

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

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## Abstract

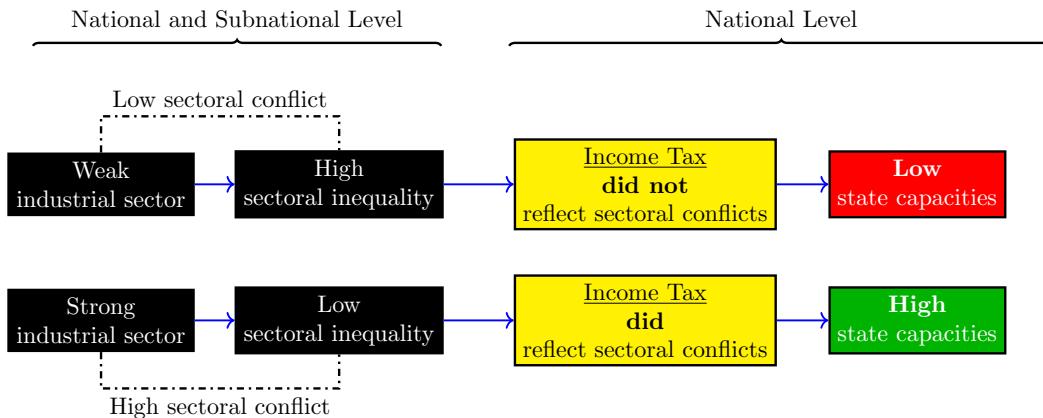
Building on the fiscal sociology paradigm, this paper argues that the development of the modern fiscal apparatus in Chile was product of a sectoral conflict around in the 1920's between the industrial and agricultural political elites. Particularly, this paper identifies the importance of the income tax. When the income tax was implemented under politically contested circumstances, this institution reflected the early foundational sectoral cleavage, crystallizing a series of inter-sectoral compromises and reforms that replaced the old institutional order inherited since colonial times, expanding the overall state capacities. Exploiting the exogeneity of earthquake shocks, I leverage a novel historical earthquake death tolls dataset and a Bayesian multilevel Poisson model to measure state capacities between 1900 and 2010. The capacity states have of deploying inspectors throughout the territory to enforce quake-sensitive zoning and building codes is a reflexion of the overall levels of a country's state capacity. The results suggest that higher levels of inter-sectoral political contestation have historically decreased the proportion of local deaths.

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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 *historical* levels of state capacities. This paper then seeks to contribute to the state formation literature in general, both from a theoretical and methodological perspectives.



**Figure 1: Causal Mechanism**

Building on the fiscal sociology paradigm,<sup>4</sup> I argue that when the implementation of the income tax reflected the *early foundational sectoral cleavage*, an important feature according to the fiscal sociology, this institution contributed to form the Latin American state (see Figure 1). Analytically, I consider sectoral conflicts the trigger of both fiscal expansion and state development. Economic sectors not only shaped the economic landscape. Given that each sector has a corresponding political arm, the *sectoral economic* conflict was also a *political* conflict.<sup>5</sup> Elsewhere I find that in high capacity states the income tax was product of an inter-sectoral conflict between the agricultural and industrial elites.<sup>6</sup> While weaker Latin American states would eventually implement the income tax law as well, in these cases this institution crystallized the leading role of the landowning class, not the profound restructuring of the post-colonial institutional order. This is relevant since the landed

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

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

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

<sup>4</sup> For an excellent overview of both classic and new fiscal sociology refer to Martin et al. [2009, Ch. 1].

<sup>5</sup> See Ansell and Samuels [2014].

<sup>6</sup> Bahamonde [2017c].

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>7</sup> However, when the structural transformation characterized by “a secular decline of agriculture and substantial expansion of manufacturing”<sup>8</sup> took place, that imposed tight constraints on the way politics was run by the incumbent landowning class.<sup>9</sup> Given the initial advantage of the landed elites, the secular emergence of the industrial sector also meant the reduction of inter-sectoral inequality, posing political, economic and military threats to the landed elites.<sup>10</sup> In turn, the lack of an economic challenger prevented political contestation and further institutional investments. I contend that low inter-sectoral inequality made possible higher levels of inter-sectoral contestation giving way to a series of inter-elite compromises. In this paper I identify one such compromise, the implementation of the income tax. The Chilean case shows that industrial elites accepted to be income taxed in exchange of being allowed to participate in politics under fairer conditions. In turn, the implementation of the income tax expanded the *dominion* of the state via bureaucratic development and accumulation of know-how.<sup>11</sup> Critically, the *praxis* of converting private income into public property gave the *tax state* the capacity to enforce other institutions throughout the territory. In this paper I identify one such institution, building codes.

