price	41.12	0.14	41.36	40.65
After-Tax Real Wage	−1.147	0.81	−0.001	−4.07
Tax Burden Before	0.02	0.02	0.07	0.00
Tax Burden After	0.03	0.02	0.11	0.00

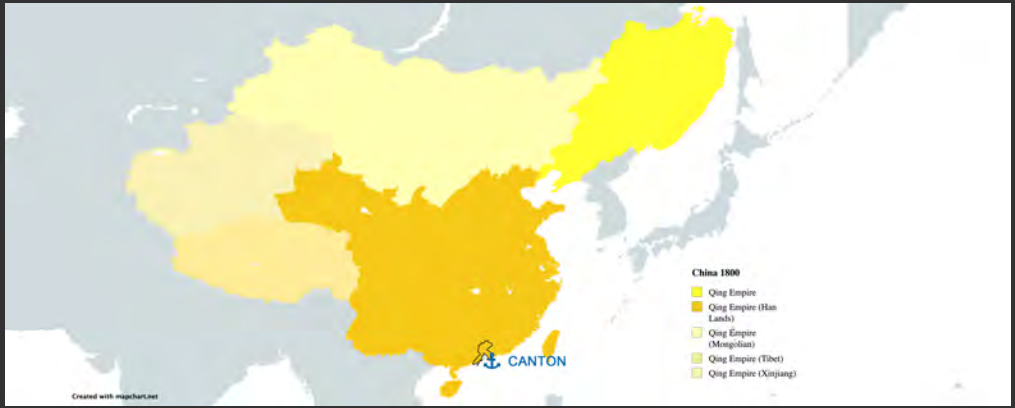
Panel C: Welfare Decomposition (Population-Weighted)

	Total	Money Holding	Consumption	Taxation
Welfare Change (%)	−1.16	−0.01	0.003	−1.15
Share of Total (%)	100.00	0.99	−0.28	99.29

Notes: This table presents the welfare effects of a 16.4% decline in silver stocks. Panel A reports population-weighted mean percentage changes together with dispersion statistics across 249 prefectures. Panel B compares tax burden levels (measured as tax payments relative to income). Panel C decomposes average welfare change into three components.

Possible reforms?

- Trade reform: What if Qing China had been more open to trade?
- Tax reform: What if taxation had been evenly distributed?



Possible Reforms?

- No reform: silver shock: -1.16%
- 4-port system: direct effect:$+0.05\%$; silver shock: -1.131%
- Treaty-port system: direct effect:$+0.04\%$; silver shock: -1.134%
- Equal per-capita tax: direct effect: $+0.71\%$; silver shock: -0.78%

Conclusion

- In early nineteenth-century Qing China, rigid trade and taxation institutions amplified an external silver shock, driving rising silver prices and local unrest.

- The effects were large and spatially uneven —helping to solve a longstanding puzzle in economic history given the limited openness to trade and low tax levels of the empire.

- When can globalization become a source of state fragility (modern implications)?

    - Institutional chokepoints shape the transmission of global shocks.

    - Trade reforms may not be sufficient; broader domestic institutional reforms are necessary.

Thank You!

