

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

Héctor Bahamonde • Assistant Professor • O'Higgins University (Chile)

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Theory

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 2. The role of structural economic transformations has been overlooked.

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- Unfortunately, these theories lack of a measurement able to capture levels of state capacity *overtime*.

Taxation and State Capacity in Chile

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1. Higher levels of sectoral competition promoted the implementation of the income tax in Latin America.

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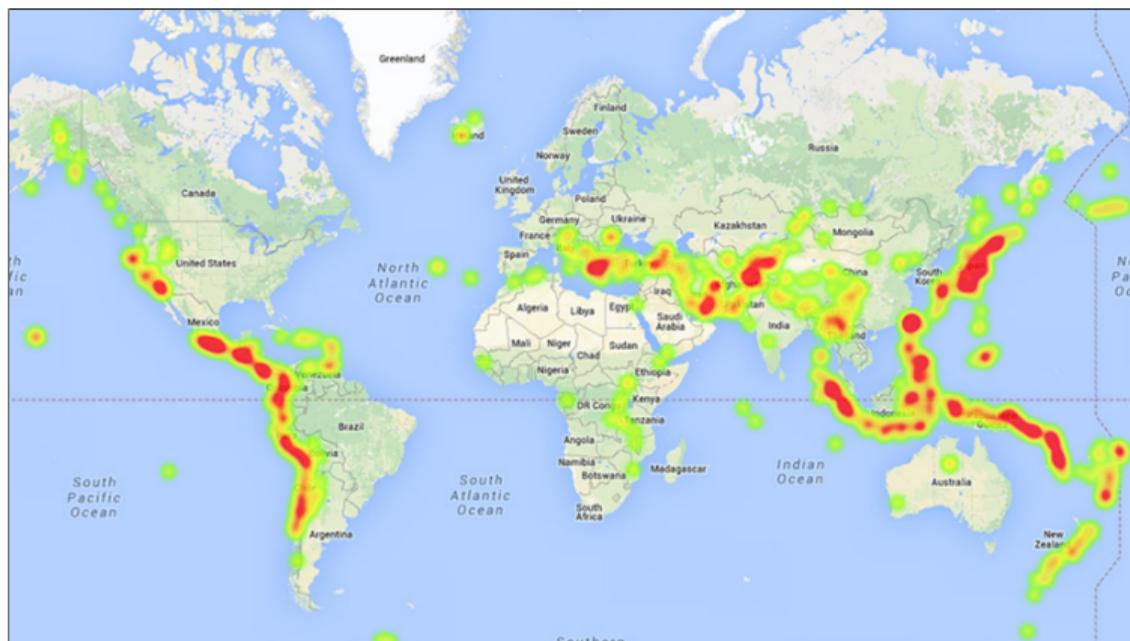
Taxation and State Capacity in Chile

Convince you:

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3. Earthquake death-tolls are good-enough proxies to measure overtime state capacity in Chile.

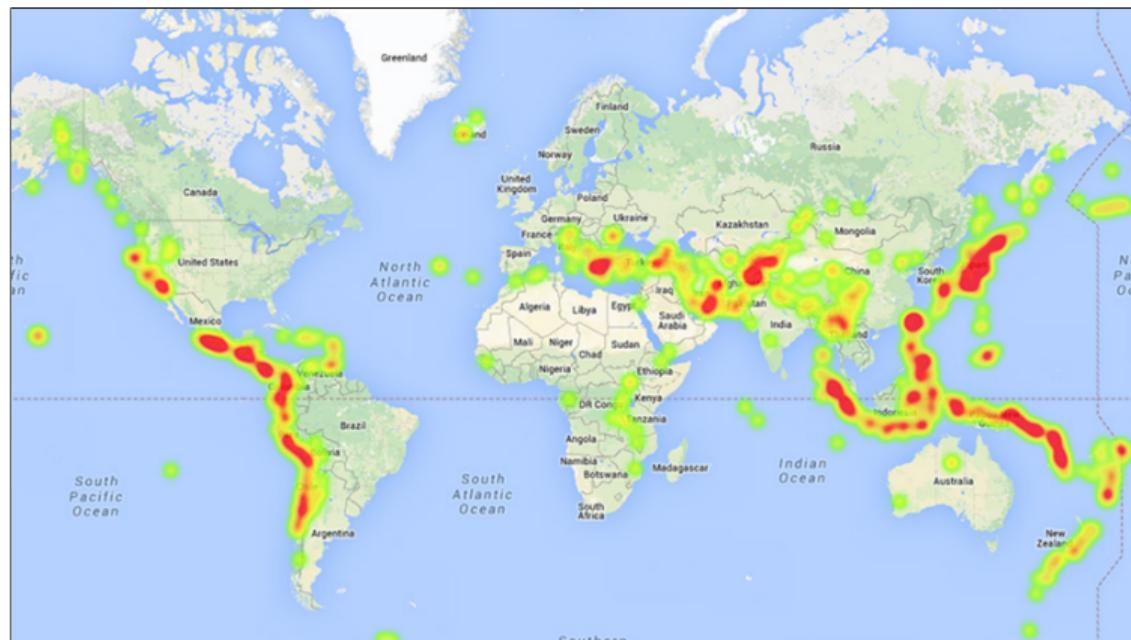
Why Earthquakes?

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



Why Earthquakes?

Earthquakes are **exogenous** to regime type and levels of political/economic development.



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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 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**.

The Spillover Effects of Taxation on State Capacity

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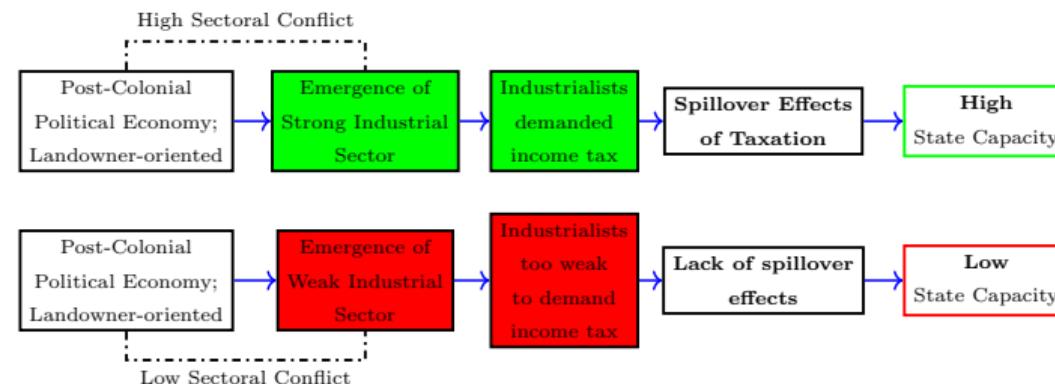
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 - “**Spillover Effects**”: Income taxation generated positive **spillover effects** for state-making, rising **economies of scale** of the **operational efficiencies** of the bureaucracy:
 - Income taxation represented the **first layer of state-complexity**.
 - **Additional layers** (bureaucracies) cheaper at the margin.

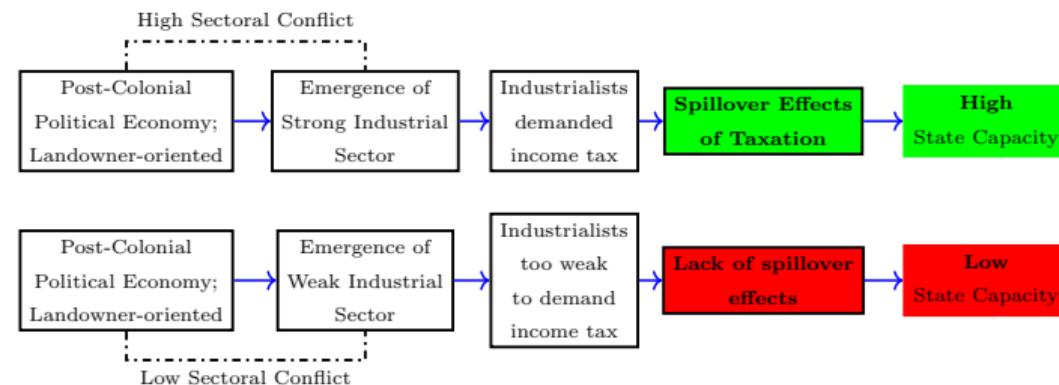
Argument (I)

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



Argument (II)

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



The Theory Should Pass The Following Tests

1. The income tax law should be **implemented earlier** under scenarios of *high sectoral contestation*.
[*rapid industrial expansion*] [Data/Equation](#)

The Theory Should Pass The Following Tests

1. The income tax law should be **implemented earlier** under scenarios of *high sectoral contestation*.
[*rapid industrial expansion*] Data/Equation
2. Implementation of the **income tax** should foster *higher state-capacity*.
[*lower death tolls overtime*] Temp. Distribution of EQs

Test 1: Duration Models. Income Taxation and Sectoral Contestation

Early and Late Income-Tax Implementers

Cox Model. Sectoral outputs ([MOxLAD dataset](#)) to investigate the sectoral contribution to the **timing** of the implementation of the income tax in 15 Latin American countries.

