

Income Taxation and State Capacities in Chile: Measuring Institutional Development Using Historical Earthquake Data

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Overview

[Origins] Most theories emphasize how important fiscal development is for state consolidation. However, the **origins** of fiscal development are less clear.

[Measurement] Most theories provide **historical** explanations for state consolidation, yet, they lack of a **historical** measurement capable of capturing levels of state capacities overtime.

- I find that these two gaps represent important **theoretical** and **empirical deficits**.

Taxation and State Capacities

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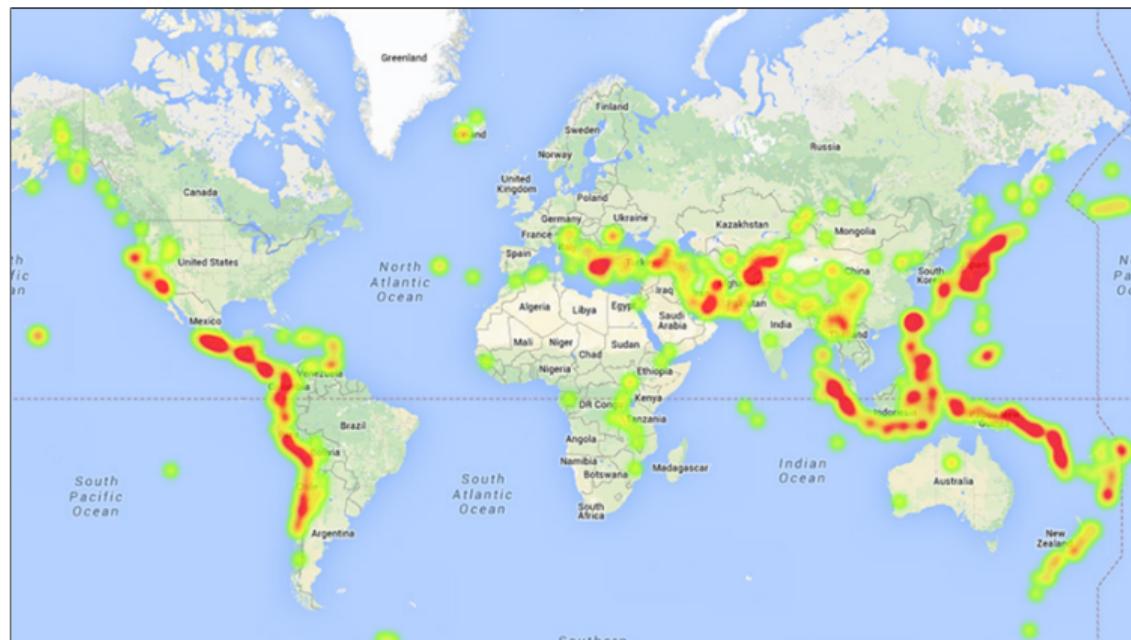
Taxation and State Capacities

Convince you:

1. Higher levels of sectoral competition promoted the implementation of the income tax.
2. The income tax fostered higher levels of state consolidation overtime.
3. Earthquake death-tolls are good proxies to measure state capacities.

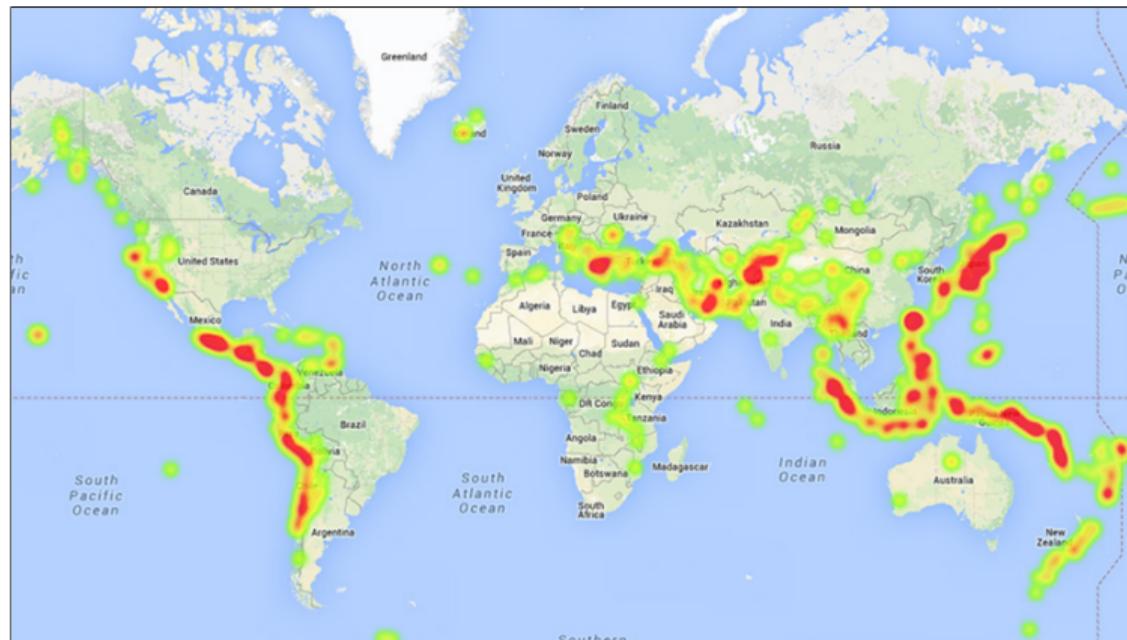
Why Earthquakes?

The **capacity** of the state to **enforce** quake-sensitive **building codes** throughout the territory, is a **reflection** of its **overall state-capacities**.



Why Earthquakes?

Earthquakes are **exogenous** to regime type, levels of political/economic development, and other sources of variation.



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Earthquakes and States Capacity

2010 Haiti: 7M, 100,000 casualties

Government Palace



2010 Chile: 8.8M, 525 casualties



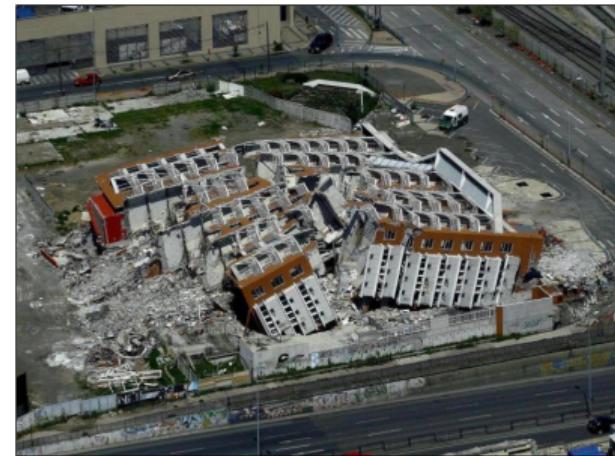
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Intuition: Chile has higher levels of “state capacity.”

The Importance of Building Codes

There exists a **popular** consensus on that **building codes do** reduce death tolls.

The New York Times

AMERICAS

Why Chile's Latest Big Earthquake Has a Smaller Death Toll

CNN

World | Africa | Americas | Asia | Europe | Middle East

Live TV U.S. Edition + 🔍 ⚙

Experts: Strict building codes saved lives in powerful Chile earthquake

The New York Times
AMÉRICA LATINA | MÉXICO

El terremoto revela falta de rigor en la aplicación de normas de construcción en Ciudad de México

Dual Political Economy and Taxation

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There are different **sectoral preferences towards income taxation**, and consequently, **state centralization**:

[Agr] Since **land fixity** increases the risk premium of the landed elite's main asset, landowners systematically **resist** taxation.

[Ind] As capital can be **reinvested in nontaxable sectors**, industrialists' preferences toward taxation are more **elastic**.

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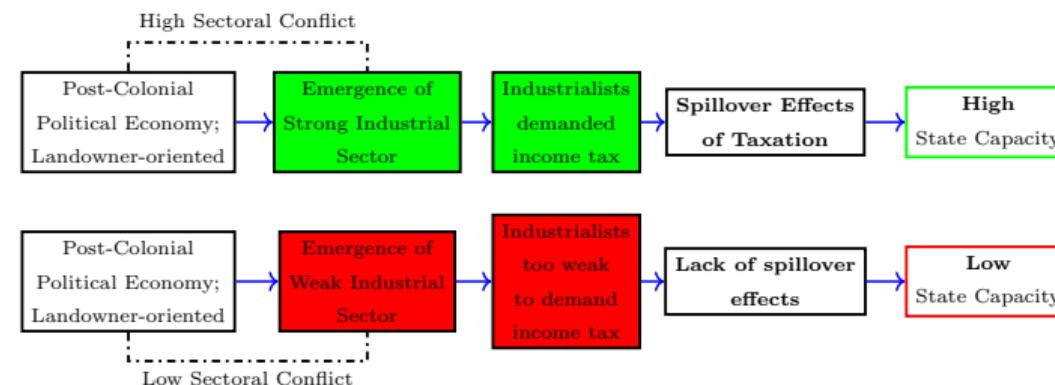
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 1. *Indirect taxes are easier to collect*: ex., collect them at ports. [appendix](#)
 2. *Direct* taxes (ex., income taxes) requires the **deployment** of tax collectors to the entire territory, increasing state presence.
- Income taxation generated positive **spillover effects** for state-making, rising **economies of scale** of the **operational efficiencies** of the bureaucracy.

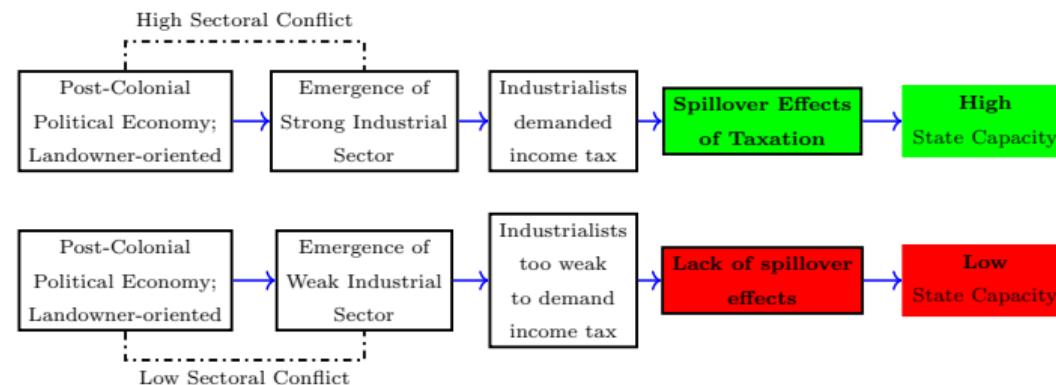
Argument

The emergence of a **strong industrial class**, accelerated the **implementation of the income tax**.