Exploiting the randomness of earthquake shocks, I leverage a novel historical dataset on Chilean earthquake death tolls and a Bayesian multilevel Poisson model to account for state capacities *at the local level* between 1900 and 2010. I contend that the capacity the state has of enforcing and monitoring building codes throughout the territory is a *reflexion* of its *overall* state capacities. Earthquakes death-tolls are orthogonal to regime type, economic development and geography. Thus, keeping magnitudes constant, (weighted) death toll differentials should be attributable to the capacities the state has of enforcing these norms throughout the territory. Critically, these capacities are not a nationally uniform process, but a territorially heterogeneous one. O'Donnell [1993, 1359] famously distinguished different levels of state penetration, where *in the same country* there were ‘brown areas,’ or heterogeneous areas that mixed both ‘high’ and ‘low’ levels of stateness. Following this distinction (and Soifer [2008] in particular), I claim that the capacity the state has for enforcing building codes is a process that varies subnationally. 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

<sup>7</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>8</sup>Johnston and Mellor [1961, 567].

<sup>9</sup>Bahamonde [2017b].

<sup>10</sup>Boix [2015]. For example, elites could use a faction of the existing army or hire private militias.

<sup>11</sup>Bahamonde [2017c].

of local government, might be incomplete.’ I argue that national agricultural expansion (at the expenses of industrial development), in the presence of important subnational clusters of industrial development, fostered a generalized situation of sectoral indeterminacy and contestation, positing credible sectoral threats to agricultural incumbents. These threats advanced sectoral alliances at the national level, in turn fostering institutional investments. Unlike [Bahamonde \[2017b,a\]](#) who proxies sectoral contestation by looking at historical national sectoral outputs, in an effort to account for these subnational dynamics I model sectoral contestation not only by accounting for the sectoral composition of the national level, but also the subnational level too.

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

The expansion of the fiscal system has been traditionally associated with sectoral conflicts. For example, Schumpeter sees “taxation in terms of group conflicts,”<sup>12</sup> while others see taxation as “an outcome of economic relations.”<sup>13</sup> Following this tradition, I sketch a theory around the (potential) sectoral conflict that existed between the industrial and agricultural elites in Latin America. State centralization affects landowners and industrialists in different ways. Consequently, every sector has different preferences towards taxation and state centralization.<sup>14</sup> On the one hand, as land fixity increases the risk premium of the landed elite’s main asset,<sup>15</sup> they systematically resisted taxation. On the other hand, as capital could be reinvested in nontaxable sectors, industrialists’ preferences toward taxation were more elastic.<sup>16</sup> However, class conflicts are more likely to resolve in favor of direct taxation when income inequality *among the elite* is low.<sup>17</sup> When inequality among the elite is high, there are no incentives to cooperate, and rather elites rule in a monopolistic way. However, given that similar degrees of sectoral economic development can be converted into armies of similar capabilities,<sup>18</sup> elites will have incentives to make agreements rather than engaging in conflict when their economic/military capacities are similar. In other words, when levels of inter-elite inequality are low, war is more likely to exhaust all existent assets without producing positive outcomes for

<sup>12</sup>[Monson and Scheidel \[2015, 14\]](#).

<sup>13</sup>Seligman (1895). In [Martin et al. \[2009, 7\]](#).

<sup>14</sup>See [Acemoglu and Robinson \[2009, 289\]](#) and [Best \[1976, 50\]](#).

<sup>15</sup>[Robinson \[2006, 512\]](#).

<sup>16</sup>[Hirschman \[1970\]](#) and Ronald Rogowski in [Drake and McCubbins \[1998, ch. 4\]](#). However, see [Bates and Lien \[1985, 15\]](#).

<sup>17</sup>[Tani \[1966, 157\]](#) explains that the absence of “wealth groups” makes passing an income tax law easier.

<sup>18</sup>[Boix \[2015\]](#).

either sector,<sup>19</sup> putting then pressures to reach agreements instead of engaging in armed conflicts.