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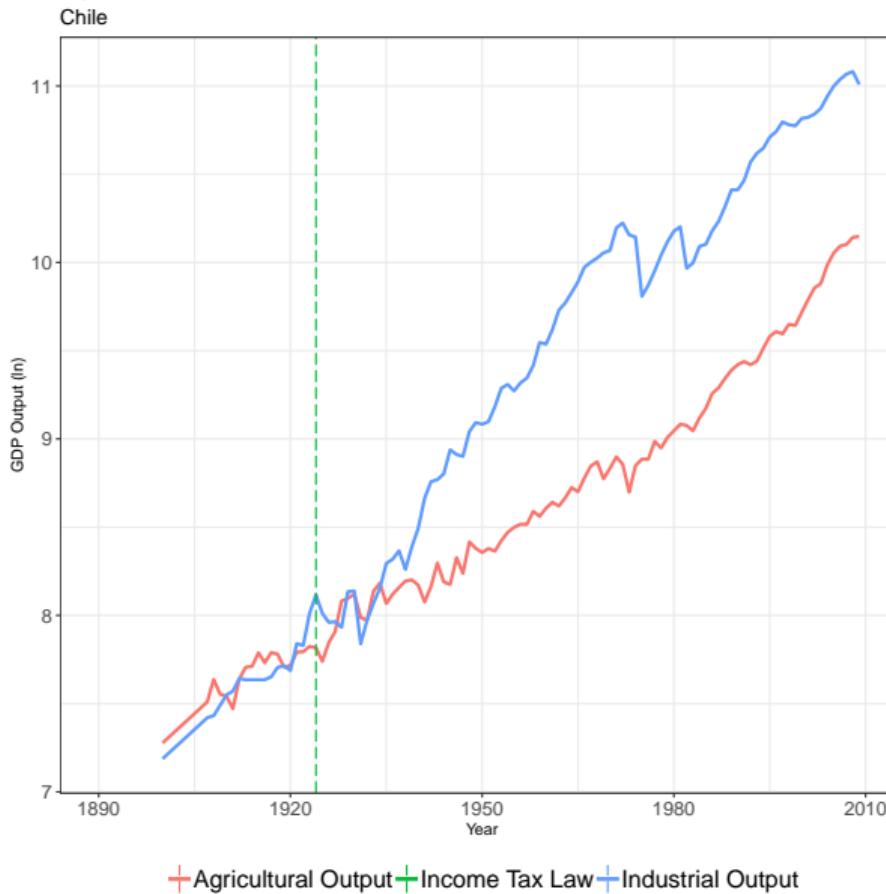
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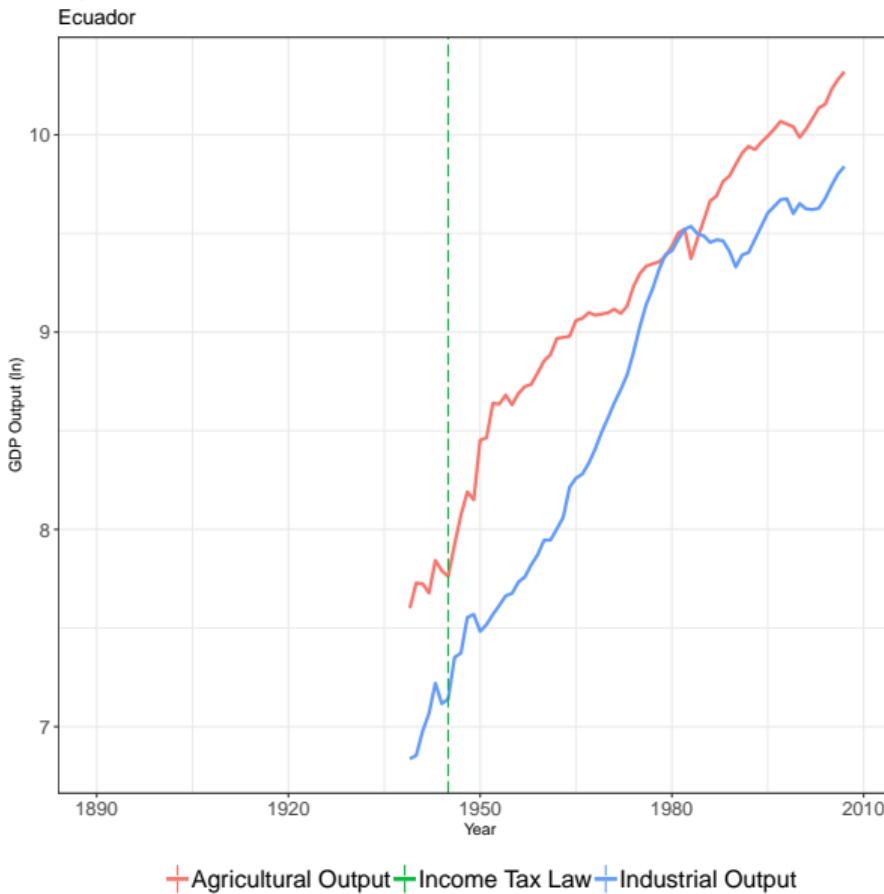
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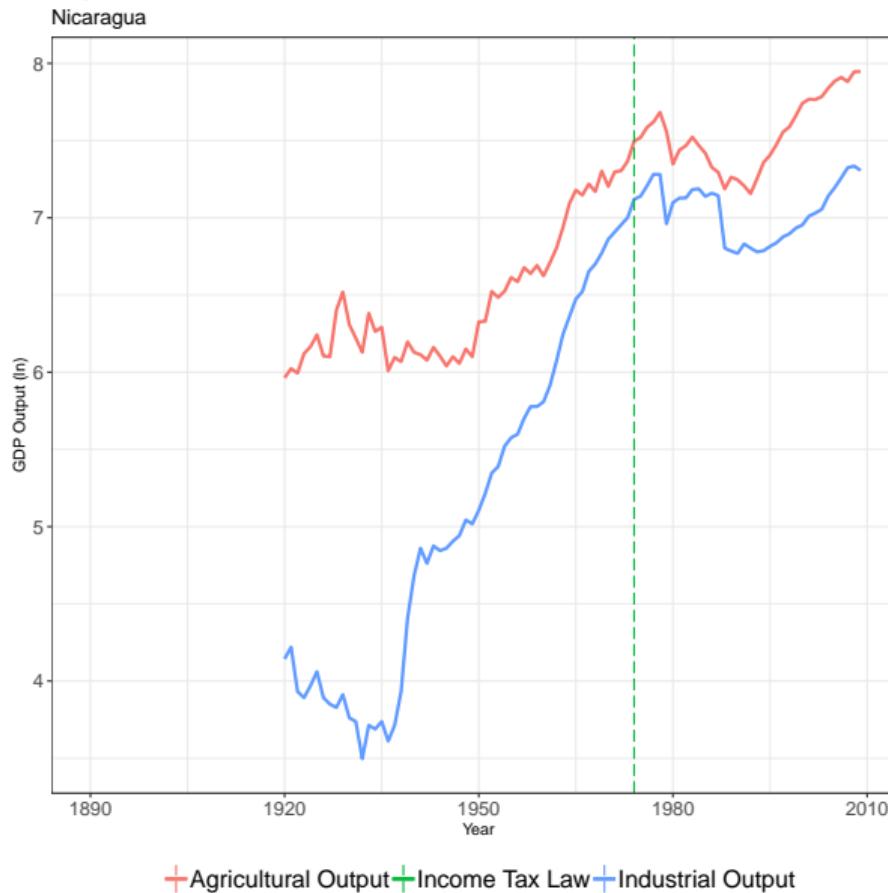
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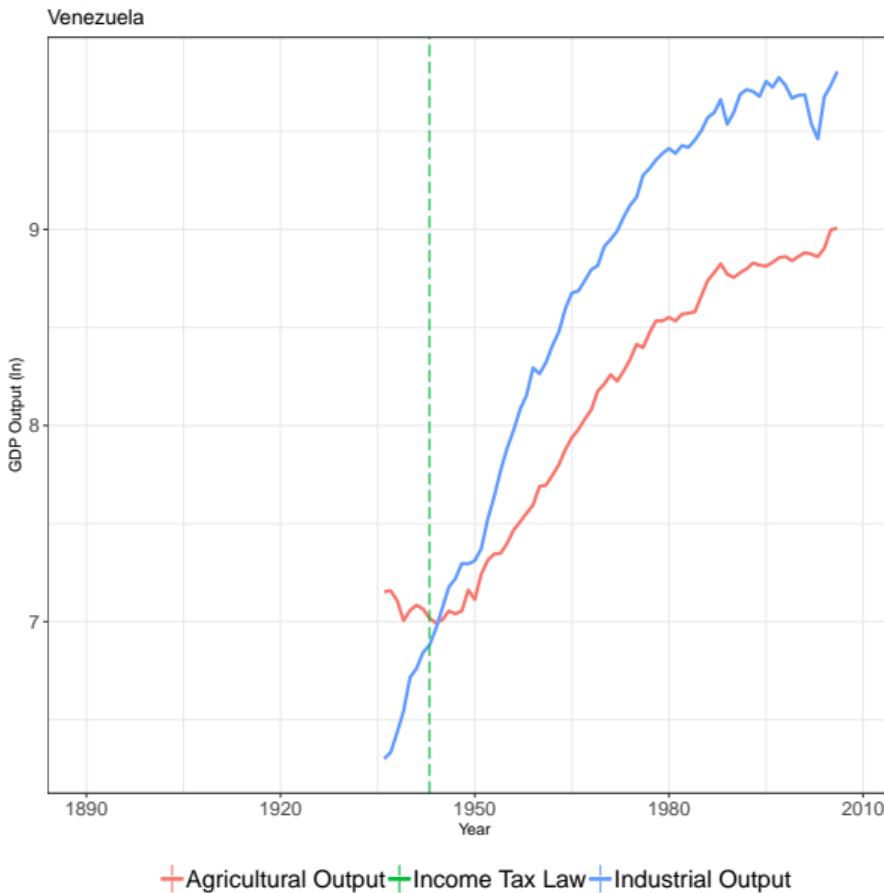
