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

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Abstract

The central argument of this paper is that income taxation fostered, via spillover effects, state-consolidation over time in Chile. The paper is novel in two ways. First, it studies the relationship between taxation and state-building outside Europe. Second, the paper tests the theory using a novel approach. Exploiting the exogeneity of earthquake shocks, a novel hand-collected longitudinal dataset on Chilean earthquake death tolls was leveraged. Under reasonable assumptions, the capacity for enforcing and monitoring building codes throughout the territory is a reflection of a state's overall capacities. Using a Bayesian Poisson regression to test the effect of implementing the income tax law on death-tolls between 1900 and 2010, the paper shows that death-tolls decrease (that is, state capacity increases) once the income tax law is implemented. To explore the causal mechanisms at work in more depth, I discuss the Chilean case since the 1920s.

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Levi (1989, p. 1) has famously explained that "the history of state revenue production is the history of the evolution of the state." However, even when we have gained considerable knowledge of fiscal expansion in the European cases, the study of the public finances within a context of state consolidation in the developing world is lacking, especially in the presence of "new leading sectors."[1] In fact, while there are a number of theories about state-capacity in Latin America, domestic explanations centered on the role of the economic structural transformation and taxation have been overlooked.[2] Besides this theoretical gap, there is also an empirical deficit. As Soifer (2012, p. 586) points out, most "scholarship on state capacity [...] lack[s] a satisfying conceptualization and measurement scheme for this concept." Moreover, while most state formation theories are situated during precolonial,[3] early,[4] or late[5] independent Latin America, we lack a measurement that corresponds *temporally* to the theories we have. In other words, most explanations of state-making are *historical* in nature. Yet, in practice, available measurements capture *contemporary* levels of *stateness*.

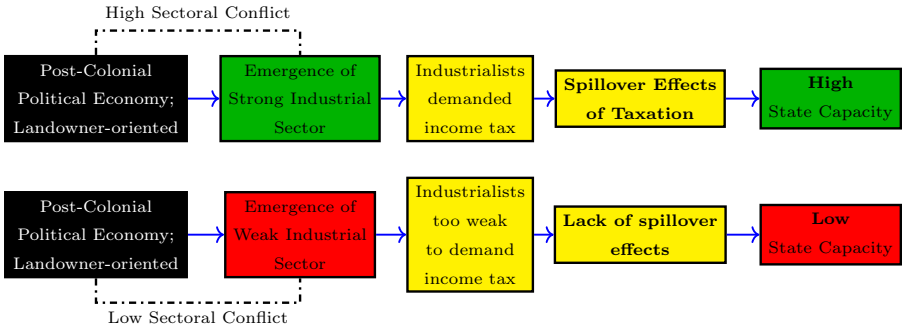

Figure 1: Causal Mechanism.

The paper contributes to the literature from both a methodological/measurement and substantive perspectives by arguing, and empirically testing, the positive relationship between income taxation and state-consolidation. The argument outlines how income taxation had positive spillover effects over state institutions, increasing levels of state consolidation over time. The evidence documents how the presence of tax assessors and collectors throughout the territory increased norms of enforcement of state regulations more generally, fostering overall state-capacities over time. Additionally, exploiting the exogeneity of earthquake shocks, I leverage a novel hand-collected dataset on Chilean earthquake

[1] Schneider (2012, p. 2).
[2] A few exceptions are Gallo (1991, pp. 7-8), Beramendi, Dincecco, and Rogers (2016) and Saylor (2014, p. 8) who consider elite conflicts to study state-making and fiscal development in the developing world. Dargent, Feldmann, and Luna (2017) focus on a "'challenger-based' causal mechanism" of state formation in Peru, however they concentrate their efforts on the role of exogenous economic shocks.
[3] Mahoney (2010).
[4] See Kurtz (2013) and Soifer (2015).
[5] Bahamonde (n.d.).

death tolls between 1900 and 2010. Earthquakes are time-invariant, and importantly, orthogonal to economic development and regime type. Under reasonable assumptions, if the state's capacity for enforcing and monitoring building codes throughout the territory is a reflection of overall state capacity, then death-toll differentials should be mainly associated with state-capacities. Exploiting this variation via a Bayesian Poisson model with year fixed-effects, I find that death-tolls associated to earthquakes systematically decreased (that is, *state capacities increased*) after the income tax law was implemented. Importantly, these changes over time are not correlated with economic growth nor industrialization levels. The empirical section also provides a qualitative case study, several robustness checks and different tests of alternative explanations.

Additionally, the article outlines a theory that explains the timing of the implementation of the income tax. Given that industrialists were more dependent on capital (relative to landowners), they opposed import taxes, favoring the implementation of the income tax. These fiscal resources paid for public goods that benefited the industrial class in the long-run, such as roads and bridges. Leveraging sectoral outputs since 1900 for a sample of nine Latin American countries, including Chile, and employing a number of survival models, the evidence suggests that the emergence of the industrial sector *accelerated* the implementation of the income tax. Also, using vector auto-regressive models and Granger-causality tests, the paper also challenges the stereotypical idea that Chilean landowners and industrialists conformed a single entrepreneurial elite with assets scattered throughout several spheres of investment. These tests strongly suggest that both sectors were, in fact, in constant opposition, and that inter-sectoral asset diversification was weak.

The paper argues that the emergence of the industrial sector caused higher levels of sectoral conflicts, triggering the implementation of the income tax, which in turn, fostered state development over time via spillover effects (Figure 1). Consequently, the paper not only builds on the fiscal sociology literature,[6] but on the sectoral politics approach too.[7] Elites whose assets were allocated in different sectors of the economy had different preferences over direct taxation, and consequently, state centralization.[8] Consequently, industrialization not only shaped the economic landscape; given that the agricultural and industrial sectors had their corresponding political "arms," the *political* conflict over state centralization was rooted in a broader *economic* conflict. The paper not only builds on Mamalakis (1969) and Mamalakis (1971), who introduced the sectoral conflict approach for the Latin American cases, but also follows Hechter and Brustein (1980, p. 1085) who explain that "state formation will be most likely to the degree that powerful individual actors form two groups

[6] Musgrave (1992).

[7] B. Moore (1966), J. Stephens, Rueschemeyer, and E. H. Stephens (1992), Ansell and Samuels (2014), Boix (2003) and Acemoglu and Robinson (2009).

[8] See Acemoglu and Robinson (2009, p. 289) and Best (1976, p. 50). Mamalakis (1971, p. 109) explains that in Latin America "[p]olitical institutions and agents are distinguished, primarily, on the basis of their sectoral foundations."

on the basis of divergent economic and political interests." And such, this article is an attempt to provide an alternative explanation of state-development to the bellicist approach famously attributed to Tilly (1992),[9] and extended to the Latin American case by Thies (2005) and Thies, Chyzh, and Nieman (2016), and Kurtz (2006).[10]

I. Sectoral Conflict, State Capacity, and the Case of the Income Tax in Chile

The landed Latin American elites were an economic hegemonic group protected by norms and institutions that originated during colonial times.[11] Moreover, the post-colonial institutional and economic orders were designed to give an unfair advantage to the agricultural sector. Mamalakis (1971, p. 99) is well-known for describing how an agriculture-government coalition was formed in Chile beginning with the colonial period. Several historians also point out that "[i]n those areas where the government did interfere in the countryside, the effect was to strengthen the position of the landowning class."[12] In fact, the little public infrastructure that existed mostly benefited the agricultural sector.[13] By extension, the landowning class controlled most of the politics too.[14] For instance, R. Collier and D. Collier (2002, p. 106) explain that the Chilean "national government was dominated by the central part of the country, with owners of large agricultural holdings playing a predominant role."[15]

However, when the structural transformation took place,[16] this process imposed tight constraints on the way politics was run by the incumbent landowning class. Given the foundational advantage of the landed elites, the secular emergence of the industrial sector translated into lower levels of inter-sectoral inequality, generating political, economic, and military threats to the landed elites.[17]

[9] For a recent application, see Dincecco and Onorato (2016).
[10] However, see M. A. Centeno (2002).
[11] Keller (1931, p. 13).
[12] Bauer (2008, p. 118).
[13] Rippy (1971), Marichal (1989), Zeitlin (1984), and Bauer (2008).
[14] Wright (1975, pp. 45-46), Zeitlin (1984, p. 13), Bauer (2008, p. 45), Baland and Robinson (2008, p. 1748), Best (1976, p. 56), Rippy (1971) and Marichal (1989).
[15] Similarly, McBride (1936, p. 15) explains that "Chile's people live on the soil. Her life is agricultural to the core. *Her government has always been of farm owners. Her Congress is made up chiefly of rich landlords.* Social life is dominated by families whose proudest possession is the ancestral estate." Emphases are mine.
[16] Defined as the "secular decline of agriculture and substantial expansion of manufacturing" (Johnston and Mellor 1961, p. 567).
[17] As Boix (2015) explains, lower levels of inter-elite economic inequality are tied to similar degrees of military capabilities. Under these circumstances, war is most likely to exhaust all existent assets without producing positive outcomes for either sector (Richard Salvucci, in Uribe-Uran 2001, p. 48), leading to heavier pressures to reach agreements instead of engaging in armed conflicts. In Chile, while initially both "antagonistic elites" (Keller 1931, pp. 37-38), confronted each other in two bloody civil wars between a "large landed property [elite against a] productive capital[ist] [elite]" (Zeitlin 1984, p. 23), due to low levels of inequality, war was not sustainable over time. For instance, while *Balmacedistas* managed to secure the support of the army, *congresistas* (the anti-Balmaceda group) gathered support from the navy. Similarly, in the subsequent years of the civil war, there were a number of *aborted* coups, in

For instance, before the civil war, *salitreras* (nitrate towns) in northern Chile were so prominent that they were considered "a state within the state."[18] Industrial 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. *Salitrera* industries also coined their own currency, and had their own particular local laws.

The preferences over fiscal policy of the expanding industrial sector clashed with the ones of the agricultural class. On the one hand, land fixity increased the risk premium of the landed elite's main asset,[19] so they systematically resisted taxation. However, as capital could be reinvested in nontaxable sectors,[20] industrialists' preferences toward taxation were more elastic. Consequently, the emergence of a strong industrial class led to heavier pressures for the implementation of the income tax law. As industrialists depended more on infrastructure implemented at the local level—such as roads, railroads, and bridges—the industrial classes in Latin America "[*preferred*] to shoulder a higher tax burden through progressive direct taxation."[21] In fact, in 1924 Chilean industrial elites accepted to be income taxed by agriculturalist incumbents *in exchange* for having more state services and being included in state politics. As others have explained, the non-agricultural sector "accepted taxation, while demanding state services and expecting to influence how tax revenues were spent [...] Consultation and cooperation were relatively institutionalised between the two sides."[22] Since both elites agreed on implementing the income tax, compliance was high. Institutionalist economists find that optimal institutional choices result from political settings where all involved actors "had a voice in the choice of institutions,"[23] essentially contributing to an equilibrium of quasi-voluntary compliance.[24]

The tax was not only important because of the new revenue it collected. In line with the fiscal sociology paradigm, the tax was also important for state consolidation. Musgrave (1992, p. 99) argues that since taxation (especially on incomes) requires such a high degree of state penetration, public finances offer also a theory of state-building. Indirect taxes are easier to levy, and, hence, this kind of revenue is generally considered "unearned income"[25] or "easy-to-collect source of revenues."[26] Given the relatively lower costs states have to incur to collect them, indirect taxes have a very low

1907, 1912, 1915, and 1919 (in R. Collier and D. Collier 2002, p. 109), suggesting an equilibrium where no elite was the leading elite.

[18] Barros (1970, p. 500). My translation.

[19] Robinson (2006, p. 512).

[20] Hirschman (1970). See Ronald Rogowski in Drake and McCubbins (1998, ch. 4). However, see Bates and Lien (1985, p. 15).

[21] Beramendi, Dincecco, and Rogers (2016, p. 18).

[22] Carmenza Gallo, in Brautigam, Fjeldstad, and M. Moore (2008, p. 165). Emphases are mine.

[23] Aghion, Alesina, and Trebbi (2004, p. 566).

[24] Levi (1989).

[25] M. Moore (2004a, p. 304).

[26] Coatsworth and Williamson (2002, p. 10).

impact on state-building.[27] For example, Krasner (1985, p. 46) explains that "tariffs and export taxes are easier to obtain than direct taxes, which require high levels of bureaucratic skill and voluntary compliance." In fact, when early Latin American states depended heavily on trade taxes, the state apparatus tended to be less developed.[28] Since customs administrations have always been concentrated in a few critical locations, especially ports, tariffs and customs duties often times did not require an elaborate fiscal structure.[29]

The very implementation of the income tax fostered state-consolidation via spillovers,[30] or *technical complementarities*, which are situations in which "an increase in the output of [a] commodity [...] lowers the marginal costs of producing [other] commodity."[31] The literature points out that the *introduction* of the income tax has been indeed associated with state expansion. For instance, Kaldor explains that the revenue service is the "point of entry." Once this institution is secured, securing the rest is marginally easier.[32] In turn, Besley, Ilzetzki, and Persson (2013) explain that *implementing* the income tax law is "associated with investments in public administrative structures that support tax collection" in a number of countries, including Chile, while Dincecco and Troiano (2015, p. 3) find "a positive and significant relationship between the introduction of the income tax and (1) per capita total expenditures, (2) per capita education expenditures, and (3) per capita health expenditures."