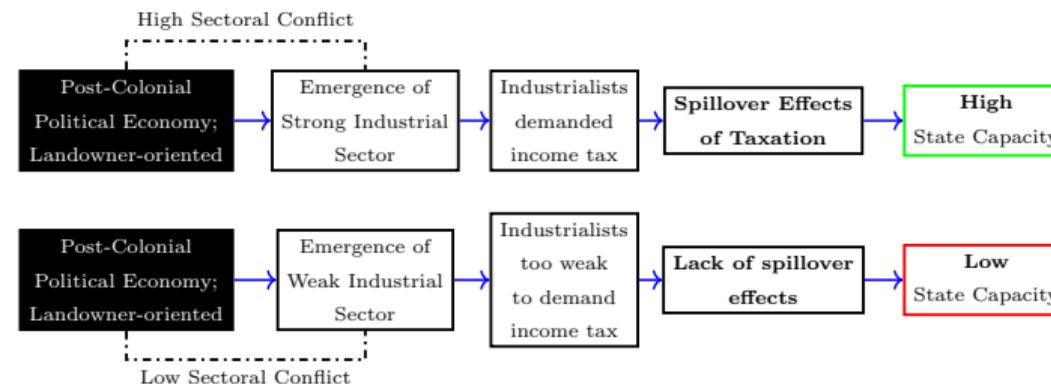
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The emergence of a strong industrial class, accelerated the implementation of the **income tax**. In turn, income taxation fostered **state-capacities** overtime.



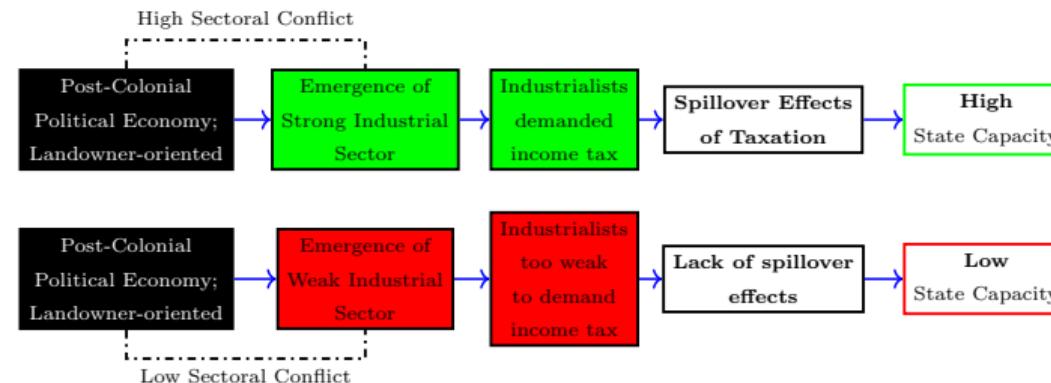
Conceptualizing Sectoral Contestation

The **post-colonial political economy** was ruled by **agricultural** political incumbents.



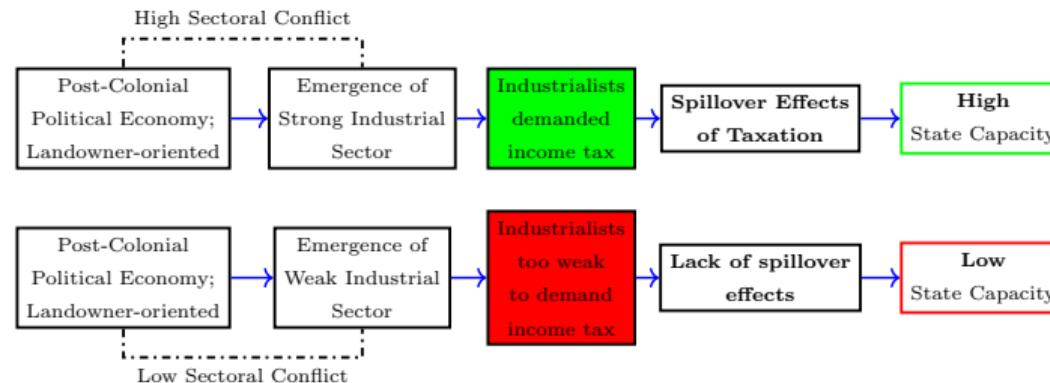
Conceptualizing Sectoral Contestation

The post-colonial political economy was ruled by **agricultural political incumbents**. Consequently, the emergence of an **industrial** elite, posited **credible threats** to the post-colonial *status quo*.



Conceptualizing Sectoral Contestation

The sectoral threats had to do with the **emergence** of a class—*industrialists*—that were more **sympathetic** to the idea of implementing an income tax law.



Chilean Case Study

- Industrial elites were **better off** paying the income tax rather than **imposing higher tariffs**—industrial class was highly *dependent on imported capital*.
- Industrialists demanded public goods delivered at the local level (bridges and ports).

The Theory Should Pass Two Tests

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[lower death tolls overtime]

Early and Late Income-Tax Implementers

Cox Model. Sectoral outputs ([MOxLAD dataset](#)) to investigate the sectoral contribution of the **timing** of the implementation of the income tax in 9 Latin American countries.

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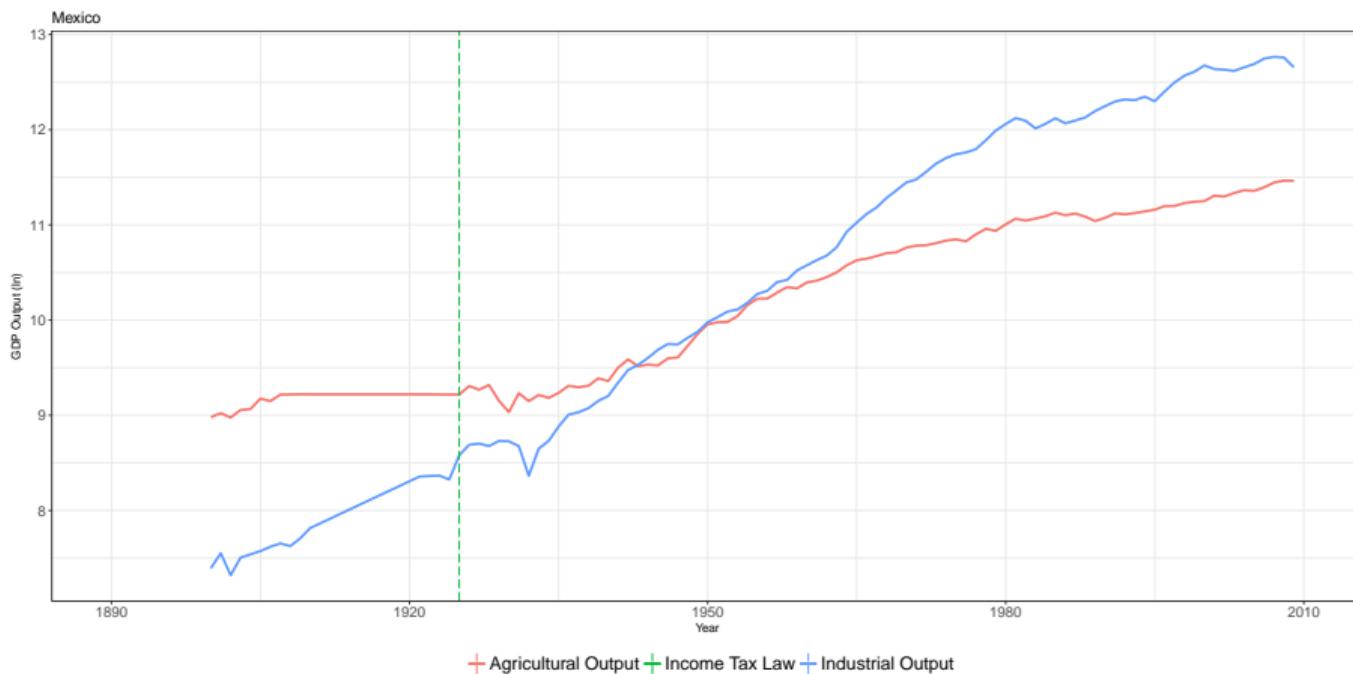
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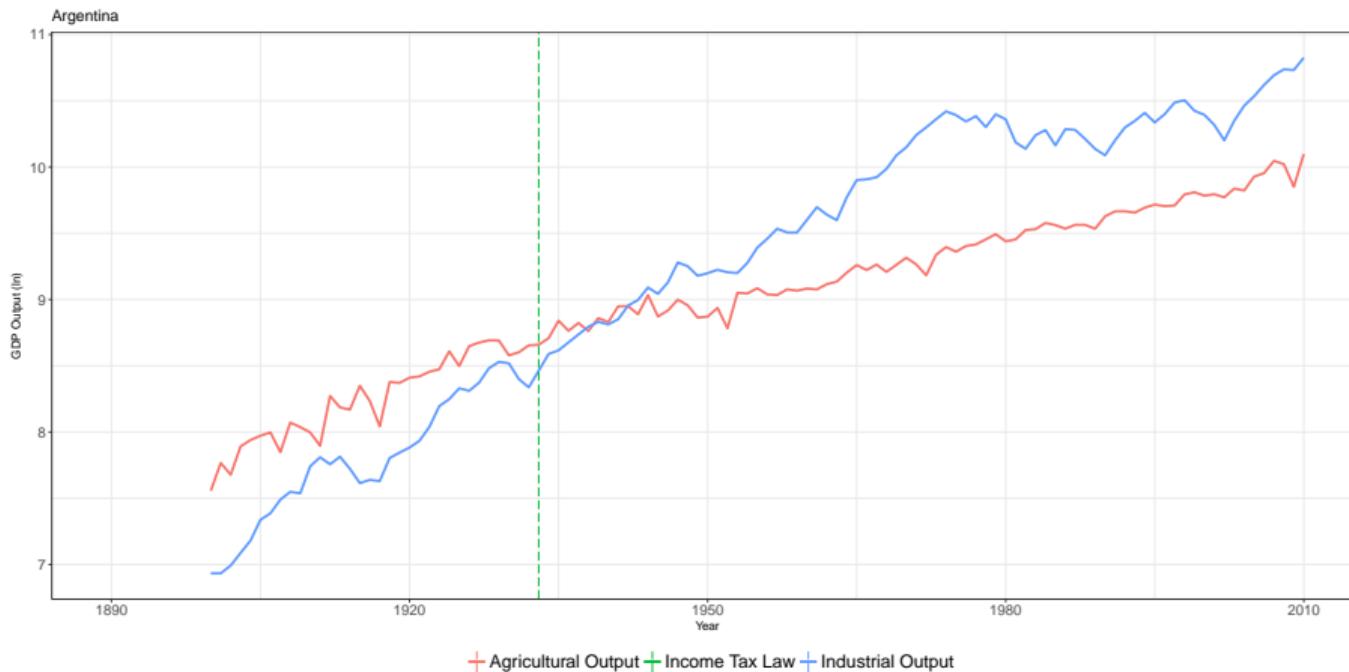
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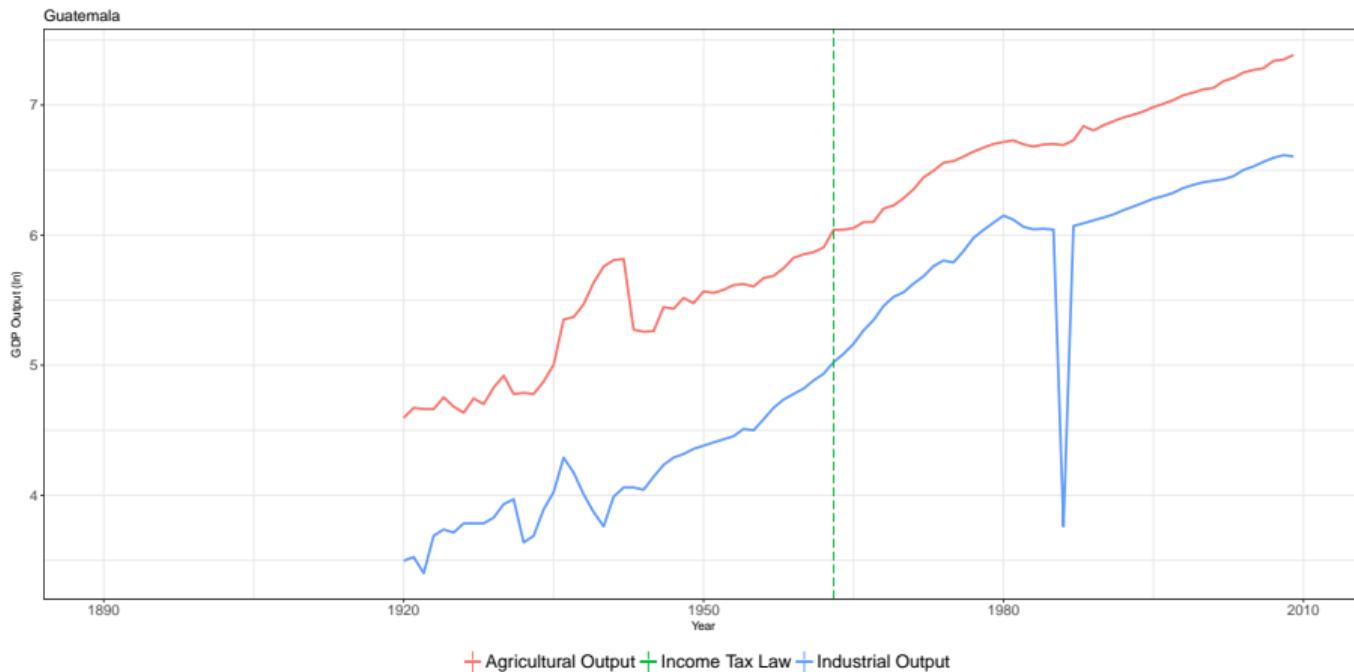
Mexico: 1925