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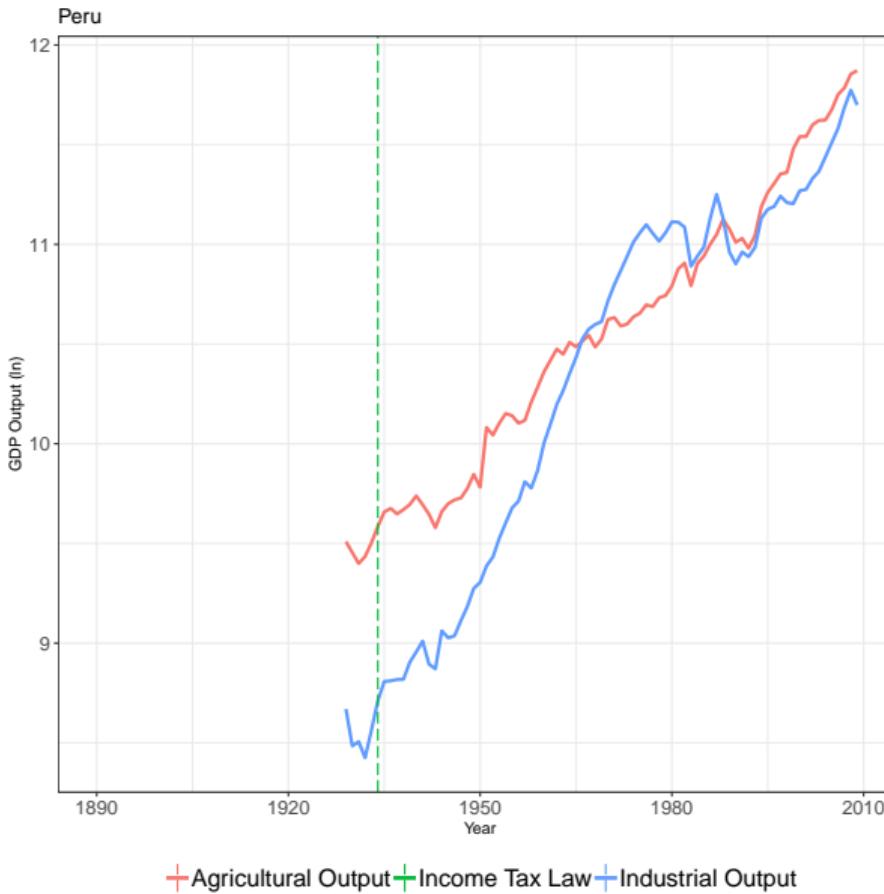
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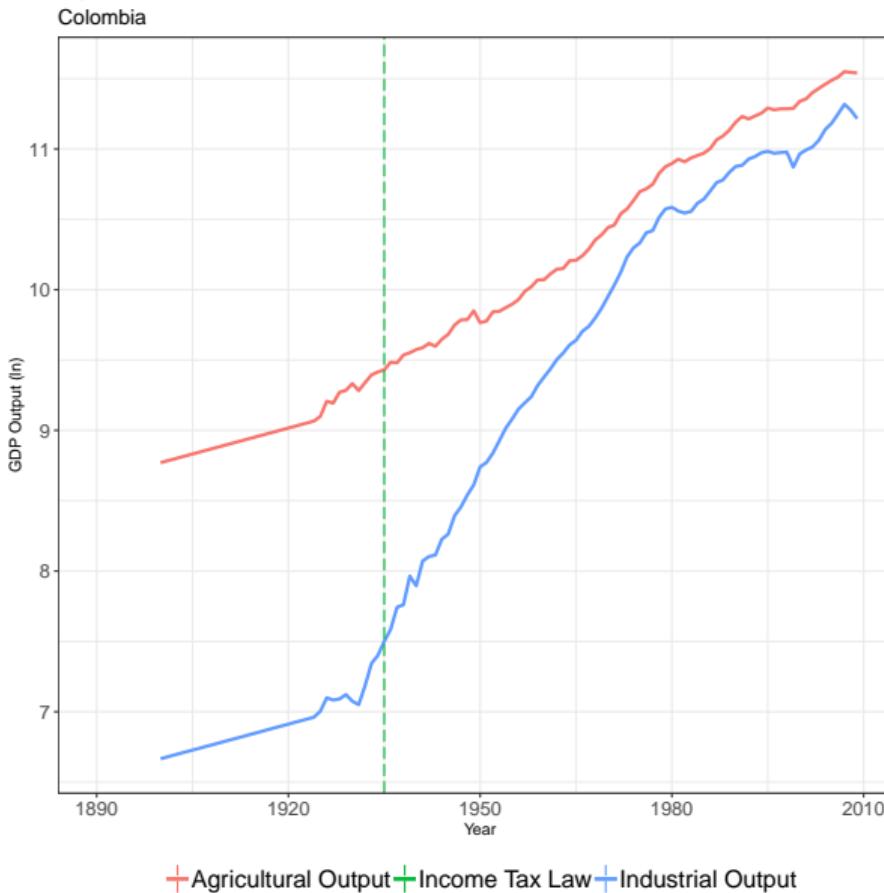
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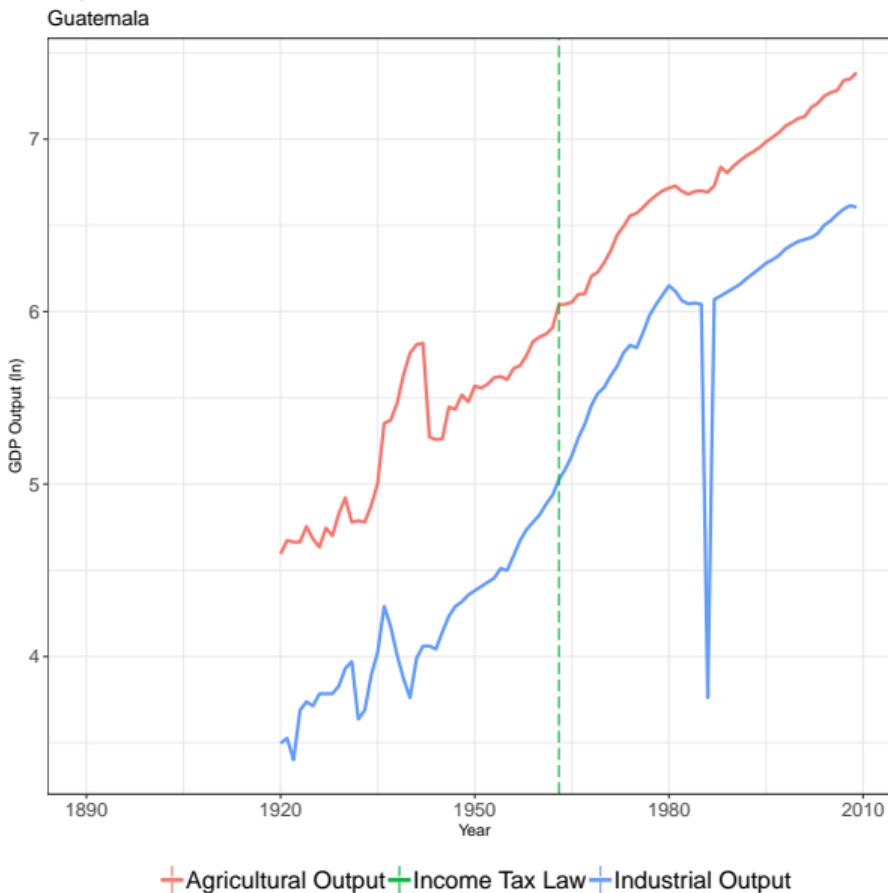
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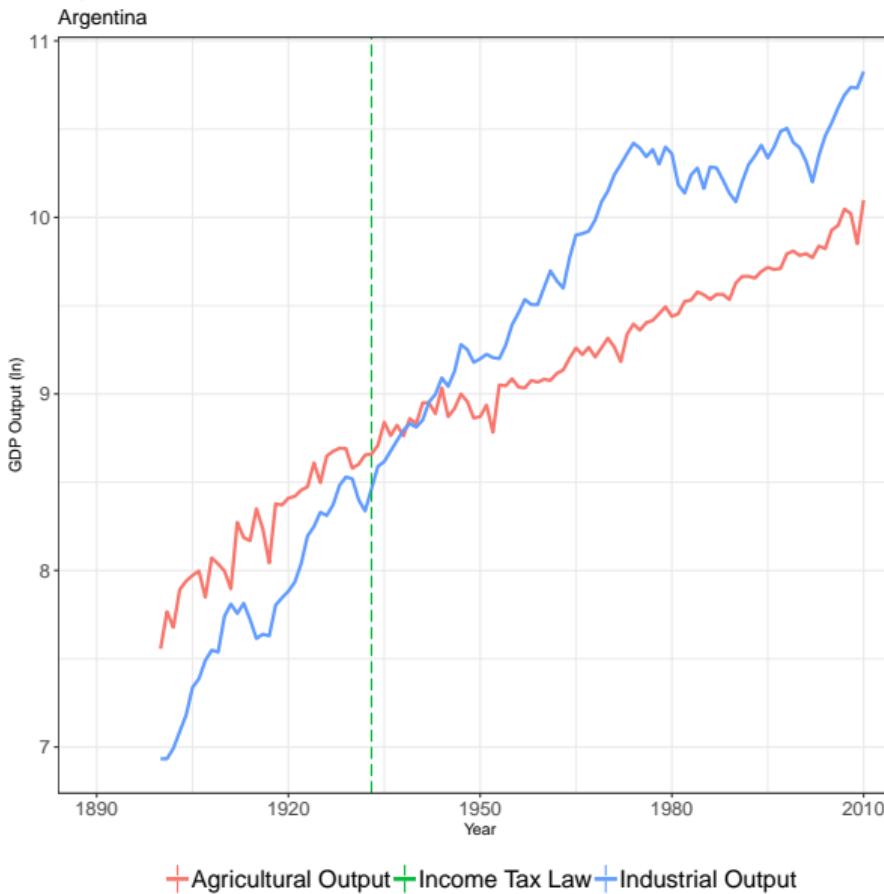