In the Latin American context, considering the initial institutional and economical advantages the agricultural sector enjoyed since colonial times, reducing inter-elite inequality meant the expansion of the industrial sector. The emergence of the industrial sector not only altered the structure of the economy but also the inter-sectoral balance of political power, accelerating the implementation of the income tax.<sup>20</sup> Critically, from the elite's perspective, it was in their interest to see these extractive capacities grow. Taxation is more likely to survive as an institution when it counts with the elite's 'blessing.' Boix [1999] and Parente and Prescott [1994] explain how the development of certain institutions or the adoption of certain technologies are implemented when they go in the benefit of the elites. In fact, for the Latin American case, Beramendi et al. [2016] argue that "capitalist elites [preferred] to shoulder a higher tax burden through progressive direct taxation, which they [viewed] as the least-worst economic option."<sup>21</sup> This approach departs from the 'fiscal contract' paradigm. As one proponent explains, economic 'agents pay their taxes [...] when they enjoy corresponding benefits themselves.'<sup>22</sup> Instead, this paper considers taxation as sectoral conflictual outcome. I agree with Martin et al. in that "a tax is not a fee paid in direct exchange for a service, but rather an obligation to contribute,"<sup>23</sup> and with Best [1976, 71] in that "taxes can be viewed as dependent upon the distribution of power rather than as an expression of the free choice of the majority of the people."

A theory focused on sectoral conflicts offers also a theory of state consolidation. As others have argued, "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>24</sup> 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>25</sup> In fact, Musgrave [1992, 99] argues that since taxation (specially 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>26</sup> or "easy-to-collect source of revenues."<sup>27</sup> Given the relatively lower costs states have to incur to collect them, indirect taxes

<sup>19</sup>Richard Salvucci in Uribe-Uran [2001, 48].

<sup>20</sup>Bahamonde [2017b].

<sup>21</sup>They particularly argue that progressive taxation was better relative to "trade taxation, which can negatively impact the industrial sector" (p. 18).

<sup>22</sup>Mahon [2015, 5].

<sup>23</sup>in Martin et al. [2009, 3].

<sup>24</sup>Hechter and Brustein [1980, 1085].

<sup>25</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>26</sup>Moore [2004b, 304].

<sup>27</sup>Coatsworth and Williamson [2002, 10].

have a very low impact on state-building.<sup>28</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>29</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>30</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>31</sup> of the modern nation-state [...] Taxation enmeshes us in the web of generalized reciprocity that constitutes modern society.”<sup>32</sup>

In all Latin American economies during and right after the colonial period, agriculture was the most important sector.<sup>33</sup> And by extension, agricultural political elites were the most powerful elite.<sup>34</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>35</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. This asymmetry led these two ‘antagonistic elites’<sup>36</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. Given their relative similar degrees of economic development and military capacities, the two elites opted for a political compromise.<sup>37</sup> In 1924, industrial elites accepted to be income taxed by agriculturalist incumbents in exchange of having a more open political system. The non-agricultural sector “accepted taxation, *while demanding state services and expecting to influence how tax revenues were spent.*”<sup>38</sup> In turn, the implementation of the income tax, as part of the sectoral bargain, was associated with the implementation of other state

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<sup>28</sup>Moore [2004a, 14].

<sup>29</sup>Campbell [1993, 177].

<sup>30</sup>Bertola and Ocampo [2012, 132].

<sup>31</sup>Anderson [2006].

<sup>32</sup>Martin et al. (in Martin et al. [2009, 3]).

<sup>33</sup>Keller [1931, 13].

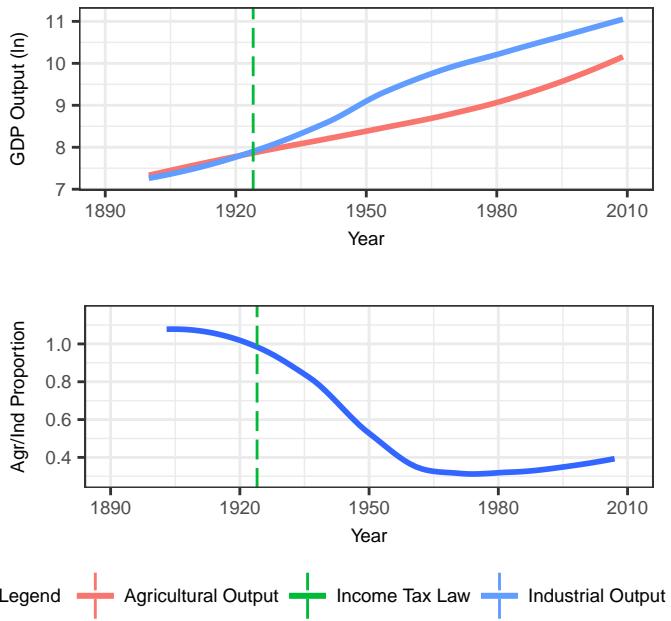
<sup>34</sup>Wright [1975, 45-46].

