

# Income Taxation and State Capacities in Chile: measuring institutional development using historical earthquake data

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## Abstract

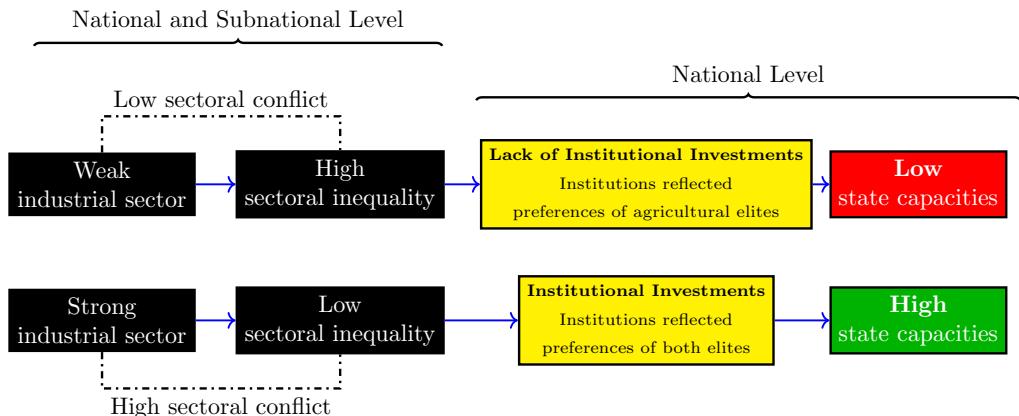
I argue that higher levels of sectoral competition increased state-capacities over time. Specifically, I explain how the emergence of industrial elites lowered levels of inter-sectoral inequality, pushing the agricultural and industrial elites to reach agreements that materialized in investments in state-making institutions, causing in turn higher state-capacities. Exploiting the exogeneity of earthquake shocks, I leverage a novel intertemporal dataset on Chilean earthquake death tolls and a Bayesian multilevel Poisson model to account for state capacities between 1900 and 2010. I contend that the capacity the state has of enforcing and monitoring building codes throughout the territory is a reflection of its overall state capacities. To explore the causal mechanisms at work more deeply, I leverage the Chilean case, presenting some historical evidence showing that the rise of the industrial economic sector pushed agricultural and industrial political elites to invest in state-making institutions, particularly, the implementation of the income tax law. What my empirical analyses show is twofold. Death-tolls decrease, that is, state capacities increase, (1) when levels of sectoral contestation increase overtime, and (2) once the income tax law is implemented, finding support for the fiscal sociology paradigm, and particularly for the idea that direct taxation causes state-building.

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Students of the Latin American states have several theories to explain the causes and consequences of state capacities. Scholars also have countless alternatives to measure state capacities. However, there exists a huge deficit. Most state formation theories (just to name a few) are situated during precolonial,<sup>1</sup> early<sup>2</sup> or late<sup>3</sup> independent Latin America. Yet, we lack of a measurement that corresponds *temporally* with the theories we have. While our explanations of state-making are *historical* in nature, in practice, most available measurements capture *contemporary* levels of stateness. In this paper I try to bridge this gap by providing an explanation on the origins of state capacities in Latin America and a corresponding indicator able to capture levels of state capacities *over time*. This paper then seeks to contribute to the state formation literature in general, both from a theoretical and methodological perspectives.



**Figure 1:** *Causal Mechanism*

I argue that higher levels of sectoral contestation, both nationally and subnationally conceptualized, increased state-capacities over time. Specifically, I explain how the emergence of industrial elites lowered levels of inter-sectoral inequality, pushing both agricultural and industrial elites to reach agreements that materialized in investments in state-*making* institutions, causing in turn higher state-capacities (**Figure 1**). Exploiting the exogeneity of earthquake shocks, I leverage a novel dataset on Chilean earthquake death tolls overtime and a Bayesian multilevel Poisson model with year fixed-effects to account for state capacities between 1900 and 2010. I contend that the capacity the state has of enforcing and monitoring building codes throughout the territory is a reflection of Chile's *overall* state capacities. Earthquakes happen at any level of development and are orthogonal to differences in regime type. Consequently, death-toll differentials should be associated with state-capacities only. However, the ability the central level has of enforcing these (and other) institutions depends on whether subnational elites are willing to cooperate with

<sup>1</sup>Mahoney [2010].

<sup>2</sup>See Kurtz [2013] and Soifer [2015].

<sup>3</sup>Bahamonde [2017b].

the central level, implementing these norms. In other words, state-*making* requires the political incorporation of subnational entities into the respective national projects. The argument explains that higher levels of sectoral threats led both political elites to make institutional compromises. In this paper I identify one such compromise, the implementation of the national income tax law. Sectoral threats were more credible when the relevant elite at the local level was *not* the same that lead the national economy, signaling a generalized situation of sectoral indeterminacy, where neither the industrial nor the agricultural sectors were the dominant elites. For instance there were higher levels of contestation when there were sustained levels of *national* agricultural growth in the presence of consolidated industrial clusters at the *subnational* level. In turn, the income tax law was a state-*making* institution. Similarly, while the income tax law was implemented nationally, compliance depended on subnational cooperation too. As I detail later, lower levels of sectoral inequality fostered the incorporation of industrial elites into the national project, and hence they were willing to pay the national income tax in exchange of public goods delivered at the subnational level. Finally, what my empirical analyses show is twofold. Death-tolls decreased, that is, *state capacities increased*, when (1) levels of national/subnational sectoral contestation increased overtime, and (2) after the income tax law was implemented. This last finding in particular finds support for the fiscal sociology paradigm, and particularly, for the idea that direct taxation has positive externalities on state-*capacities*, making this institution a state-*making* institution.

The crux of the argument is that sectoral conflicts *triggered* state development. Elites whose assets are allocated in different sectors of the economy have different preferences over state centralization and direct taxation. Consequently, economic expansion of these two economic sectors not only shaped the economic landscape; given that each sector had a corresponding political arm, the *political* conflict is rooted into a broader *economic conflict* conflict too.<sup>4</sup> I sketch a theory where state-penetration and institutional enforcement are higher when the major economic sectors of the economy are incorporated into the same state-building national project. Elite incorporation is possible contingent on the capacity the new elites have of overthrowing the institutional order that permitted hegemonic groups to rule without opposition. The landed Latin American elites were an economic hegemonic group protected by norms and institutions that originated in colonial times. While the agricultural sector dominated most of the economy, the landowning class controlled most of the politics.<sup>5</sup> However, when the *structural transformation* (that is, the “secular decline of agriculture and substantial expansion of manufacturing”)<sup>6</sup> took place, this process imposed tight constraints on the way politics was run by the incumbent landowning class.<sup>7</sup> Thus, given the initial advantage of the landed elites, the secular emergence of the industrial sector also meant the reduction

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<sup>4</sup>See Ansell and Samuels [2014].

<sup>5</sup>See for the Chilean case Zeitlin [1984, 13], Bauer [2008, 45], Baland and Robinson [2008, 1748] and Best [1976, 56], Rippy [1971], Marichal [1989].

<sup>6</sup>Johnston and Mellor [1961, 567].

<sup>7</sup>Bahamonde [2017b].

of inter-sectoral inequality, generating political, economic and military threats to the landed elites.<sup>8</sup> The higher the threats, the more likely the inter-sectoral compromises.

I contend that lower levels of inter-sectoral inequality made possible higher levels of inter-sectoral contestation giving way to a series of inter-elite compromises (yellow box in Figure 1) that fostered higher levels of state-capacities overtime. In this paper I identify one such compromise, the implementation of the income tax, and how this crucial institution for state-*making* included the preferences of both elites. Leveraging historical evidence, I explain that Chilean industrial elites accepted to be income taxed while demanding more state services and in exchange of being allowed to participate in politics under fairer conditions. In turn, I show statistical evidence that suggests that the implementation of the income tax law had positive externalities for state-building over time. [Bahamonde \[2017b\]](#) finds that the emergence of a strong industrial sector *accelerated* the implementation of the income tax law in a number of Latin American countries. While he theoretically *relies* on the fiscal sociology paradigm to argue about these positive externalities of direct taxation on state-building, here I present empirical cross-time evidence supporting his claims. Additionally, I introduce a new strategy to measure levels of state capacity over time.

Critically, I claim that the capacity the state has of enforcing and monitoring building codes depends on both *national* and *subnational* sources of cooperation, and hence, state incorporation. [O'Donnell \[1993, 1359\]](#) famously distinguished different levels of state penetration, where there were *in the same country* ‘brown areas,’ or heterogeneous areas that mixed both ‘high’ and ‘low’ levels of stateness. This approach goes in line with [Snyder \[2001, 103\]](#) who explains that subnational comparisons are useful to compare political and economic processes that vary spatially, and with [Ziblatt \[2008, 286\]](#), who points out that ‘any account, which attempts to explain local public goods provision *without* reference to the capabilities of local government, might be incomplete.’ Following these distinctions (and [Soifer \[2008\]](#) in particular), I implement an identification strategy that not only accounts for temporal but also for geographical sources of sectoral contestation. While [Bahamonde \[2017b\]](#) and [Bahamonde \[2017a\]](#) conceptualize sectoral contestation only at the national level, here I argue that *national* agricultural expansion in the presence of important *subnational* clusters of industrial development fostered a generalized situation of sectoral indeterminacy, where no group was the leading elite. Thinking of sectoral contestation in subnational terms is useful for state-building. Higher levels of subnational sectoral contestation translated into more credible threats coming from the provinces and other distant parts of the territory. Should these subnational sources of contestation *not* be translated into sectoral agreements, the country risked being torn apart, or alternatively, see the emergence of local *caudillos* or other regional ‘bosses.’ For example, historian [Barros \[1970, 500\]](#) explains that before the civil war, *salitreras* (nitrates towns) in northern Chile were locally so important that they were considered ‘a state within the state.’<sup>9</sup> Local bosses had to

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<sup>8</sup>[Boix \[2015\]](#). For example, elites could use a faction of the existing army or hire private militias.

<sup>9</sup>My translation.

approve on whether public employees could be fired, whether public works could be developed, and on whether politicians could give public speeches. Moreover, they coined their own currency and had their own particular local laws. While my proposed measurement captures this subnational/national *dissonance*, the theory explains how contestation translates into cooperation and state incorporation. Particularly, industrial elites accepted to comply with the national income tax in exchange of public goods delivered at the local level, suggesting a process of sectoral incorporation into the national state-building project. Here I explain how the process of income taxation increased state-capacities over time.