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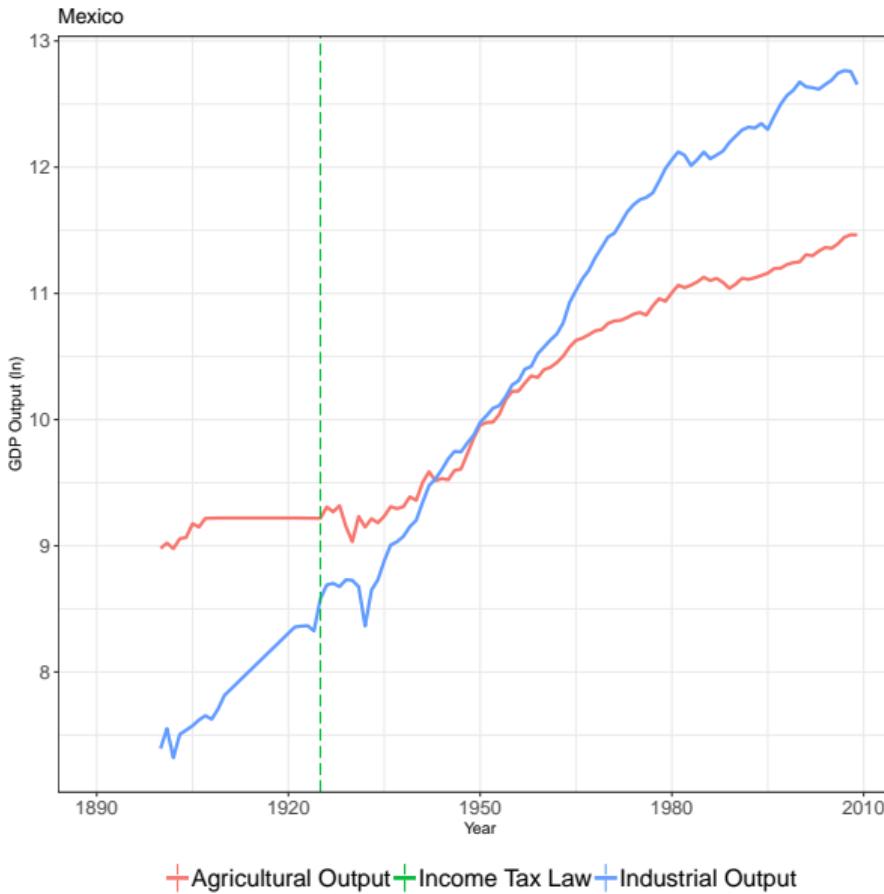
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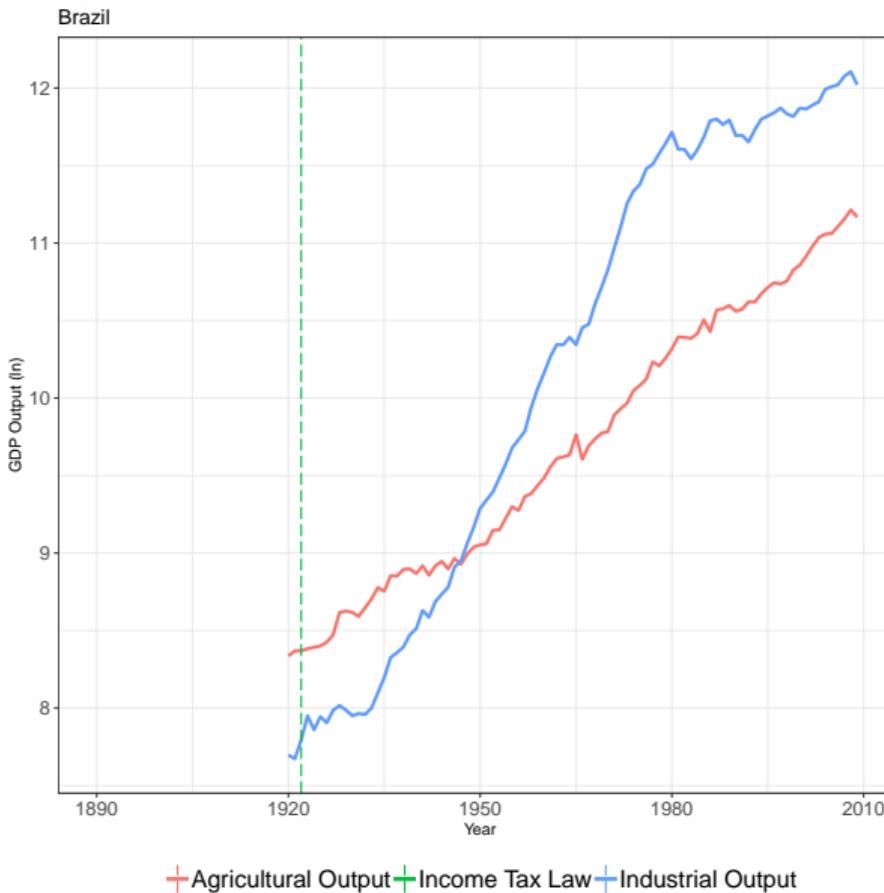
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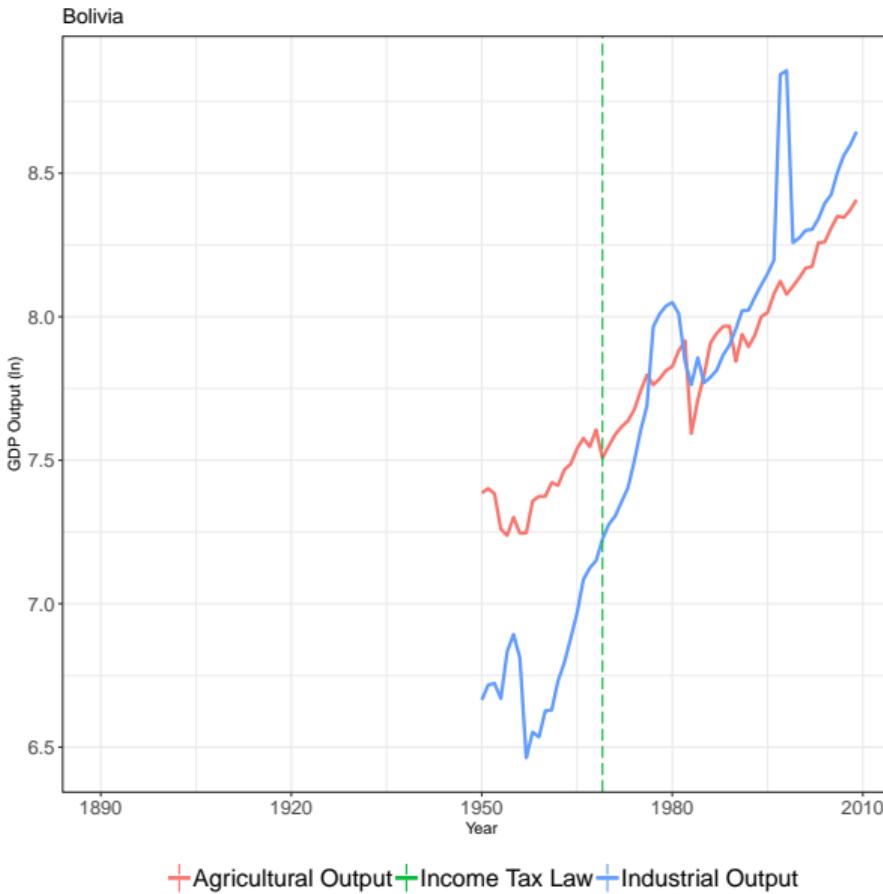
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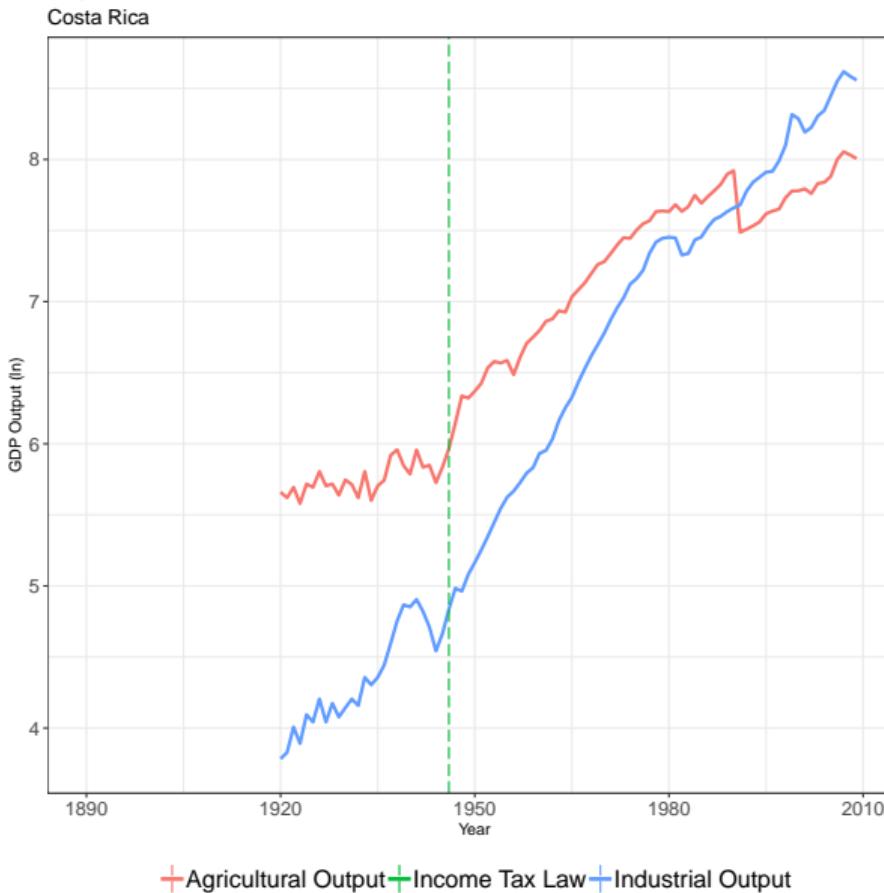