<sup>35</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>36</sup>Keller [1931, 37-38].

<sup>37</sup>Geddes [1991] argues that competition between two rival parties of about the same size creates clearer incentives to invest in political institutions.

<sup>38</sup>Carmenza Gallo, in Brautigam et al. [2008, 165]. Emphases are mine.



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

institutions, expanding the bureaucratic *dominion* of the state. However, unlike other ‘regular’ state institutions and services, taxing incomes in fact inflicted the state’s coercive sovereignty unto the individual itself. Bahamonde [2017c] finds that the expansion of the industrial sector in Chile leveraged industrial elites, accelerating the implementation of the income tax law. Importantly, the implementation of the income tax law was situated within a framework of sectoral conflicts and eventual concessions. For instance, the *Servicio de Impuestos Internos* is among the finest tax institutions in Latin America. However, Guatemala imposed the income tax law very late, in 1963, and by 1967 the national income tax office employed 194 people, and only 9 of whom had graduated from college.<sup>39</sup> While this case did implement the tax, this (potentially) state-*making* institution was not situated during the formative period and consequently it did not reflect the early foundational sectoral economic cleavage. In this paper I show evidence that suggests that the implementation of the income tax in the presence of sectoral conflicts expanded Chilean state capacities. I also introduce a new measurement able to capture historical outcomes of state efforts.

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<sup>39</sup>Di John [2006, 5].

## 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>40</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>41</sup> And second, most indices are conflated with analytical and conceptual problems.<sup>42</sup> One notable example is protection of the rule of law which is commonly used to proxy state capacities.<sup>43</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>44</sup> introducing in this way systematic measurement error.<sup>45</sup> Likewise, expert surveys suffer from the same problem.<sup>46</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>47</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>48</sup> a state that can barely provide basic services to its population. Focusing on tax rates is not a solution either.<sup>49</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>50</sup>

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

<sup>40</sup>Hanson and Sigman [2013, 10] compiled 24 different types of measurements of state-capacities, while Mata and Ziaja [2009] constructed a combined measurement of 12 other indicators.

<sup>41</sup>Mata and Ziaja [2009, 35]. They point out particularly to the fact that data are usually poor or unavailable.

<sup>42</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>43</sup>See for one example Besley and Persson [2009, 1237].

<sup>44</sup>Kurtz and Schrank [2007, 542]. Emphasis in original.

<sup>45</sup>See also Kurtz and Schrank [2012, 618].

<sup>46</sup>Fukuyama [2013, 349].

<sup>47</sup>Kurtz and Schrank [2007, 543].

<sup>48</sup>Fukuyama [2013, 348].

<sup>49</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>50</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>51</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 historical levels of state capacities, such as investments in public goods like infrastructure, roads,<sup>52</sup> electrification (measured as light intensity per pixel),<sup>53</sup> and railroads.<sup>54</sup> However, many of these measurement are debatable. For example, Soifer [2012, 593] explains that “railroads were often constructed by private actors.”<sup>55</sup> The same problem applies to other types of infrastructures. There are others more appropriated strategies such as the opening of postal offices,<sup>56</sup> the administration of national censuses<sup>57</sup> and vaccination.<sup>58</sup> While these measurements advance our knowledge on *historical* state capacities, 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 historical state capacities. 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>59</sup> “[d]isasters are not as well studied [...] in the field of political science.”<sup>60</sup> Building on

<sup>51</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>52</sup>See for example Mann [1984, 2008], Acemoglu [2005], Saylor [2012], Thies [2009], Besley and Persson [2010].

<sup>53</sup>Huntington and Wibbels [2014].

<sup>54</sup>Saylor [2012, 302] and Coatsworth [1974].

<sup>55</sup>Footnote #11.

<sup>56</sup>See for example Acemoglu et al. [2016].

<sup>57</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>58</sup>Soifer [2012].

<sup>59</sup>Anbarci et al. [2005, 1908].

<sup>60</sup>Brancati [2007, 719].