chong.pang@bse.eu

www.pangchongecon.com

ADDITIONAL SLIDES

Spanish American Wars of Independence

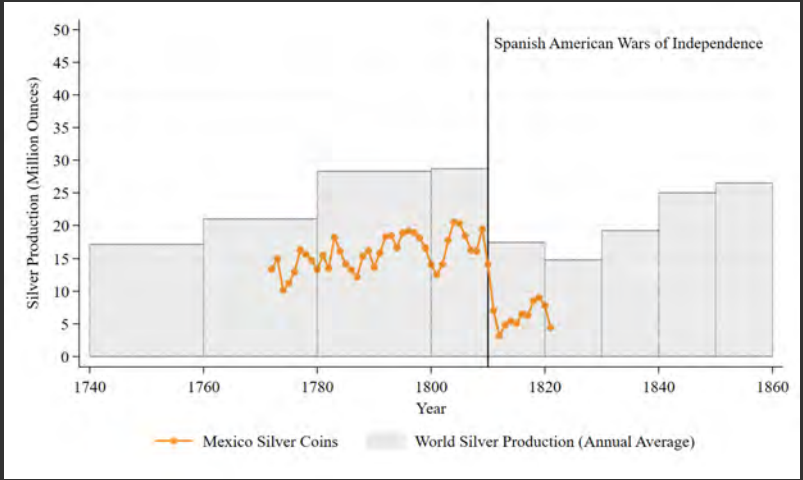


Figure: World and Mexico Silver Production

Carlos IV Coin in China | Relevance | Back

Significance of the Carlos IV Coin in Chinese Trade

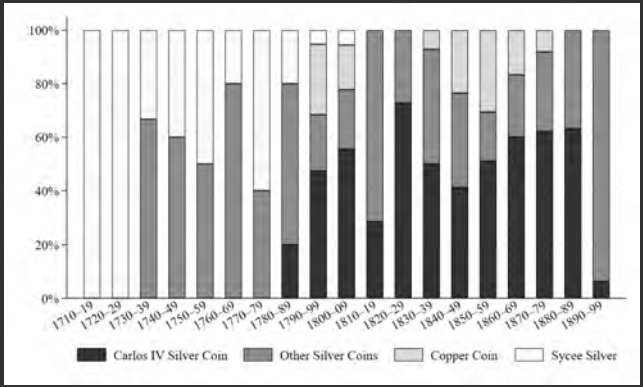


Figure: Means of Payment in Quanzhou Contracts, 1710–1899

Notes: Adapted from von Glahn (2007), based on data originally compiled by Yang Guozhen in *Minnan qiyue wenshu zonglu* (Comprehensive Catalogue of Contract Documents from Southern Fujian), published as a special issue of *Zhongguo Shehui Jingji Shi Yanjiu* (1990).

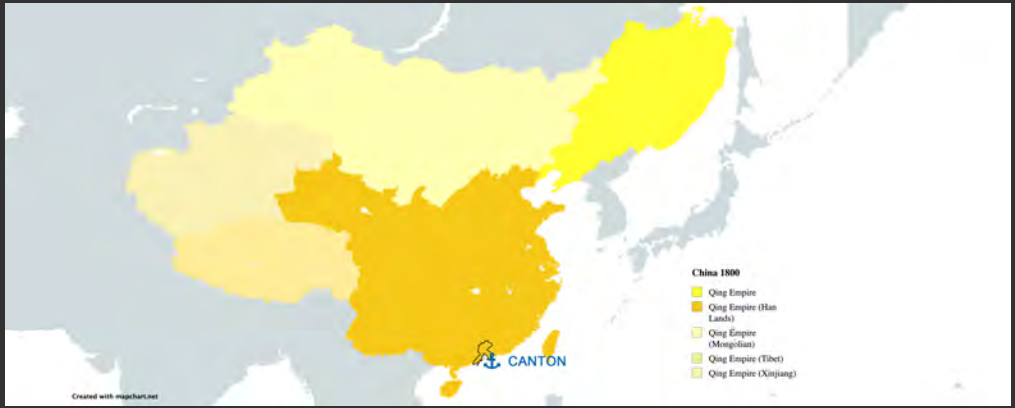
Relevance of Mexican Silver to Chinese Inflows and Silver Prices

	$\Delta Silver_t$		$SilverInflow_t$	
	1721-1911		1721-1840	
	(1)	(2)	(3)	(4)
$SilverInflow_t$	-0.0140**	-0.0141**		
	(0.006)	(0.006)		
$MexicoSilver_t$			0.103***	0.161***
			(0.032)	(0.050)
Year Linear Trend	No	Yes	No	Yes
Observations	180	180	120	120
R-squared	0.046	0.046	0.025	0.229

Notes: The variable $\Delta Silver_t$ represents the log change in silver prices relative to copper, calculated from Lin (2020); $SilverInflow_t$ is China's net silver inflow (in ten million taels) from Lee (2009); $MexicoSilver_t$ represents the log of Mexican silver production, based on Borah (1949). The data are time series and cover the period 1721 to 1911 for columns (1)–(2), and 1721 to 1840 for columns (3)–(4). Coefficients are estimated using OLS, with robust standard errors reported in parentheses: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Back Next

Western Trade: Canton System (一口通商, 1757-1842)



Silver-denominated, Fixed Taxation (Debt)

- Land-based tax quota collected in silver, frozen at 1710 figures (70% of fiscal revenue)
- Extractive taxation: revenues funded bureaucracy (*30%*) and military payrolls (*60%*), with minimal public return.
- Collected in Han China (China Proper), the focus of our study