The rest of the paper proceeds as follows. In [section I](#) I explain how the conflicting sectoral nature of the implementation of the income tax is linked to state capacities. Next, in [section II](#) I introduce and explain the proposed measurement, and how it maps with state capacities. Then, in [section III](#) I present some econometric evidence, and finally I offer some final comments in [section IV](#). In [section V](#) I show some Bayesian convergence diagnostics.

## I. FISCAL SOCIOLOGY, SECTORAL CONFLICTS AND STATE CONSOLIDATION

Political scientists have leveraged the sectoral conflict approach to explain mostly democratization. For example, [Geddes \[1991\]](#) explains that competition between two rival parties of about the same size creates clearer incentives to invest in political institutions. Similarly, [Ansell and Samuels \[2014\]](#) and [Boix \[2015\]](#) examine the role of inter-elite economic inequality/equality on democratization. Here I argue that a theory focused on sectoral conflicts offers also a theory of state consolidation. As others have explained, “state formation will be more likely to the degree that powerful individual actors form two groups on the basis of divergent economic and political interests.”<sup>10</sup> This approach is particularly relevant for the Latin American cases due to the sectoral conflicts that existed between the agricultural and industrial sectors.<sup>11</sup> Here I contend that there are two elements that propelled state consolidation, namely, (1) how elites invested in different assets had different preferences over state centralization and taxation, and (2) how lower levels of inter-sectoral inequality fostered investments in state-*making* institutions, especially direct taxation.

Since state centralization affects landowners and industrialists in different ways, both sectors have different preferences towards taxation and state centralization.<sup>12</sup> On the one hand, land fixity increases the risk premium of the landed elite’s main asset,<sup>13</sup> so they systematically resist taxation. In turn, as capital can be reinvested in nontaxable sectors, industrialists’ preferences toward taxation are more elastic. In other words, industrialists have an ‘exit’ option<sup>14</sup> that landowners do not have.

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<sup>10</sup>[Hechter and Brustein \[1980, 1085\].](#)

<sup>11</sup>[Bahamonde \[2017b\]](#) and [Bahamonde \[2017a\]](#).

<sup>12</sup>See [Acemoglu and Robinson \[2009, 289\]](#) and [Best \[1976, 50\]](#).

<sup>13</sup>[Robinson \[2006, 512\].](#)

<sup>14</sup>[Hirschman \[1970\].](#)

Should fiscal policy not respond to the industrial class' demands, they can leave the country and reinvest.<sup>15</sup> That said, these cross-sectoral differences are more likely to resolve in favor of direct taxation when income inequality among the elites is low.<sup>16</sup> Considering the initial institutional and economical advantages the agricultural sector enjoyed since colonial times in the Latin American cases, reducing inter-elite inequality meant the expansion of the industrial sector. When income inequality among the elites is high, there are no incentives to invest in state institutions, and rather elites rule in a monopolistic way. In other words, in non-contested contexts, the institutional order reflects the preferences of the landowning elites, keeping industrialists excluded from the state-building project. However, the emergence of a strong industrial class put pressures for centralization and investment in public goods. Beramendi et al. [2016, 18] explain that as industrialists depended more on infrastructure implemented at the local level such as roads, railroads and bridges, they “[preferred] to shoulder a higher tax burden through progressive direct taxation.” Lower levels of inter-elite economic inequality meant also similar degrees of military capabilities.<sup>17</sup> Under these circumstances elites had incentives to make agreements rather than engaging in conflict when their economic/military capacities were similar. When levels of inter-elite inequality were low, war was more likely to exhaust all existent assets without producing positive outcomes for either sector,<sup>18</sup> putting then pressures to reach agreements instead of engaging in armed conflicts.

In all Latin American economies during and right after the colonial period, agriculture was the most important sector.<sup>19</sup> And by extension, agricultural political elites were the most powerful elite.<sup>20</sup> For the Chilean case in particular, Collier and Collier [2002, 106] have argued that initially the “national government was dominated by the central part of the country, with owners of large agricultural holdings playing a predominant role.”<sup>21</sup> There existed an important asymmetry, however. While both the agricultural and industrial sectors were growing at the same pace (see Figure 2, top panel), the latter were kept from participating in politics under fair conditions.<sup>22</sup> This asymmetry led these two ‘antagonistic elites’<sup>23</sup> to two bloody civil wars. Zeitlin [1984, 23] argues that the civil wars challenged a “large landed property [elite against a] productive capital[ist] [elite].” However, war was not sustainable over time. For instance, *Balmacedistas* managed to secure the support of the army, while *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 1907, 1912, 1915

<sup>15</sup>Ronald Rogowski in Drake and McCubbins [1998, ch. 4]. However, see Bates and Lien [1985, 15].

<sup>16</sup>Tani [1966, 157] explains that the absence of “wealth groups” makes passing an income tax law easier.

<sup>17</sup>Boix [2015].

<sup>18</sup>Richard Salvucci in Uribe-Uran [2001, 48].

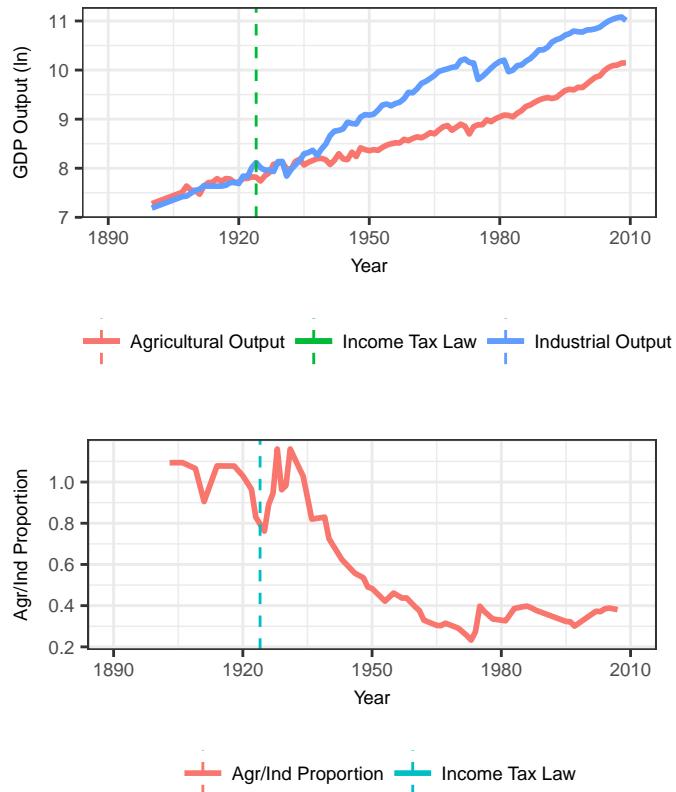
<sup>19</sup>Keller [1931, 13].

<sup>20</sup>Wright [1975, 45-46].

<sup>21</sup>Similarly, McBride [1936, 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.

<sup>22</sup>Bahamonde [2017b].

<sup>23</sup>Keller [1931, 37-38].



**Figure 2:** Industrial and Agricultural Outputs, and The Passage of the Income Tax Law in Chile

and 1919,<sup>24</sup> suggesting an equilibrium where neither elite was the leading elite. Given their relative similar degrees of economic development and military capacities, the two elites opted for a political compromise. In 1924, industrial elites accepted to be income taxed by agriculturalist incumbents in exchange of having more *state services* and having a more open political system. Importantly, 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.”<sup>25</sup> Critically, from the elite’s perspective, it was in their interest to see these extractive capacities grow,<sup>26</sup> securing this inter-elite compromise for a longer period of time. For instance, Boix [1999] and Parente and Prescott [1994] explain how the development of certain institutions or the adoption of certain technologies are not only implemented by sustained overtime when they go in the benefit of the elites.

The tax was not important because of the new revenue it collected, however. While Humud

<sup>24</sup>Collier and Collier [2002, 109].

<sup>25</sup>Carmenza Gallo, in Brautigam et al. [2008, 165]. Emphases are mine.

<sup>26</sup>Beramendi et al. [2016].

(1969, p. 154) explains that the income tax generated considerable resources for the Chilean treasury,<sup>27</sup> following the fiscal sociology paradigm, I contend that the tax was important for state-making because its implementation required a series of sectoral compromises, triggering a series of other institutional investments, such as the implementation of checks-and-balances (to monitor tax spending) and the development of skilled bureaucracies. Moreover, unlike other ‘regular’ state institutions and services, taxing incomes in fact infiltrated the state’s coercive sovereignty unto the individual itself. The very implementation of the income tax produced a secular accumulation of know-how, particularly, of technologies able to monitor individual incomes. Observing individual economies and transforming private income into public property is what *causes* state consolidation.<sup>28</sup> In fact, Musgrave [1992, 99] argues that since taxation (especially of incomes) requires such a high degree of state penetration, public finances offer the key for a theory of state-building. Indirect taxes are, *ceteris paribus*, easier to levy, and hence this kind of revenue is generally considered “unearned income”<sup>29</sup> or “easy-to-collect source of revenues.”<sup>30</sup> Given the relatively lower costs states have to incur to collect them, indirect taxes have a very low impact on state-building.<sup>31</sup> For example Krasner [1985, 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.<sup>32</sup> Since customs administrations have always been concentrated in a few critical locations, especially ports, tariffs and customs duties did not require an elaborate fiscal structure.<sup>33</sup> Income taxation not only triggered other state capacities helping with the development of more skilled bureaucracies. Via a process of assimilation, it also helped to construct 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 oblige 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’<sup>34</sup> of the modern nation-state [...] Taxation enmeshes us in the web of generalized reciprocity that constitutes modern society.”<sup>35</sup>

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<sup>27</sup>Bowman and Wallerstein [1982, 451-452].

<sup>28</sup>Musgrave [1992, 98] and Moore [2004b, 298]. While Kurtz [2009, 2013], Soifer [2015] situate the relevant state-building critical juncture at the end of the colonial period, before the class compromises I identify in this paper, I argue that the implementation of the income tax was an important building block in this process.

<sup>29</sup>Moore [2004b, 304].

<sup>30</sup>Coatsworth and Williamson [2002, 10].

<sup>31</sup>Moore [2004a, 14].

<sup>32</sup>Campbell [1993, 177].

<sup>33</sup>Bertola and Ocampo [2012, 132].

<sup>34</sup>Anderson [2006].

<sup>35</sup>Martin et al. (in Martin et al. [2009, 3]).