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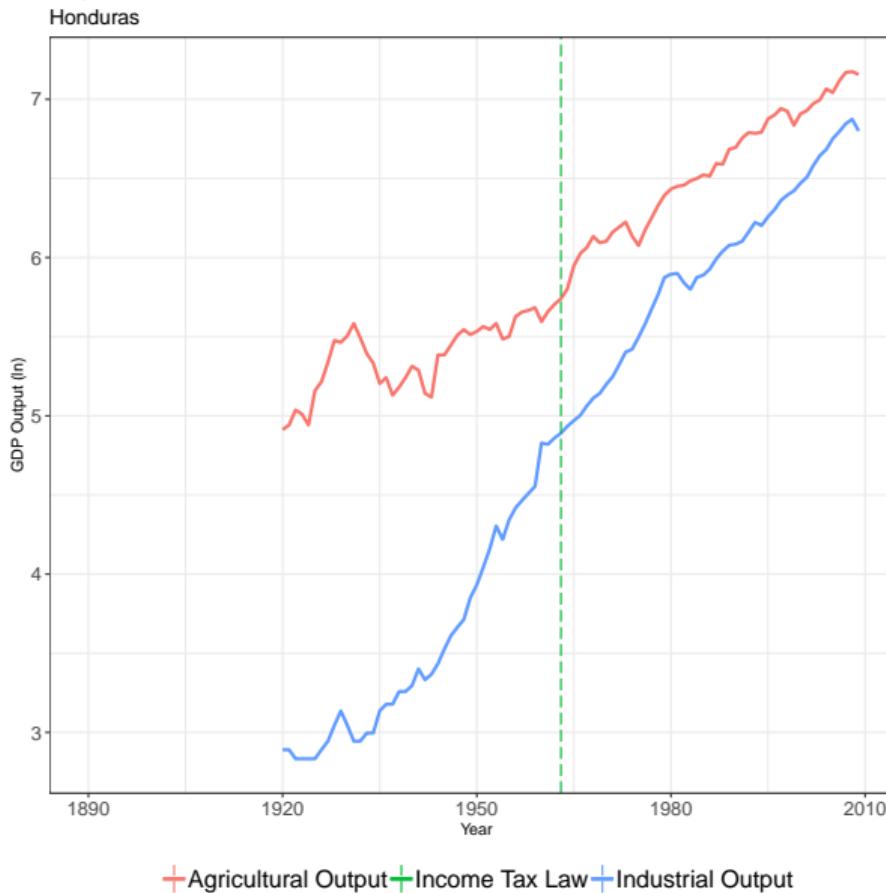
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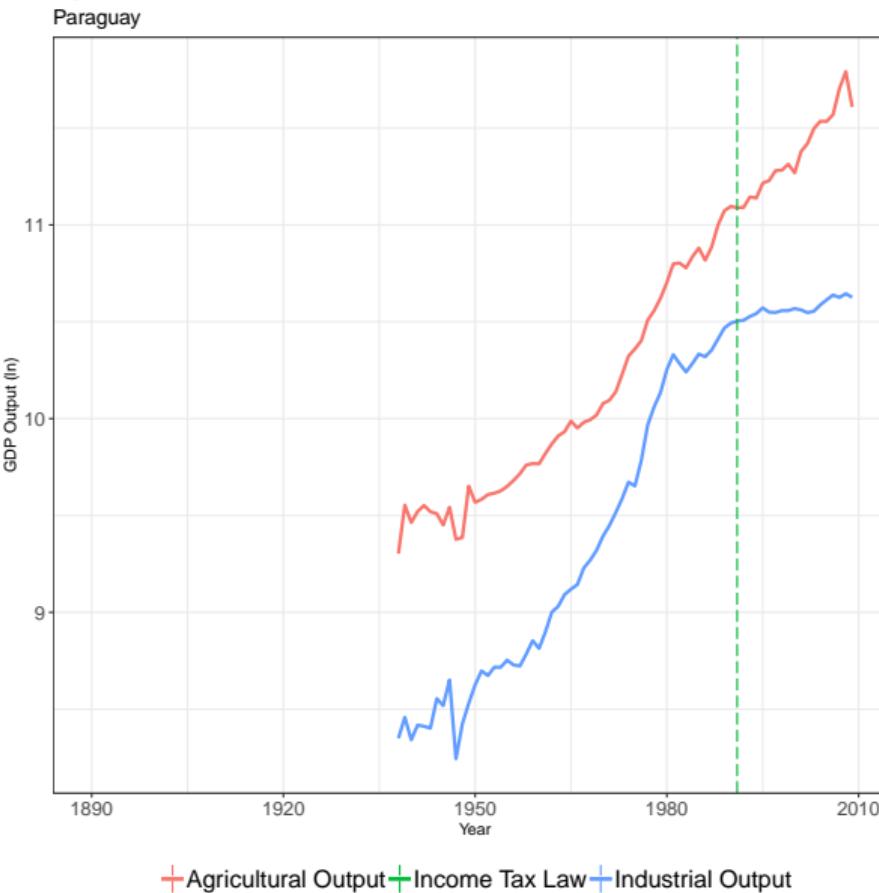
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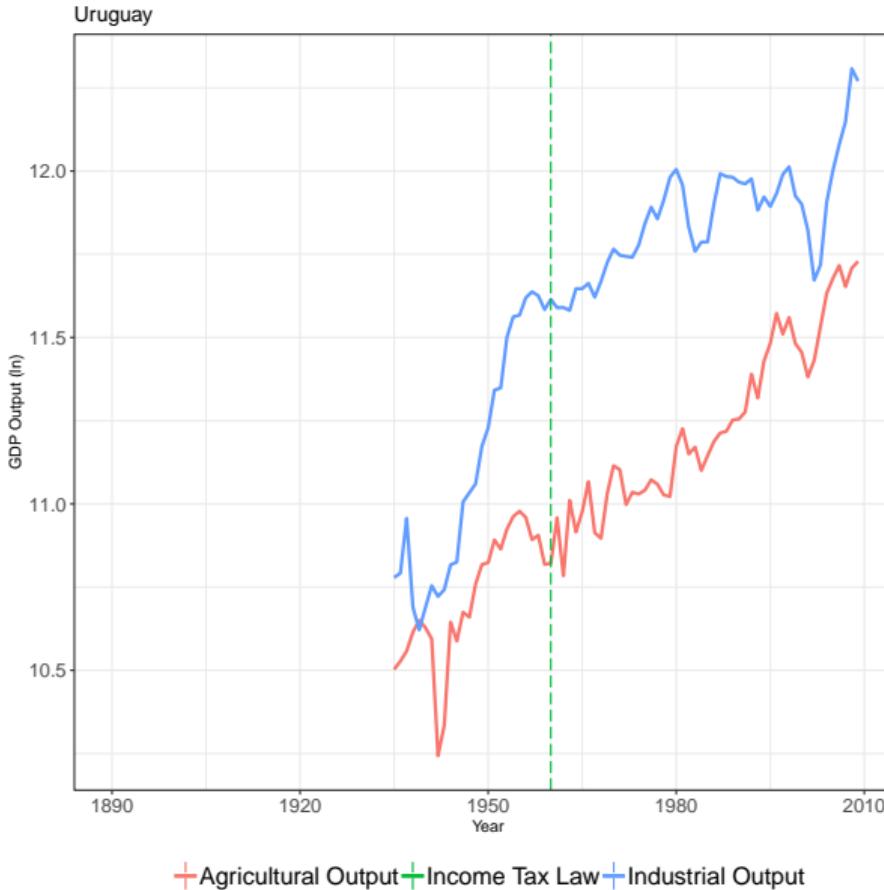
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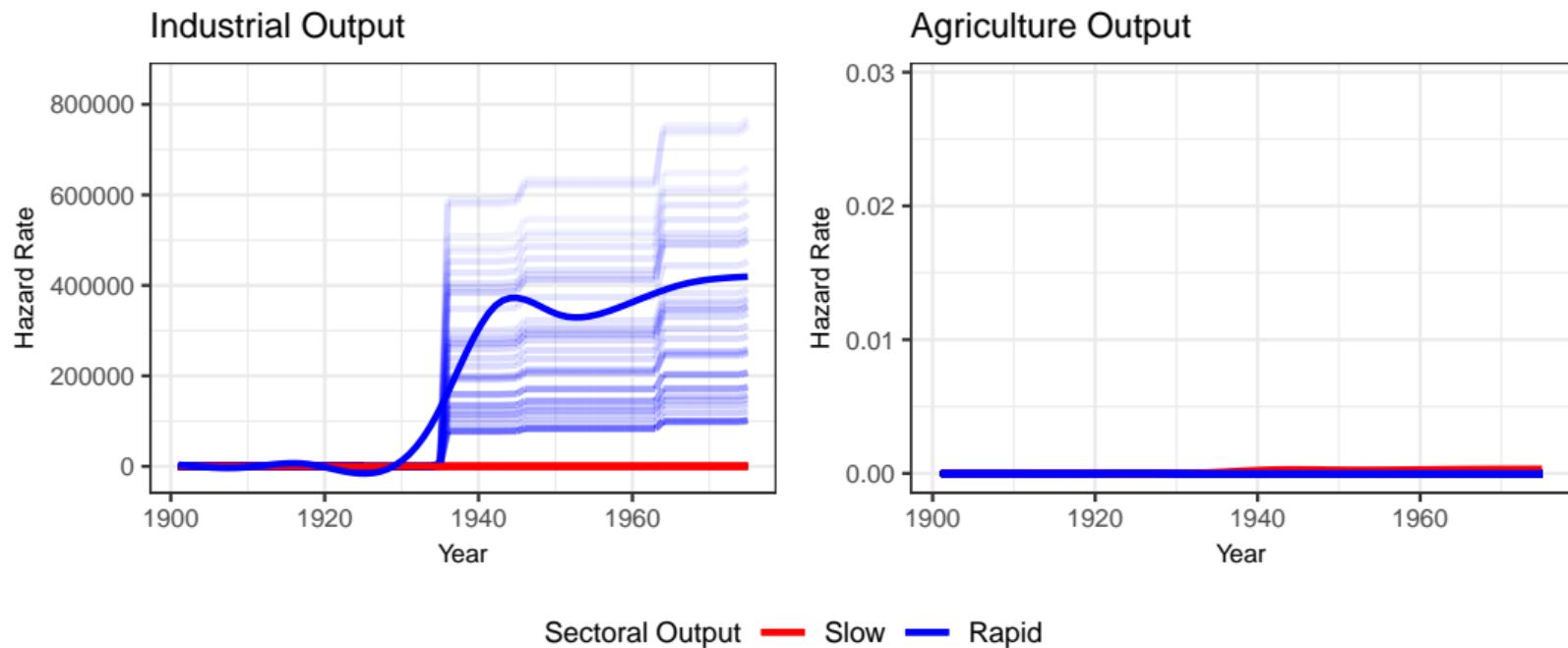