In Chile, bureaucrats that were sent to collect and administer taxes eventually learned to solve land disputes and dispense justice, among other state tasks. For instance, it was necessary to send official emissaries to check on accounting books of the refinery in the north, the winery in the central valley, and the *hacienda* in the south. Eventually, these delegations became more complex, increasing the density of state presence in the territory.[33] Others have found that literacy levels rose in 1907 from 40% to 66% in 1925,[34] the share of national revenue accounted for by income taxes after implementing the income tax in 1924, rose from 6% in 1920 to 23.7% in 1940,[35] and that the dependence on custom taxes decreased from 70.2% to 41.1% during those same years.[36] These developments suggest that policies that expanded the reach of the state, particularly schooling and

[27] M. Moore (2004b, p. 14).
[28] Campbell (1993, p. 177).
[29] Bertola and Ocampo (2012, p. 132).
[30] Musgrave (1992, p. 98) and M. Moore (2004a, p. 298) explain that transforming private incomes into public property fostered state expansion.
[31] Hirschman (1958, p. 67).
[32] In Brautigam, Fjeldstad, and M. Moore (2008, p. 15).
[33] For the European context, Strayer (2005) explains how official state delegations traveled the territory dispensing judicial decisions, thereby fostering state centralization.
[34] Engerman, Sokoloff and Mariscal, in Engerman and Sokoloff (2011, Ch. 5).
[35] Engerman, Sokoloff and Zolt, in Engerman and Sokoloff (2011, p. 178). Humud (1969, p. 154) documents that the income tax was widely enforced, generating considerable resources for the Chilean treasury (in Bowman and Wallerstein 1982, pp. 451-452).
[36] Engerman, Sokoloff and Zolt, in Engerman and Sokoloff (2011, Ch. 6).

taxation, increased considerably *after* implementing the income tax.

Did the implementation of the income tax in Chile foster state development over time? The next section motivates the measurement approach pursued in this paper. The following section leverages a number of quantitative models that show that (1) income taxation in Chile fostered state development over time, (2) implementing the income tax in Latin America was attributed to the emergence of the industrial sector, not overall economic growth, (3) in Chile, both sectors were in permanent conflict, precluding cross-sectoral investments.

II. From Earthquake Death Tolls to State Capacities

More than being blessed, the literature is in fact cursed due to an over-abundance of poor indicators of state consolidation.[37] In fact, its abundance "points to the poor state of empirical measures of the quality of states."[38]

One notable example is protection of the rule of law, which is commonly used as proxy for state capacities.[39] As Kurtz and Schrank (2007, p. 543) explain, this strategy is severely confounded "with policy preferences over the structure of private property rights." On the one hand, this is problematic since the sources of this data are usually elite interviews.[40] To "the extent that public bureaucracies *are* effective in imposing taxes or regulatory demands [...] they are likely to be judged 'burdensome' and 'growth-inhibiting' by many businesspersons,"[41] thereby introducing systematic measurement error.[42] On the other hand, the problem is conceptual. As Soifer (2008, p. 247) puts it, there is a widely spread "problem of misalignment between dimension and indicator." Kurtz and Schrank (2012, p. 619) recommend "explicitly avoid[ing] an emphasis on outputs that are at the center of political or policy debates, such as property rights." For example, the U.S.S.R. had a strong state, however it did *not* protect property rights.

Another iconic example of this misalignment problem is the use of fiscal extraction as a proxy of state capacity. Johnson and Koyama (2017, p. 3) explain that "[t]ax revenue per capita is a commonly used metric of fiscal capacity," which in turn speaks to levels of state-capacity. In fact, Thies (2015, p. 172) conceptualizes "fiscal capacity [...] in terms of tax revenue extracted from society."[43] Not only tax shares reflect policy preferences too,[44] but also, as Fukuyama (2013, p. 353)

[37] Soifer (2012, p. 589).
[38] Fukuyama (2013, p. 347).
[39] See for one example Besley and Persson (2009, p. 1237).
[40] Fukuyama (2013, p. 349).
[41] Kurtz and Schrank (2007, p. 542).
[42] See also Kurtz and Schrank (2012, p. 618).
[43] Other examples are Besley, Ilzetzki, and Persson (2013, p. 224) and Besley and Persson (2014).
[44] Soifer (2013, p. 9).

explains it, there "is a difference between extractive *potential* and *actual* extraction rates."[45] For instance, since American institutions were deliberately designed to limit the exercise of state power, the U.S. taxes very little.[46] However, it is not reasonable to say that the U.S. has a "weak state." Moreover, in late imperial China, "high taxes on peasants [...] were the result of rulers' *lack* of power. Chinese rulers consistently attempted to limit officials' excessive extractions from the masses, but were unable to do so."[47]

Finally, others have proxied state-capacity with economic growth, which is also problematic.[48] As Dargent, Feldmann, and Luna (2017) explain, state-capacity and economic growth are causally distinct mechanisms. For instance, boom-led economic growth has left net state capacity low in Peru.

This paper identifies an additional limitation. Beyond conceptual and analytical problems, most available measurements are unable to capture temporal sources of variation of state capacity. Since most explanations of state-making have a strong historical component, the lack of an indicator able to *travel in time* represents a huge deficit in the literature. Just to name a few examples, Soifer (2012, p. 585) "builds a new measure of state capacity for [...] *contemporary* Latin America [combining] multiple dimensions (extraction, security, and the administration of basic services)."[49] Kurtz and Schrank (2012, pp. 618-619) designed some list-experiments to study bureaucrat's opinions, Dargent, Feldmann, and Luna (2017) "analyses the evolution of state capacity in Peru during the *recent* commodity boom,"[50] while Luna and Toro (2014) and Luna and Soifer (2017) employ a survey-based design to measure *contemporary* subnational state capacities. While these measurements do overcome the conceptual and analytical problems mentioned above, they do not help us in studying state capacities in a historical setup.

Economic historians offer other alternatives. Some examples are levels of investments in public goods,[51] such as infrastructure, roads,[52] electrification (measured as light intensity per pixel),[53] and railroads.[54] However, many of these measurements are debatable. For instance, Soifer (2012, p. 593) explains that "railroads were often constructed by private actors."[55] The same problem applies to other types of infrastructure. There are others more appropriate strategies, such as the

[45] Emphases are mine.
[46] Fukuyama (2004, p. 6).
[47] Kiser and Tong (1992, p. 301). Emphasis is mine.
[48] Fearon and Laitin (2003) and Besley and Persson (2011), and Mahoney (2010, pp. 4, 6-7).
[49] Emphasis is mine.
[50] Emphasis is mine.
[51] Enriquez, Sybblis, and M. Centeno (2017).
[52] Mann (1984), Mann (2008), Acemoglu (2005), Saylor (2012), Thies (2009), and Besley and Persson (2010).
[53] Huntington and Wibbels (2014).
[54] Saylor (2012, p. 302) and Coatsworth (1974).
[55] Footnote #11.

opening of postal offices,[56] the administration of national censuses,[57] and vaccination.[58] While these measurements do capture historical variations of state capacities, some other problems arise. Censuses, for example, provide a *non-continuous temporal measurement* of state capacities. For instance, censuses are applied in Chile every ten years. Having just a few snapshots of state-capacity should compromise any statistical analysis. In turn, vaccines are usually targeted at primary and high school students. In practice, vaccines are administered by the schools themselves, both public and private. Private schools might be more efficient in doing so, inflating the *average* level of state-capacity.

To solve some of these limitations, the paper proposes earthquake death tolls as an alternative to measure state capacities over time. Unlike censuses—*unfortunately*— earthquakes happen in Chile very often. While "[e]arthquakes alone claim thousands of lives a year,"[59] they are not well studied in the discipline.[60] Building on Mann (1984, p. 113), the proposed measurement intends to capture the state's *infrastructural* power.[61] "Natural hazards can be seen as a function of a specific natural process and human [...] activity."[62] Given that earthquakes happen at random and are exogenous to the affected locality,[63] the only part that is left unexplained is the systematic human component, which is what the measurement captures. Earthquakes are orthogonal to levels of state capacity and economic development.[64] Thus, keeping earthquake magnitudes constant at their means, (population-weighted) death counts should be attributed to the (*in*)capacity of the states to invest in preparedness and earthquake-mitigation institutions.[65] I focus on earthquakes and not on other natural disasters, such as "extreme temperature events, floods, landslides, and windstorms,"[66] because earthquakes cannot be foreseen and, as such, they put to test the states' capacity for having their preventive institutions *already* in place and in good shape.[67] State capacity

[56] Acemoglu, Moscona, and Robinson (2016).

[57] Lee and Zhang (2017), Soifer (2013), M. A. Centeno (2002) and Hanson and Sigman (2013) and Hanson (2015). Another variation of this technique is "age heaping."

[58] Soifer (2012).

[59] Anbarci, Escaleras, and Register (2005, p. 1908).

[60] Brancati (2007, p. 719) explains that "[d]isasters are not as well studied [...] in the field of political science."

[61] He defines infrastructural power as "the capacity of the state [to] actually [...] penetrate civil society, and to implement logistically political decisions throughout the realm."

[62] Raschky (2008, p. 627).

[63] Brancati (2007, p. 728) explains that "earthquakes constitute a natural experiment." Gignoux and Menéndez (2016, p. 27) also point out "that the occurrence of earthquakes can be viewed as random [allowing the analyses of] these events as a set of repeated social experiments." Caruso (2017, 32, unpublished), for instance, "[exploits] the exogenous variation in the location and timing of natural disasters."

[64] Kahn (2005, p. 271) and Brancati (2007).

[65] To make sure, while "earthquakes may not be preventable, it is possible to prevent the disasters they cause" (Escaleras, Anbarci, and Register 2007, p. 209). Similarly, Anbarci, Escaleras, and Register (2005, p. 1911) explain that "the potentially devastating effects of major earthquakes are, if not preventable, at least subject to significant mitigation." For a similar approach, see Noji (1996, p. 130).

[66] Kahn (2005, p. 280).

[67] In fact, Brancati (2007, p. 716) explains that "[e]arthquakes may provoke conflict more than any other type of natural disaster because they have rapid onsets [and] are not predictable." Emphasis is mine.

consist of sustained proactive efforts of enforcing institutions in the territory, and, hence, short-term reactive actions should not be considered state-*making*.

Under reasonable assumptions, the capacity of deploying inspectors to enforce quake-sensitive zoning and building codes should be a reflection of the overall levels of state capacity. Since "[e]arthquake-resistant construction depends on responsible governance,"[68] state capacity act as a scope condition undermining (facilitating) the implementation of these norms. For example, Bilham (2013, p. 169) explains that "although engineering codes may *exist*[,] mechanisms to *implement* these codes are largely unavailable"[69] in low-capacity states. For example, Anbarci, Escaleras, and Register (2005, p. 1910) explain that "while Iran has building codes [...] comparable to those existing in the United States, they tend to be enforced only in the country's larger cities," not in the countryside.

Only high-capacity states overcome their own limitations, not only implementing but also enforcing quake-sensitive regulations. The Chilean government started its efforts to ameliorate the impact of earthquakes after the great quake of 1928 in Talca. A first effort happened in 1929, when *Ley* number 4563 was implemented. The law was among the first attempts to prohibit "construction, reconstruction or any other repairing or transformations [...] without a permit from the authorities." Importantly, the law required that all blueprints had to be signed off by an expert before the construction started. By 1930, *Decreto* number 4882 was adopted, but this time the rule made a number of technical prescriptions,[70] determining what kinds of construction materials ought to be used, among other requirements. Critically, while the central government had retained the control of the supervision of the code since the promulgation of the *ley*, the *decreto* explicitly created the role of the *inspector* to supervise, enforce, and monitor these measures at the local level. Furthermore, *artículo* 414 of the Chilean *Decreto* 4882 granted inspectors "free access to the building" at any time during the construction process. The proposed measurement captures whether these good intentions achieved lower death tolls.

The proposed measurement has a number of advantages. Unlike non-experimental survey-based or purely policy-based measures, earthquake death tolls are an *objective* measurement of earthquake preparedness, an activity that *any* state *must* perform.[71] However, the measurement has a number of drawbacks. Obviously, the country needs to have earthquakes, possibly limiting the number of potential cases. However, most earthquakes occur at the various borders of the Pacific, Latin

[68] Ambraseys and Bilham (2011, p. 153). Similarly, Raschky (2008, p. 628) argue that "the effects of natural hazards [do] not solely depend on a region's topographic or climatic exposure to natural processes [...] but [on] the region's *institutional* vulnerability." Emphasis is mine.

[69] Emphases are mine.

[70] See especially article 151.

[71] Carlin, Love, and Zechmeister (2014, p. 422) explain that "a basket of 'minimal' state functions [typically includes] primary education, public health, rule of law, public finance management, and disaster relief."

American, African, Arabic, Indian and Eurasian plates,[72] allowing a number of potential cross-country comparisons.[73] Thus, like other measurements available, this is a context-specific strategy. For instance, Soifer (2012, p. 593) and Slater (2008, p. 252) propose a measurement based on whether states are able to enforce voter registration "where voting is mandatory," or conduct "state registration of marginal populations," respectively, limiting the study of state-capacity to democratic countries only.

Moving forward, there are countries, like India or the United States, where earthquakes happen in certain regions only. Presumably, mitigation policies in these places would need to be targeted to specific areas, possibly undermining the assumption that these kinds of policies should penetrate the entire territory.[74] Another potential concern is that the ability of counting the death-toll might be a function of state capacities itself.[75] However, in most cases, civic organizations, the Catholic Church, and, particularly, the press (national and local) have been the main entities who (willingly or not) have carried out the task of enumerating the deaths. Another potential issue is the measurement of the magnitudes. Before the instrumental period, magnitudes were obtained in an estimative way, and, while there are methods to approximate historically-felt magnitudes to instrumental-like intensities,[76] this strategy unfortunately adds more than one layer of complexity. All in all, this measurement offers a rough approximation of levels of state capacities over time.