Mann [1984, 113], the proposed measurement captures state's 'infrastructural' power.<sup>61</sup> "Natural hazards can be seen as a function of a specific natural process and human [...] activity."<sup>62</sup> Given that earthquakes happen at random and are completely exogenous to the affected locality,<sup>63</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>64</sup> and by extension, they happen at any level of state capacity. Consequently, keeping earthquake magnitudes constant, (weighted) death counts should be attributed to the (in)capacity of the states to invest in preparedness and mitigation institutions.<sup>65</sup> I focus on earthquakes and not on other natural disasters such as 'extreme temperature events, floods, landslides, and windstorms'<sup>66</sup> because earthquakes cannot be foreseen, and such, they put to a test the capacity of the states to have 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>67</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>68</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>69</sup>

The capacity states have of deploying inspectors throughout the territory to enforce quake-sensitive zoning and building codes is a reflexion of the overall levels of a country's state capacity. Since "[e]arthquake-resistant construction depends on responsible governance,"<sup>70</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>61</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>62</sup>Raschky [2008, 627].

<sup>63</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>64</sup>Kahn [2005, 271] and Brancati [2007].

<sup>65</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>66</sup>Kahn [2005, 280].

<sup>67</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>68</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>69</sup>Emphasis is mine.

<sup>70</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>71</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>72</sup> The proposed measurement bridges this gap by incorporating and modeling the state’s effort 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 in concrete 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>73</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>74</sup>

Only states with higher capacities overcome their 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 regulate “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>75</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>76</sup>

Properly enforced and implemented building codes, among other mitigation measures, not only

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<sup>71</sup>Emphases are mine.

<sup>72</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>73</sup>[Keefer et al. \[2011, 1531\]](#).

<sup>74</sup>[Bilham \[2013, 167\]](#).

<sup>75</sup>See specially article 151.

<sup>76</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.’

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>77</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>78</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>79</sup> an activity that *any state must* perform.<sup>80</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>81</sup> the ‘weight of the state’<sup>82</sup> and a ‘subnational’ component which tracks “the ability of the state to exercise control within its territory.” Earthquake death tolls (as a measurement of state capacities) maps well into the first and third components. Since death tolls are a function of how well/bad building codes are *enforced* by the state *throughout the territory*, state-capacities is not a nationally uniform process, making a subnational approach more

<sup>77</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>78</sup>Reed [2011]. See also Laursen [2010].

<sup>79</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>80</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.” In fact, he mentions building codes as one possibility. 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>81</sup>This layer ‘sees state infrastructural power as a characteristic of the central state’.

<sup>82</sup>This relates to ‘how the exercise of state power shapes the society it controls.’

appropriated.

This 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>83</sup> Moreover, there are countries, like India or the United States, where earthquakes happen in certain regions only. Presumably, mitigation policies in these place would need to be targeted to specific areas, possibly undermining the assumption that the these kinds of policies should penetrate the ‘entire’ territory.<sup>84</sup> Another potential concern is that the ability of counting the death-toll might be a function of state capacities itself.<sup>85</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>86</sup> this unfortunately adds more than one layer of complexity. All in all, this measurement offers a rough approximation of historical state capacities. 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>87</sup> The dataset ‘contains information on destructive earthquakes from 2150 B.C. to the present,’ and records the number of deaths,<sup>88</sup> the magnitude and year, and the latitude and longitude of every quake, among other information. Using archival census data from 1907 to 2012,<sup>89</sup> I complemented the NOAA dataset with local population at the municipal level where the quake hit. This way I am able to weight

<sup>83</sup>Keefe 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>84</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.

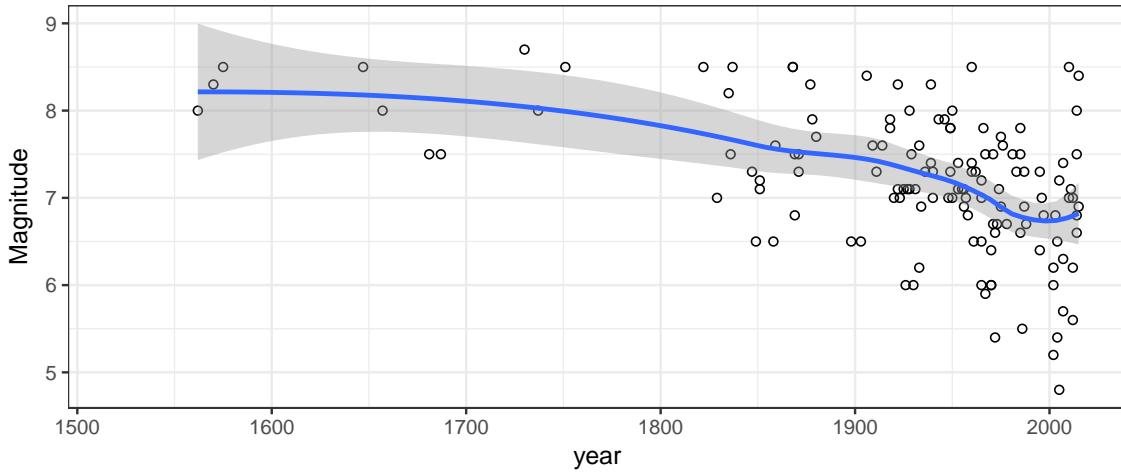
<sup>85</sup>If this were true, states with higher capacities would have higher death tolls, while states with lower capacities, due to their incapacity to count, lower death tolls.