(center–periphery in Chinese statecraft)

Institutional Context: Additional

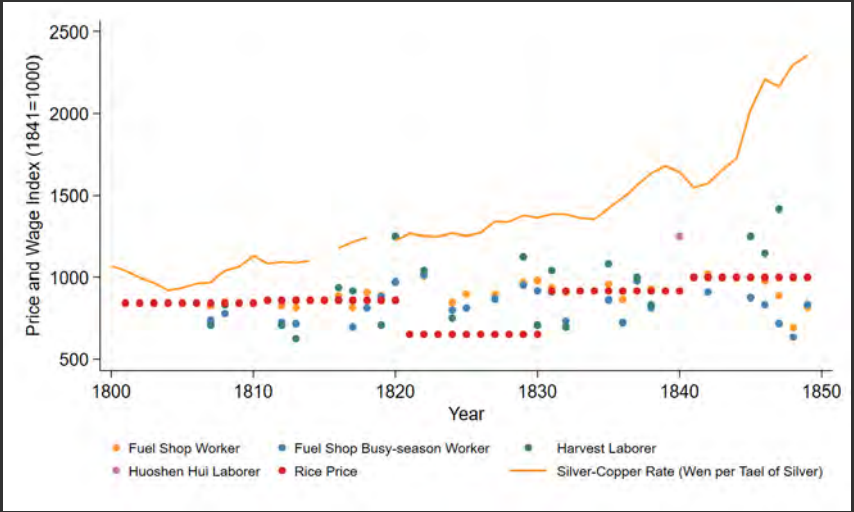
- Taxes collected across 18 Han provinces (China Proper)
- Focus on commoners: they bore the tax burden and drove local unrest

- Fiscal circulation: center–frontier transfers
  - 8 surplus provinces remitted silver to Beijing and frontiers; 3 broke even
  - 5 together with non-Han frontiers received net transfers
  - Silver flowed back through trade: frontier soldiers and Beijing elites purchased goods from interior merchants

⇒ Taxes extracted local real output; silver largely recirculated within China Proper