## II. FROM EARTHQUAKE DEATH TOLLS TO STATE CAPACITIES

More than being blessed, the literature is in fact cursed with the over abundance of poor indicators of state capacities.<sup>36</sup> Soifer [2012, 589] explains that there exists an “industry of indices measuring state weakness, state failure, and state fragility [which] has cropped up in recent years.” Yet, as Fukuyama [2013, 347] explains, its abundance “points to the poor state of empirical measures of the quality of states.” The literature points out to two main concerns. First, ‘most fragility indices barely satisfy scientific standards.’<sup>37</sup> And second, most indices are conflated with analytical and conceptual problems.<sup>38</sup> One notable example is protection of the rule of law which is commonly used to proxy state capacities.<sup>39</sup> As Kurtz and Schrank [2007, 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 these data are usually elite interviews. 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,”<sup>40</sup> introducing in this way systematic measurement error.<sup>41</sup> Likewise, expert surveys suffer from the same problem.<sup>42</sup> On the other hand, the problem is conceptual. As Soifer [2008, 247] puts it, there is a widely spread “problem of misalignment between dimension and indicator.” Kurtz and Schrank [2012, 619] recommend to “explicitly avoid 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. did have a strong state, however it did *not* protect property rights. Another example has to do with the indicators provided by the World Bank. These series are “[c]learly, the most comprehensive source for cross-national measures of governance.”<sup>43</sup> One of the dimensions is the absence of violence. However, “there isn’t much byway of street crime or military coup attempts in North Korea,”<sup>44</sup> a state that can barely provide basic services to its population. Focusing on tax rates is not a solution either.<sup>45</sup> For example, in late imperial China, “the high taxes on peasants [...] were the result of rulers’ lack of power. Chinese rulers consistently attempted to limit official’s excessive extractions from the masses, but were unable to do so.”<sup>46</sup>

This paper identifies a third limitation. Besides of their conceptual and analytical problems,

<sup>36</sup>Hanson and Sigman [2013, 10] compiled 24 different types of measurements of state-capacities. In turn Mata and Ziaja [2009] constructed a combined measurement of 12 other indicators.

<sup>37</sup>Mata and Ziaja [2009, 35]. They point out particularly to the fact that data are usually poor or unavailable.

<sup>38</sup>I agree with Soifer [2012, 586] in that most “scholarship on state capacity [...] lack[s] a satisfying conceptualization and measurement scheme for this concept.” See also Ferreira [2017, 1292].

<sup>39</sup>See for one example Besley and Persson [2009, 1237].

<sup>40</sup>Kurtz and Schrank [2007, 542]. Emphasis in original.

<sup>41</sup>See also Kurtz and Schrank [2012, 618].

<sup>42</sup>Fukuyama [2013, 349].

<sup>43</sup>Kurtz and Schrank [2007, 543].

<sup>44</sup>Fukuyama [2013, 348].

<sup>45</sup>Yet, Johnson and Koyama [2017, 3] explain that ‘[t]ax revenue per capita is a commonly used metric of fiscal capacity,’ which in turn might work as a proxy of state capacities. For example, Besley and Persson [2014] adopt this strategy.

<sup>46</sup>Kiser and Tong [1992, 301].

most measurements provide a rough approximation of *contemporary* state capacities. Just to name a few examples, Soifer [2012, 585] “builds a new measure of state capacity for [...] contemporary Latin America [combining] multiple dimensions (extraction, security, and the administration of basic services).” Kurtz and Schrank [2012, 618-619] propose an experimental design based on list-experiments<sup>47</sup> to study (in an unbiased way) bureaucrat’s opinions on whether “the bureaucracy was really based on a competitive, meritocratic process; whether tenure protections are effective; whether extralegal payments or extortion take place,” among others. Finally, Soifer and Luna [2016] employ a survey-based design to measure subnational state capacities. While these measurements overcome the problems mentioned above, they do not help us to study state capacities in a historical setup. Economic historians and students of political development have offered other measures that seek (or could potentially be used) to capture levels of state capacities overtime, such as investments in public goods like infrastructure, roads,<sup>48</sup> electrification (measured as light intensity per pixel),<sup>49</sup> and railroads.<sup>50</sup> However, many of these measurement are debatable. For example, Soifer [2012, 593] explains that “railroads were often constructed by private actors.”<sup>51</sup> The same problem applies to other types of infrastructures. There are others more appropriated strategies such as the opening of postal offices,<sup>52</sup> the administration of national censuses<sup>53</sup> and vaccination.<sup>54</sup> While these measurements advance our knowledge on levels of state capacities *overtime*, there are still other problems. 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 to 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, I propose earthquake death tolls as an alternative measurement of state capacities overtime. Unlike censuses, *unfortunately*, earthquakes happen very often. Yet, they are not well studied in the discipline. While “[e]arthquakes alone claim thousands of lives a year,”<sup>55</sup> “[d]isasters are not as well studied [...] in the field of political science.”<sup>56</sup> Building on

<sup>47</sup>Refer to Aronow et al. [2014], Blair and Imai [2012], Blair et al. [2014], Corstange [2008, 2010], Glynn [2013], Imai [2011], Imai et al. [2015], Kane et al. [2004], Kiewiet de Jonge [2015].

<sup>48</sup>See for example Mann [1984, 2008], Acemoglu [2005], Saylor [2012], Thies [2009], Besley and Persson [2010].

<sup>49</sup>Huntington and Wibbels [2014].

<sup>50</sup>Saylor [2012, 302] and Coatsworth [1974].

<sup>51</sup>Footnote #11.

<sup>52</sup>See for example Acemoglu et al. [2016].

<sup>53</sup>See for example Soifer [2013] and Centeno [2002]. This technique is borrowed from demographers, and it compares the age structure (incorrectly) captured in the census with the an assumed ‘right’ theoretical age distribution. Low-capacity states should inaccurately round ages or inflate certain intervals, producing error. This error is usually computed in the Whipple’s index which serves as a proxy for state capacities.

<sup>54</sup>Soifer [2012].

<sup>55</sup>Anbarci et al. [2005, 1908].

<sup>56</sup>Branacati [2007, 719].

Mann [1984, 113], the proposed measurement captures state's 'infrastructural' power.<sup>57</sup> "Natural hazards can be seen as a function of a specific natural process and human [...] activity."<sup>58</sup> Given that earthquakes happen at random and are completely exogenous to the affected locality,<sup>59</sup> 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 and economic development development,<sup>60</sup> and by extension, they happen at any level of state capacity. Consequently, keeping earthquake magnitudes constant at their means, (weighted) death counts should be attributed to the (in)capacity of the states to invest in preparedness and mitigation institutions.<sup>61</sup> I focus on earthquakes and not on other natural disasters such as 'extreme temperature events, floods, landslides, and windstorms'<sup>62</sup> because earthquakes cannot be foreseen, and such, they put to a test the capacity of the states of having their preventive institutions *already* in place and in good shape. State capacities consist of sustained *proactive* efforts of enforcing institutions throughout the territory, and hence short-term *reactive* actions should *not* be considered state-making.<sup>63</sup> Moreover, unlike other natural disasters, earthquakes do not allow actors to adapt their behavior while the quake is happening. For example, in the case of famines, the institutions of "calamity relief in India [...] emphasize the need for local administrators to look for *signs*, such as large drops in food production and increases in food prices, which *signal* an impending crisis."<sup>64</sup> In fact, Brancati [2007, 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."<sup>65</sup>

The capacity states have of deploying inspectors throughout the territory to enforce quake-sensitive zoning and building codes is a reflection of the overall levels of a country's state capacity. Since "[e]arthquake-resistant construction depends on responsible governance,"<sup>66</sup> state capacities act as a scope condition, particularly, undermining or permitting the *implementation* of these norms. For example, Bilham [2013, 169] explains that "although engineering codes may *exist* [,] mechanisms

<sup>57</sup>He defines infrastructural power as "the capacity of the state [to] actually [...] penetrate civil society, and to implement logically political decisions throughout the realm."

<sup>58</sup>Raschky [2008, 627].

<sup>59</sup>Brancati [2007, 728] explains that "earthquakes constitute a natural experiment." Gignoux and Menéndez [2016, 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] also "[exploits] the exogenous variation in the location and timing of natural disasters, as well as the exposure of different cohorts to the shock."

<sup>60</sup>Kahn [2005, 271] and Brancati [2007].

<sup>61</sup>To make sure, while "earthquakes may not be preventable, it is possible to prevent the disasters they cause" (Escaleras et al. [2007, 209]). Similarly, Anbarci et al. [2005, 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, 130].

<sup>62</sup>Kahn [2005, 280].

<sup>63</sup>In other words, other "natural disasters can be foreseen (or predicted with some probability) and thus measures can be taken to limit their severity" (Anbarci et al. [2005, 1908]).

<sup>64</sup>Besley and Burgess [2002, 1423]. Emphases are mine. In fact, as Kahn [2005, 273] points out to the very non-significant low correlation between predictable and unpredictable natural disasters.

<sup>65</sup>Emphasis is mine.

<sup>66</sup>Ambraseys and Bilham [2011, 153]. Similarly, Raschky [2008, 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.

to *implement* these codes are largely unavailable”<sup>67</sup> in low-capacity states. For example, [Anbarci et al. \[2005, 1910\]](#) explain that “while Iran has building codes which are comparable to those existing in the United States, they tend to be enforced only in the country’s larger cities,” failing to monitor the countryside, which was where most of the deaths occurred in the 6.4 earthquake in Changureh in 2002.<sup>68</sup> The proposed measurement bridges this gap by incorporating and modeling the state’s capacities of enforcing these codes at the subnational level. Critically, “[e]arthquake-resistant features are costly to verify after construction is complete [...] Steel reinforcement bars make a well-known contribution to earthquake resistance concretely buildings[,] not only is the steel itself invisible [...] but the durability of the steel depends on the quality and quantity of concrete around it.”<sup>69</sup> This is the so called ‘cover-up’ concept: “inappropriate foundations can be hidden beneath walls, shoddily assembled steel work can be hidden beneath concrete [and] poorly mixed concrete can be hidden behind paint.”<sup>70</sup>

Only states with higher capacities overcome their political and logistic limitations and successfully implement and enforce these regulations at the local level. 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 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,<sup>71</sup> 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 figure of the *inspector* to supervise, enforce and monitor these measures at the local level. Furthermore, *artículo* 414 of the Chilean *Decreto* 4882 granted *inspectores* ‘free access to the building’ at any time during the construction process. My measurement picks up whether these good intentions written in paper actually scored lower death tolls when shocked by the average earthquake.<sup>72</sup> Particularly, I find that localities with higher levels of sectoral contestation score lower death tolls relative to localities with lower levels of sectoral conflicts.

<sup>67</sup>Emphases are mine.