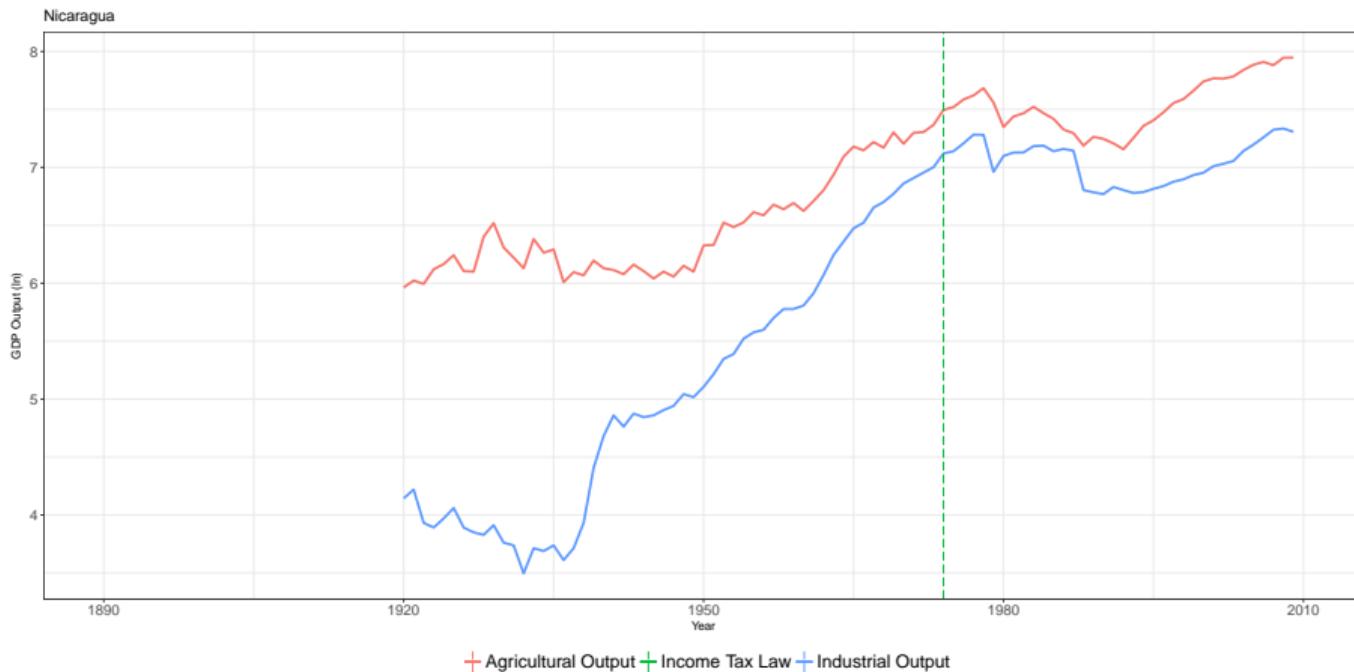
Argentina: 1933



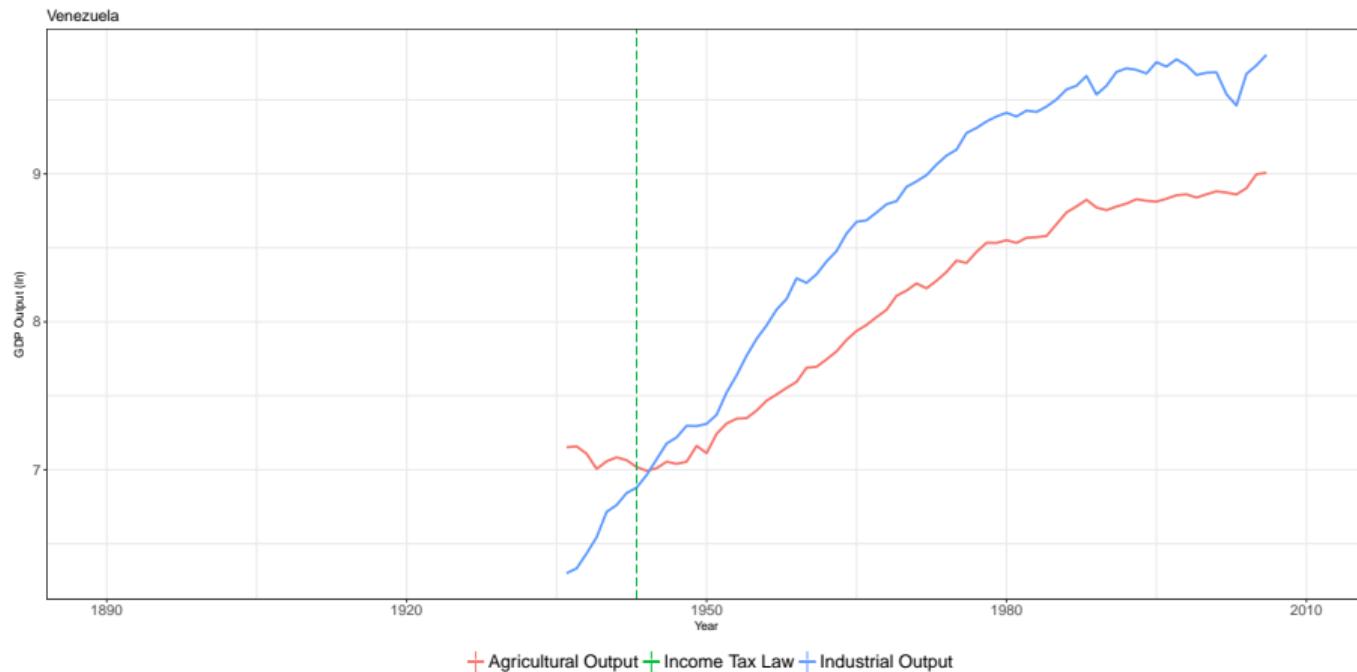
Guatemala: 1963



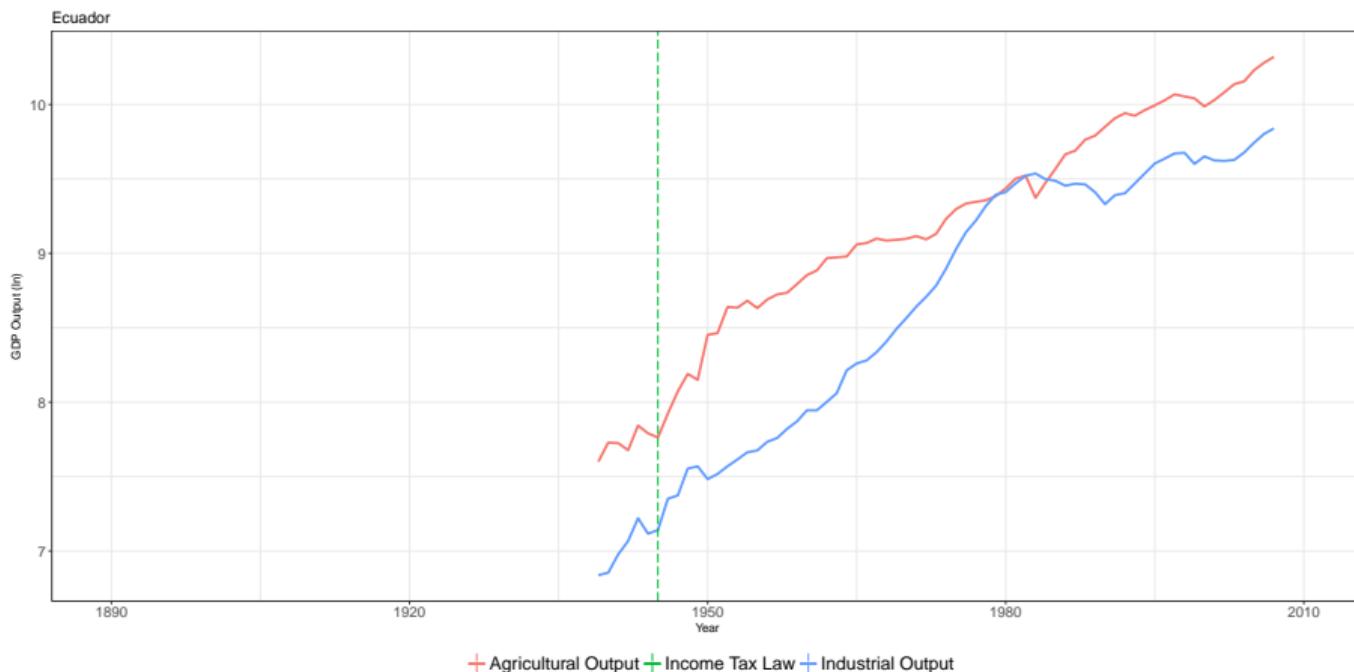
Nicaragua: 1974



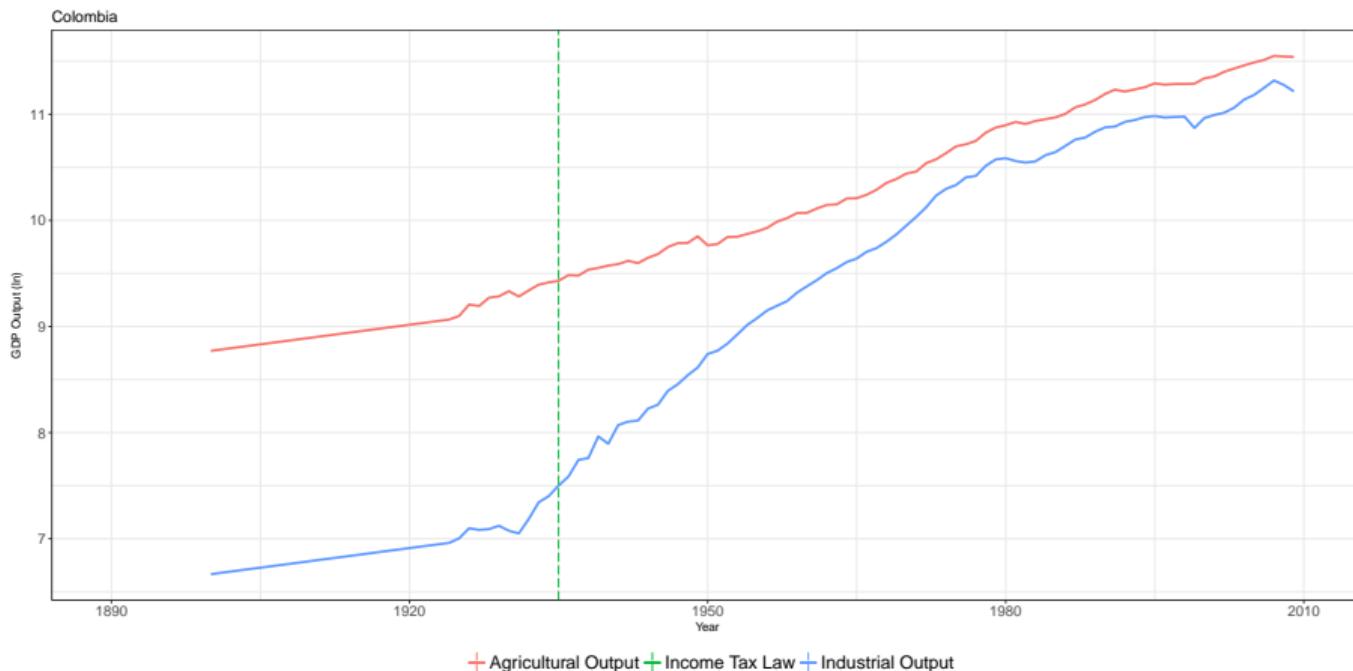
Venezuela: 1943



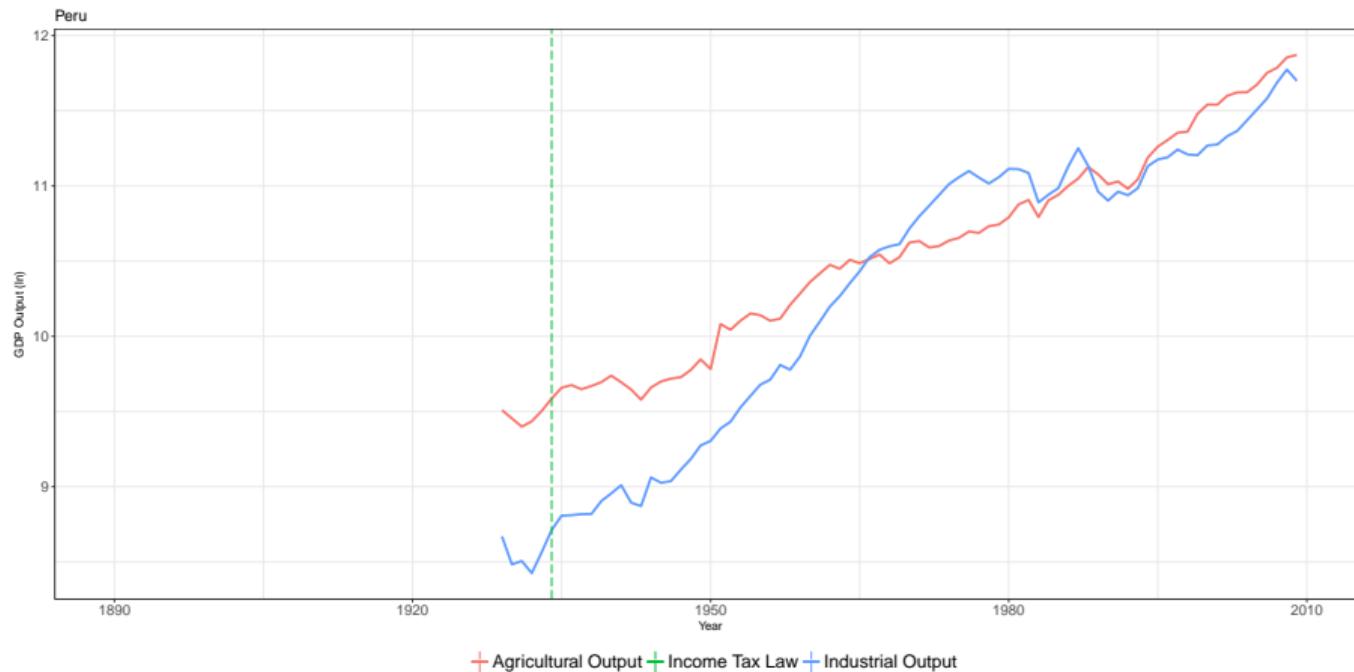
Ecuador: 1945



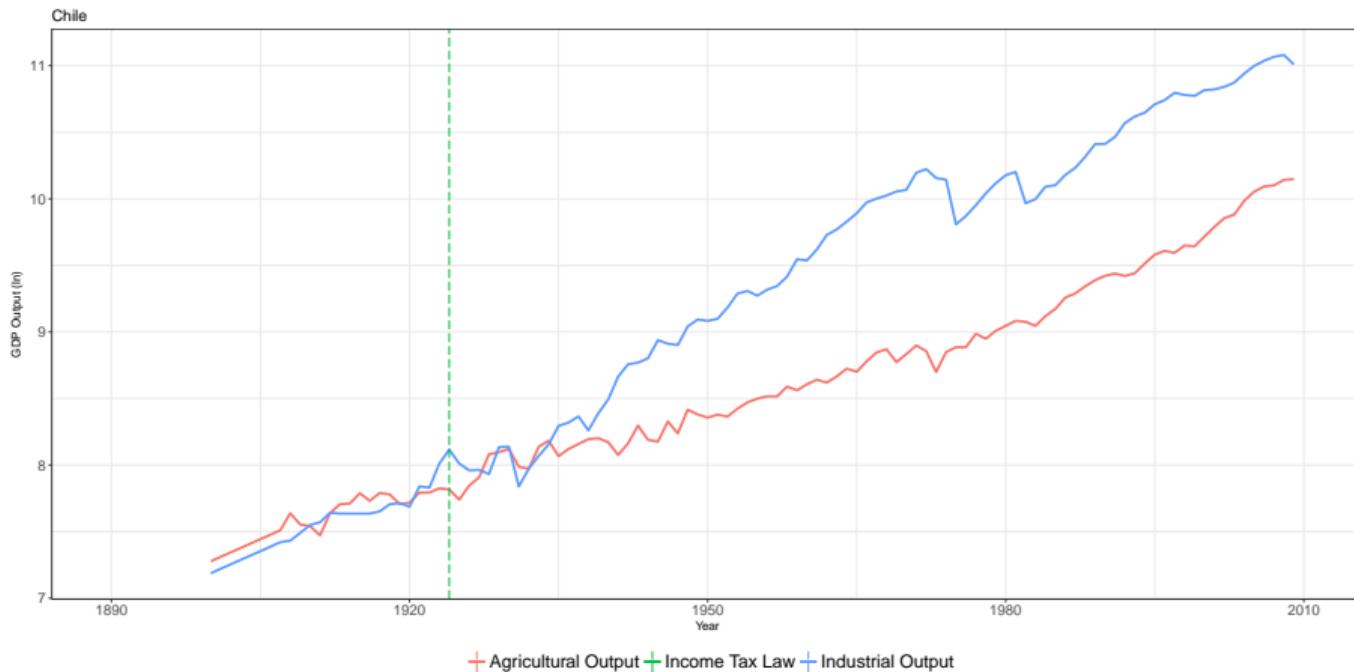
Colombia: 1935



Peru: 1934



Chile: 1924



Technical Details: Count Model

State Capacities Overtime in Chile

Bayesian Poisson model with year fixed-effects. [Jags Code](#)

Deaths ~ Poisson(λ_i)

Distribution of Deaths

$$\log(\lambda_i) = \mu + \beta_1 \text{Income Tax}_i + \beta_2 \text{Magnitude}_i^2 + \beta_3 \text{Latitude}_i + \\ \beta_4 \text{Longitude}_i + \beta_5 \text{Population}_i + \beta_6 \text{Urban}_i + \beta_7 \text{Year}_i$$

where,

$i_{1,\dots,I}$ where $I = 91$ earthquakes

$t_{1,\dots,T}$ where $T = 59$ years.

4 chains, 200K iterations, burn-in of 5000.

Densities

Trace plots

Model fit

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Download detailed diagnostics plots

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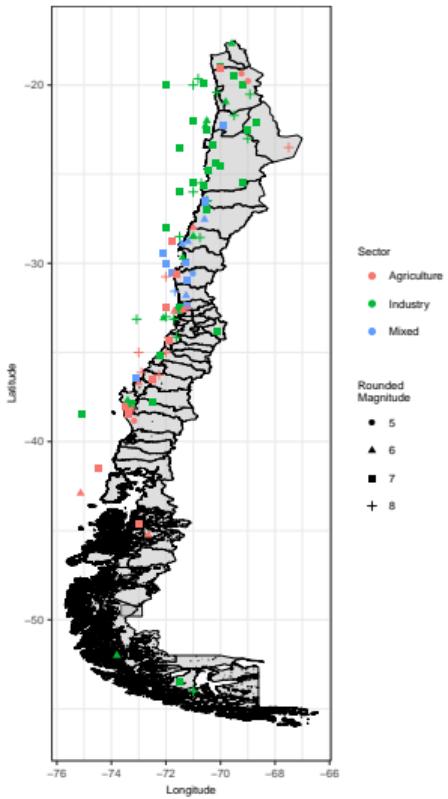
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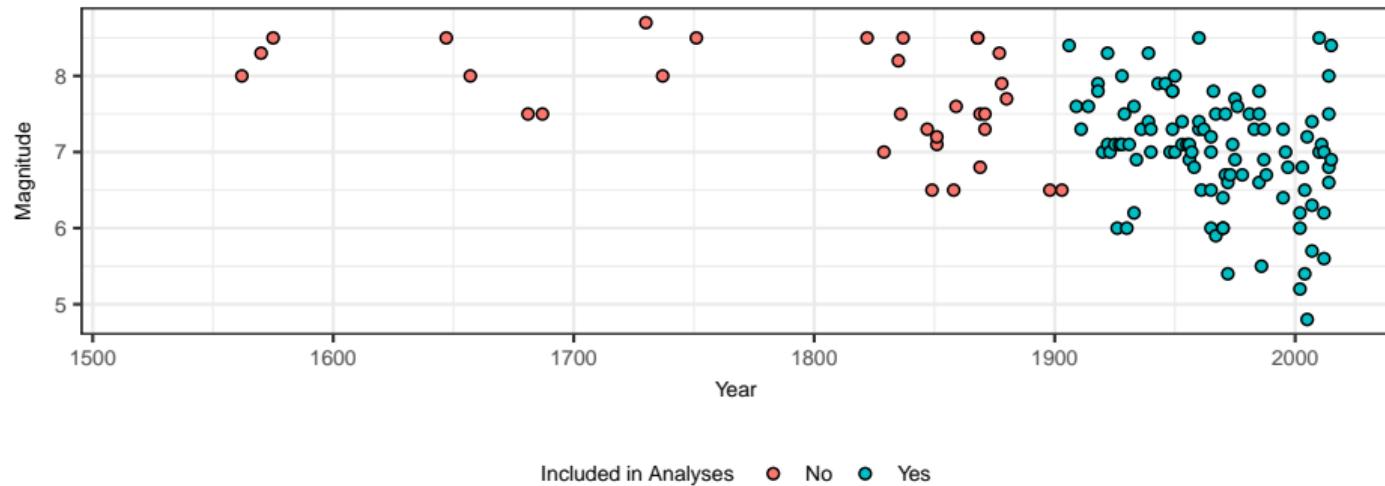