III. Empirical Section

I. Spillover Effects of Income Taxation on State Capacity

I constructed a novel hand-collected longitudinal dataset using the *Significant Earthquake Database* compiled by the National Centers for Environmental Information (NOAA) as a starting point.[77] The dataset "contains information on destructive earthquakes from 2150 B.C. to the present," and records the number of deaths,[78] the magnitude, date, latitude, and longitude of every quake, among other variables. Using archival census data from 1907 to 2012,[79] the NOAA dataset was complemented

[72] Keefer, Neumayer, and Plümper (2011, p. 1534).
[73] Keefer, Neumayer, and Plümper (2011, p. 1534). From a population size perspective, this measurement is also convenient. A "quarter of the world's population inhabits [...] the northern edge of the Arabian and Indian Plates that are colliding with the southern margin of the Eurasian Plate" (Bilham and Gaur 2013, p. 618).
[74] Dunbar, Bilham, and Laituri (2003, p. 164) explains that the Indian state implements targeted policies (that might not necessarily correspond to the administrative areas) based on isoseismal maps that define different zones of seismic hazard.
[75] I thank Paul Poast for this comment.
[76] Szeliga et al. (2010).
[77] (NGDC/WDS) (n.d.).
[78] Tsunami casualties were excluded.
[79] Particularly, censuses of 1907, 1920, 1930, 1940, 1952, 1960, 1970, 1982, 1992, 2002 and 2012. Some of them were kept at the *Biblioteca Nacional* and others at the *National Statistic Institute* historical library.

with local population at the municipal level where the quake hit. Local population was used to weight the death toll.[80] Using archival census data as well, the main economic activity of the affected municipality was coded,[81] in addition to whether the municipality was urban or rural.[82] The death tolls and magnitudes proportionated by the NOAA dataset were contrasted case by case with historical press archival information.[83] Magnitudes, in particular, were also compared with the International Seismological Centre.

Figure OA1 plots the over time earthquakes and magnitudes, while Figure 2 plots the geographical distribution and magnitudes of the quakes, as well as the dominant productive sector.[84] Both figures suggest that Chile is a good case to study infrastructural state-capacity using the earthquake framework, since it has considerable variance regarding quake magnitudes, locations and sectoral variation. The northern part of Chile has historically been an industrial region, while the southern part of Chile has traditionally been an agricultural region. Relatedly, both regions vary according to their climate. Furthermore, the distance from Santiago, which is located near latitude 33°, might impose some degree of difficulty for the central government to reach the farthest northern/southern parts of the territory.[85] There is also variance considering longitude. Closeness to the Andean mountains (around longitude 70°) determines the ruggedness of the terrain, presumably making it harder for the state to penetrate these areas.[86] All things considered, earthquakes have affected the territory from coast to mountain,[87] and both north and south, solving potential concerns about geographical sectoral self-selection.

The unit of analysis is the earthquake.[88] As an event, each earthquake has associated to it a death toll, a location, a magnitude, a local population, and an urban/rural setting. Specifically, following the statistical convention, a Bayesian Poisson regression was employed to test the effect of implementing the income tax law on death-tolls over time.[89] The main quantity of interest is a binary

[80] Around 90% of the times it was possible to recover the actual local population. For the rest, the population of the most concentrated area nearby was recovered. Consequently, population is used as a control, not to directly weight the dependent variable.

[81] This variable was constructed by coding press and official sources (mainly censuses) of the main economic sector at the local level. *Agriculture* (n=27), *Industry* (n=51), *Mixed* (n=13).

[82] Urban=74, rural=17. If more than 50% of the population lived in an urban setting, I assigned a 1 to that municipality, 0 otherwise. Urban concentrations are most likely to have vertical constructions rather than one-story buildings, increasing the potential number of casualties. Consequently, it is important to control for this source of variation. I thank Daniel Kelemen for this suggestion.

[83] *El Mercurio* and *La Nación* newspapers, both kept at the *Archivo Nacional* of the *Biblioteca Nacional de Chile*.

[84] For illustrative purposes, both plots consider the full sample starting in 1520 and ending in 2015.

[85] Foa and Nemirovskaya (2016, p. 418).

[86] Brancati (2007, p. 729) explains that "[e]arthquakes often occur in mountainous areas."

[87] Since "most of the damage in major earthquakes occurs within 30 km of the epicenter" (Dunbar, Bilham, and Laituri 2003, p. 172), earthquakes that did not happen on land were not dropped. While the epicenter might have been a few miles away from the shore, the consequences certainly reached the land.

[88] Kahn (2005, p. 273) also considers that "the unit of analysis is [the] disaster."

[89] Anbarci, Escaleras, and Register (2005, p. 1907) use "a Negative Binomial estimation strategy with both random and fixed estimators" to estimate death-tolls, Kahn (2005, p. 276) estimates a Zero Inflated Negative Binomial model, Brancati (2007, p. 729) uses "a negative binomial model with robust standard errors clustered by country," and

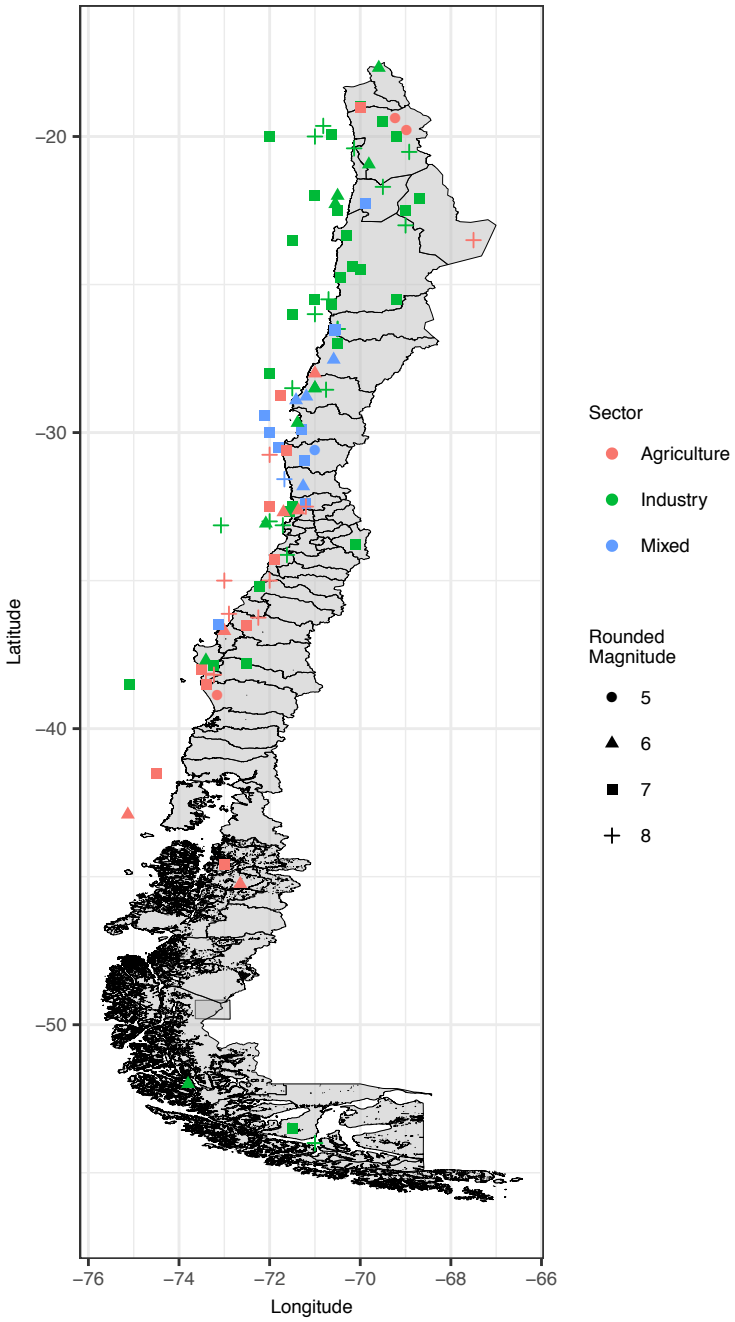

Figure 2: Data Used in the Analyses: Geographical Distribution of Earthquakes in Chile, 1903-2015.

Note: *Using a combination of archival information and external sources, the figure shows a total of 101 earthquakes. Each quake was colorized according to the predominant economic sector at the municipal level. In total, there were 29 earthquakes that took place in agricultural localities, 56 in industrial, and 16 in mixed municipalities. Figure OA1 shows the overtime variation.*

variable (i.e. *Income Tax*) that denotes whether the income tax is implemented or not. The model considers year fixed-effects to account for time-varying confounding factors and for unmeasured sources of variation.[90] For instance, fiscal development is also a function of country-specific prior state-capacities. Additionally, technological changes (advances in construction, for example) should diminish death-tolls.[91] Fixed-effects should be able to account for these and other unmeasured yearly factors. In addition, local population also serves as a rough proxy for local economic development,[92] which might impact negatively casualties. Latitude was included to control for the proximity to the Andean mountains, aiming to control for a built-in tectonic earthquake predisposition. Longitude seeks to control for climate and other unmeasured conditions that make agricultural development more difficult. In turn, both measurements serve as good proxies of terrain ruggedness and the difficulties the state faces in reaching these areas.[93]

Fiscal sociologists, mostly focusing on the continental cases, have for a long time claimed that the capacity of taxing individuals' incomes fosters overall state-capacities. Unfortunately, there have not been attempts to study this relationship for the Latin American cases. The results presented in Table OA1 find support for this claim. Particularly, implementing the income tax *decreases* the death-toll by an estimated over time average of 4. Figure 3 shows that death-tolls (state capacities) systematically *decrease* (increase) over time once the income tax law is implemented. Before the income tax law was implemented, death-tolls were relatively stable, averaging approximately 29 casualties per earthquake. However, once the income tax law was implemented, the death-toll decreased to 25. Moreover, the figure shows that the trajectory of casualties goes from 28 in 1903 to 22 in 2007. The fixed-effects estimation makes these results robust to considerations of geography

Escaleras, Anbarci, and Register (2007) use "a Negative Binomial." Yet, no study tests for over dispersion. No evidence of over dispersion is found in the analyzed dataset.

[90] More formally, Equation 1 was fitted:

$$\begin{aligned} \text{Deaths} &\sim \text{Poisson}(\lambda_i) \\ log(\lambda_i) &= \mu + \beta_1 \text{Income Tax}_i + \beta_2 \text{Magnitude}_i^2 + \beta_3 \text{Latitude}_i + \beta_4 \text{Longitude}_i + \\ &\quad \beta_5 \text{Population}_i + \beta_6 \text{Urban}_i + \beta_7 \text{Year}_t \end{aligned} \tag{1}$$

According to the NOAA, an "increase of one in magnitude represents a tenfold increase in the recorded wave amplitude." To account for non-linear effects, Equation 1 considers the square term of magnitude. Parameters β_k have noninformative normally distributed priors. Precisions τ_p have noninformative Gamma priors. See section V for technical details. Brancati (2007, p. 729) also includes in his analyses "year-fixed effects to control for trends over time."

[91] I thank Hillel Soifer for this suggestion.

[92] Sokoloff and Engerman (2000).

[93] Undoubtedly, there are many more factors that might increase death tolls. Ambraseys and Bilham (2011, p. 154), for example, explain that the "number of fatalities depends on whether an earthquake happens at night or during the day, in the winter or in the summer, in a mountainous region or in a valley, after strong and protracted fore-shocks and with or without warning." While the model has some of these factors accounted for, complete hourly data is lacking. However, Lomnitz (1970, p. 1309) explains that "some of the larger Chilean earthquakes which have caused deaths" between the 1900's and the 1960's have been afternoon quakes. Other factors such as "the speed of tectonic movements [and] the degree to which the lower plate bends the upper plate" and the focal depth (Keefer, Neumayer, and Plümper 2011, p. 1534), could not be included due to the lack of complete data over time.

and economic development.

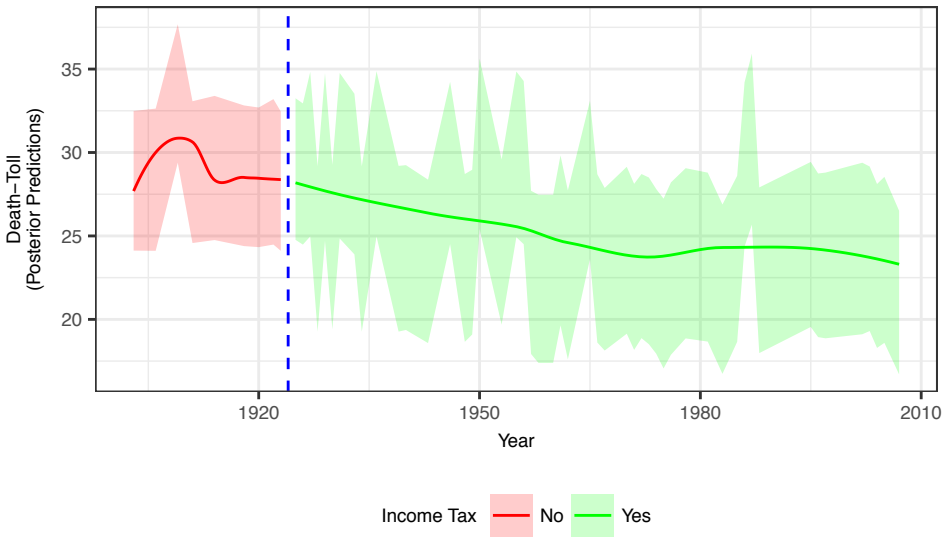

Figure 3: Income Taxation and State Capacity in Chile: An Overtime Approach.
Note*: Using the estimations from Table OA1 (Equation 1), the figure shows predicted death-tolls before and after the implementation of the income tax in 1924. In average, the death-toll decreases from 29 to 25. The figure suggests that implementing the income tax law had positive effects on state-capacity overtime. The figure also shows credible intervals at the 80% level.*

II. Industrial Expansion and the Origins of the Income Tax

In an effort to generalize the argument about the sectoral origins of the income tax law, data on eight other Latin American countries were collected (Ecuador, Nicaragua, Venezuela, Peru, Colombia, Guatemala, Argentina and Mexico). The degree in which industrial elites challenged incumbent landowners (e.g. sectoral contestation) was measured by using industrial and agricultural sectoral growth rates as presented in the MOxLAD data.[94] The dataset spans from 1900 to (potentially) 2010.[95] According to Astorga, Berges, and Fitzgerald (2005, p. 790), these data provide extended comparable sectoral value-added series in constant purchasing power parity prices.[96] Leveraging some more additional archival data, Table OA2 shows the year when the income tax law was passed in these countries. Finally, Figure 4 conveys both agricultural and industrial outputs (independent variables) and the year when the income tax law was passed (dependent variable).