<sup>68</sup>Similarly, [Bardhan \[2016, 865\]](#) explains that “unlike in the case of some macroeconomic policies, [...] the effectiveness of the state varies enormously across localities and administrative levels within the same country.”

<sup>69</sup>[Keefer et al. \[2011, 1531\]](#).

<sup>70</sup>[Bilham \[2013, 167\]](#).

<sup>71</sup>See especially article 151.

<sup>72</sup>Thus, my measurement captures state outcomes. [Fukuyama \[2013\]](#) is very critical of ‘outcome-oriented’ measurements. However, this outcome is different. Unlike the proportion of tax over GDP which could end up being wasted (p. 353), or “educational outcomes [which depend] much more strongly on factors like friends and family” (p. 355), death tolls associated to earthquakes are *not* ‘hard to measure’ (p. 356) neither they are subject to ‘normative’ concerns. I also disagree in that ‘econometric techniques’ to control for these and other factors add ‘another layer of complexity.’ Similarly, [Kurtz and Schrank \[2012, 619\]](#) explain that the “problem [...] with output based measures is that they necessarily include information on policy choice.” However, it would be hard to say that people’s lives are subject to ‘ideological’ or ‘policy preferences.’

Properly enforced and implemented building codes, among other mitigation measures, not only save lives. These kinds of institutions embody the most basic form of social contract that exists between the state and its subjects. The collapse of commerce buildings and private houses trigger higher levels of looting and social unrest. States are interested in preventing looting and social unrest because elected officials, as the visible faces of *the state*, care not only about their electoral survival (or just ‘survival’ in the case of unelected officials), but also about the legitimacy of the whole apparatus. That is, in the event of social unrest, not only the essential social Hobbesian-like contract is broken but also the expectations for social peace and the ability of the state to monopolize physical violence are questioned.<sup>73</sup> 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 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.<sup>74</sup> Critically, under these circumstances, the legitimacy of the state, and particularly, the *tax state*, reduces to zero. Thus, officials (elected or not), care about the potentially negative outcomes the lack of building code enforcement might cause. For humanitarian or selfish reasons, it is in their best interest to make sure that these institutions are enforced throughout the territory. Should the state fail, its extractive enterprise will be the first one in being scrutinized.

This measurement has a number of advantages. Unlike survey-based or policy-based measures, earthquake death tolls are an *objective* measurement of earthquake preparedness,<sup>75</sup> an activity that *any state must* perform.<sup>76</sup> Kurtz [2013, 58] for example explains that “the best measures [of state capacities] would be of the sorts of activities that all (or nearly all) states consider to be of primary importance.” Additionally, Soifer [2008, 235-236] divides the state infrastructural power in three layers, ‘national capabilities,’<sup>77</sup> the ‘weight of the state’,<sup>78</sup> and a ‘subnational’ component which tracks “the ability of the state to exercise control within its territory.” Earthquake death tolls map well into all three components. Since death tolls are a function of how well/bad building codes are *enforced* by the state throughout the territory, adopting a subnational approach seems more

<sup>73</sup>Others have studied how in some context earthquakes damage interpersonal trust. For example, Carlin et al. [2014, 419] argue that “state capacity plays a decisive role in determining natural disasters’ consequences for social capital.”

<sup>74</sup>Reed [2011]. See also Laursen [2010].

<sup>75</sup>That is, “it does not rely on an effort to measure the beliefs of citizens about the nature of the state, the legitimacy of its leaders or the institutional procedures that selected them, or even perceptions of the efficiency of public bureaucracies” (Kurtz and Schrank [2012, 616]).

<sup>76</sup>I agree with Kurtz and Schrank [2012, 619] in that an “output-linked approach [...] should only examine public sector outputs that are not particularly politicized, and generally perceived to be essential state functions across a very broad set of states.” Similarly, Carlin et al. [2014, 422] explain that “a basket of ‘minimal’ state functions [typically includes] primary education, public health, rule of law, public finance management, and disaster relief.”

<sup>77</sup>This layer ‘sees state infrastructural power as a characteristic of the central state’.

<sup>78</sup>This relates to ‘how the exercise of state power shapes the society it controls.’

appropriate. For instance, there might be excluded local elites that might not be willing to comply with national policies at the subnational level. The proposed measurement and theoretical framework capture these tensions, offering a theory for the conditions that foster subnational cooperation.

The measurement has a number of drawbacks, however. 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 plate, the Western border of the Latin American plate, and the boundaries between the African, the Arabic and the Indian plates and the Eurasian plate,” allowing potential cross-country comparisons within most of the developing world.<sup>79</sup> Moreover, 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.<sup>80</sup> Another potential concern is that the ability of counting the death-toll might be a function of state capacities itself.<sup>81</sup> However, 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 casualties. Another potential issue has to do with the measurement of the magnitudes. Before the instrumental period, magnitudes were obtained in an estimative way. And while there are methods to approximate historical felt magnitudes to instrumental-like intensities,<sup>82</sup> this unfortunately adds more than one layer of complexity. All in all, this measurement offers a rough approximation of levels of state capacities overtime. And while some econometric techniques might ameliorate some of the problems, it is unlikely that they disappear completely.

### III. MULTILEVEL ANALYSES

I constructed a novel dataset using the *Significant Earthquake Database* compiled by the National Centers for Environmental Information (NOAA) as a starting point.<sup>83</sup> The dataset ‘contains information on destructive earthquakes from 2150 B.C. to the present,’ and records the number of deaths,<sup>84</sup> the magnitude and year, and the latitude and longitude of every quake, among other

<sup>79</sup> Keefer et al. [2011, 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, 618]). Finally, other measurements also are contingent on the context. For example, Soifer [2012, 593] proposes a measurement of administrative capacities focusing on how states are able to enforce voter registration ‘where voting is mandatory.’ This strategy evidently shortens the sample to only democratic countries, introducing potential sample selection biases.

<sup>80</sup> Dunbar et al. [2003, 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.

<sup>81</sup> If this were true, states with higher capacities would have higher death tolls, while states with lower capacities, due to their incapacity to count, lower death tolls.

<sup>82</sup> Szeliga et al. [2010].

<sup>83</sup> NGDC/WDS.

<sup>84</sup> Importantly, the NOAA distinguishes earthquake deaths from total deaths (which includes tsunami casualties). I use the former.

information. Using archival census data from 1907 to 2012,<sup>85</sup> I complemented the NOAA dataset with local population at the municipal level where the quake hit. This way I am able to weight the death toll by local population.<sup>86</sup> Using archival census data as well, I also considered the main economic activity of the affected municipality,<sup>87</sup> and also whether the municipality was urban or rural.<sup>88</sup> The death tolls and magnitudes proportionated by the NOAA dataset were contrasted case by case with historical press archival information.<sup>89</sup> Magnitudes in particular were also compared with the International Seismological Centre. All these are subnational-level variables. Next, I included national-level indicators that aim to proxy sectoral conflicts at the national level. Following Bahamonde [2017b] and Bahamonde [2017a], I proxy national sectoral competition and specifically the degree in which the industrial elites challenged incumbent landowners by calculating the proportion of agricultural growth relative to industrial growth as presented in the MOxLAD data (see Figure 2, bottom panel).<sup>90</sup> According to Astorga et al. [2005, 790], these data provide extended comparable sectoral value-added series in constant purchasing power parity prices. Even when pre-1900 earthquakes are recorded in both the NOAA data and my own dataset (Figure 3), the economic data provided by MOxLAD limits the scope of this paper from 1903 to 2007 (Figure 2).

Chile is a good case to study infrastructural state-capacities using this earthquake dataset since it has considerable variance regarding quake magnitudes and locations. Figure 3 plots the earthquakes, the years and the magnitudes, while Figure 4 plots the geographical distribution and magnitudes of the quakes. For illustrative purposes, both plots consider the full sample starting in 1520 and ending in 2015. 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 as well. Chile is arid in the north, limiting agricultural activity, but it has a temperate oceanic climate in the south, a more appropriated climate for agriculture. Also, distance from Santiago, the capital city located in the middle (around latitude 33°) might impose some degree of difficulty for the central government to reach out the farthest northern/southern parts of the territory. All in all, given that earthquakes happen at various latitudes and in different magnitudes,

<sup>85</sup>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.

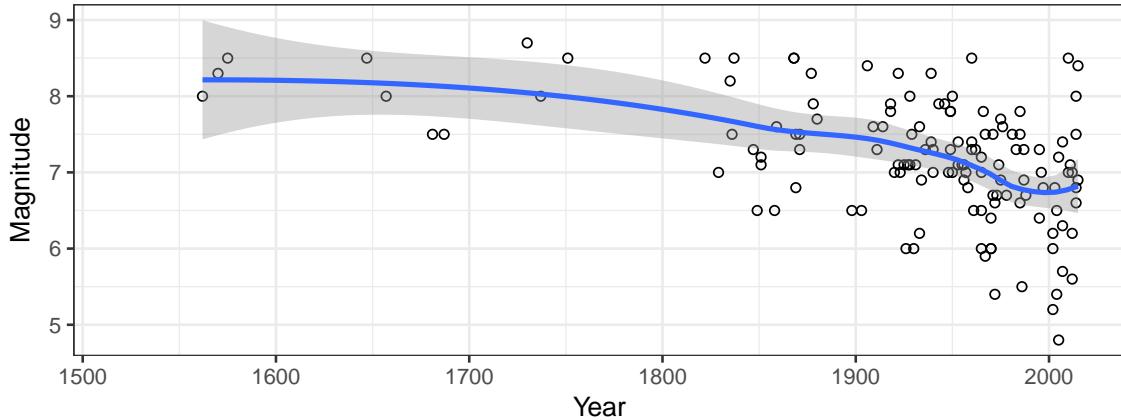
<sup>86</sup>While in most occasions I was able to recover the actual local population, in some instances that was not possible. In these cases, I recovered the population of the most concentrated area nearby. Consequently, I adopted a more general approach and used the population variable as a control variable, not to construct a dependent proportion variable.

<sup>87</sup>Agricultural, industrial, or mixed (i.e., both agricultural and industrial).

<sup>88</sup>If more than 50% of the population lives in an urban setting, I assigned a 1 to that municipality, 0 otherwise. Urban concentrations are more likely to have vertical constructions rather than one-story buildings, increasing the potential number of casualties. I thank Daniel Kelemen for this suggestion.

<sup>89</sup>*El Mercurio* and *La Nación* newspapers, both kept at the *Archivo de la Biblioteca Nacional de Chile*.