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Geographic Distribution of EQs

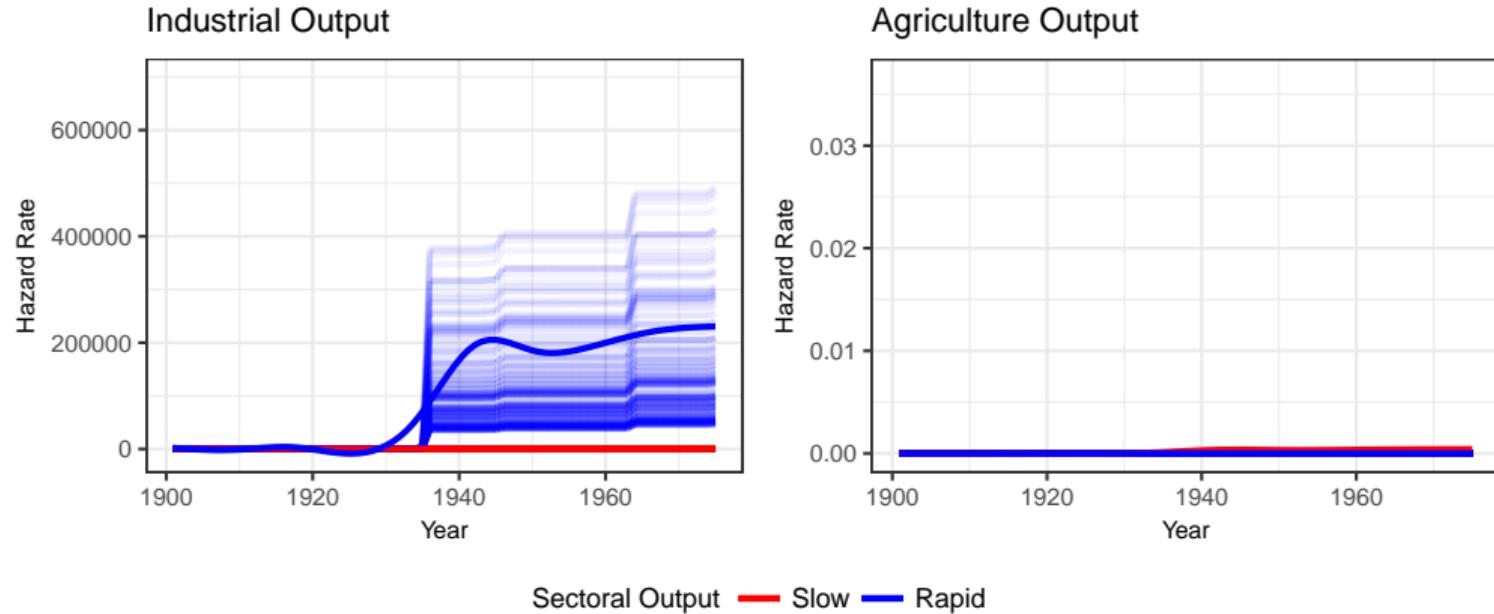


Temporal Distribution of EQs



Results

Sectoral Contestation, and the Timing of the Income Tax Law (9 Lat Am Count)



reg table

Income Taxation Increases State Development Overtime (Chile)



Summary

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1. A **novel earthquake dataset** was used to measure state capacities overtime. Under reasonable assumptions, the capacity of a state to enforce building codes, is a reflection of its overall state capacity.
2. *Unlike other theories, my paper stressed the domestic factors at play (sectoral contestation), relaxing the conflict—Tillian—hypothesis.*

Thank you

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TOC Cover

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- P2: Unit Root Tests
- P2: Johansen Tests for Cointegration
- P2: Lags Tests
- P2: Sectoral Outputs
- P2: Granger-causality Tests
- P3: Income Tax Model Density Plots
- P3: Income Tax Model Trace Plots
- P3: Sectoral and Income Tax Model Goodness of Fit Plot
- P3: Sectoral Model Regression Table
- P3: Income Tax Model Regression
- P3: Jags code for sectoral model
- P3: Distribution of Deaths
- Credible Threats

- From Conflict to Cooperation