Econometrically, this section is concerned about the *timing* of implementing the income tax law

[94] Both the *agriculture value-added* and *manufacturing value-added* variables were used.
[95] Since countries are censored once they implement the income tax law, they leave the sample (potentially) before 2010.
[96] Using a similar strategy, Thies (2005) also uses data on taxation and compare those data between cross sections.

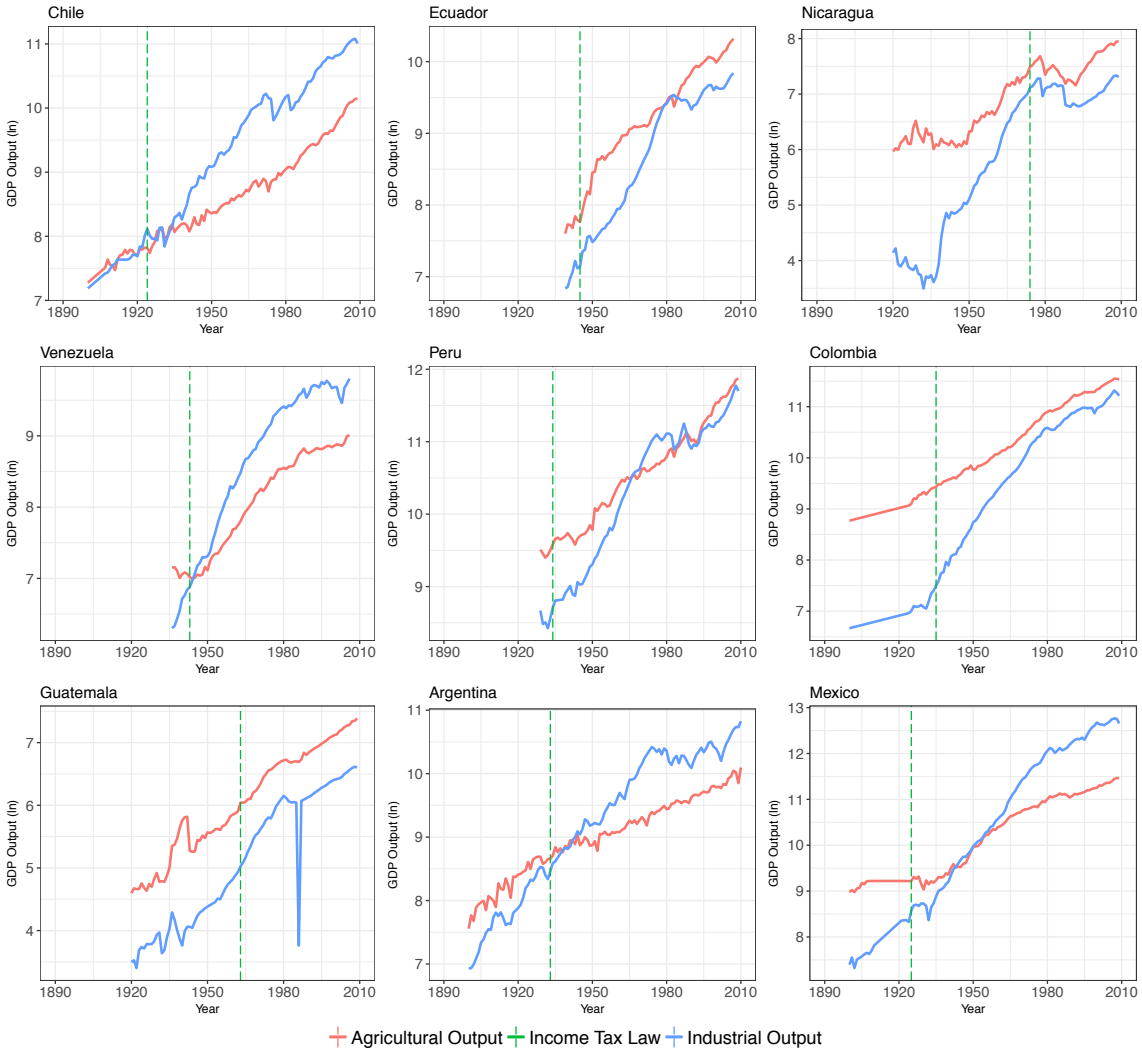

Figure 4: Industrial and Agricultural Outputs, and The Passage of the Income Tax Law.
Note: *Figure shows historical sectoral outputs, and year of the passage of the income tax law. Following convention, the figure shows logged values.*
Source: *MOxLAD, and other sources compiled by the author (see Table OA2).*

in nine Latin American polities, and particularly, about the individual contribution of both the agricultural and industrial sectors. Table OA3 shows 3 models.[97] Following Aidt and Jensen (2009), Model 1 computes the lagged conditional hazard ratio of a country which has not yet adopted the income tax adopts it in a given year, as a function of industrial and agricultural outputs.[98] Countries drop out of the sample when they adopt the income tax. Model 2 shows the estimated coefficients of a generalized estimating equation (GEE).[99] Generalized estimating equations were introduced by Liang and Zeger (1986) to fit clustered, repeated/correlated, and panel data.[100] From a substantive standpoint, GEE models provide an estimated marginal mean, or the *weighted*

average of all cluster-specific effects (or conditional means). Model 3 is a conditional logit.[101]. Since population has been associated with the probability elites expand the franchise,[102] and consequently the tax base, country-year population was included as a control variable.

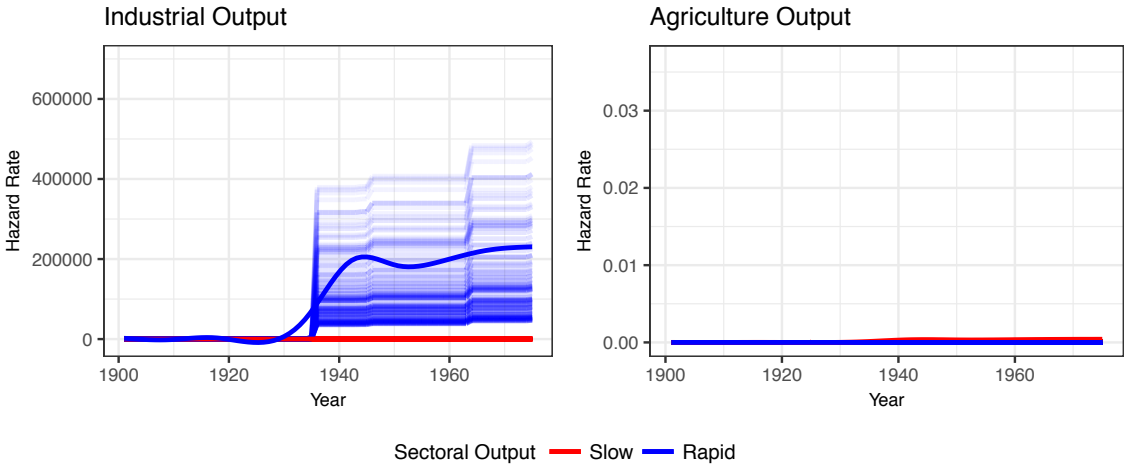

Figure 5: Hazard Rate of Implementing the Income Tax Law.
Note*: Using estimations of Model 1 in Table OA3 (Equation 2), figure shows 10,000 simulations with different sectoral growth speeds. "Slow" is the minimum value, while "rapid" is the maximum value for each sectoral output. The figure also shows the 95% confidence intervals.*

Figure 5 shows that it is not *overall* growth that accelerates the implementation of the income tax, but *industrial* growth. In fact, agricultural expansion *delays* the implementation of the law, harming state development. Since industrialists preferred the income tax, these analyses suggest

[97]Tables were produced using the `texreg` package (Leifeld 2013). All Cox models were computed using the `survival R` package (Therneau (2015)). The GEE logistic regression was computed using the `geepack` package (Hojsgaard, Halekoh, and Yan 2016). The simulations were performed using the `simPH R` package (Gandrud 2015).

[98]Since the idea is to capture the *sectoral contribution* of the implementation of the income tax law, these variables were not combined. Following Box-Steffensmeier and Jones (2004, p. 49), the next equation was fitted:

$$h_i(t) = exp(\beta_1 \text{Industrial Growth}_{i,t} + \beta_2 \text{Agricultural Growth}_{i,t} + \beta_3 \text{Total Population}_{i,t}) h_0(t) \quad (2)$$

for all countries i and years t.

[99]Following Zorn (2006, p. 331), the next equation was fitted:

$$\pi_{i,t} = \Phi(\beta_1 \log(\text{Industrial Growth}_{i,t}) + \beta_2 \log(\text{Agricultural Growth}_{i,t}) + \beta_3 \log(\text{Total Population}_{i,t})) \quad (3)$$

where π is the logit link function, and Φ is as scale parameter (i.e. the cumulative distribution function), for all i countries, and years t.

[100]Zorn (2006, p. 322). This method is especially well suited to analyze binary data (Hanley et al. 2003), something particularly useful given the nature of the dependent variable. GEE methods require analysts to parameterize the working correlation matrix. While GEE models are robust to misspecification of the correlation structure (Hedeker and Gibbons 2006, p. 139), following Hardin and Hilbe (2013, p. 166), the "independence" working covariance structure was used, since observations were collected over time.

[101]More formally, the next equation was fitted:

$$\pi_{i,t} = \Phi(\beta_0 + \beta_1 \log(\text{Industrial Growth}_{i,t}) + \beta_2 \log(\text{Agricultural Growth}_{i,t}) + \beta_3 \log(\text{Total Population}_{i,t}) + \alpha_i) \quad (4)$$

where α are the country fixed effects for all countries i.

[102]Engerman and Sokoloff (2005, pp. 892-893).

that industrial expansion is systematically associated with the implementation of the income tax, not only in Chile, but in other Latin American polities too. These results support the idea that income tax is directly related with industrial expansion rather than economic development, but also support the idea of the sectoral *conflict* behind its implementation. Since each sector had their own preferences toward income taxation, the emergence of the industrial sector facilitated state development by implementing the income tax, while agricultural expansion not only delayed the income tax, but also compromised state formation.

III. Alternative Explanations

Undoubtedly, some municipalities should be wealthier than others, and presumably, better able to *privately* investment in earthquake proofing.[103] Inhabitants of such municipalities could be able to afford better construction materials and more advanced construction techniques, lowering death-tolls. If this possibility is not ruled out, then lower death-tolls have less to do with the capacity of the state to enforce building codes than with private wealth. To examine this possibility, a "rolling" version of Equation 1 was performed. Figure 6 plots 91 models which resulted from iteratively excluding one observation at a time. Since earthquakes happen at any level of economic development, this strategy is especially appealing. By subtracting (with replacement) iteratively one observation at a time, these analyses account for possible concerns about influential municipalities (especially wealthy ones) downpressing the death-count. The figure shows that the substantive results are not being driven by the capacity of the rich (or incapacity of the poor) municipalities. There is a steady pattern of decline in death-tolls, regardless of which observations are included/excluded.

[103] I thank Hillel Soifer and Mark Dincecco for this suggestion.

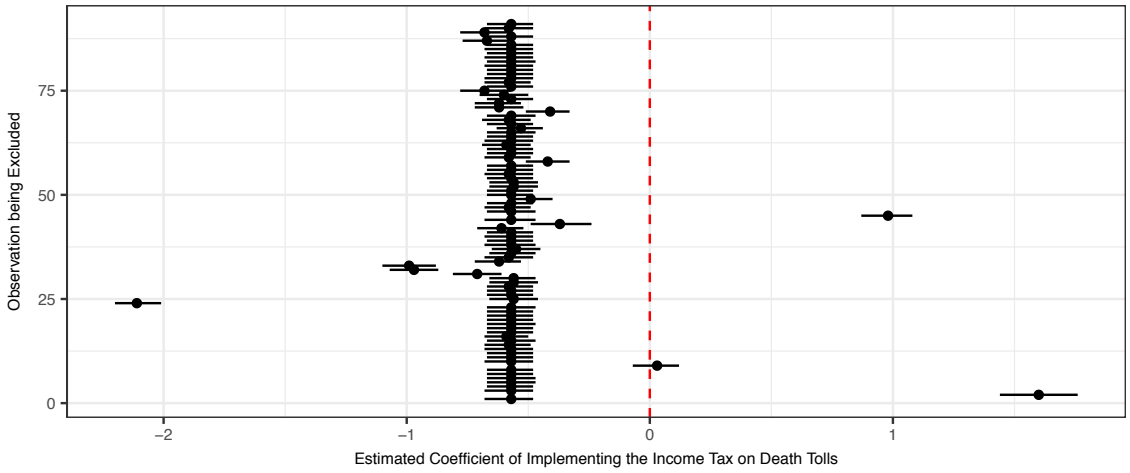

Figure 6: Rolling Bayesian Poisson Regression.
Note*: Figure shows the estimates of implementing the income tax on death-tolls of 91 models which correspond to fully estimating Equation 1, but excluding one observation at a time. 95% credible intervals were included. The figure suggest that the negative results of income taxation and death-tolls are not driven by wealthy municipalities, but to the capacity of the state of enforcing building codes.*

A second potential issue might be whether certain sectors self-select into less earthquake-prone geographical locations. For instance, it might be argued that agricultural areas, being mostly rural, might have lower constructions, while industrial areas, being more urban, might have both highly populated municipalities and higher constructions (edifices), potentially showing higher default death-tolls. To rule-out this possibility, a hierarchical variant of Equation 1 was estimated. Using the same set of control variables, Equation 5 considers whether earthquake magnitudes affect the death-toll of agricultural, industrial or mixed municipalities in different ways.[104] Table 1 suggests that death-tolls are orthogonal to the economic sector. Belonging to an agricultural or industrial sector contributes with 0.05 or 0.04 additional deaths, respectively.