<sup>86</sup>Szeliga et al. [2010].

<sup>87</sup>[NGDC/WDS].

<sup>88</sup>Importantly, the NOAA distinguishes earthquake deaths from total deaths (which includes tsunami casualties). I use the former.

<sup>89</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.



**Figure 3:** Time Cross-Sectional Earthquakes in Chile 1500-2010

the death toll by local population.<sup>90</sup> Using archival census data as well, I also considered the main economic activity of the affected municipality,<sup>91</sup> and also whether the municipality was urban or rural.<sup>92</sup> The death tolls and magnitudes proportionated by the NOAA dataset were contrasted case by case with historical press archival information.<sup>93</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>94</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

<sup>90</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>91</sup>Agricultural, industrial, or mixed (i.e., both agricultural and industrial).

<sup>92</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>93</sup>*El Mercurio* and *La Nación* newspapers, both kept at the Archivo of the Biblioteca Nacional de Chile.

<sup>94</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.

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. 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  $33^\circ$ ), 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, 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  $70^\circ$ ) determines the ruggedness of the terrain, presumably making it harder for the state to penetrate these areas.<sup>95</sup> However shocks have affected the territory from coast to mountain.<sup>96</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>97</sup> As an event, each earthquake has a death toll, a subnational location identified by its latitude and longitude, a magnitude,<sup>98</sup> a 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, year, and a dummy variable indicating whether in a given year the income tax was adopted. Specifically, using a Bayesian Poisson regression,<sup>99</sup> I model the count of dead individuals caused by earthquakes. The main independent variable is the interaction between the proportion of national agriculture output relative to national industrial output (one slope per economic activity at the local level) and a dummy variable which indicates whether by year  $t$  the income tax law had been implemented (see [Figure 2](#), bottom panel). This strategy is relevant since I am interested in whether the implementation of the income tax was implemented in a context of national sectoral contestation. Multiple slopes models subnational sources of sectoral contestation. I also included

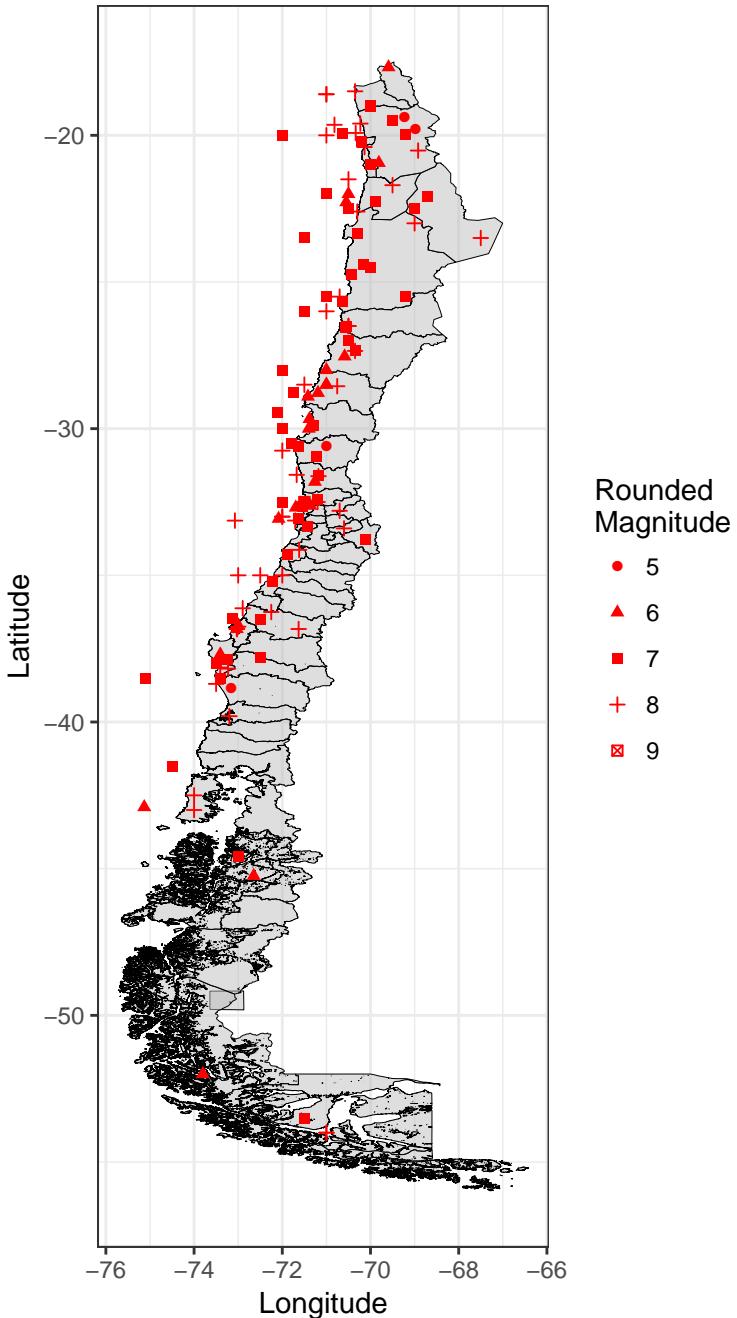
<sup>95</sup>Moreover, [Brancati \[2007, 729\]](#) explains that “[e]arthquakes often occur in mountainous areas.”