<sup>90</sup>“These data build on the studies and statistical abstracts of the Economic Commission for Latin America, but also rely on Mitchell’s International Historical Statistics, International Monetary Fund’s International Financial Statistics, the World Bank’s World Development Indicators and a variety of national sources.” I used the *agriculture value-added* and *manufacturing value-added* variables. The former measures “the output of the sector net of intermediate inputs and includes the cultivation of crops, livestock production, hunting, forestry and fishing.” The later “[r]eports the output of the sector net of intermediate inputs.” Both of them are expressed in local currency at 1970 constant prices.



**Figure 3:** *Earthquakes in Chile: 1500-2010*

both regions have been exposed indistinctly to a wide range of shocks. 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.<sup>91</sup> However shocks have affected the territory from coast to mountain.<sup>92</sup> In sum, quakes have shocked the country as a whole regardless of longitude and latitude, distance from the center, type of climate and main economic activity.

The unit of analysis is the earthquake.<sup>93</sup> As an event, each earthquake has attached to it, a death toll, a subnational location identified by its latitude and longitude, a magnitude, the main economic activity of the locality where the quake hit, a local population, and an urban/rural setting. All these factors are subnational. At the national level, I consider sectoral outputs (as a proportion), population and year. Specifically, using a Bayesian Poisson regression,<sup>94</sup> I model the count of dead individuals caused by earthquakes. Since I am interested in testing the effect of different sources of sectoral contestation, both national and subnational, on death-tolls overtime, the main variable of interest is the national proportion of agriculture output relative to national industrial output with different slopes for agricultural, industrial or mixed localities. I also included year fixed-effects to account for time-varying confounding factors.<sup>95</sup> For instance, fiscal development could be a function of country-specific prior state-building capacities. Fixed-effects should be able

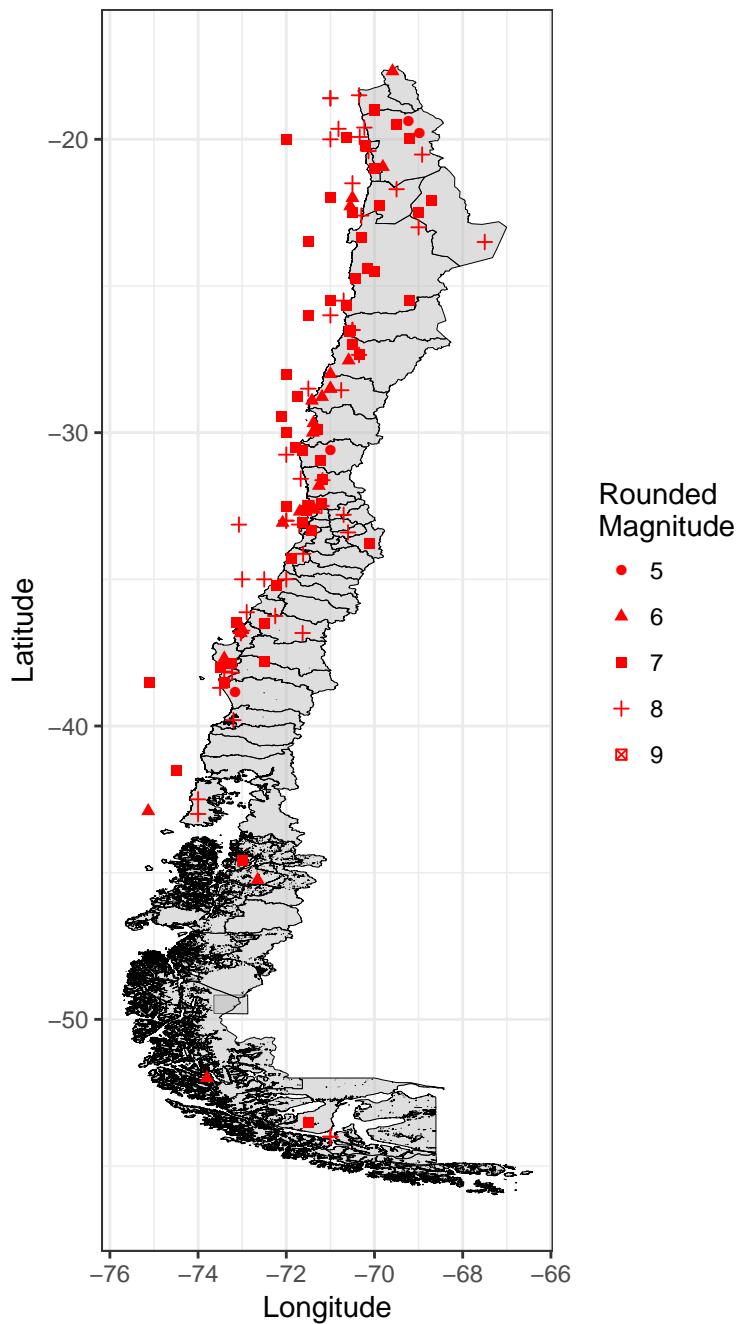
<sup>91</sup> Moreover, Brancati [2007, 729] explains that “[e]arthquakes often occur in mountainous areas.”

<sup>92</sup> Since “most of the damage in major earthquakes occurs within 30 km of the epicenter,” (Dunbar et al. [2003, 172]) I don’t necessarily drop quakes that didn’t happen on land. While the epicenter might have happened a few miles away from the shore, the consequences certainly reached the land.

<sup>93</sup> Kahn [2005, 273] also considers that “the unit of analysis is [the] disaster.”

<sup>94</sup> Anbarci et al. [2005, 1907] use “a Negative Binomial estimation strategy with both random and fixed estimators” to estimate death tolls, Kahn [2005, 276] estimates a Zero Inflated Negative Binomial model, Brancati [2007, 729] uses “a negative binomial model with robust standard errors clustered by country,” and Escaleras et al. [2007] use “a Negative Binomial specification.” Yet, no study tests for over dispersion. In my dataset I do not find evidence for that, hence I employ a Poisson model.

<sup>95</sup> Brancati [2007, 729] also includes in his analyses “year-fixed effects to control for trends over time.”



**Figure 4:** Geographical Distribution of Earthquakes in Chile 1500-2015

to account for these and other unmeasured yearly factors such as the evolution of the political system, demographic, climate and cultural changes as well as economic shocks (both national and international). I also included latitude to control for the proximity to the Andean mountains. This variable controls for a built-in tectonic predisposition to earthquakes, and longitude 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 of the state in reaching these parts of the country.<sup>96</sup>

More formally, I fit the next equation,

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

$$\log(\lambda_i) = \mu + \beta_{1,j} \text{Proportion}_i + \beta_{2,j} \text{Magnitude}_i^2 + \beta_3 \text{Latitude}_i + \beta_4 \text{Longitude}_i + \beta_5 \text{Population}_i + \beta_6 \text{Urban}_i + \beta_{7,t} \text{Year}_i \quad (1)$$

where,

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

$$j_{1,\dots,J} \text{ where } J = 3$$

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

the  $i$  subscript denotes the unit of analysis (i.e. earthquake),<sup>97</sup> the  $j$  index expresses the type of subnational economic composition of the affected municipality (agricultural, industrial, or mixed), and the  $t$  subscripts denotes the year when earthquake  $i$  happened. Also, since earthquakes can happen more than once per year, in my dataset  $I > T$ .<sup>98</sup> Finally,  $\mu$  is the intercept. Since the ‘treatment’ (sources of sectoral contestation) occurs simultaneously at the national and subnational levels, I implement a multilevel model.<sup>99</sup> The multilevel component of [Equation 1](#) allows the slope of the national proportion of agriculture relative to industry ( $\beta_{1,j}$ ) to vary by the  $j$ th dominant subnational sector. Due to space constrains, I exclude mixed subnational units from my theoretical

<sup>96</sup>Undoubtedly, there are many more factors that might increase the death tolls. [Ambraseys and Bilham \[2011, 154\]](#) 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 in my model some of these factors are accounted for, I do not have complete data on the hour of the shock. However, [Lomnitz \[1970, 1309\]](#) explains that “some of the larger Chilean earthquakes which have caused deaths” between the 1900’s and the 1960’s have been afternoon quakes. See especially Table 1 in p. 1310. 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 ([Keefe et al. \[2011, 1534\]](#)) could not be included due to the lack of complete data overtime. However, the year fixed effects could pick up at some extent these unmeasured components.

<sup>97</sup>[Kahn \[2005, 278\]](#) follows the same strategy.

<sup>98</sup>For the years in which there is just one earthquake, the ‘group’ variable has only one observation. This does not endangers the robustness of the model. [Gelman and Hill \[2006, 276\]](#) explain that it “is even acceptable to have one observation in many of the groups.”

<sup>99</sup>[Gelman and Hill \[2006, 237\]](#). I do not claim in any way this is a causal method.

analyses. Additionally, to rule out the possibility that sectors self-select into less earthquake-prone geographical locations, I also modeled magnitude with different slopes ( $\beta_{2j}$ ).<sup>100</sup> The results strongly suggest that there is not a self-selection mechanism in the data generating process. Nearly-zero posteriors indicate that the three types of subnational localities are affected in the same way, and that casualties are independent of the subnational predominant sector. Finally, the estimated parameters  $\beta_k$  have noninformative normally distributed priors,<sup>101</sup> while precisions  $\tau_p$  of  $\beta_{1j}$ ,  $\beta_{2j}$  and  $\beta_{7t}$  have noninformative Gamma priors.

More formally, I considered the following:

$$\beta_{k,\dots,K} \sim \mathcal{N}(0, 0.01) \text{ where } K = 8$$

$$\tau_{p,\dots,P} \sim \mathcal{G}(0.5, 0.001) \text{ where } P = 3.$$

**Do higher levels of sectoral contestation translate into state development?** Table 1 shows the posterior predictive distributions of the multi-level Bayesian Poisson regression, particularly, the predicted death counts conditional on observed covariates. The main quantity of interest is  $\beta_{1j}$ , the coefficient on  $\frac{\text{Agriculture}}{\text{Industry}}$  with different slopes, one per type of subnational sectoral predominance. The results strongly suggest that as the relative size of agriculture increases, the death toll increases. Given the initial advantage of the agricultural sector, as agriculture keeps developing rapidly leaving the system unchallenged, national sectoral contestation decreases. Under these circumstances the death toll increases by 13 when the subnational locality is *also* agricultural. This scenario exemplifies a situation where agricultural elites are the main national *and* subnational hegemonic elite. However, as the national proportion of agriculture expands *in the presence of strong industrial subnational clusters*, the death-toll decreases by 16. To ease meaningful interpretation of these results, Figure 5 shows that as the proportion of the agricultural sector increases, the death toll decreases by a 4-19 range when the average affected locality is industrial, but it increases by a 3-15 range when the average affected locality is *also* agricultural.