[104]More formally, Equation 5 was fitted:

$$\begin{aligned} \text{Deaths} &\sim \text{Poisson}(\lambda_i) \\ log(\lambda_i) &= \mu + \beta_{1_j}\text{Magnitude}_i^2 + \beta_2\text{Latitude}_i + \beta_3\text{Longitude}_i + \\ &\quad \beta_4\text{Population}_i + \beta_5\text{Urban}_i + \beta_6\text{Year}_t \end{aligned} \tag{5}$$

where,

$i_{1,\dots I}$ and I = 91 observations,
$j_{1,\dots J}$ and J = 3 sectors,
$t_{1,\dots T}$ and T = 59 years.

	Mean	SD	Lower	Upper	Pr.
Magnitude [Agr]	0.05	0.01	0.03	0.07	1.00
Magnitude [Ind]	0.04	0.02	0.02	0.07	1.00
Magnitude [Mixed]	0.05	0.02	0.02	0.08	1.00
Latitude	0.05	0.02	0.02	0.09	1.00
Longitude	-0.40	0.09	-0.58	-0.24	1.00
Population	-0.02	0.00	-0.02	-0.01	1.00
Urban	-5.16	0.76	-6.74	-3.88	1.00

Note: 200,000 iterations with a burn-in period of n = 5,000 iterations discarded.
95% 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.

Table 1: Simulated Posterior Predictions (Hierarchical Poisson Regression, Equation 5).

Finally, it could be argued that the distinction between two separate and opposite sectors is inaccurate. Some historians claim that since landowners also invested in industry,[105] there was a blurry class division between the industrial and agricultural sectors.[106] Perhaps the most cited reference regarding this issue is Veliz (1963, pp. 231-247). However, there are a number of stylized facts that strongly suggest that there was indeed a structural sectoral cleavage. For example, it was common that industrialists invested in real estate. Yet, in many instances they did so *just* to obtain credit. Kirsch (1977, p. 59) explains that "in a *rural society* land offered one of the best guarantees for loans [since] loans could not be secured by equipment, machinery, or inventory. Only real estate was acceptable collateral."[107] In fact, this practice shows how the credit system was oriented to give unfair advantage to the landed elites.[108] Similarly, Zeitlin (1984, p. 174) finds "the combined ownership of capital and landed property was a distinctive quality of *certain* [elites] actors,"[109] not *all* elites. There were also other instances where miners invested in banking. Yet, Segall (1953) argues that Chilean bankers, after the crisis of the mining sector around the 1870s, had acquired a number of mineral deposits given as collateral years before. And finally, but for the Argentinean case, Hora (2002, p. 609) explains that "the image of an entrepreneurial elite with assets *scattered throughout several spheres of investment* does not appear entirely correct."[110]

Additionally, there are structural reasons to believe that cross-sectoral investments were not

[105] Kirsch (1977, pp. 57, 95), citing Bauer (2008), who explains that "[m]iners and merchants bought haciendas but landowners in turn invested in banks, insurance companies, commercial firms and the incipient industrial sector." Coatsworth and Williamson (2002, p. 23) argue that "[t]he only landowners that mattered in 19th century Latin American politics were those for whom land represented but one asset in a much broader portfolio."
[106] Bauer (2008, pp. 30, 44, 94, 108).
[107] Emphases are mine.
[108] Unda (2017, p. 9) explains that in Mexico, industrial elites complied with the income tax in exchange for having a credit system more adequate for them.
[109] Emphasis is mine.
[110] Emphasis is mine.

efficient. The "dual sector" model argues that the economy is divided into agriculture and industry.[111] One finding of this paradigm is that the "natural" structural role of the agricultural sector is to provide labor and cheap foodstuff to the industrial sector.[112] For instance, Dixit (1973, p. 326) argues that the "agricultural sector *must* fulfill [...] its dual *role* of supplier of labour to industry and of food for the industrial labour force."[113] The rationale is that more efficient agricultural techniques make agricultural production less labor intensive, allowing landowners to free workers, which the industrial sector can rely on.[114] Surplus of labor naturally leads to a reallocation of redundant workers into the industrial sector, which is the crux of economic development.[115] Nurkse (1953), in fact, argues that development means to employ the surplus labor.[116]

Pre/Post Income Tax	Period	Directionality	chi2	P-value
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

Table 2: Granger Causality Wald Tests (Chilean Sectoral Growth).
Note*: The table shows which sector Granger-causes the other. The p-values change in a way that suggests that there was a reversal of institutions after implementing the income tax. Before the tax, industrial expansion Granger-caused agricultural production (a backwards equilibrium). However, after implementing the tax, agricultural expansion Granger-causes industrial development (modern growth).*

The paper has argued about the effect of sectoral conflicts on state consolidation. Was there a sectoral conflict? Were there two separate elites? To empirically test the existence of a sectoral duality, particularly in the context of income taxation, the same MOxLAD sectoral data were used. Since the income tax (1) had positive spillover effects on overall state capacity and (2) its implementation was split across a sectoral base, we should see that (1) adopting the income tax fostered state institutions, causing long-term economic growth,[117] and that (2) its implementation altered the sectoral mechanics of growth accumulation. In empirical terms, we should see that by altering the post-colonial order, implementing the income tax *reversed* the flow of inputs, installing a mechanism of growth generation that went *from* the agricultural sector *to* the industrial sector. In econometric terms, we should see that the implementing the tax reversed the way in which

[111] Jorgenson (1961, p. 311).
[112] Ranis and Fei (1964, p. 114). Reyes (2015, p. 129) documents a real increment in industrial salaries around 1938.
[113] Emphases are mine.
[114] Johnston (1951, p. 498).
[115] Ranis and Fei (1964, p. 7) and Leibenstein (1957, p. 51).
[116] Similarly, Matsuyama (1991, pp. 621-622) points out that "[i]ndustrialization [*consists of*] a shift of resources from agriculture to manufacturing."
[117] North (1990) and Besley and Persson (2011).

one sector "Granger-caused" the other.[118] Table 2 tests for Granger-causality both prior to and after the implementation of the income tax law.[119] The results strongly suggest that before the income tax law, industrial growth Granger-caused agricultural growth (backwards growth), but after the income tax law, the agricultural sector Granger-caused industrial development (modern growth), indicating that the implementation of the income tax was associated with the reversal of economically backwards institutions, fostering longer-run economic development.

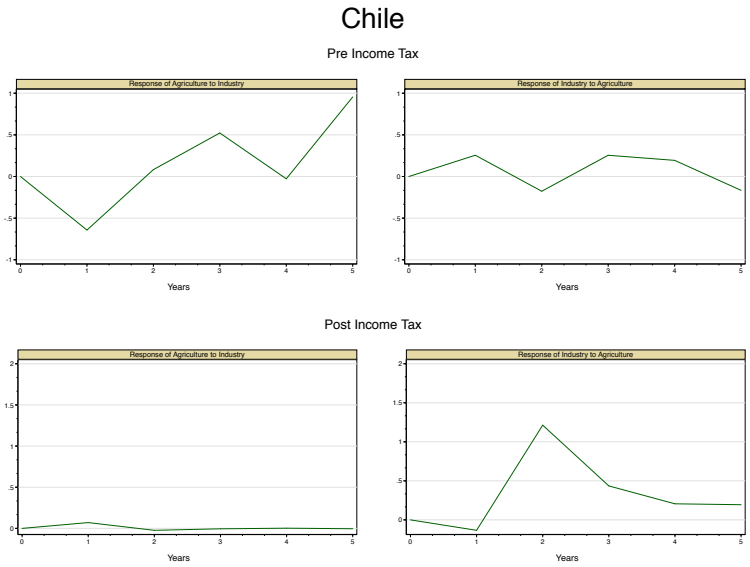

Figure 7: VAR Impulse Response Functions: Sectoral Responses to Each Other's Growths.
Note*: Granger-causality tests in Table 2 show the instantaneous causality between industrial and agricultural expansion, and vice versa. Impulse response functions, however, show via forecasting methods the inter-sectoral long-run equilibrium. In particular, the figure shows that the instantaneous Granger-causal relationships established in Table 2 (i.e. the reversal of institutions after implementing the income tax), persist in the long-run.*

It also needs to be examined whether these changes persisted in the long-term. Following Johansen (1988), the long-run sectoral relationship was estimated using a vector-autoregressive (VAR) approach. Figure 7 suggests that implementing the tax is associated with long-term economic growth. Particularly, the response of industry to agriculture after implementing the tax seems to

[118] Lutkepohl (2006, p. 42) explains that if some variable X forecasts variable Y (and not vise versa), X is said to "Granger-cause" Y. According to Granger (1980, p. 349), this concept of "causation" is based on the idea "that the future cannot cause the past."

[119] The tests were computed after estimating Equation 6, which is a reduced form VAR in differences, both before and after implementing the tax. For both periods, the VAR equation passes standard unit root tests (see Table OA5), and as per the lag length structure, it also passes standard normality and stability tests (Table OA4). More formally, the next equation was fitted:

$$\begin{aligned} \triangle M_{t_m} &= \alpha_m + \beta_m \triangle M_{t-l} + \beta_m \triangle A_{t-l} + \epsilon_{t_m} \\ \triangle A_{t_a} &= \alpha_a + \beta_a \triangle M_{t-l} + \beta_a \triangle A_{t-l} + \epsilon_{t_a} \end{aligned} \tag{6}$$

persist for some time, not decaying at least after five periods.

Overall, these structural conditions should have prevented cross-sectoral investments. Given the transference of inputs from one sector to another, and given that the agricultural sector is determined to lag behind the industrial sector,[120] elites invested in both sectors should experiment important allocative inefficiencies and deadweight losses, putting heavy pressures to invest in one or the other, not both. Granger-causality tests also suggest that after the tax is implemented, the agricultural sector lagged behind the industrial sector, while the VAR equation suggests a long-term equilibrium between the two sectors, where growth (i.e. factor allocation) begins in the land and ends in the industries.[121]

IV. Final Comments

The paper sketched an argument about how higher levels of sectoral contestation increased state-capacities over time. Particularly, it explained how the emergence of industrial elites lowered levels of inter-sectoral inequality, pushing agricultural and industrial elites to reach agreements that materialized in investments in state-making institutions (the income tax), fostering higher levels of state-capacities over time. The empirical analyses showed that death-tolls decrease (state capacities increase) after the income tax law is implemented, and that the emergence of the industrial sector, and not purely economic growth, accelerated the implementation of the income tax. Additional analyses also suggest that there was a structural sectoral cleavage rather than a blurred elite separation. While Kurtz (2009), Kurtz (2013), and Soifer (2015) situate the relevant state-building critical juncture at the end of the colonial period, before the class compromises this paper identifies, the argument posited that the implementation of the income tax was an important building block in this process.

Enforcing quake-sensitive building codes embodies the most basic form of social contract that exists between the state and its subjects. Earthquake damage poses a major threat to commercial, official, and residential buildings, potentially triggering higher levels of looting and social unrest. And such, any kind of political leader should be interested in preventing looting and social unrest. Leaders not only care about their own survival but also about the legitimacy of *the state*. In the event of heavy social unrest, not only is the essential social Hobbesian-like contract broken but

[120] The industrial sector uses capital and labor with increasing returns to scale, while agriculture uses land (which is fixed) as the main input (Jorgenson 1961, p. 311, Ranis and Fei 1964, p. 59, Jorgenson 1967, p. 291, Skott and Larudee 1998, pp. 279-280, and Vollrath 2009, p. 290).

[121] To clarify, "the agricultural sector declines relative to the overall economy but continues to expand absolutely" (Nerlove 1994, p. 14). In other words, it is the "the proportional contribution of agriculture to the growth" that decays (Kuznets 1961, p. 45), implying that in the long run the agricultural sector "must also grow" (Ranis and Fei 1961, p. 534), especially given the continuing dependence on a constant supply of food (Nicholls 1963, p. 2).

the expectations of social peace are also questioned.[122] The physical presence of the state literally *crumbles* when institutions of social coercion and discipline, such as state schools, prisons, and police stations, collapse. For example, when the magnitude 7.0 earthquake hit Hati in 2010, the *Prison Civile de Port-au-Prince* had a population of 4,500 inmates. During the quake, five inmates died. As a prison guard describes it, "everyone escaped. Everyone. Except the dead." This natural disaster exacerbated the already existent chaos, freeing "gang bosses, kidnappers, gunmen," among others,[123] reducing the legitimacy of the state to zero.

Finally, income taxation did even more than just triggering other state capacities. Via a process of assimilation, it also helped in constructing the figure of the citizen centered around the concept of the taxpayer. Regardless of an individual's race, religion, culture, or any other kind of status, the state classifies its subjects according to their incomes and obliges them to pay, punishing whoever refuses to do so. From a sociological standpoint, this "generality makes taxation a crucial element in the development of the "imagined community"[124] of the modern nation-state [...] Taxation enmeshes us in the web of generalized reciprocity that constitutes modern society."[125]

[122] Carlin, Love, and Zechmeister (2014, p. 419) study how earthquakes damage interpersonal trust. They argue that "state capacity plays a decisive role in determining natural disasters' consequences for social capital."
[123] Reed (2011). See also Laursen (2010).
[124] Anderson (2006).
[125] Martin et al., in Martin, Mehrotra, and Prasad 2009, p. 3.

References

Acemoglu, Daron (2005). "Politics and Economics in Weak and Strong States." In: *Journal of Monetary Economics* 52.7, pp. 1199–1226.

Acemoglu, Daron, Jacob Moscona, and James Robinson (2016). *State Capacity and American Technology: Evidence from the 19th Century*. Tech. rep. Cambridge, MA: National Bureau of Economic Research.

Acemoglu, Daron and James Robinson (2009). *Economic Origins of Dictatorship and Democracy*. Cambridge University Press.

Aghion, Philippe, Alberto Alesina, and Francesco Trebbi (2004). "Endogenous Political Institutions." In: *The Quarterly Journal of Economics* 119.2, pp. 565–611.