The Timing of the Implementation of the Income Tax



Results

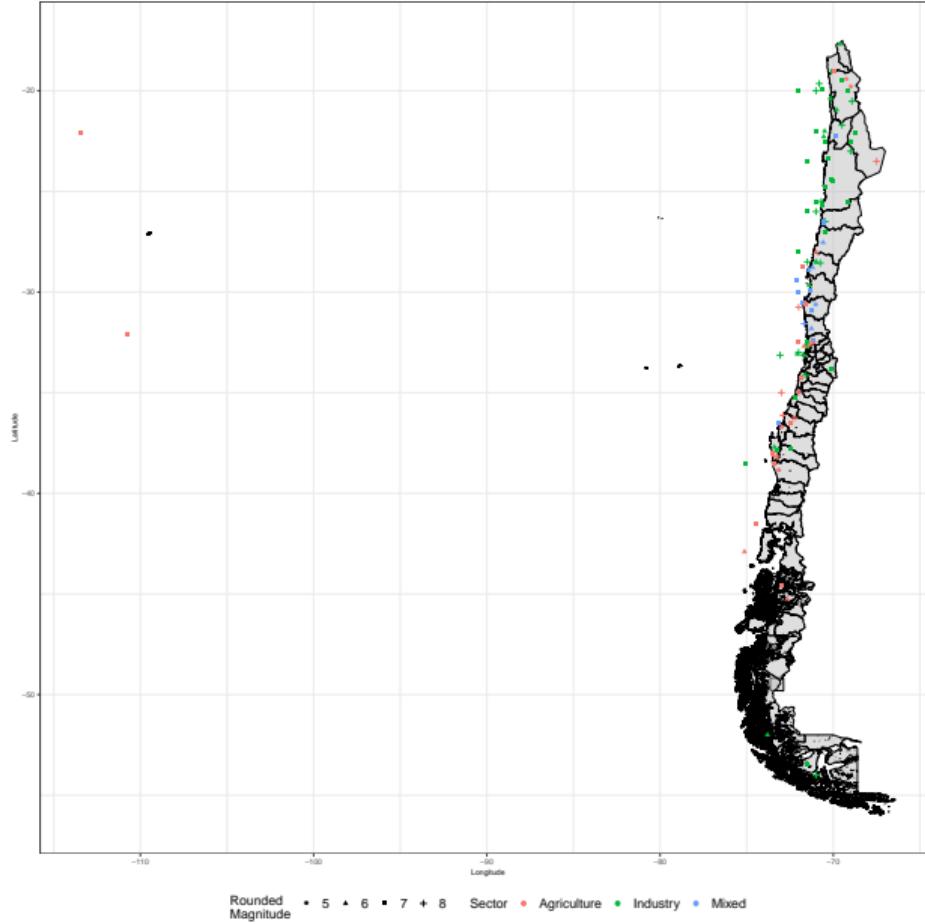
Implementing the Income Tax: Simulated Hazards



Test 2: Count Model. Spillover Effects of Income Taxation

Did the income tax foster state consolidation over time?

Geographic Distribution of EQs



Test 2: Count Model. Spillover Effects of Income Taxation

State Capacity Overtime in Chile

Bayesian Poisson model. [Jags Code](#)

Deaths $\sim \text{Poisson}(\lambda_i)$

$$\begin{aligned} \log(\lambda_i) = & \mu + \beta_1 \text{Magnitude}_i + \beta_2 \text{Income Tax}_i + \\ & \beta_3 \text{Magnitude}_i \times \text{Income Tax}_i + \\ & \beta_4 \text{Population}_i + \beta_5 \text{Longitude}_i + \beta_6 \text{Latitude}_i + \\ & \beta_{7,k} \text{Sector}_i; \end{aligned} \tag{1}$$

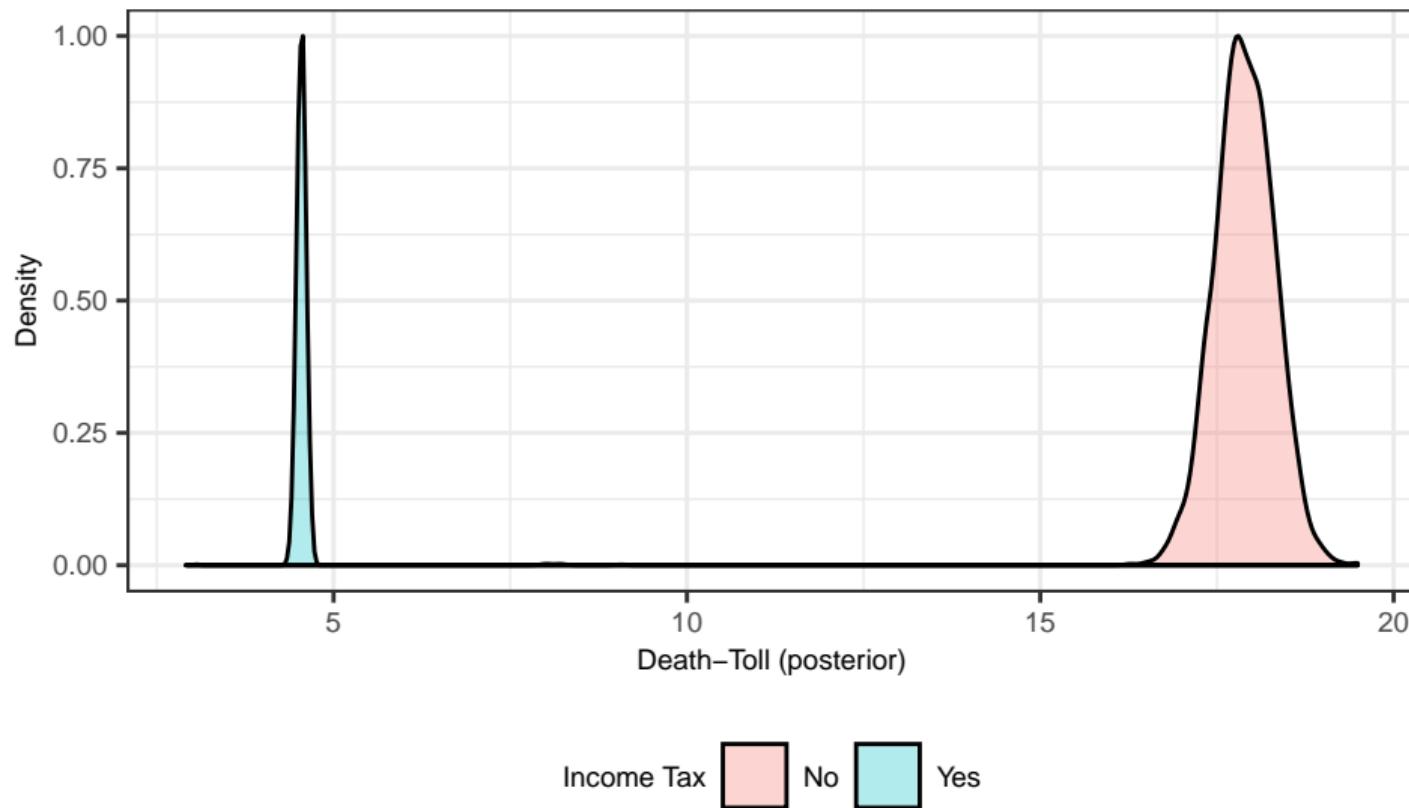
$i_{1,\dots,I}$ and $I = 103$ events;