<sup>100</sup>According to the NOAA, an “increase of one in magnitude represents a tenfold increase in the recorded wave amplitude.” Consequently the effect of this variable should not be linear. Consequently, both in Equation 1 and Equation 2 I consider the square term of magnitude.

<sup>101</sup>“Noninformative prior distributions are intended to allow Bayesian inference for parameters about which not much is known beyond the data included in the analysis at hand” (Gelman [2006, 520]).

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

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

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

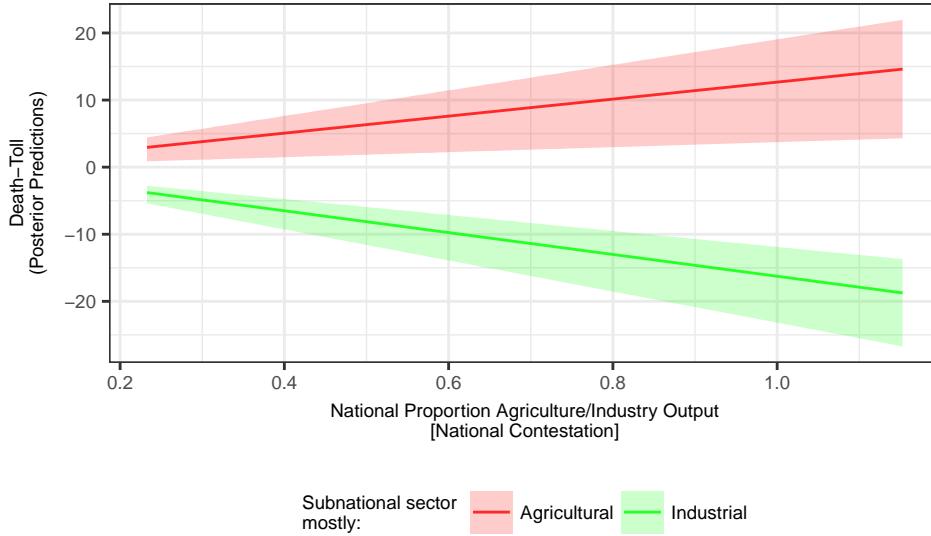
Standard convergence diagnostics suggest good mixing and convergence.

Year fixed effects were omitted in the table.

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

**Table 1:** *Sectoral Competition Model: Simulated Posterior Predictions (Poisson Regression)*

Substantively, these results strongly suggest that sectoral contestation conceptualized at both the national and subnational levels had a positive effect on state-building. These results are relevant since the capacity the state has of enforcing and monitoring building codes throughout the territory is affected by local differences in subnational contestation. Should these subnational sources of contestation not be translated into sectoral agreements, the country risked seeing the emergence of local bosses. These local authorities for instance might not be interested in implementing building codes coming from Santiago. In line with my theoretical expectations, I find that these threats fostered inter-sectoral agreements when levels of inter-sectoral inequality were low. For instance, historical evidence suggests that Chilean industrial elites made political compromises with agricultural elites in exchange of having more state services and being allowed to participate in politics under fairer conditions. This kind of sectoral incorporation into the national project was possible contingent on the capacity the new elites had of overthrowing the institutional order that permitted hegemonic groups to rule without opposition. These results find empirical support for the positive relationship between the emergence of *local* industrial clusters and higher levels of state-capacities. However, they do not tell us how these sectoral dynamics impacted state-capacities *overtime*. That is what I do next.



**Figure 5:** Death-Toll by National and Subnational Sources of Sectoral Contestation

**Did taxation cause state-making overtime?** I argued that lower levels of inter-elite inequality led to higher levels of sectoral contestation, fostering inter-elite compromises. In this paper I identified one such compromise, the implementation of the income tax law. It was argued here that the implementation of the income tax had positive externalities for state-building overtime. Following the same setup and using the same dataset, I fit a simpler one-dimensional Poisson model. The only complexity that was kept were the year fixed-effects. The main difference is the inclusion of an indicator variable that denotes whether in year  $t$  the income tax had been implemented or not, and whose estimated parameter is the main quantity of interest now. Just like before, the structure of the prior mean and precision of  $\beta_1 \sim \mathcal{N}(0, 0.01)$ . The rest is the same.

More formally, I fitted the next equation:

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

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

**Table 2** also shows posterior predictive distributions. The results show that implementing the income tax overtime *decreases* death-tolls by 3. The effect is small. This might be due to the short dataset. **Figure 6** shows the disaggregated effects overtime, and how death-tolls (state capacities) do vary, and particularly, *decrease* (increase) overtime. Before the income tax law was implemented, death-tolls were relatively stable, averaging 28 casualties approximately per earthquake. However,

once the income tax law was implemented, the death-toll declined from 28 to 22, approximately.

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

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

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

Standard convergence diagnostics suggest good mixing and convergence.

Year fixed effects were omitted in the table.

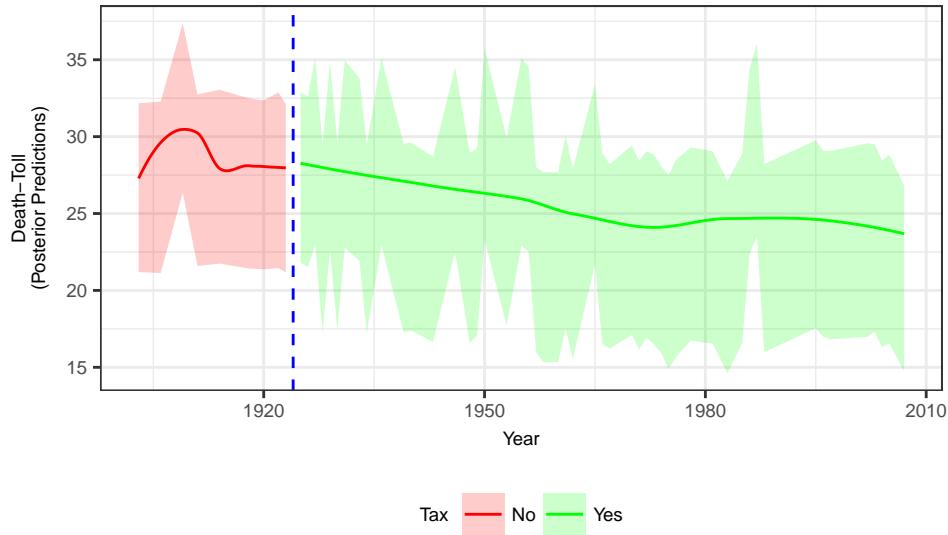
A total of 4 chains were run. Detailed diagnostic plots available [here](#).

**Table 2:** *Income Tax Adoption Model: Simulated Posterior Predictions (Poisson Regression)*

The endogenous capacities of efficiently monitoring individual incomes and deploying bureaucracies throughout the territory to collect these taxes were transferred to other state institutions via spillover effects. This has been a long-time claim of the fiscal sociology. Here find support for these claims. The implementation of the income tax law in Chile increased the capacities of the state of monitoring and enforcing building codes. The relationship between collecting revenue and getting good at it is an endogenous one. The ‘big push’ or definitive set of initial incentives to monitor personal incomes to convert them into public property was mobilized by the incentives of capitalizing increasing industrial incomes (see [Figure 2](#), top panel).

Following the fiscal sociology, I contend that unlike other regular state institutions and services, taxing incomes *required more* from the state, producing a secular accumulation of know-how. Indirect taxation demands less from the state. It suffices to establish a staffed office in all ports of entry. However, direct taxation requires sending government emissaries to the whole territory. The cumulative expertise of knowing-how to send and keeping accountable local skilled tax emissaries was transferred to other audit bodies of the state. Historical evidence suggests that the treasury did increase the Chilean fiscal coffers right after the implementation of the income tax law in 1924. This suggests that there was also a denser state presence at the local level, materialized mainly in official visits that were sent from the capital to other regions. As the Chilean state solved its logistical and political difficulties to do so, it generated the necessary routines and standard procedures, applying the same norm throughout the whole territory. For instance, it was necessary 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 and other public services were added, such as doctors, judges, land surveyors to solve land disputes, and engineers to check whether ongoing repairings or edifications followed the national building norms. Similarly, [Strayer \[2005\]](#) for instance explains how official state delegations traveled the territory dispensing judicial decisions, something

that eventually generated the systematization, centralization and -importantly- the monopoly of justice provision by the state. In sum, I find that the act of *sending* bureaucrats to other parts of the territory to collect taxes had positive externalities on other state activities. Here, I identify one of these activities, the enforcing of national quake-sensitive norms.



**Figure 6:** Death-Tolls Over Time: Before and After the Implementation of the Income Tax

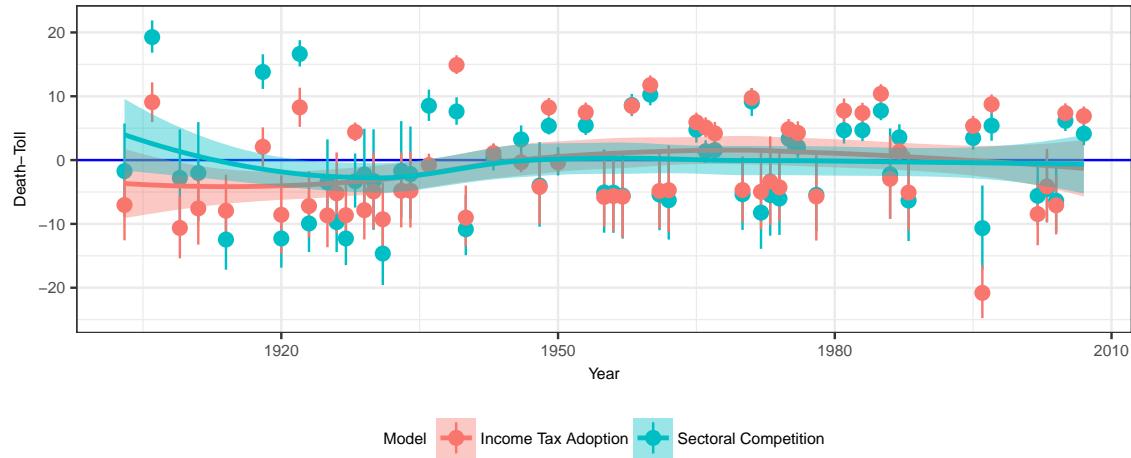
#### IV. FINAL COMMENTS

I argued that higher levels of sectoral competition, both nationally and subnationally conceptualized increased state-capacities over time. Specifically, I explained how the emergence of industrial elites lowered levels of inter-sectoral inequality, pushing the agricultural and industrial elites to reach agreements that materialized in investments in state-making institutions, fostering higher levels of state-capacities. What my empirical analyses showed were twofolds. Death-tolls decrease (state capacities increase) when levels of national/subnational sectoral contestation increased, and once the income tax law was implemented. This last finding in particular finds support for the fiscal sociology paradigm, namely, direct taxation had positive externalities on state-capacities. This paradigm focused on the intertwining of the development of the fiscal state and sectoral-economic conflicts. Here I argued that higher levels of sectoral contestation translated into more credible threats, advancing sectoral alliances at the national level. I identified one such compromise, the implementation of the income tax, and how this crucial institution for state-making included the preferences of both elites. Elite incorporation was possible contingent on the capacity the new elites had of overthrowing the institutional order that permitted hegemonic groups to rule without