Aguilera, Xavier and Efrén Vera (2013). *Análisis del Impacto de las Variaciones del Anticipo del Impuesto a la Renta en Sociedades del Austro Periodo 2007-2012*.

Aidt, Toke and Peter Jensen (2009). "The Taxman Tools Up: An Event History Study of the Introduction of the Personal Income Tax." In: *Journal of Public Economics* 93.1-2, pp. 160–175.

Ambraseys, Nicholas and Roger Bilham (2011). "Corruption Kills." In: *Nature* 469.7329, pp. 153–155.

Anbarci, Nejat, Monica Escaleras, and Charles Register (2005). "Earthquake Fatalities: The Interaction of Nature and Political Economy." In: *Journal of Public Economics* 89.9-10, pp. 1907–1933.

Anderson, Benedict (2006). *Imagined Communities: Reflections on the Origin and Spread of Nationalism, Revised Edition*. Verso, p. 240.

Ansell, Ben and David Samuels (2014). *Inequality and Democratization: An Elite-Competition Approach*. Cambridge University Press.

Astorga, Pablo, Ame Berges, and Valpy Fitzgerald (2005). "The Standard of Living in Latin America During the Twentieth Century." In: *Economic History Review* 58.4, pp. 765–796.

Bahamonde, Hector (n.d.). "Sectoral Origins of Income Taxation: Industrial Development in Latin America and The Case of Chile (1900-2010)." In: *Unpublished*.

Baland, Jean Marie and James Robinson (2008). "Land and Power: Theory and Evidence from Chile." In: *American Economic Review* 98.5, pp. 1737–1765.

Barros, Mario (1970). *Historia diplomática de Chile, 1541-1938*. Andres Bello.

Bates, Robert and Donald Lien (1985). "A Note on Taxation, Development, and Representative Government." In: *Politics & Society* 14.1, pp. 53–70.

Bauer, Arnold (2008). *Chilean Rural Society: From the Spanish Conquest to 1930*. Cambridge University Press.

Beramendi, Pablo, Mark Dincecco, and Melissa Rogers (2016). "Intra-Elite Competition and Long-Run Fiscal Development." In:

Bertola, Luis and Jose Antonio Ocampo (2012). *The Economic Development of Latin America since Independence*. Oxford University Press.

Besley, Timothy, Ethan Ilzetzki, and Torsten Persson (2013). "Weak States and Steady States: The Dynamics of Fiscal Capacity." In: *American Economic Journal: Macroeconomics* 5.4, pp. 205–235.

Besley, Timothy and Torsten Persson (2009). "The Origins of State Capacity: Property Rights, Taxation, and Politics." In: *American Economic Review* 99.4, pp. 1218–1244.

Besley, Timothy and Torsten Persson (2010). "State Capacity, Conflict, and Development." In: *Econometrica* 78.1, pp. 1–34.

Besley, Timothy and Torsten Persson (2011). *Pillars of Prosperity: The Political Economics of Development Clusters*. Princeton University Press.

Besley, Timothy and Torsten Persson (2014). "Why Do Developing Countries Tax So Little?" In: *Journal of Economic Perspectives* 28.4, pp. 99–120.

Best, Michael (1976). "Political Power and Tax Revenues in Central America." In: *Journal of Development Economics* 3.1, pp. 49–82.

Bilham, Roger (2013). "Societal and Observational Problems in Earthquake Risk Assessments and their Delivery to Those Most at Risk." In: *Tectonophysics* 584, pp. 166–173.

Bilham, Roger and Vinod Gaur (2013). "Buildings as Weapons of Mass Destruction." In: *Science* 341.6146, pp. 618–619.

Boix, Carles (2003). *Democracy and Redistribution*. Cambridge University Press.

Boix, Carles (2015). *Political Order and Inequality: Their Foundations and their Consequences for Human Welfare*. Cambridge Studies in Comparative Politics.

Bowman, John and Michael Wallerstein (1982). "The Fall of Balmaceda and Public Finance in Chile: New Data for an Old Debate." In: *Journal of Interamerican Studies and World Affairs* 24.4, pp. 421–460.

Box-Steffensmeier, Janet and Bradford Jones (2004). *Event History Modeling A Guide for Social Scientists*. Cambridge: Cambridge University Press.

Brancati, Dawn (2007). "Political Aftershocks: The Impact of Earthquakes on Intrastate Conflict." In: *Journal of Conflict Resolution* 51.5, pp. 715–743.

Brautigam, Deborah, Odd-Helge Fjeldstad, and Mick Moore (2008). *Taxation and State-Building in Developing Countries: Capacity and Consent*. Cambridge University Press, p. 261.

Campbell, John (1993). "The State and Fiscal Sociology." In: *Annual Review of Sociology* 19.1, pp. 163–185.

Carlin, Ryan, Gregory Love, and Elizabeth Zechmeister (2014). "Trust Shaken: Earthquake Damage, State Capacity, and Interpersonal Trust in Comparative Perspective." In: *Comparative Politics* 46.4, pp. 419–453.

Caruso, Germán (2017). "The Legacy of Natural Disasters: The Intergenerational Impact of 100 Years of Disasters in Latin America." In: *Journal of Development Economics*, pp. 1–54.

Centeno, Miguel Angel (2002). *Blood and Debt: War and the Nation-State in Latin America*. Penn State University Press.

Coatsworth, John (1974). "Railroads, Landholding, and Agrarian Protest in the Early Porfiriato." In: *The Hispanic American Historical Review* 54.1, pp. 48–71.

Coatsworth, John and Jeffrey Williamson (2002). *The Roots of Latin American Protectionism: Looking Before the Great Depression*. Tech. rep. Cambridge, MA: National Bureau of Economic Research, pp. 37–73.

Collier, Ruth and David Collier (2002). *Shaping The Political Arena: Critical Junctures, the Labor Movement, and Regime Dynamics in Latin America*. University of Notre Dame Press.

Dargent, Eduardo, Andreas Feldmann, and Juan Pablo Luna (2017). "Greater State Capacity, Lesser Stateness: Lessons from the Peruvian Commodity Boom." In: *Politics & Society* 45.1, pp. 3–34.

Dincecco, Mark and Massimiliano Onorato (2016). "Military Conflict and the Rise of Urban Europe." In: *Journal of Economic Growth* 21.3, pp. 259–282.

Dincecco, Mark and Ugo Troiano (2015). "Broadening the State: Policy Responses to the Introduction of the Income Tax." In: *NBER Working Paper* 21373, pp. 1–25.

Dixit, Avinash (1973). "Models of Dual Economy." In: ed. by James Mirrlees and Nicholas Stern. Models of Economic Growth: Proceedings of a Conference Held by the International Economic Assicuation at Jerusalem.

Drake, Paul and Mathew McCubbins, eds. (1998). *The Origins of Liberty: Political and Economic Liberalization in the Modern World*. Princeton University Press.

Dunbar, Paula, Roger Bilham, and Melinda Laituri (2003). "Earthquake Loss Estimation for India Based on Macroeconomic Indicators." In: *Earthquake*, pp. 163–180.

Engerman, Stanley and Kenneth Sokoloff (2005). "The Evolution of Suffrage Institutions in the New World." In: *The Journal of Economic History* 65.04, p. 891.

Engerman, Stanley and Kenneth Sokoloff (2011). *Economic Development in the Americas since 1500: Endowments and Institutions*. Cambridge University Press.

Enriquez, Elaine, Martin Sybblis, and Miguel Centeno (2017). "A Cross-National Comparison of Subnational Variation." In: *American Behavioral Scientist*, p. 000276421772394.

Escaleras, Monica, Nejat Anbarci, and Charles Register (2007). "Public Sector Corruption and Major Earthquakes: A Potentially Deadly Interaction." In: *Public Choice* 132.1-2, pp. 209–230.

Fearon, James and David Laitin (2003). "Ethnicity, Insurgency, and Civil War." In: *American Political Science Review* 97.01, pp. 75–90.

Figueroa, Alfredo Lewin (2008). "Historia de las Reformas Tributarias en Colombia." In: *Fundamentos de la Tributación*. Bogotá: Universidad de los Andes Editorial Temis, p. 371.

Foa, Roberto and Anna Nemirovskaya (2016). "How State Capacity Varies within Frontier States: A Multicountry Subnational Analysis." In: *Governance* 29.3, pp. 411–432.

Fukuyama, Francis (2004). *State-Building: Governance and World Order in the 21st Century*. Cornell University Press.

Fukuyama, Francis (2013). "What Is Governance?" In: *Governance: An International Journal of Policy, Administration, and Institutions* 26.3, pp. 347–368.

Gallo, Carmenza (1991). *Taxes and state power: Political instability in Bolivia, 1900-1950*. Temple University Press.

Gandrud, Christopher (2015). "simPH: An R Package for Illustrating Estimates from Cox Proportional Hazard Models Including." In: *Journal of Statistical Software* 65.3, pp. 1–20.

Gignoux, Jérémie and Marta Menéndez (2016). "Benefit in the Wake of Disaster: Long-Run Effects of Earthquakes on Welfare in Rural Indonesia." In: *Journal of Development Economics* 118.33, pp. 26–44.

Gobierno del Perú (1934). *Ley Nº 7904, Ley de Impuestos a la Renta*.

Granger, Clive (1980). "Testing for Causality: A Personal Viewpoint." In: *Journal of Economic Dynamics and Control* 2, pp. 329–352.

Hanley, James et al. (2003). "Statistical Analysis of Correlated Data Using Generalized Estimating Equations: An Orientation." In: *American Journal of Epidemiology* 157.4, pp. 364–375.

Hanson, Jonathan (2015). "Democracy and State Capacity: Complements or Substitutes?" In: *Studies in Comparative International Development* 50.3, pp. 304–330.

Hanson, Jonathan and Rachel Sigman (2013). "Leviathan's Latent Dimensions: Measuring State Capacity for Comparative Political Research." In: *American Political Science Association Meeting*, pp. 1–31.

Hardin, James and Joseph Hilbe (2013). *Generalized Estimating Equations*. 2nd. Boca Raton, FL: CRC Press.

Hechter, Michael and William Brustein (1980). "Regional Modes of Production and Patterns of State Formation in Western Europe." In: *American Journal of Sociology* 85.5, pp. 1061–1094.

Hedeker, Donald and Robert Gibbons (2006). *Longitudinal Data Analysis*. Wiley Series in Probability and Statistics. Hoboken, NJ, USA: John Wiley & Sons, Inc.

Hirschman, Albert (1958). *The Strategy of Economic Development*. Yale University Press.

Hirschman, Albert (1970). *Exit, Voice, and Loyalty: Responses to Decline in Firms, Organizations, and States*. Harvard University Press.

Hojsgaard, Soren, Ulrich Halekoh, and Jun Yan (2016). *geepack: Generalized Estimating Equation Package*. Version 1.2-0.1.

Hora, Roy (2002). "Landowning Bourgeoisie or Business Bourgeoisie? On the Peculiarities of the Argentine Economic Elite, 1880-1945." In: *Journal of Latin American Studies* 34.03, pp. 587–623.

Huntington, Heather and Erik Wibbels (2014). "The Geography of Governance in Africa: New Tools from Satellites, Surveys and Mapping Initiatives." In: *Regional & Federal Studies* 24.5, pp. 625–645.

Instituto Centroamericano de Estudios Fiscales (2007). *Historia de la Tributación en Guatemala*. Tech. rep. Instituto Centroamericano de Estudios Fiscales.

Johansen, Soren (1988). "Statistical Analysis of Cointegration Vectors." In: *Journal of Economic Dynamics and Control* 12.2-3, pp. 231–254.

Johnson, Noel and Mark Koyama (2017). "States and Economic Growth: Capacity and Constraints." In: *Explorations in Economic History* 64.December 2015, pp. 1–20.

Johnston, Bruce (1951). "Agricultural Productivity and Economic Development in Japan." In: *Journal of Political Economy* 59.6, pp. 498–513.

Johnston, Bruce and John Mellor (1961). "The Role of Agriculture in Economic Development." In: *The American Economic Review* 51.4, pp. 566–593.

Jorgenson, Dale (1961). "The Development of a Dual Economy." In: *The Economic Journal* 71.282, pp. 309–334.

Jorgenson, Dale (1967). "Surplus Agricultural Labour and the Development of a Dual Economy." In: *Oxford Economic Papers, New Series* 19.3, pp. 288–312.

Kahn, Matthew (2005). "The Death Toll from Natural Disasters: The Role of Income, Geography, and Institutions." In: *Review of Economics and Statistics* 87.2, pp. 271–284.

Keefer, Philip, Eric Neumayer, and Thomas Plümper (2011). "Earthquake Propensity and the Politics of Mortality Prevention." In: *World Development* 39.9, pp. 1530–1541.

Keller, Carlos (1931). *La Eterna Crisis Chilena*. Santiago, Chile: Nascimiento, p. 323.

Kirsch, Henry (1977). *Industrial Development in a Traditional Society: The Conflict of Entrepreneurship and Modernization in Chile*. The University Presses of Florida.

Kiser, Edgar and Xiaoxi Tong (1992). “Determinants of the Amount and Type of Corruption in State Fiscal Bureaucracies: An Analysis of Late Imperial China.” In: *Comparative Political Studies* 25.3, pp. 300–331.

Krasner, Stephen (1985). *Structural Conflict: The Third World Against Global Liberalism*. University of California Press.

Kurtz, Marcus (2006). “Where Does a "Strong" State Come from? Resources, War, or Society in South American State Building.” In: *Annual Meeting of the American Political Science Association*. Philadelphia, PA, pp. 1–52.

Kurtz, Marcus (2009). “The Social Foundations of Institutional Order: Reconsidering War and the "Resource Curse" in Third World State Building.” In: *Politics & Society* 37.4, pp. 479–520.

Kurtz, Marcus (2013). *Latin American State Building in Comparative Perspective: Social Foundations of Institutional Order*. Cambridge University Press.