- War was in 1891, but income tax was implemented in 1924
- Why does taxation increase with sectoral competition?
- Everything depends on industrial expansion. Where does industry come from, then?
- Why not indirect taxation?
- Duration Models

	Cox (1 lag)	Cox (1 lag, ln)	Logit GEE	Conditional Logit (FE)	Spatial Dependence
Manufacture Output _{t-1}	4.923** (1.851)				
Agricultural Output _{t-1}	-4.208* (1.638)				
Total Population	0.000** (0.000)				
Manufacture Output _{t-1} (ln)		7.685* (3.333)			
Agricultural Output _{t-1} (ln)		-6.971* (3.227)			
Total Population (ln)		5.059* (2.228)	1.259 (1.052)	1.030** (0.391)	4.676 (2.682)
Manufacture Output (ln)			1.924*** (0.514)	0.668*** (0.143)	7.148 (4.815)
Agricultural Output (ln)			-1.596** (0.603)	-0.941*** (0.281)	-6.465 (4.636)
AIC	12.796	10.894		4505.538	11.056
R ²	0.059	0.068		0.341	0.065
Max. R ²	0.085	0.088		0.997	0.085
Num. events	9	9		610	9
Num. obs.	241	232	842	842	241
Missings	0	0		0	0
PH test	0.388	0.877	9		0.667
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AIC	12.796	10.894		4505.538	11.056
R ²	0.059	0.068		0.341	0.065
Max. R ²	0.085	0.088		0.997	0.085
Num. events	9	9		610	9
Num. obs.	241	232	842	842	241
Missings	0	0		0	0
PH test	0.388	0.877	9		0.667
Num. clust.					