$k_{1,\dots,K}$ and $K = 3$ sectors;

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

Results

Income Taxation Increases State Development Overtime (Chile)



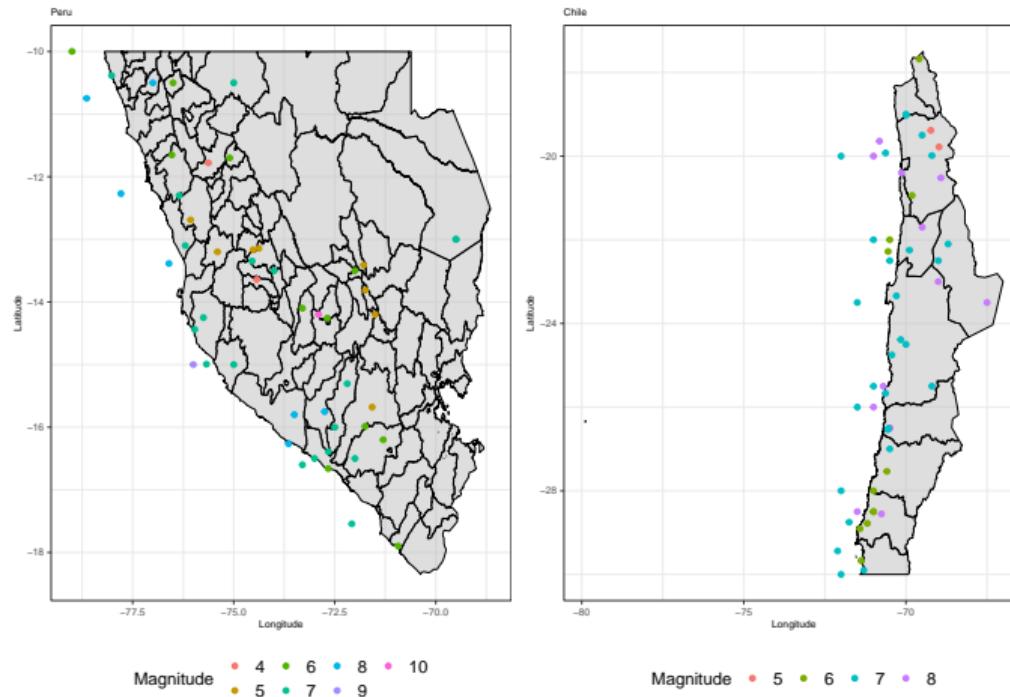
Summary

- The **emergence of a strong industrial sector**, accelerated the implementation of the *income tax* in 15 countries in Latin America.
- **Income taxation** increased overtime levels of *state capacity* in Chile.

Next Steps

- Have three separate papers:
 1. Timing of the income tax.
 2. Spillover effects of taxation on state consolidation.
 3. Measurement paper (earthquakes).

Measurement Paper: Earthquakes as Repeated Natural Experiments



Thank you

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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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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?

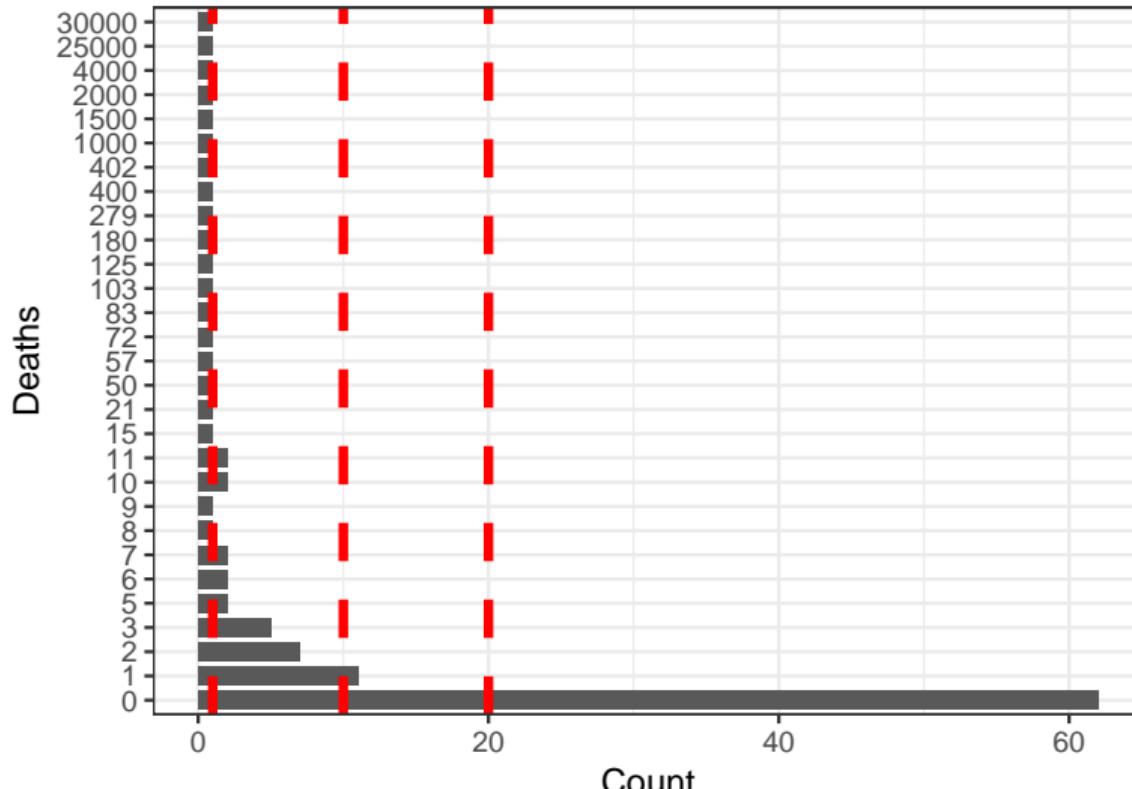
Agricultural production, as it needs mostly land, it does not rely on capital as much as the industrial sector does. Moreover, they oppose taxation because their main asset (land) is fixed, hence landowners not being able to move their asset, resist taxation. On the contrary, industrial elites rely on 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).

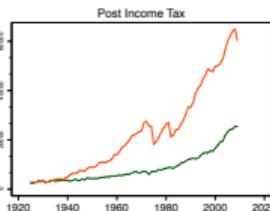
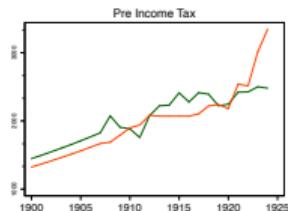
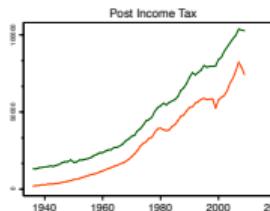
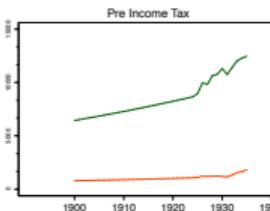
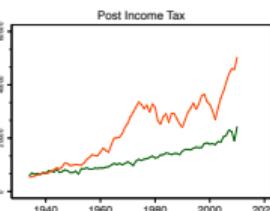
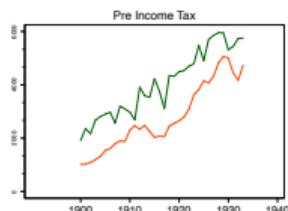
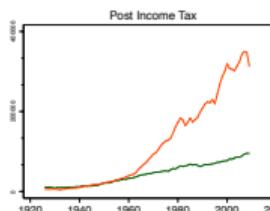
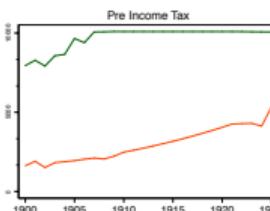
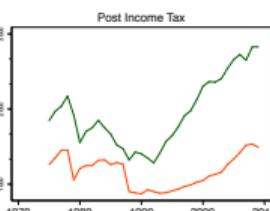
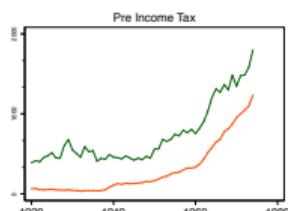
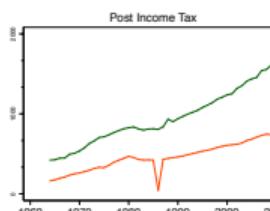
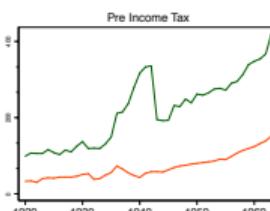
War was in 1891, but Income Tax in 1924?