<sup>96</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>97</sup>[Kahn \[2005, 273\]](#) also considers that “the unit of analysis is [the] disaster.”

<sup>98</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, in [Equation 1](#) I consider the square term of magnitude.

<sup>99</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.



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

year fixed-effects to account for time-varying confounding factors.<sup>100</sup> For instance, fiscal development could be a function of country-specific prior state-building capacities. Fixed-effects should be able to account for this 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>101</sup> More formally, I fit the next equation,

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

$$\log(\lambda_i) = \mu + \beta_{1,j} \text{Proportion}_i + \beta_2 \text{Tax}_i + \beta_{3,j} \text{Proportion}_i \times \text{Tax}_i + \beta_{4,j} \text{Magnitude}_i^2 + \beta_5 \text{Population}_i + \beta_6 \text{Urban}_i + \beta_7 \text{Latitude}_i + \beta_8 \text{Longitude}_i + \beta_{9,t} \text{Year}_i \quad (1)$$

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>102</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. Finally,  $\mu$  is the intercept.

Since the ‘treatment,’ i.e. sources of sectoral contestation, occur simultaneously at the national and subnational levels, I implement a multilevel model.<sup>103</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. To rule out the possibility that sectors self-select into less earthquake-prone geographical locations, I also modeled magnitude with different slopes ( $\beta_{4,j}$ ). Substantively, while the proportion of agricultural/industrial outputs and the implementation of the income tax take place at the national level, there exists a secular tendency of economic regional clusters to expand despite national sectoral growth aggregates. I conceptualize this tendency as a source of subnational sectoral contestation. For instance, when *national* agricultural output is faster

<sup>100</sup>Brancati [2007, 729] also includes in his analyses “year-fixed effects to control for trends over time.”

<sup>101</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 specially 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 (Keefer et al. [2011, 1534]) could not be included due to the lack of complete historical data. However, the year fixed effects could pick up at some extent these unmeasured components.

<sup>102</sup>Kahn [2005, 278] follows the same strategy.

<sup>103</sup>Gelman and Hill [2006, 237]. I do not claim in any way this is a causal method.

than industrial growth, but industrialists are the most advantaged elite at the *subnational* level, that speaks of a generalized situation of sectoral indeterminacy and contestation, where the landowning class is *not* completely the dominant elite. Thus, in this example, the emergence of these clusters are also signals of the secular relative declining of the agricultural sector. Substantively, and as argued here, higher levels of sectoral contestation translated into more credible threats, advancing sectoral alliances at the national level, fostering institutional investments and state-capacities.

Finally, the estimated parameters  $\beta_k$  have noninformative normally distributed priors,<sup>104</sup> while precisions  $\tau_p$  of  $\beta_{(1,3)_j}$ ,  $\beta_{4_j}$  and  $\beta_{9_t}$  have noninformative Gamma priors. Also, since earthquakes can happen more than once per year, in my dataset  $i > t$ .<sup>105</sup> More formally, I considered the following:

$$\beta_{k,\dots,K} \sim \mathcal{N}(0, 0.01) \text{ where } K = 9$$

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

Developed states should be able to supervise quake-resistant construction practices, lowering death-tolls of the average earthquake. *Do higher levels of sectoral contestation translate into state development?* In this paper I concentrate on the state-building effects of the income tax law. I explain that when the tax is implemented under contexts of sectoral contestation, a series of inter-elite reforms crystallized a new institutional order, replacing the old one inherited since colonial times, fostering state-building.