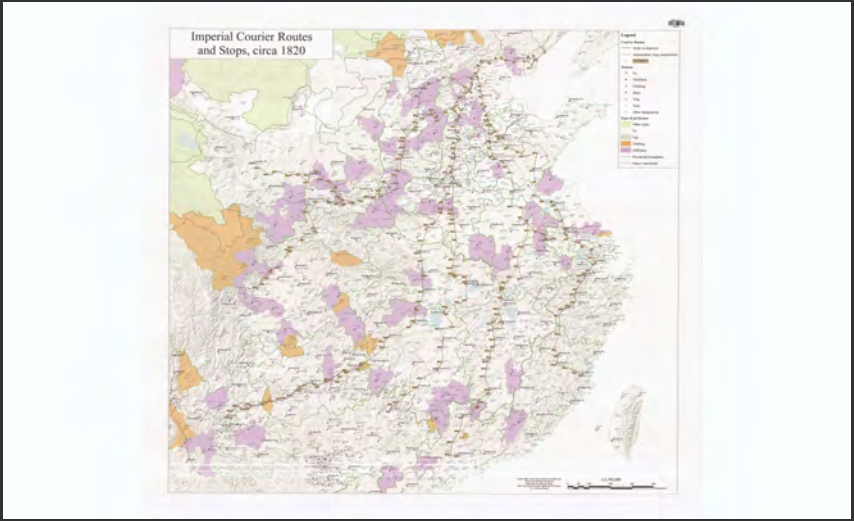
Back

Wages and Prices in Beijing, 1800–1850



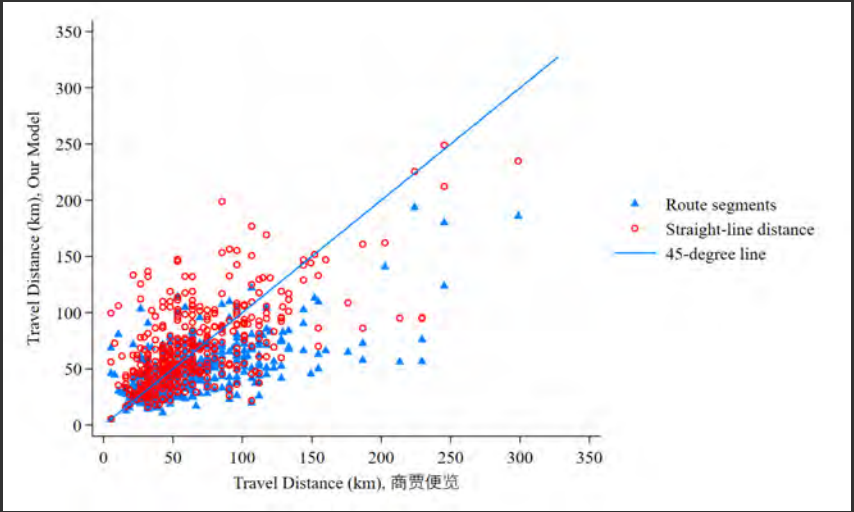
Back

Imperial Courier Routes of the Qing Dynasty



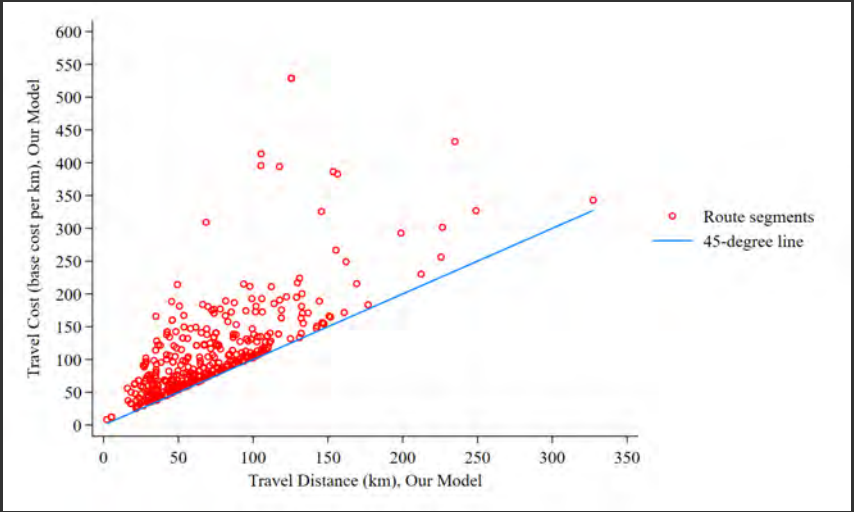
Source: Skinner, G. W. (n.d.). *Imperial courier routes of the Qing Dynasty*. Retrieved from University of Washington Libraries' Map Collection `https://digitalcollections.lib.washington.edu/digital/collection/skinner/id/1306/`

Validating Travel Distance



Back

Estimated Travel Distance vs. Trade Cost



Back

Geospatial Model

- Cost ratios: Bai & Jia (2025); Scheidel (2014).
- Enhanced route estimation:
  - Integrated elevation and waterway data.
  - Adapted Tobler's hiking function for land travel.

	Route Type	Travel Cost
(1)	Natural Waterway	$1\times$ length
(2)	Grand Canal	$1.5\times$ length
(3)	Road (Slope $\leq 30\%$)	$3 \times e^{3.5\times\lvert\text{slope}\rvert} \times$ length
(4)	Road (Slope $> 30\%$)	$3 \times e^{3.5\times 0.3+4\times\lvert\text{excess slope}\rvert} \times$ length
(5)	Trail (Off Connecting Points)	$6\times$ road cost for the same slope

Back

Silver Supply Alleviates Social Unrest

	$Conflicts_{it}$			
	Travel Cost to Cost-minimizing Silver Mine		Straight Line Distance to nearest Silver Mine	
	Cost.≥medium	Cost.<medium	Dist.≥medium	Dist.<medium
	(1)	(2)	(3)	(4)
$TradeCanton_i \times \Delta Silver_t$	16.4754***	7.3352	15.0383***	5.3748
	(4.8362)	(4.4885)	(5.7250)	(4.7402)
Baseline Controls	Yes	Yes	Yes	Yes
$Distance_i \times \Delta Silver_t$	Yes	Yes	Yes	Yes
County FE, Year FE	Yes	Yes	Yes	Yes
Observations	17712	18468	18180	18000
Pseudo R-squared	0.314	0.408	0.322	0.414