*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, · $p < 0.1$. Robust standard errors in all models

Why Not *Indirect* Taxation

Indirect taxes (like import taxes) require less **state efforts** to capture revenue.

Staffing an office, waiting for the ships to come in and **count** the goods. **Sacks of wheat**, for ex.



Talcahuano Port, Chile 19th Century.

```

1 model.jags.sectoral <- function() {
2   for (i in 1:N){ # number of earthquakes
3
4     Deaths[i] ~ dpois(lambda[i]) log(lambda[i]) <-
5       b.propagrmnu[Sector[i]]*propagrmnu[i] + # multi-level
6       b.Magnitude[Sector[i]]*Magnitude[i] + # multi-level
7       b.p.Population*p.Population[i] +
8       b.Urban*Urban[i] +
9       b.year[yearID[i]] + # year fixed-effects
10      b.r.long*r.long[i] +
11      b.r.lat*r.lat[i] +
12      mu ## intercept
13   }
14
15   ## Non-informative/Flat Priors
16   b.r.lat ~ dnorm(0, 0.01)
17   b.r.long ~ dnorm(0, 0.01)
18   mu ~ dnorm(0, 0.01) ## intercept
19   b.p.Population ~ dnorm(0, 0.01)
20   b.Urban ~ dnorm(0, 0.01)
21
22   ## Year Fixed-Effects
23   for (t in 1:yearN){
24     b.year[t] ~ dnorm(m.b.year[t], tau.b.year[t])
25     m.b.year[t] ~ dnorm(0, 0.01)
26     tau.b.year[t] ~ dgamma(0.5, 0.001) # uninformative Gamma priors
27   }
28
29   ## Varying Slopes for Magnitude (unmodeled)
30   for (k in 1:NSector){#
31     b.Magnitude[k] ~ dnorm(m.Magnitude[k], tau.Magnitude[k])
32     m.Magnitude[k] ~ dnorm(0, 0.01)
33     tau.Magnitude[k] ~ dgamma(0.5, 0.001) # uninformative Gamma priors
34   }
35
36   ## Varying Slopes for Agr/Ind Proportion (unmodeled)
37   for (k in 1:NSector){#
38     b.propagrmnu[k] ~ dnorm(m.b.propagrmnu[k], tau.b.propagrmnu[k])
39     m.b.propagrmnu[k] ~ dnorm(0, 0.01)
40     tau.b.propagrmnu[k] ~ dgamma(0.5, 0.001) # uninformative Gamma priors
41   }
42
43 }

```

Sectoral Competition and Taxation?

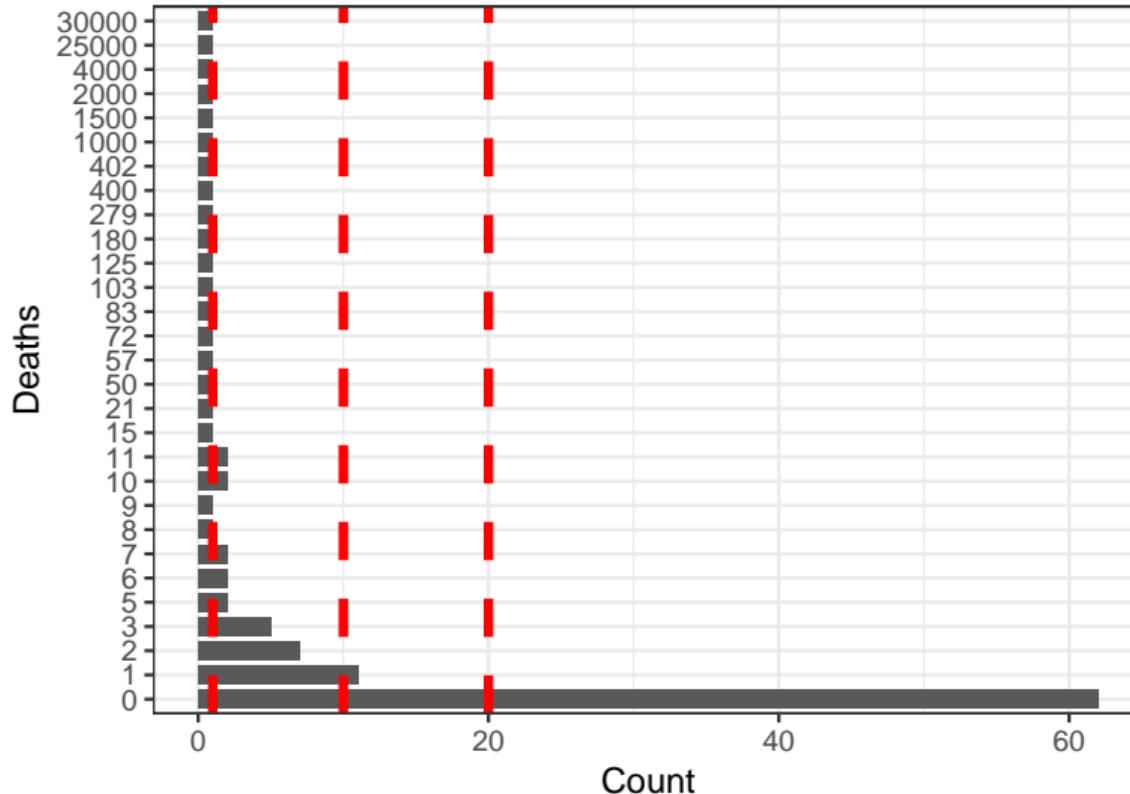
Agricultural production, as it needs mostly land, it does not rely on capital as much as the industrial sector does. Moreover, they oppose taxation because their main asset (land) is fixed, hence landowners not being able to move their asset, resist taxation. On the contrary, industrial elites rely on public goods that are beneficial for their business (railroads, bridges, etc.). And while industrialists would prefer imposing higher import taxes (NOT the income tax), that increases the price of importing industrial capital (for ex., machines). Consequently, their second best choice is imposing an income tax.

For these reasons, the emergence of the industrial sector (which implies higher levels of sectoral/elite contestation) leads to the implementation of the income tax.

Where does industry come from?

p. 20 of dissertation. Industry, as predicted by the dual sector model, came from agriculture:

- After the mining boom, mining elites shifted their focus to what is considered the first *true* industrial work which began under agricultural auspices: the cotton mills: “[t]he first power looms were brought [in Perú, Ecuador, and Venezuela] in the 1840s, 1850s; but in all three they were a failure, some of the early mills in Ecuador being destroyed by an earthquake. It was not until after 1890 that the textile industries of these nations began to operate with reasonable success. Guatemala's first cotton mill was established in 1882, and between that date and 1910 a few mills appeared in Chile, Argentina, Uruguay, and Colombia.”
- The first industries were called *obreros* and beyond textiles, early industrialists processed other agricultural goods. For example, animal grease and tallow, dried and cured meats, flour, bread, beer, wines and spirits, being most of them for domestic consumption. Sugar was used in the production of chocolate, candies and biscuits.
- The industrial sector was boosted by favorable international conditions, many times stimulating a positive complementarity between the two sectors. Industrial activities started very small, progressing “from the shop to the factory during the latter half of the nineteenth century.”
- Importantly, modern industrialization did *not* begin with ISI, but around 1900. Others find that the “fact that manufacturing was alive and thriving in Latin America before the 1929 crash is now beyond question.” And that the “development of large-scale, mechanized (and even “heavy”) industry can be dated back to the 1890s.” By the 1870's the carriage industry was on a firm basis.



But Where Does Industrialization Come From?!

The theory puts heavy emphasis on the role of industrialization on state development. However, *Where does industrialization come from?*

Haber 2005 explains that:

"The impetus for industrial development came from the expansion of foreign trade. Driving the growth of foreign trade were two factors. The first was that most Latin American countries were on the silver standard, and silver fell in value relative to gold in the last two decades of the nineteenth century. Most Latin American countries therefore saw their currencies depreciate in real terms relative to the gold-backed currencies of the economies of the North Atlantic. As international trade theory would predict, real exchange rate depreciation resulted in the expansion of the tradables (e.g. industrial goods) [...] Second, the late nineteenth century also saw a dramatic decline in the international costs of transport, as steel-hulled steamships came to replace wood and sail."

From Conflict to Cooperation

Why do lower levels of **sectoral inequality** (which implied **higher military threats**) lead to **sectoral cooperation**?

The rising of the industrial sector allowed industrial political elites to get access to military capacities that were as good as the agricultural elite's. The **threat** is what leads to **cooperation** rather than **conflict**. It makes no sense to engage in conflict when (1) both groups have the same 'fire power' and (2) when there is a cheaper exit (sectoral bargains).