Kurtz, Marcus and Andrew Schrank (2007). “Growth and Governance: Models, Measures, and Mechanisms.” In: *Journal of Politics* 69.2, pp. 538–554.

Kurtz, Marcus and Andrew Schrank (2012). “Capturing State Strenght: Experimental and Econometric Approaches.” In: *Revista De Ciencia Política* 32.3, pp. 613–622.

Kuznets, Simon (1961). “Economic Growth and the Contribution of Agriculture: Notes on Measurement.” In: *1961 Conference, August 19-30, 1961, Cuernavaca, Morelos, Mexico*.

Laursen, Lucas (2010). “Haiti Earthquake may have Primed Nearby Faults for Failure.” In: *Nature* 463.February, pp. 878–879.

Lee, Melissa and Nan Zhang (2017). “Legibility and the Informational Foundations of State Capacity.” In: *The Journal of Politics* 79.1, pp. 118–132.

Leibenstein, Harvey (1957). *Economic Backwardness and Economic Growth*. 1st. John Wiley and Sons.

Leifeld, Philip (2013). “texreg: Conversion of Statistical Model Output in R to LaTeX and HTML Tables.” In: *Journal of Statistical Software* 55.8, pp. 1–24.

Levi, Margaret (1989). *Of Rule and Revenue*. University of California Press.

Liang, Kung-Yee and Scott Zeger (1986). “Longitudinal Data Analysis Using Generalized Linear Models.” In: *Biometrika* 73.1, pp. 13–22.

Lomnitz, Cinna (1970). “Casualties and Behavior of Populations During Earthquakes.” In: *Bulletin of the Seismological Society of America* 60.4, pp. 1309–1313.

Luna, Juan Pablo and Hillel Soifer (2017). “Capturing Subnational Variation in State Capacity: A Survey-Based Approach.” In: *American Behavioral Scientist*.

Luna, Juan Pablo and Sergio Toro (2014). "State Capacity and Democratic Government in Latin America: A Survey Data-Based Approach to Measurement and Assessment."

Lutkepohl, Helmut (2006). *New Introduction to Multiple Time Series Analysis*. Springer.

Mahoney, James (2010). *Colonialism and Postcolonial Development: Spanish America in Comparative Perspective*. Cambridge University Press.

Mamalakis, Markos (1969). "The Theory of Sectoral Clashes." In: *Latin American Research Review* 4.3, pp. 9–46.

Mamalakis, Markos (1971). "The Theory of Sectoral Clashes and Coalitions Revisited." In: *Latin American Research Review* 6.3, pp. 89–126.

Mamalakis, Markos (1976). *Growth and Structure of the Chilean Economy: From Independence to Allende*. Yale University Press.

Mann, Michael (1984). "The Autonomous Power of the State: Its Origins, Mechanisms and Results." In: *European Journal of Sociology* 25.02, p. 185.

Mann, Michael (2008). "Infrastructural Power Revisited." In: *Studies in Comparative International Development* 43.3-4, pp. 355–365.

Marichal, Carlos (1989). *A Century of Debt Crises in Latin America: From Independence to the Great Depression, 1820-1930*. Princeton University Press.

Martin, Isaac, Ajay Mehrotra, and Monica Prasad, eds. (2009). *The New Fiscal Sociology Taxation in Comparative and Historical Perspective*. Cambridge University Press, p. 314.

Matsuyama, Kiminori (1991). "Increasing Returns, Industrialization, and Indeterminacy of Equilibrium." In: *The Quarterly Journal of Economics* 106.2, pp. 617–650.

McBride, George McCutchen (1936). *Chile: Land and Society*. Octagon Books.

Moore, Barrington (1966). *Social Origins of Dictatorship and Democracy: Lord and Peasant in the Making of the Modern World*. Penguin University Books.

Moore, Mick (2004a). "Revenues, State Formation, and The Quality of Governance in Developing Countries." In: *International Political Science Review* 25.3, pp. 297–319.

Moore, Mick (2004b). "Taxation and the Political Agenda, North and South." In: *Forum for Development Studies* 1, pp. 7–32.

Musgrave, Richard (1992). "Schumpeter's Crisis of The Tax State: An Essay in Fiscal Sociology." In: *Journal of Evolutionary Economics* 2.2, pp. 89–113.

Nerlove, Marc (1994). "The Role of Agriculture in General Economic Development: A Reinterpretation of Jorgenson and Lewis." In: *Agricultural Development, Population Growth and the Environment: Lecture Notes for AREC 445*. Chap. 4.

(NGDC/WDS), National Geophysical Data Center / World Data Service (n.d.). *Significant Earthquake Database. National Geophysical Data Center, NOAA*.

Nicholls, William (1963). "An "Agricultural Surplus" as a Factor in Economic Development." In: *Journal of Political Economy* 71.1, pp. 1–29.

Noji, Eric, ed. (1996). *The Public Health Consequences of Disasters*. Oxford University Press.

North, Douglass (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge University Press.

Nurkse, Ragnar (1953). *Problems of Capital Formation in Underdeveloped Countries*. 2nd. Basil Blackwell.

Ranis, Gustav and John Fei (1961). "A Theory of Economic Development." In: *The American Economic Review* 51.4, pp. 533–565.

Ranis, Gustav and John Fei (1964). *Development of the Labor Surplus Economy*. The Economic Growth Center, Yale University. Richard D.Irwin, Inc.

Raschky, Paul (2008). "Institutions and the Losses from Natural Disasters." In: *Natural Haxards and Earth System Sciences* 8, pp. 627–634.

Reed, Dan (2011). *The Ballad of Haiti Jail: On the trail of the fugitive convicts after the earthquake set them free*.

Reyes, Nora (2015). "Salarios Agrícolas Durante la Industrialización en Chile: Factores Económicos e Institucionales." In: *Estudios de Economía* 42.2, pp. 121–141.

Rippy, James (1971). *Latin America and the Industrial Age*. Greenwood Press.

Robinson, James (2006). "Economic Development and Democracy." In: *Annual Review of Political Science* 9.1, pp. 503–527.

Saylor, Ryan (2012). "Sources of State Capacity in Latin America: Commodity Booms and State Building Motives in Chile." In: *Theory and Society* 41.3, pp. 301–324.

Saylor, Ryan (2014). *State Building in Boom Times: Commodities and Coalitions in Latin America and Africa*. Oxford University Press.

Schneider, Aaron (2012). *State-Building and Tax Regimes in Central America*. Cambridge University Press.

Segall, Marcelo (1953). *Desarrollo del Capitalismo en Chile: Cinco Ensayos Dialecticos*. Del Pacifi. Santiago, Chile, p. 353.

Skott, Peter and Mehrene Larudee (1998). "Uneven Development and the Liberalisation of Trade and Capital Flows: The Case of Mexico." In: *Cambridge Journal of Economics* 22.3, pp. 277–295.

Slater, Dan (2008). "Can Leviathan be Democratic? Competitive Elections, Robust Mass Politics, and State Infrastructural Power." In: *Studies in Comparative International Development* 43.3-4, pp. 252–272.

Soifer, Hillel (2008). "State Infrastructural Power: Approaches to Conceptualization and Measurement." In: *Studies in Comparative International Development* 43.3-4, pp. 231–251.

Soifer, Hillel (2012). "Measuring State Capacity in Contemporary Latin America." In: *Revista de Ciencia Política* 32.3, pp. 585–598.

Soifer, Hillel (2013). "State Power and the Economic Origins of Democracy." In: *Studies in Comparative International Development* 48.1, pp. 1–22.

Soifer, Hillel (2015). *State Building in Latin America*.

Sokoloff, Kenneth and Stanley Engerman (2000). "History Lessons: Institutions, Factor Endowments, and Paths of Development in the New World." In: *Journal of Economic Perspectives* 14.3, pp. 217–232.

Stephens, John, Dietrich Rueschemeyer, and Evelyne Huber Stephens (1992). *Capitalist Development and Democracy*. University of Chicago Press.

Strayer, Joseph (2005). *On the Medieval Origins of the Modern State*. Princeton University Press.

Szeliga, Walter et al. (2010). "Intensity, Magnitude, Location, and Attenuation in India for Felt Aarthquakes Since 1762." In: *Bulletin of the Seismological Society of America* 100.2, pp. 570–584.

Therneau, Terry (2015). *survival: Package for Survival Analysis*. R package version 2.38-3.

Thies, Cameron (2005). "War, Rivalry, and State Building in Latin America." In: *American Journal of Political Science* 49.3, pp. 451–465.

Thies, Cameron (2009). "National Design and State Building in Sub-Saharan Africa." In: *World Politics* 61.4, pp. 623–669.

Thies, Cameron (2015). "State Fiscal Capacity and State failure." In: *European Political Science Review* 7.02, pp. 167–187.

Thies, Cameron, Olga Chyzh, and Mark Nieman (2016). "The Spatial Dimensions of State Fiscal Capacity The Mechanisms of International Influence on Domestic Extractive Efforts." In: *Political Science Research and Methods* 4.01, pp. 5–26.

Tilly, Charles (1992). *Coercion, Capital and European States: AD 990 - 1992*. Wiley-Blackwell.

Unda, Mónica (2017). "A Tale of Two Taxes: The Diverging Fates of the Federal Property and Income Tax Decrees in Post-Revolutionary Mexico." In: *Investigaciones de Historia Económica - Economic History Research* 13.2, pp. 107–116.

Uribe-Uran, Victor (2001). *State and Society in Spanish America during the Age of Revolution*. Rowman & Littlefield Publishers.

Veliz, Claudio (1963). "La Mesa de Tres Patas." In: *Desarrollo Economico* 3.1/2 America Latina 1, pp. 231–247.

Ventura, Juan and María Elena Armas (2013). "Beneficios Tributarios en la Ley del Impuesto Sobre la Renta." In: *Comercium et Tributum* 10, pp. 25–44.

Vollrath, Dietrich (2009). "The Dual Economy in Long-Run Development." In: *Journal of Economic Growth* 14.4, pp. 287–312.

Wright, Thomas (1975). "Agriculture and Protectionism in Chile, 1880-1930." In: *Journal of Latin American Studies* 7.1, pp. 45–58.

Zeitlin, Maurice (1984). *The Civil Wars in Chile: (or The Bourgeois Revolutions that Never Were)*. Princeton University Press.

Zorn, Christopher (2006). "Comparing GEE and Robust Standard Errors for Conditionally Dependent Data." In: *Political Research Quarterly* 59.3, pp. 329–341.

Word count: 8,845

V. Online Appendix

$$i_{1,\dots I} \text{ and I} = 91$$

$$t_{1,\dots T} \text{ and T} = 59;$$

and,

$$\begin{aligned} \beta_{k,\dots K} &\sim \mathcal{N}(0, 0.01) \text{ where K} = 8 \\ \tau_{p,\dots P} &\sim \mathcal{G}(0.5, 0.001) \text{ where P} = 59. \end{aligned}$$

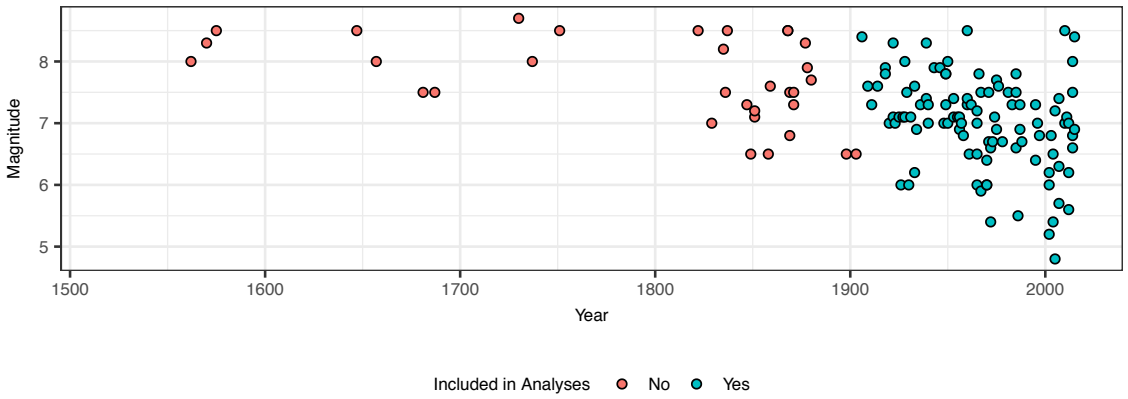

Figure OA1: Earthquakes in Chile: 1500-2010.

Note: *Figure shows earthquakes available in the NOAA dataset. Due to data availability at the local level (local population, for example), however, it was possible to include in the analyses the earthquakes that took place begining in 1903. Figure 2 shows the actual observations used in the analyses (N=101).*

	Mean	SD	Lower	Upper	Pr.
Income Tax	-3.88	3.60	-11.22	3.18	0.86
Magnitude	0.06	0.01	0.04	0.08	1.00
Latitude	0.06	0.02	0.03	0.09	1.00
Longitude	-0.49	0.07	-0.63	-0.36	1.00
Population	-0.02	0.00	-0.02	-0.01	1.00
Urban	-5.19	0.73	-6.78	-3.96	1.00

Note: 200,000 iterations with a burn-in period of n = 5,000 iterations discarded.

95% 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.

Table OA1: Income Tax Adoption Model: Simulated Posterior Predictions (Poisson Regression, Equation 1).