Notes: The dependent variable is the number of conflicts for a given county and year. This table replicates the regressions reported in Table 2, but splits the sample into two subsamples. Columns (1) and (2) divide the sample according to whether a county's travel cost to the cost-minimzing domestic silver mine is above or below the median. Columns (3) and (4) divide the sample based on whether the distance of a county to the nearest domestic silver mine is above or below the median. All regressions include the full set of control variables from column (4) of Table 2. Standard errors, clustered at the prefecture level, are reported in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Back

Robustness: Alternative Samples and Controls

	$Conflicts_{it}$						
	Full Sample					Excl. White Locus Rebellion Prov.	Excl. Guangdong Prov.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
$\Delta Silver_t \times TradeCanton_i$	10.2529***	8.9720**	10.1514***	9.9470**	11.2881***	9.4030**	10.0087***
	(3.6175)	(3.5464)	(3.8785)	(4.5005)	(3.5856)	(4.197)	(3.8370)
Baseline FEs and Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grand $Canal_i \times I(t \geq 1826)$	Yes	No	No	No	No	No	No
Province-Year FE	No	Yes	No	No	No	No	No
$\Delta Silver_t \times ExportIndustry_i$	No	No	Yes	No	No	No	No
$\Delta Silver_t \times TradeRouteIntensity_i$	No	No	No	Yes	No	No	No
$Opium_t \times TradeCanton_i$	No	No	No	No	Yes	No	No
Observations	36180	34282	36180	36180	36180	27612	33912
R-squared	0.362	0.431	0.362	0.361	0.362	0.381	0.330

Notes: The dependent variable is the number of conflicts per county-year. This table replicates Table 21 regressions, adding controls or subsamples to test robustness. Column 1 adds an interaction between Grand Canal location and post-1826 years; column 2 includes province-year fixed effects; column 3 interacts export-good dummies (silk, tea, ceramics) with $\Delta Silver_t$; column 4 interacts trade route intensity with $\Delta Silver_t$; column 5 interacts log India opium exports to China with $TradeCost_i$; column 6 excludes provinces affected by the White Lotus Rebellion (Henan, Shaanxi, Sichuan, Hubei); column 7 excludes Guangdong province. See Data Appendix for variable construction details. Coefficients are from pseudo-Poisson models with prefecture-level clustered standard errors. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Back

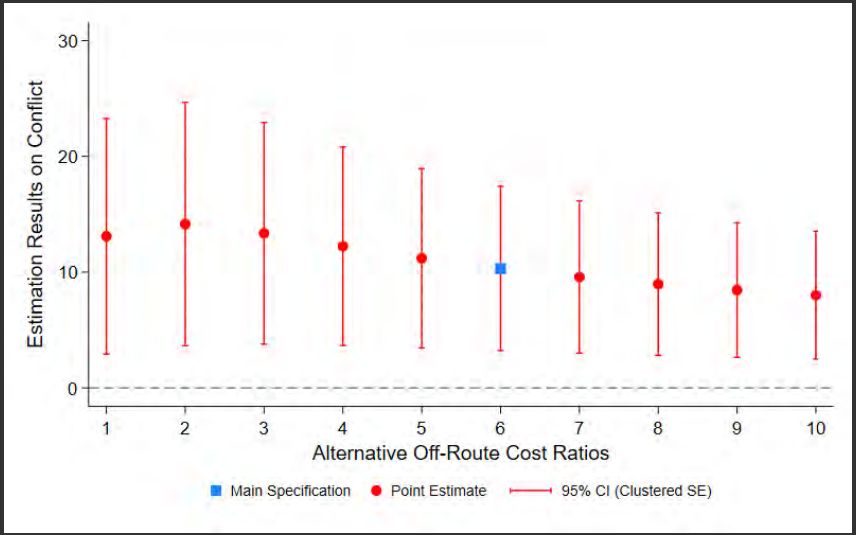
Robustness: Alternative Measure of Travel Cost

	$Conflicts_{it}$		
	(1)	(2)	(3)
$TradeCanton_i \times \Delta Silver_t$	2.4040	5.4703**	8.9905***
	(2.1033)	(2.6162)	(3.4774)
Baseline Controls	No	No	Yes
$Distance_i \times \Delta Silver_t$	No	Yes	Yes
County FE, Year FE	Yes	Yes	Yes
Observations	36180	36180	36180
Pseudo R-squared	0.359	0.359	0.361