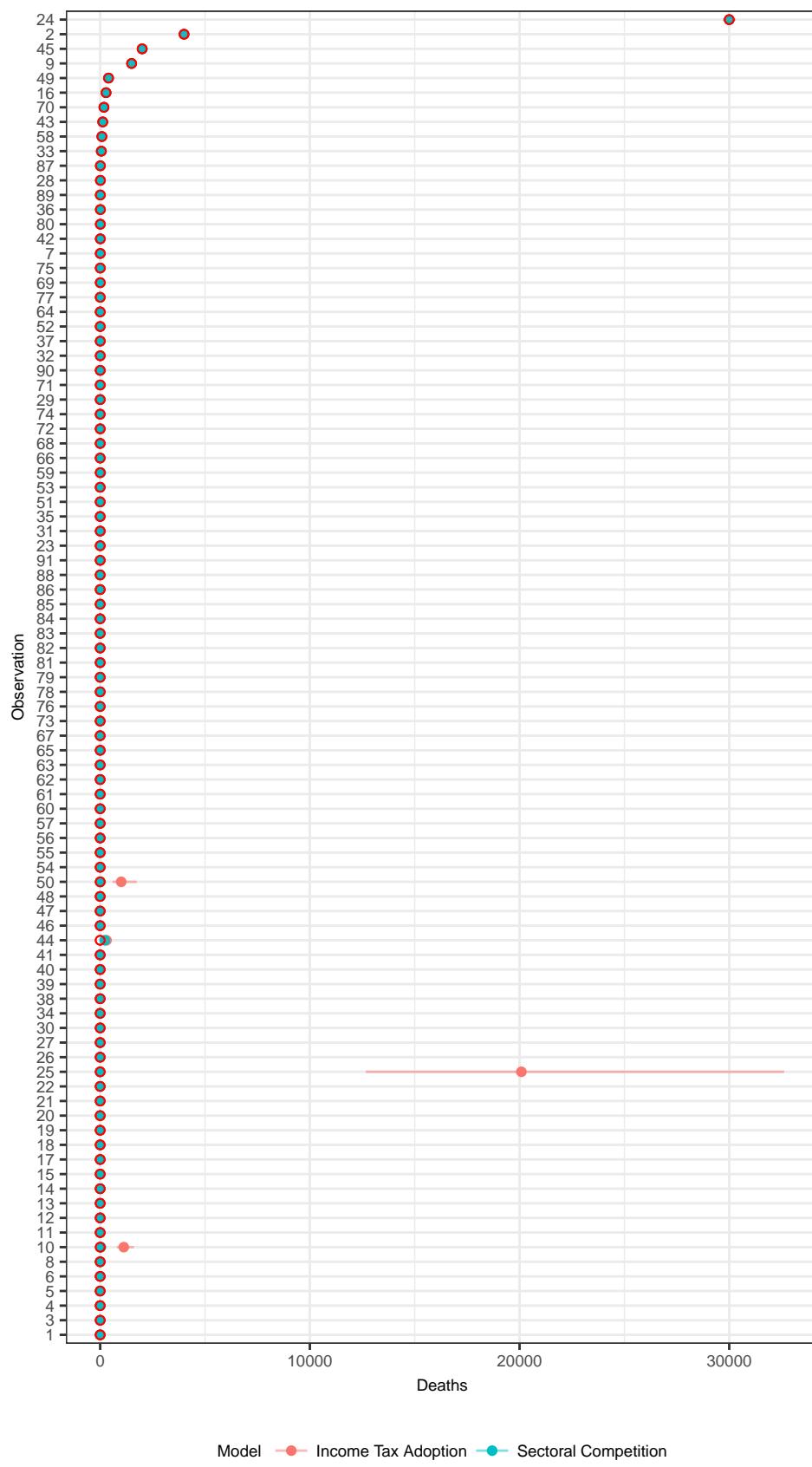
opposition. And also, it was contingent on the benefits industrial obtained out of complying with the income tax, particularly receiving infrastructure that benefited industrial expansion at the subnational level.

I also introduced a novel framework that leverages the exogeneity of earthquakes to capture how the Chilean state has been able to enforce a number of regulations that sought to norm the construction and infrastructure sectors. The capacity the state has of enforcing these institutions is a projection of *overall* state capacities. Importantly, local differences in subnational contestation affected how these national norms were implemented. The measurement is not confounded with levels of economic growth or type of regime either. The measurement has a number of limitations. However, it serves as a rough but good proxy of state capacities. Future research should apply this measurement to other countries, and if possible, with a larger time span.