- 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)	10.7 [*]	I(1)
		Industry	2.310 (0.99)	2.936 (0.99)	11.1 [*]	I(1)
	Past	Agriculture	4.557 (1.00)	5.40 (1.00)	289 (1)	I(1)
		Industry	0.908 (0.99)	1.458 (0.99)	249	I(1)
Colombia	All	Agriculture	5.521 (1.00)	6.722 (1.00)	.31	I(1)
		Industry	1.582 (0.99)	2.325 (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 (1)	I(1)
Argentina	Past	Agriculture	2.392 (0.99)	3.736 (1.00)	282	I(1)
		Industry	0.520 (0.98)	1.044 (0.99)	241	I(1)
	All	Agriculture	4.216 (1.00)	5.893 (1.00)	372	I(1)
		Industry	1.674 (0.99)	2.707 (0.99)	374 (1)	I(1)
Mexico	Pre	Agriculture	-0.849 (0.80)	-1.201 (0.67)	0.001 [†]	I(1)
		Industry	-0.495 (0.89)	-0.378 (0.91)	11.1 [*]	I(1)
	Past	Agriculture	1.197 (0.99)	1.013 (0.99)	.277	I(1)
		Industry	0.228 (0.97)	0.381 (0.98)	0.001 [†]	I(1)
Nicaragua	All	Agriculture	1.484 (0.99)	1.401 (0.99)	.332	I(1)
		Industry	1.007 (0.99)	1.217 (0.99)	183	I(1)
	Pre	Agriculture	4.981 (1.00)	5.952 (1.00)	288	I(1)
		Industry	5.803 (1.00)	10.776 (1.00)	.29	I(1)
Guatemala	Past	Agriculture	0.399 (0.987)	0.497 (0.99)	10.6 [*]	I(1)
		Industry	-1.255 (0.95)	-0.982 (0.76)	11.1 [*]	I(1)
	All	Agriculture	3.431 (1.00)	3.667 (1.00)	341	I(1)
		Industry	0.672 (0.99)	2.020 (0.99)	387	I(1)
	Pre	Agriculture	2.475 (0.99)	2.355 (0.99)	.25	I(1)
		Industry	4.958 (1.00)	9.100 (1.00)	244	I(1)
	Past	Agriculture	-0.154 (0.94)	0.154 (0.97)	.2	I(1)
		Industry	-1.237 (0.8577)	-1.176 (0.68)	.189	I(1)
	All	Agriculture	0.636 (0.99)	0.739 (0.99)	11.6 [*]	I(1)
		Industry	-0.164 (0.94)	-0.080 (0.95)	1.23	I(1)
	Pre	Agriculture	-0.393 (0.92)	-0.343 (0.91)	0.001 [†]	I(1)
		Industry	1.258 (0.99)	1.704 (0.99)	.199	I(1)
	Past	Agriculture	1.786 (0.99)	1.963 (0.99)	.162	I(1)
		Industry	-0.958 (0.73)	-1.354 (0.61)	0.019 [†]	I(1)
	All	Agriculture	3.349 (1.00)	3.714 (1.00)	323	I(1)
		Industry	0.413 (0.98)	0.017 (0.98)	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	✓-	✓-	✓-	✓-	✓

Chile**Colombia****Argentina****Mexico****Nicaragua****Guatemala**

— Agriculture — Industry

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

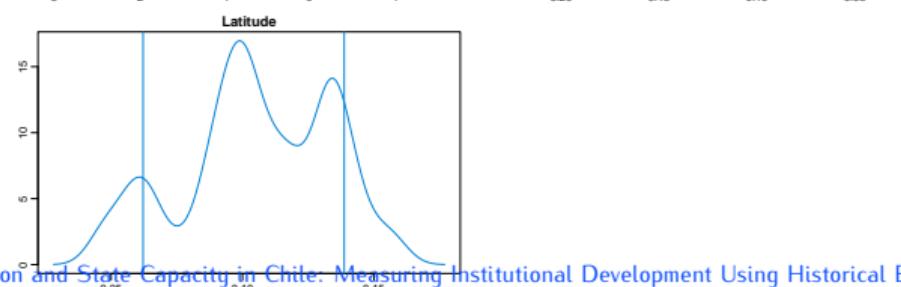
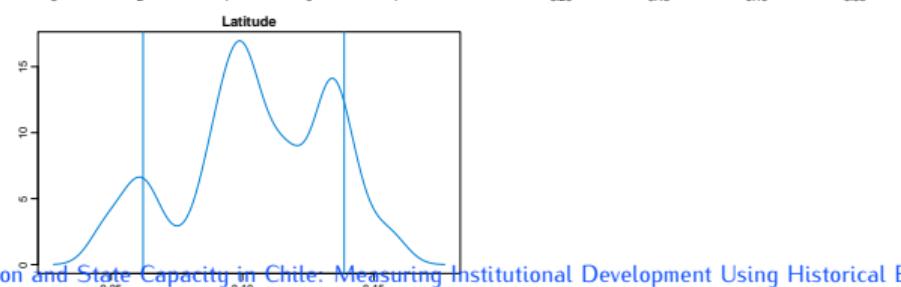
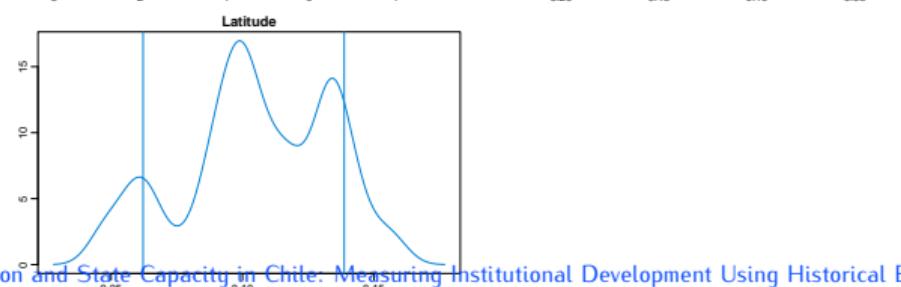
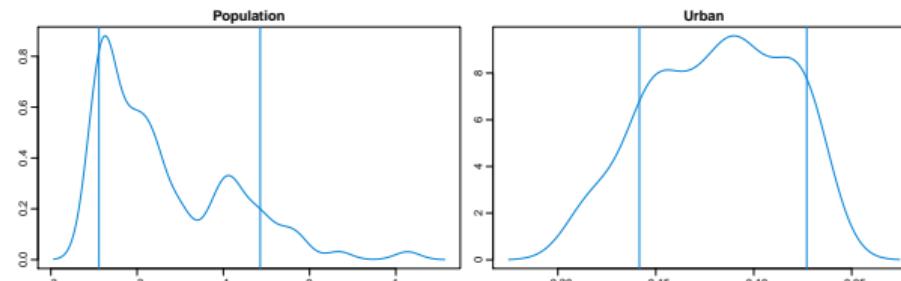
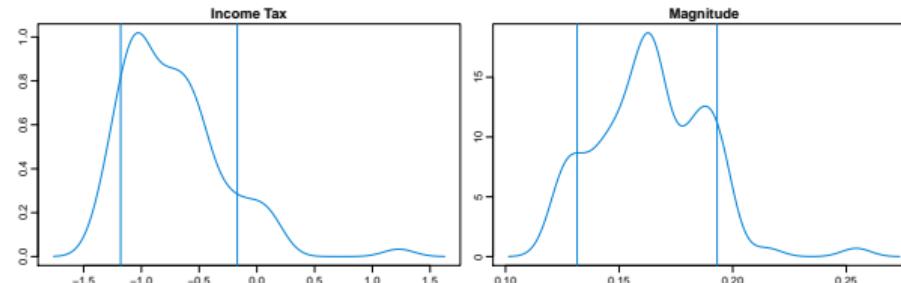
Note: 200000 iterations with a burn-in period of n = 5000 iterations discarded.

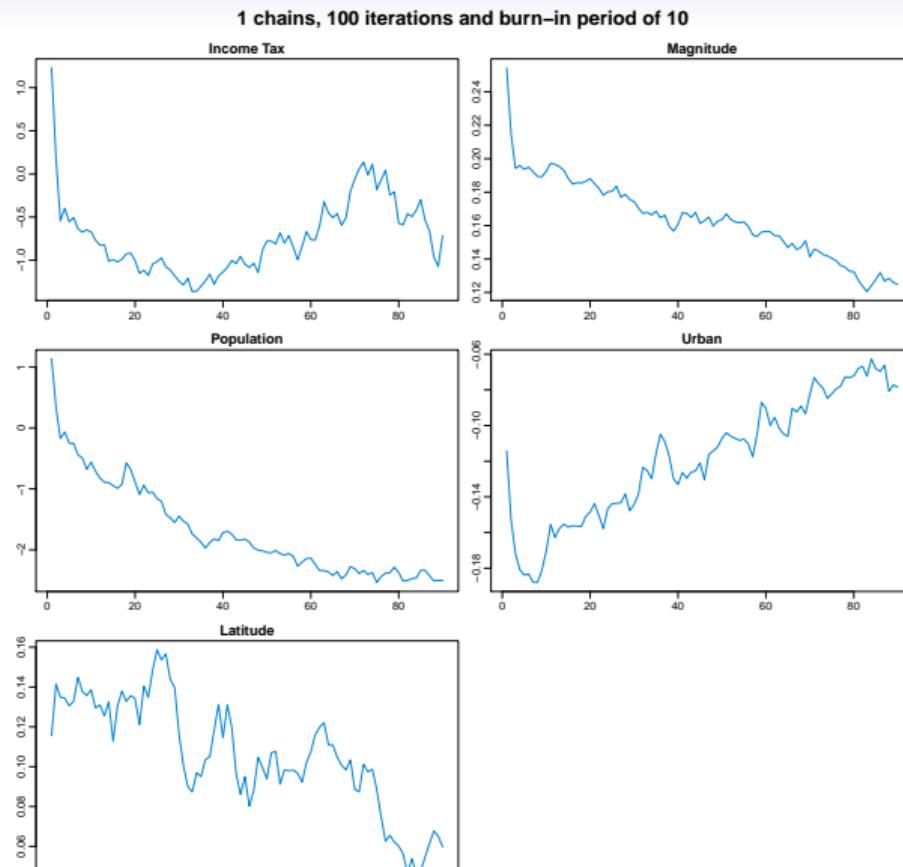
80% credible intervals (upper/lower bounds). All R-Hat statistics below critical levels.

Standard convergence diagnostics suggest good mixing and convergence.

Year fixed effects were omitted in the table.

1 chains, 100 iterations, burn-in period of 10 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**.

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