Notes: The dependent variable is the number of conflicts per county-year. This table replicates Table 21 regressions, adding controls or subsamples to test robustness. Column 1 adds an interaction between Grand Canal location and post-1826 years; column 2 includes province-year fixed effects; column 3 interacts export-good dummies (silk, tea, ceramics) with $\Delta Silver_t$; column 4 interacts trade route intensity with $\Delta Silver_t$; column 5 interacts log India opium exports to China with $TradeCost_i$; column 6 excludes provinces affected by the White Lotus Rebellion (Henan, Shaanxi, Sichuan, Hubei); column 7 excludes Guangdong province. See Data Appendix for variable construction details. Coefficients are from pseudo-Poisson models with prefecture-level clustered standard errors. Significance: * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

Back

Robustness: Alternative Off-Route Cost Parameters



Back

References

Ahlfeldt, G. M., Redding, S. J., Sturm, D. M., and Wolf, N. (2015). The economics of density: Evidence from the berlin wall. *Econometrica*, 83(6):2127–2189.

Arkolakis, C. (2010). Market penetration costs and the new consumers margin in international trade. *Journal of Political Economy*, 118(6):1151–1199.

Berman, N., Couttenier, M., Rohner, D., and Thoenig, M. (2017). This mine is mine! how minerals fuel conflicts in africa. *American Economic Review*, 107(6):1564–1610.

Boehm, J. and Chaney, T. (2024). Trade and the end of antiquity. CEPR Discussion Paper 19459, CEPR Press, Paris & London.

Borah, W. W. (1949). The mining guild of new spain and its tribunal general 1770-1821.

Brzezinski, A., Chen, Y., Palma, N., and Ward, F. (2024a). The vagaries of the sea: Evidence on the real effects of money from maritime disasters in the Spanish empire. *The Review of Economics and Statistics*, 106(5):1220–1235.

Brzezinski, A., Palma, N., and Velde, F. R. (2024b). Understanding money using historical evidence. *Annual Review of Economics*, 16:571–595.

Cao, S. (2001). *Zhongguo renkoushi (Qing shiqi) (The Population History of China (Qing Dynasty))*. Fudan University Press, Shanghai. (in Chinese).

Cao, S., Li, Y., and Yang, B. (2012). Mt. tambora, climatic changes, and china's decline in the nineteenth century. *Journal of World History*, pages 587–607.

References

Cao, Y. and Chen, S. (2022). Rebel on the canal: Disrupted trade access and social conflict in china, 1650–1911. *American Economic Review*, 112(5):1555–1590.

Couttenier, M., Marcoux, J., Mayer, T., and Thoenig, M. (2024). The gravity of violence. CEPR Discussion Paper 19527, CEPR Press, Paris & London.

Dell, M., Feigenberg, B., and Teshima, K. (2019). The violent consequences of trade-induced worker displacement in mexico. *American Economic Review: Insights*, 1(1):43–58.

Donaldson, D. (2018). Railroads of the raj: Estimating the impact of transportation infrastructure. *American Economic Review*, 108(4-5):899–934.

Donaldson, D. and Hornbeck, R. (2016). Railroads and american economic growth: A "market access" approach. *Quarterly Journal of Economics*, 131(2):799–858.

Eaton, J., Kortum, S., and Kramarz, F. (2011). An anatomy of international trade: Evidence from french firms. *Econometrica*, 79(5):1453–1498.

Fogel, R. W. (1964). *Railroads and American Economic Growth: Essays in Econometric History*. Johns Hopkins Press, Baltimore.

Galor, O. and Özak, Ö. (2016). The agricultural origins of time preference. *American Economic Review*, 106(10):3064–3103.

Guo, Y. (2022). *Land and Labor Tax in Imperial Qing China (1644-1912)*, volume 18. Brill.

Hornbeck, R. and Rotemberg, M. (2024). Growth off the rails: Aggregate productivity growth in distorted economies. *Journal of Political Economy*, 132(11):3547–3602.

References

Hu, Y. (2021). *Qingdai yinqian bijia bodong yanjiu (1644–1911) (Research on the Exchange Rate Fluctuation between Silver and Copper Coin in the Qing Dynasty (1644–1911))*. PhD thesis, East China Normal University, Shanghai. (in Chinese).

Huang, P. C. (1990). *The Peasant Family and Rural Development in the Yangzi Delta, 1350-1988*. Stanford University Press, Stanford, California.