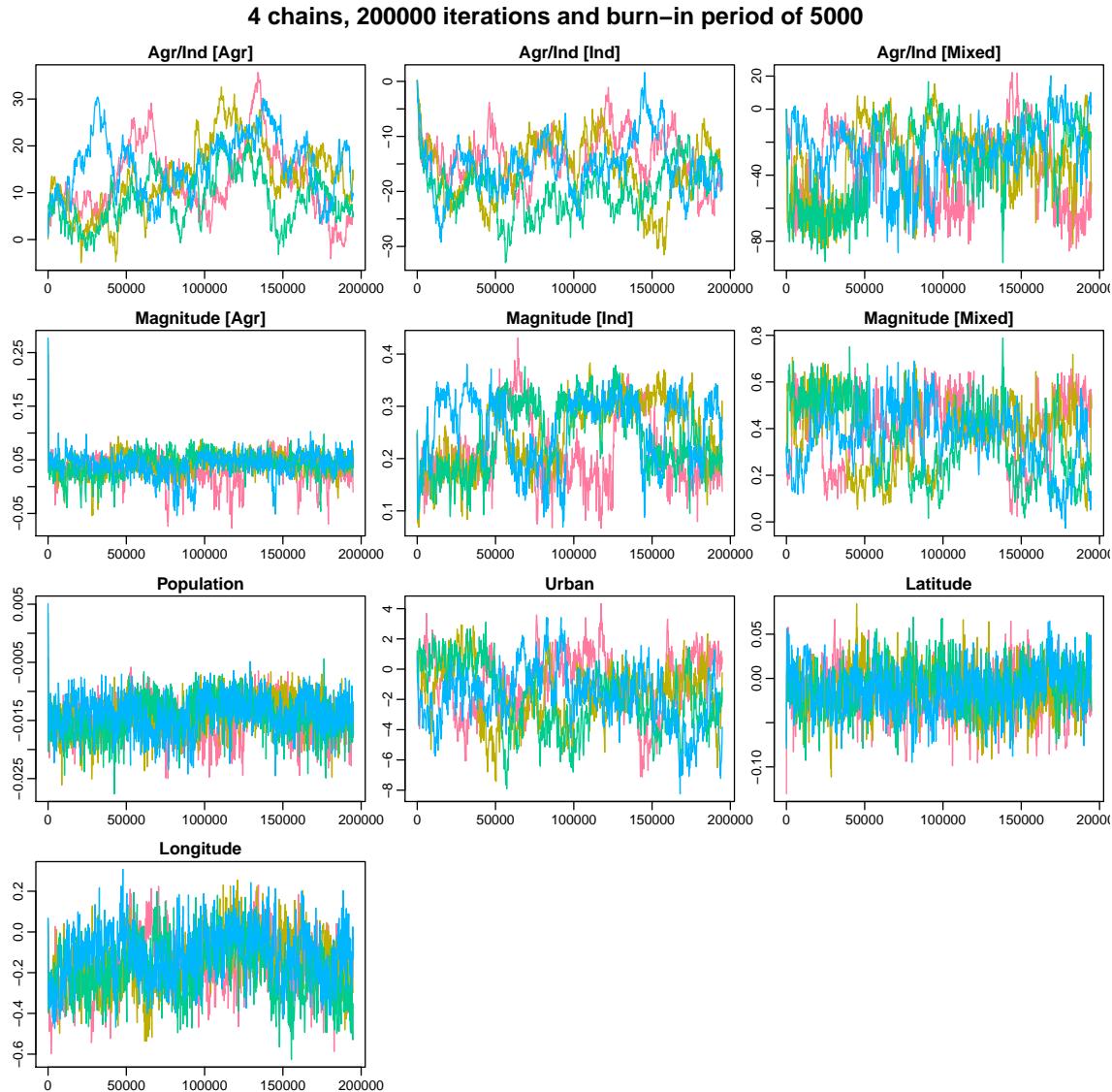
## V. APPENDIX



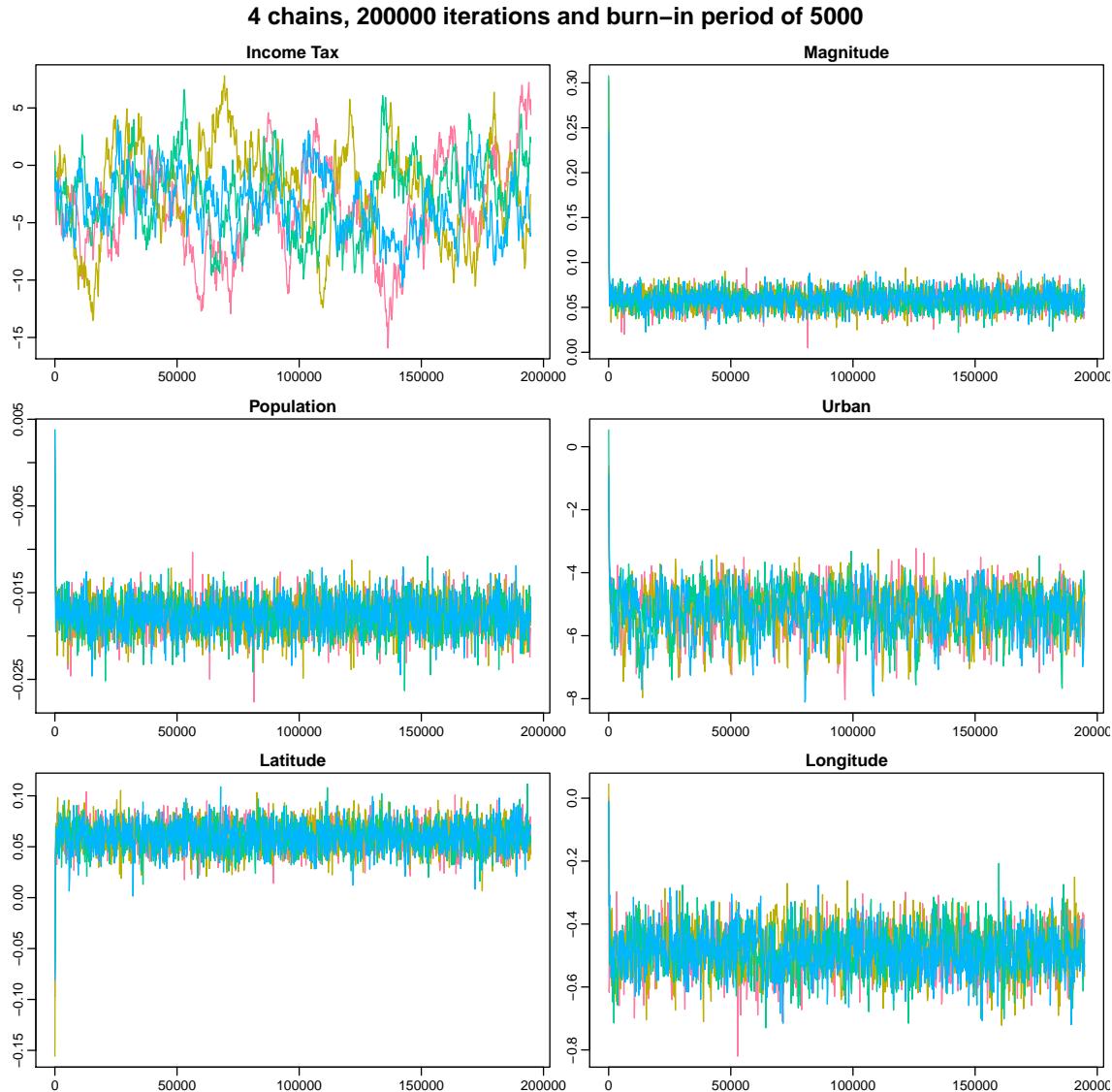
**Figure A1:** *Year Fixed Effects*



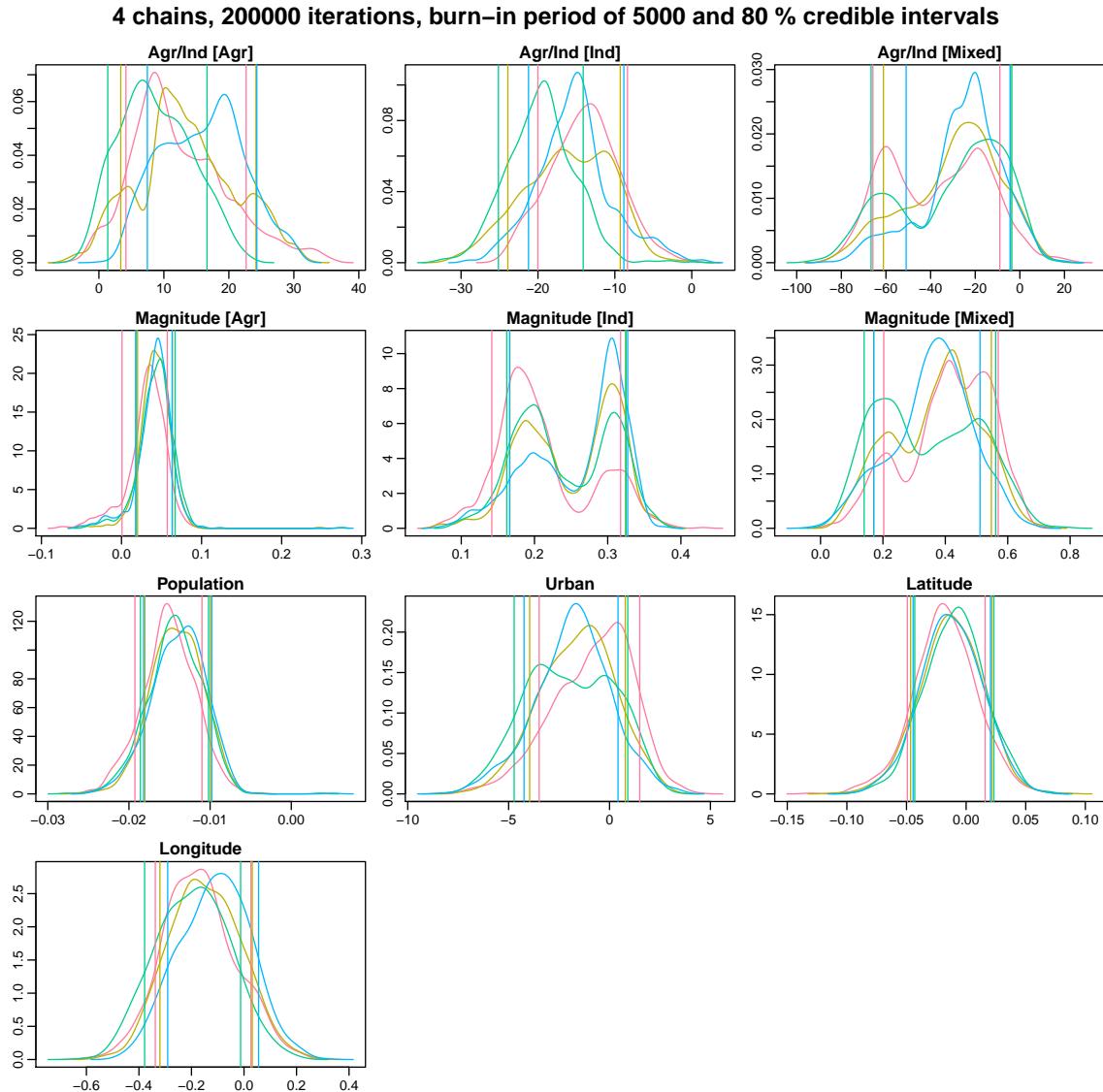
**Figure A2:** Assessing Model Fit



**Figure A3:** Trace Plots: Sectoral Conflicts Model

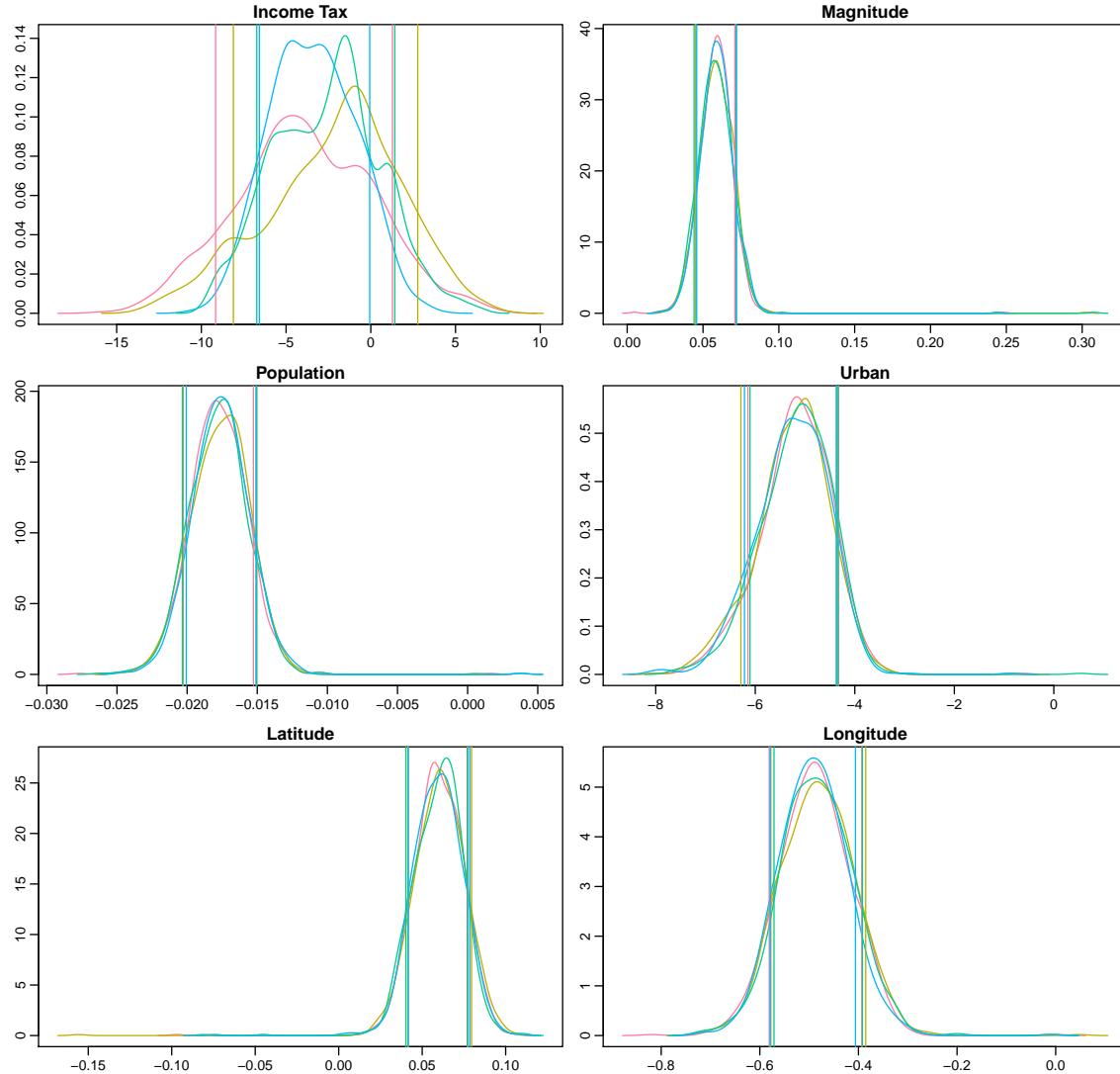


**Figure A4:** Trace Plots: Income Tax Adoption Model



**Figure A5:** Density Plots: Sectoral Conflicts Model

**4 chains, 200000 iterations, burn-in period of 5000 and 80 % credible intervals**



**Figure A6:** Density Plots: Income Tax Adoption Model

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