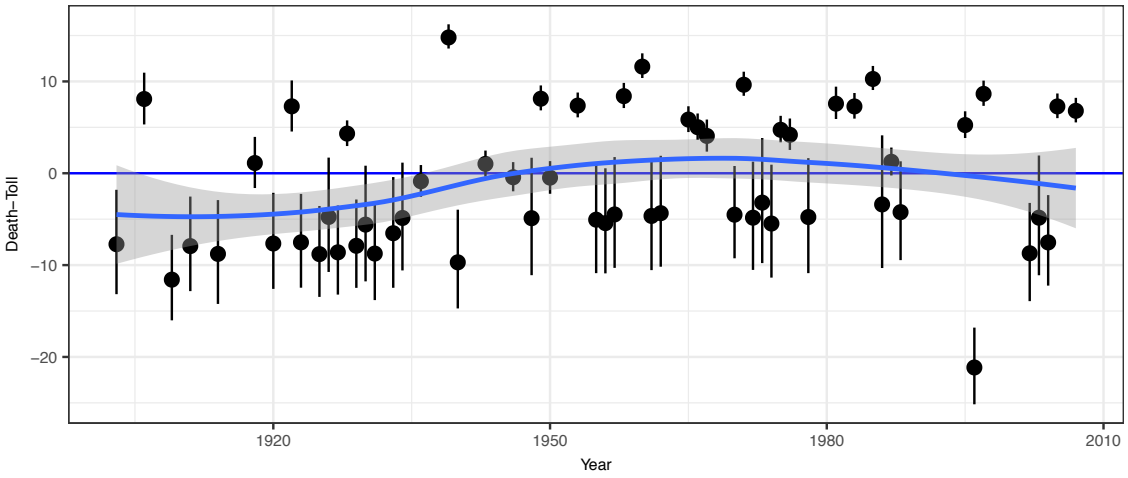

Figure OA2: Year Fixed Effects.

Note: *Figure shows the estimated posteriors of the year fixed effects (as per Table OA1). Formally, it shows all β_6's in Equation 5. Substantively, the figure suggests that, overall, there are no influential years driving the results.*

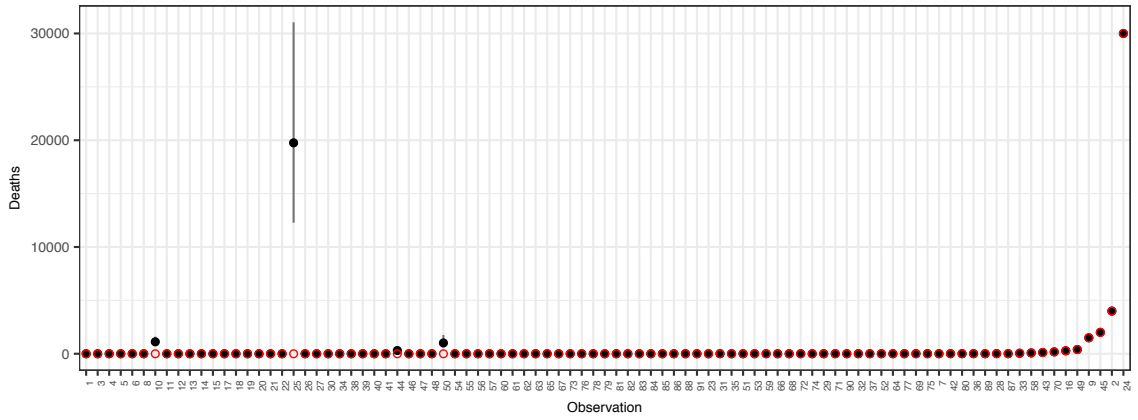

Figure OA3: Assessing Model Fit.

Note: *The figure assesses the goodness of fit of Equation 5 (Table OA1). Since the model deals with the count of casualties associated with earthquakes (Y-axis), a "good" model should minimize the distance between the predicted count (black dots, with confidence intervals) and the actual count (red dots). The figure shows that the model does a good job in predicting the actual death-toll.*

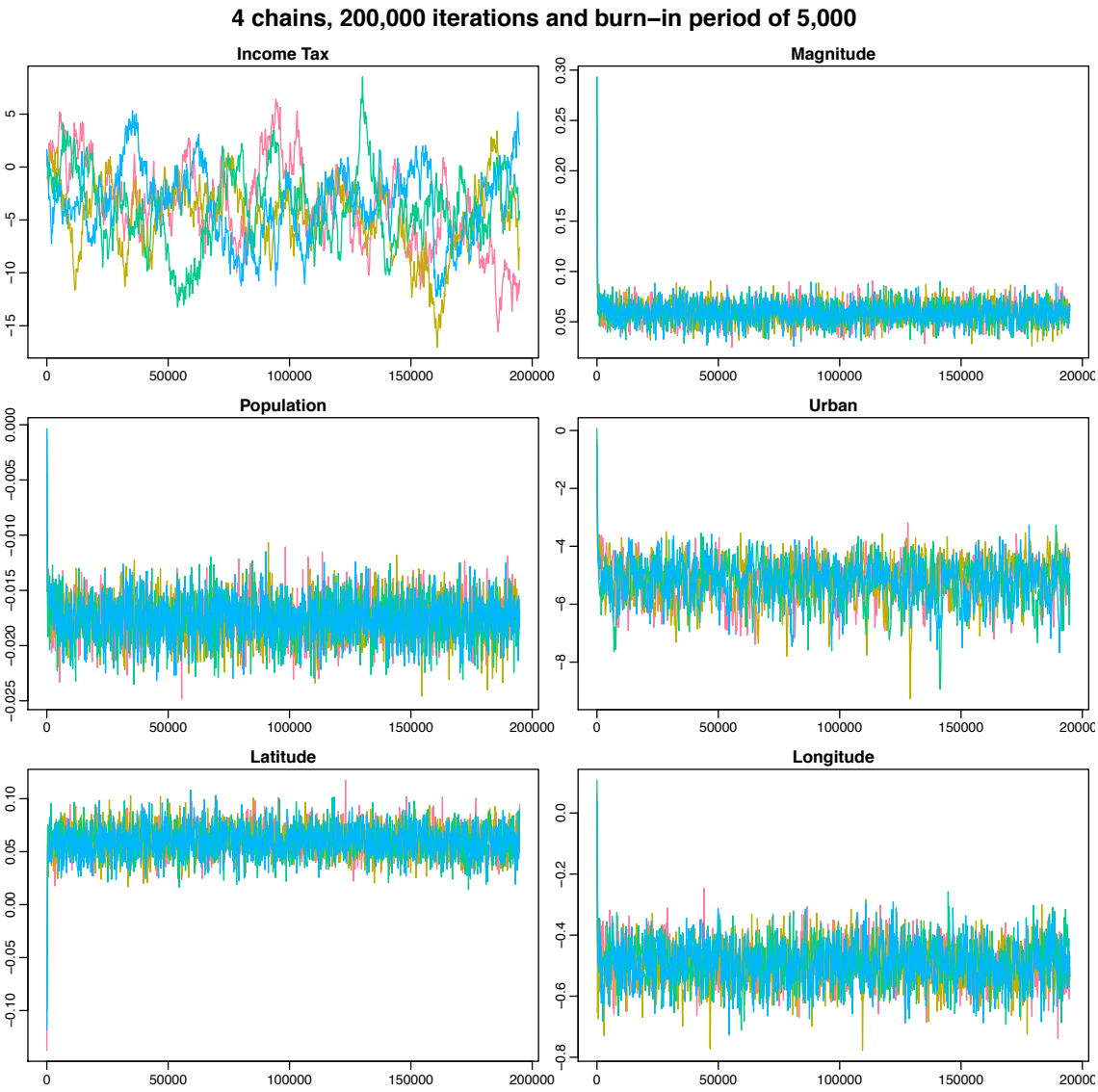

Figure OA4: *Trace Plots: Income Tax Adoption Model*

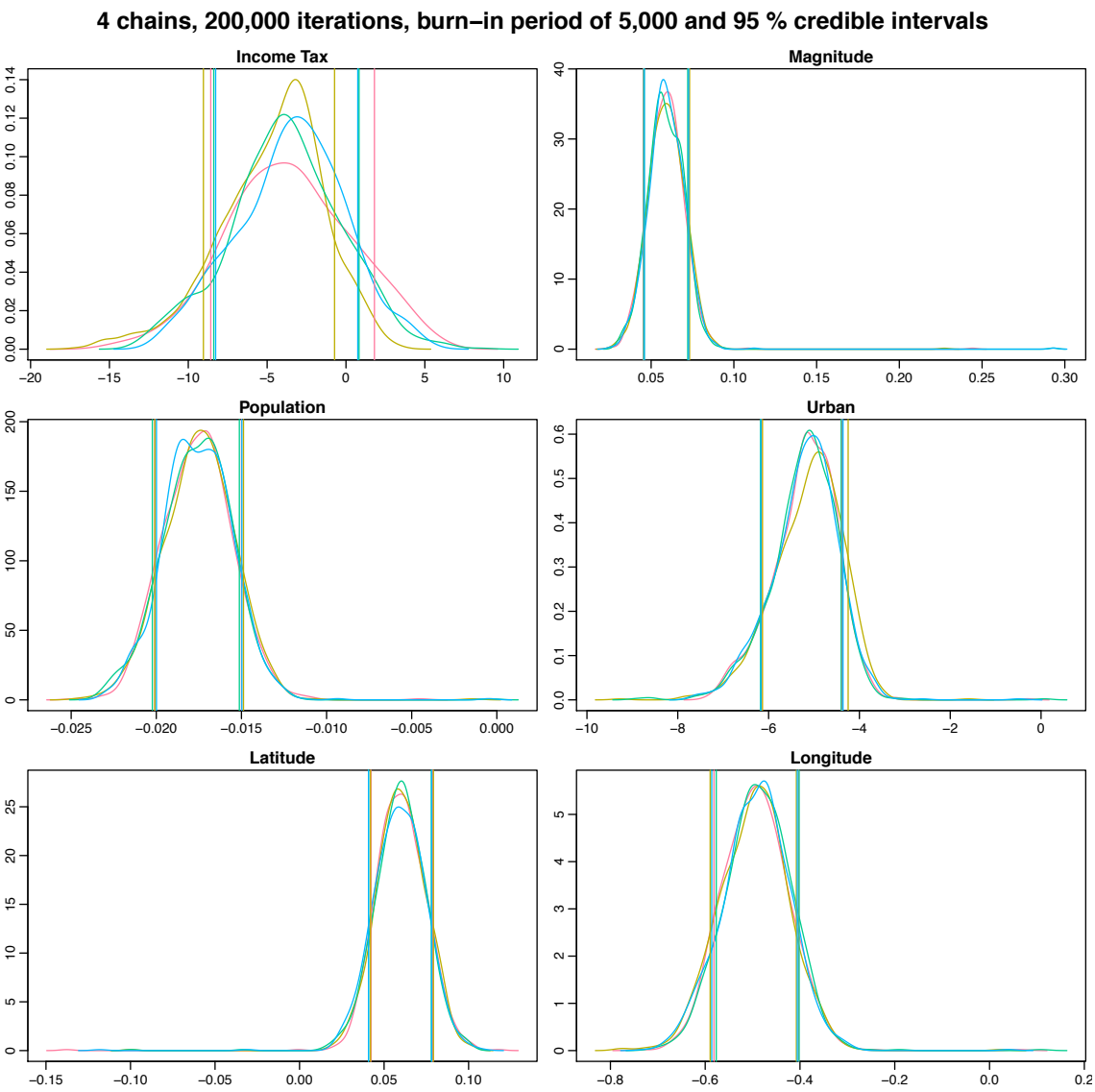

Figure OA5: *Density Plots: Income Tax Adoption Model*

Country	Available Data	Year Income Tax	Law	Source
Chile	1900 - 2009	1924	*Ley* 3996	Mamalakis (1976, p. 20) and LeyChile.Cl (official)
Peru	1929 - 2009	1934	*Ley* 7904	Gobierno del Perú (1934) (official)
Venezuela	1936 - 2006	1943	*Ley* 20851	*Gaceta Oficial* (official) and Ventura and Armas (2013, p. 27)
Colombia	1900 - 2009	1935	*Ley* 78	Figueroa (2008, p. 9)
Argentina	1900 - 2010	1933	*Ley* 11682	Infoleg.Gob.Ar (official)
Mexico	1900 - 2009	1925	*Ley de Impuesto sobre la Renta*	Unda (2017, p. 8)
Ecuador	1939 - 2007	1945	-	Aguilera and Vera (2013, p. 135)
Nicaragua	1920 - 2009	1974	*Ley* 662	Legislacion.Asamblea.Gob.Ni (official)
Guatemala	1920 - 2009	1963	*Decreto* 1559	Instituto Centroamericano de Estudios Fiscales (2007, p. 165)

Table OA2: *Sample, Data Available and Year the Income Tax was Implemented*

	(1) Cox (1 lag)	(2) Logit GEE	(3) Conditional Logit (FE)
Manufacture Output$_{t-1}$	4.923**		
	(1.851)		
Agricultural Output$_{t-1}$	−4.208*		
	(1.638)		
Total Population	0.000**		
	(0.000)		
Manufacture Output (ln)		1.924***	0.668***
		(0.514)	(0.143)
Agricultural Output (ln)		−1.596**	−0.941***
		(0.603)	(0.281)
Total Population (ln)		1.259	1.030**
		(1.052)	(0.391)
AIC	12.796		4505.538
R^2	0.059		0.341
Max. R^2	0.085		0.997
Num. events	9		610
Num. obs.	241	842	842
Missings	0		0
PH test	0.388		
Num. clust.		9	

$^{***}p < 0.001$, $^{**}p < 0.01$, $^{*}p < 0.05$, $^{cdot}p < 0.1$. Robust standard errors in all models. Intercept omitted.

Table OA3: *Sectoral Origins of Income Taxation: Income Tax Law and Industrial Development*

Country	Time Frame	Number of Lags	LM	Normally Tests			Stability Condition
				Jarque-Bera	*Skewness*	*Kurtosis*	
Chile	Pre	4	✓	✓	✓	✓	✓
	Post	2	✓	✓⁻	✓⁻	✓⁻	✓

Table OA4: *Lag Length and Post-Estimation Results*

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)	2.556 (0.99)	.113†	I(1)
	Post	Agriculture	4.557 (1.00)	5.40 (1.00)	.289	I(1)
		Industry	0.908 (0.99)	1.458 (0.99)	.249	I(1)
	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)

Table OA5: *Unit Root Tests for Agricultural and Industrial Growth*