Jones, S. M. and Kuhn, P. A. (1978). Dynastic decline and the roots of rebellion. In Fairbank, J. K., editor, *The Cambridge History of China, Volume 10: Late Ch'ing, 1800–1911, Part 1*, pages 107–162. Cambridge University Press.

Juhász, R. (2018). Temporary protection and technology adoption: Evidence from the napoleonic blockade. *American Economic Review*, 108(11):3339–3376.

Kydland, F. E. and Prescott, E. C. (1982). Time to build and aggregate fluctuations. *Econometrica: Journal of the Econometric Society*, pages 1345–1370.

Lee, L. (2009). Estimating the yearly amount of silver inflow during the ching dynasty in china (1645-1911). *Journal of Humanities and Social Sciences*, 5(2):31–58.

Lee, L. (2010). *Qingdai de guoji maoyi: Baiyin liuru, huobi weiji he wanqing gongyehua (International Trade in the Qing Dynasty: Silver Inflows, Currency Crises, and Late Qing Industrialization)*. Showwe Publishing, Taipei. (in Chinese).

Li, B. (2015). The "daoguang depression" and the "guiwei great flood" : Economic decline and climatic cataclysm in early nineteenth-century songjiang in a new perspective. *Études chinoises*, 34(2):89–119.

References

Lin, M.-h. (2020). China upside down: Currency, society, and ideologies, 1808–1856. In *China Upside Down*. Harvard University Asia Center.

Liu, C.-y. (1993). "Chong, Fan, Pi, Nan": Qingdai Dao, Fu, Ting, Zhou, Xian dengji chutan ("Cong, Fan, Pi, Nan": A Preliminary Study of the Hierarchy of Circuits, Prefectures, Departments, Subprefectures, and Counties in the Qing Dynasty). *Bulletin of the Institute of History and Philology, Academia Sinica*, 64(1):175–204. (in Chinese).

Ma, D. (2012). Money and monetary system in china in the 19th-20th century: An overview. Economic History Working Paper 159/12, London School of Economics and Political Science, Department of Economic History.

Martin, P., Mayer, T., and Thoenig, M. (2008). Make trade not war? *The Review of Economic Studies*, 75(3):865–900.

Nagy, D. K. (2023). Hinterlands, city formation and growth: Evidence from the u.s. westward expansion. *Review of Economic Studies*, 90(6):3238–3281.

Palma, N. (2022). The real effects of monetary expansions: Evidence from a large-scale historical experiment. *The Review of Economic Studies*, 89(3):1593–1627.

Pascali, L. (2017). The wind of change: Maritime technology, trade, and economic development. *American Economic Review*, 107(9):2821–2854.

Redding, S. J. and Sturm, D. M. (2008). The costs of remoteness: Evidence from german division and reunification. *American Economic Review*, 98(5):1766–1797.

References

Richards, J. F. (2002). The opium industry in british india. *The Indian Economic & Social History Review*, 39(2-3):149–180.

Simonovska, I. and Waugh, M. E. (2014). The elasticity of trade: Estimates and evidence. *Journal of International Economics*, 92(1):34–50.

Vicard, V. (2012). Trade, conflict, and political integration: Explaining the heterogeneity of regional trade agreements. *European Economic Review*, 56(1):54–71.

von Glahn, R. (2018). Economic depression and the silver question in nineteenth-century china. In Perez Garcia, M. and de Sousa, L., editors, *Global History and New Polycentric Approaches*, pages 81–118. Palgrave Macmillan, Singapore.

Wang, Y.-c. (1997). Shijiu shiji qianqi wujia xialuo yu taipingtianguo geming (Deflation and the Mass Peasant Uprisings in Mid-19th Century China). In *Qingdai jingjishi lunwenji (Collected Essays in the Economic History of Qing China)*, volume 3, pages 417–448. Linking Publishing, Taipei. (in Chinese).

Wei, Q. (1983). *Qingdai de kuangye (Mining in the Qing Dynasty. Volume 2)*. Zhonghua Book Company, Beijing. (in Chinese).

Yan, Z. (2016). *Zhongguo jindai jingjishi tongji ziliaoxuanji (Selection of Modern Chinese Economic History Statistical Data)*. Science Press, Beijing. (in Chinese).

Zhang, D. (2013). *Zhongguo sanqiannian qixiang jiluzongji (A Comprehensive Collection of Meteorological Records of China over the Past 3000 Years)*. Jiangsu Education Press, Nanjing. (in Chinese).