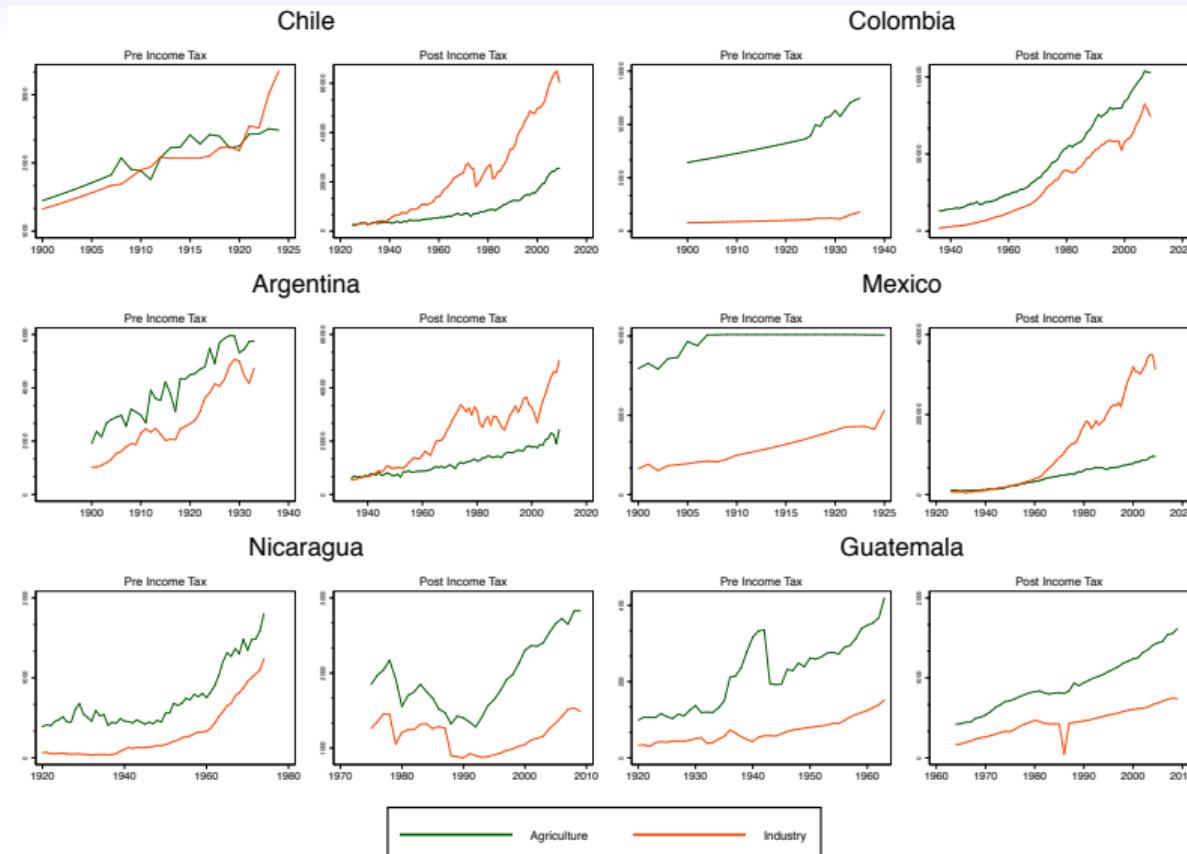
War was in 1891, but Income Tax in 1924?

- Civil wars of 1851-859 and 1891 between a “large landed property [elite against a] productive capital [elite].”
- President **Balmaceda’s overthrowing in 1891** explains the sectoral nature of these conflicts.
- He was mainly supported by the landed elites, but later overthrown in 1891 by a mainly industrial/mining coalition:
 - His agenda on “industrial” infrastructure benefited mostly agricultural areas.
 - his attitude towards the banking sector (closely linked to the mining sector) confiscatory.
- At the same time, however, he failed to secure a coalition with his own sector.
 - Decline of wheat exports. Balmaceda’s policies fostered sectoral dependence of agriculture on industrial production, forcing the “landed proprietors [to] become dependent to a considerable extent on the continuing prosperity of the major nitrate capitalists.” (Zeitlin).
 - While it would be inaccurate to say that Balmaceda was *completely* supported by agriculturalists and *completely* opposed by industrialists, this example illustrates how (failed) inter-sectoral alliances and biased public goods provision against industrialists led these two groups to a military conflict in 1891.
 - The conflict left a permanent scar in the Chilean society. While the civil war lasted only nine months, it took 10,000 lives (out of a total population of 3 million people) and cost more than \$ 100 million,a significant amount for a small country.
 - There was an intention to avoid more violence. For instance, while all “ministers, counselors of state, members of the constituent congress [,] municipal officials, provincial governors and intendants, members of the judiciary and even the lowest functionaries and ordinary employees of Balmaceda’s government were investigated [or] brought to trial,” there were a number of amnesties issued. Similarly, there were a number of *aborted* coups in 1907, 1912, 1915 and 1919. I identify a third additional factor. War was more likely to exhaust all existent assets without producing positive outcomes for either sector, putting pressures for a sectoral compromise.

Country	Time Frame	Sector	Augmented Dickey-Fuller	Phillips-Perron	KPSS	Conclusion
Chile	Pre	Agriculture	-1.185 (0.68)	-1.241 (0.66)	.107 [*]	I(1)
		Industry	2.310 (0.99)	2.356 (0.99)	.113 [*]	I(1)
	Post	Agriculture	4.957 (1.00)	5.40 (1.00)	.289	I(1)
		Industry	0.908 (0.99)	1.434 (0.99)	.249	I(1)
Colombia	All	Agriculture	5.521 (1.00)	6.722 (1.00)	.31	I(1)
		Industry	1.582 (0.99)	2.305 (0.99)	.314	I(1)
	Pre	Agriculture	2.709 (0.99)	2.414 (0.99)	.204	I(1)
		Industry	2.103 (0.99)	3.257 (1.00)	.183	I(1)
Argentina	Post	Agriculture	2.392 (0.99)	3.159 (1.00)	.282	I(1)
		Industry	0.520 (0.98)	1.044 (0.99)	.241	I(1)
	All	Agriculture	4.256 (1.00)	5.893 (1.00)	.372	I(1)
		Industry	1.874 (0.99)	2.707 (0.99)	.374	I(1)
Mexico	Pre	Agriculture	-0.849 (0.80)	-1.201 (0.67)	.0891 [*]	I(1)
		Industry	-0.495 (0.89)	-0.378 (0.91)	.115 [*]	I(1)
	Post	Agriculture	1.197 (0.99)	1.093 (0.99)	.277	I(1)
		Industry	0.228 (0.97)	0.381 (0.98)	.0901 [*]	I(1)
Nicaragua	All	Agriculture	1.484 (0.99)	1.403 (0.99)	.332	I(1)
		Industry	1.007 (0.99)	1.237 (0.99)	.183	I(1)
	Pre	Agriculture	4.001 (1.00)	5.952 (1.00)	.288	I(1)
		Industry	5.803 (1.00)	10.776 (1.00)	.29	I(1)
Guatemala	Post	Agriculture	0.599 (0.9876)	0.497 (0.99)	.109 [*]	I(1)
		Industry	-1.255 (0.65)	-0.982 (0.71)	.113 [*]	I(1)
	All	Agriculture	3.431 (1.00)	3.607 (1.00)	.341	I(1)
		Industry	0.872 (0.99)	2.020 (0.99)	.387	I(1)
Panama	Pre	Agriculture	2.473 (0.99)	2.355 (0.99)	.25	I(1)
		Industry	4.958 (1.00)	9.100 (1.00)	.244	I(1)
	Post	Agriculture	-0.154 (0.94)	0.154 (0.97)	.2	I(1)
		Industry	-1.237 (0.8577)	-1.176 (0.68)	.189	I(1)
Brazil	All	Agriculture	0.616 (0.99)	0.759 (0.99)	.116 [*]	I(1)
		Industry	-0.164 (0.94)	-0.096 (0.95)	.123	I(1)
	Pre	Agriculture	-0.393 (0.91)	-0.343 (0.92)	.0639 [*]	I(1)
		Industry	1.358 (0.99)	1.704 (0.99)	.199	I(1)
Peru	Post	Agriculture	1.786 (0.99)	1.965 (0.99)	.162	I(1)
		Industry	-0.998 (0.73)	-1.352 (0.61)	.0919 [*]	I(1)
	All	Agriculture	3.349 (1.00)	3.714 (1.00)	.321	I(1)
		Industry	0.412 (0.98)	0.017 (0.96)	.288	I(1)

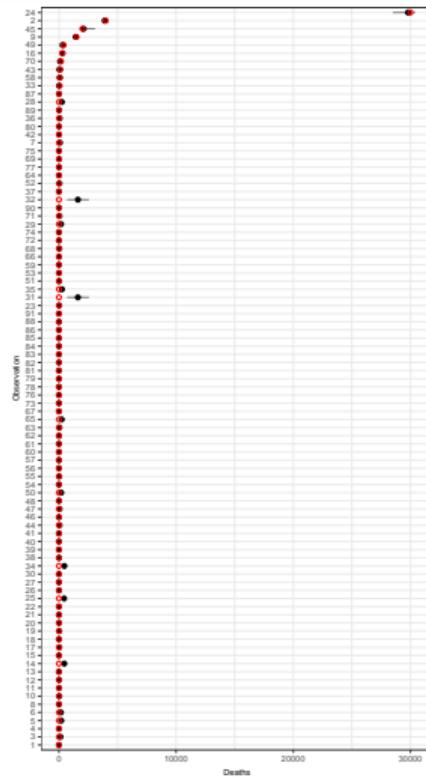
Country	Number of Cointegrated Vectors (rank)	Restrictions	Lags	Log-Likelihood	Trace
Chile	at least 1	Restricted Constant	5	-1665.9736	0.3799
Argentina	at least 1	Restricted Constant	3	-1802.292	4.7657
Colombia	at least 1	Restricted Trend	2	-1805.6773	10.0076
Mexico	at least 1	Restricted Constant	4	-1978.1322	1.0274
Nicaragua	0	Restricted Constant	2	-1020.221	11.5297
Guatemala	0	Trend	3	-859.2802	16.5493

Country	Time Frame	Number of Lags	LM	Normality Tests			Stability Condition
				Jarque-Bera	Skewness	Kurtosis	
Chile	Pre	4	✓	✓	✓	✓	✓
	Post	2	✓	✓-	✓-	✓-	✓
Colombia	Pre	1	✓-	✗	✗	✗	✓
	Post	1	✓	✓-	✓-	✓-	✓
Argentina	Pre	2	✓	✓	✓	✓	✓
	Post	2	✓	✓-	✓	✓-	✓
Mexico	Pre	1	✓	✓-	✓-	✓-	✓
	Post	2	✓	✓	✓	✓	✓
Nicaragua	Pre	2	✓	✓-	✓-	✓-	✓
	Post	1	✓	✓-	✓-	✓-	✓
Guatemala	Pre	3	✓	✗	✓-	✓-	✓
	Post	1	✓-	✓-	✓-	✓-	✓



Income Taxation and State Capacities in Chile: Measuring Institutional Development Using Historical Earthquake Data

Country	Pre/Post Income Tax	Sample	Directionality	chi2	P-value
Chile	Pre	1905 - 1924	Agriculture → Industry	3.55	0.47
			Industry → Agriculture	12.13	0.02
	Post	1925 - 2009	Agriculture → Industry	11.92	0.00
			Industry → Agriculture	5.37	0.07
Colombia	Pre	1902 - 1935	Agriculture → Industry	4.96	0.03
			Industry → Agriculture	10.44	0.00
	Post	1938 - 2009	Agriculture → Industry	4.32	0.04
			Industry → Agriculture	1.63	0.20
Argentina	Pre	1903 - 1933	Agriculture → Industry	4.19	0.12
			Industry → Agriculture	.42	0.81
	Post	1937 - 2010	Agriculture → Industry	.18	0.91
			Industry → Agriculture	1.37	0.50
Mexico	Pre	1902 - 1965	Agriculture → Industry	.73	0.39
			Industry → Agriculture	11.57	0.00
	Post	1969 - 2009	Agriculture → Industry	5.56	0.06
			Industry → Agriculture	1.32	0.52
Nicaragua	Pre	1923 - 1974	Agriculture → Industry	.48	0.79
			Industry → Agriculture	6.83	0.03
	Post	1977 - 2009	Agriculture → Industry	.014	0.91
			Industry → Agriculture	4.96	0.03
Guatemala	Pre	1924 - 1963	Agriculture → Industry	2.18	0.54
			Industry → Agriculture	6.72	0.08
	Post	1966 - 2009	Agriculture → Industry	.58	0.45
			Industry → Agriculture	6.05	0.01



	Mean	SD	Lower	Upper	Pr.
Agr/Ind [Agr]	12.68	7.21	3.73	22.65	0.98
Agr/Ind [Ind]	-16.26	5.30	-23.17	-9.62	1.00
Agr/Ind [Mixed]	-30.73	21.74	-63.78	-4.89	0.95
Magnitude [Agr]	0.04	0.02	0.01	0.06	0.95
Magnitude [Ind]	0.24	0.07	0.16	0.32	1.00
Magnitude [Mixed]	0.37	0.14	0.17	0.55	1.00
Latitude	-0.01	0.03	-0.05	0.02	0.69
Longitude	-0.16	0.14	-0.34	0.03	0.85
Population	-0.01	0.00	-0.02	-0.01	1.00
Urban	-1.54	2.01	-4.22	1.00	0.76

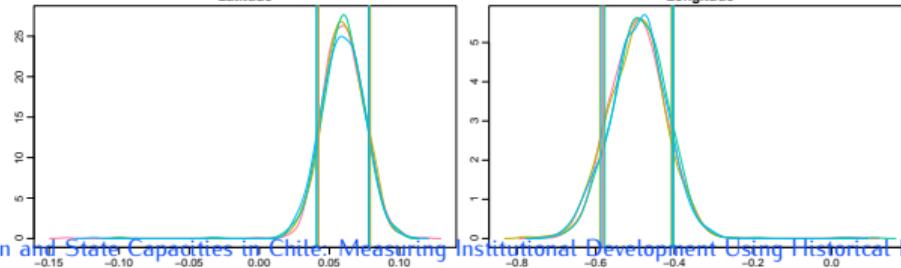
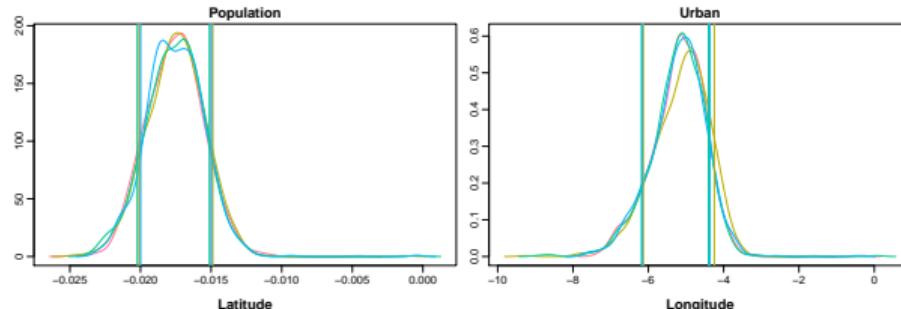
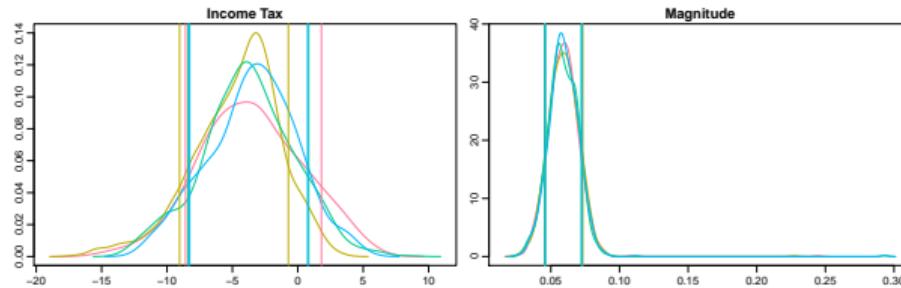
Note: 200000 iterations with a burn-in period of n = 5000 iterations discarded.

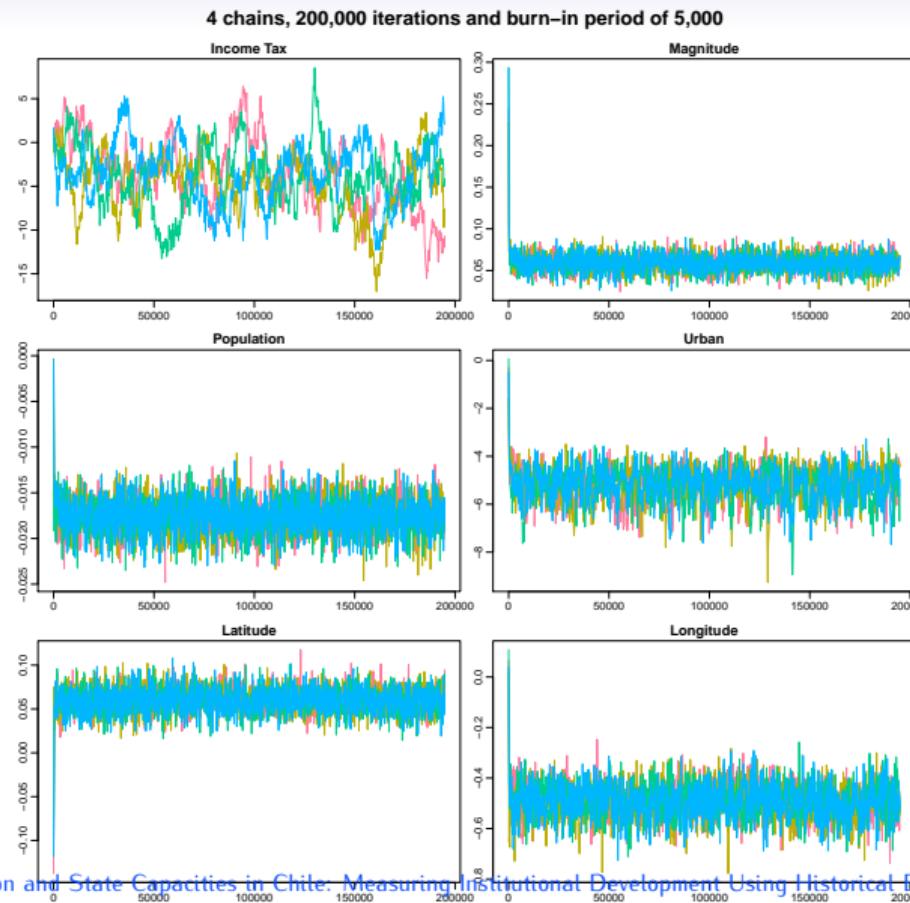
80% credible intervals (upper/lower bounds). All R-Hat statistics below critical levels.

Standard convergence diagnostics suggest good mixing and convergence.

Year fixed effects were omitted in the table.

4 chains, 200,000 iterations, burn-in period of 5,000 and 95 % credible intervals





	Mean	SD	Lower	Upper	Pr.
Income Tax	-3.01	3.55	-7.55	1.41	0.81
Magnitude	0.06	0.01	0.04	0.07	1.00
Latitude	0.06	0.01	0.04	0.08	1.00
Longitude	-0.49	0.07	-0.58	-0.39	1.00
Population	-0.02	0.00	-0.02	-0.02	1.00
Urban	-5.22	0.73	-6.19	-4.35	1.00

Note: 200000 iterations with a burn-in period of n = 5000 iterations discarded.

80% credible intervals (upper/lower bounds). All R-Hat statistics below critical levels.

Standard convergence diagnostics suggest good mixing and convergence.

Year fixed effects were omitted in the table.

A total of 4 chains were run. Detailed diagnostic plots available [here](#).

For example, the historian Barros (1970) explains that before the civil war, *salitreras* (nitrate towns) in northern Chile were locally so important that they were considered “a state within the state.” **Local bosses had to approve decisions on whether public employees could be fired, whether public works could be developed, and on whether politicians could give public speeches.** Moreover, **they coined their own currency** and had their own particular **local laws**.