**Table 1** shows the posterior predictive distributions of the multi-level Poisson regression, particularly, the predicted death counts conditional on observed covariates. The main quantity of interest is  $\beta_{3_j}$ , the coefficient on the interaction between the national proportion of  $\frac{\text{Agriculture}}{\text{Industry}}$  and the implementation of the income tax law. Given the initial advantage of the landed elites, a higher proportion means lower levels of sectoral contestation, while a lower proportion means higher contestation levels. To account for subnational sources of sectoral contestation, this coefficient is indexed by  $j$ , the sectoral composition of the average subnational unit. **Brambor et al.** [2005] explain that constitutive terms ( $\beta_{1_j}$  and  $\beta_2$ ) should not be interpreted, while **Ai and Norton** [2003] explain the coefficient of the interaction term ( $\beta_{3_j}$ ) should not be interpreted either. Following their advice, I computed and plotted the conditional effect of the implementation of the income tax law under different contexts of sectoral competition. **Figure 5** shows that when the income tax is implemented under non-competitive circumstances, the state has less capacities enforcing building codes, increasing its vulnerability to earthquakes, and hence the death-toll. As argued, only when the tax is implemented under contexts of sectoral contestation this institution will be more likely

<sup>104</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]).

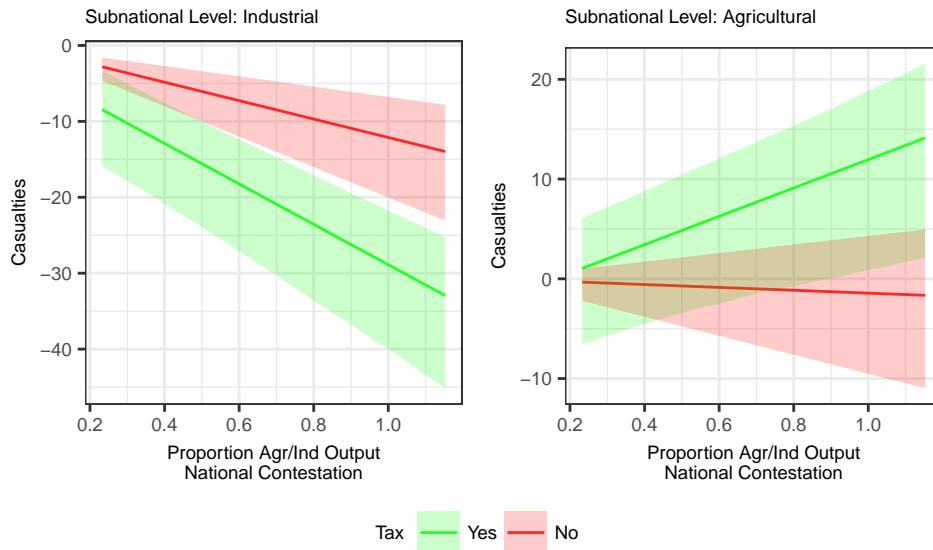
<sup>105</sup>For the years in which there is just one earthquake, the ‘group’ variable has only one observation. This does not endangers the robustness of the model. **Gelman and Hill** [2006, 276] explain that it “is even acceptable to have one observation in many of the groups.”

	Mean	SD	Lower	Upper	Pr.
Agr/Ind [Agr]	-1.44	7.21	-9.52	7.11	0.57
Agr/Ind [Ind]	-12.12	6.01	-20.02	-4.42	0.99
Agr/Ind [Mixed]	-17.15	10.48	-29.58	-4.70	0.96
Income Tax	-2.26	5.56	-9.66	4.82	0.64
Agr/Ind * Income Tax [Agr]	15.65	6.81	7.39	24.22	0.99
Agr/Ind * Income Tax [Ind]	-14.50	5.92	-22.46	-7.23	0.99
Agr/Ind * Income Tax [Mixed]	-17.53	11.64	-29.52	-5.04	0.97
Magnitude [Agr]	0.04	0.02	0.02	0.06	0.98
Magnitude [Ind]	0.33	0.04	0.29	0.37	1.00
Magnitude [Mixed]	0.42	0.08	0.33	0.51	1.00
Population	-0.01	0.00	-0.02	-0.01	1.00
Urban	-1.40	1.24	-2.94	0.12	0.88

**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, latitude and longitude were omitted in the table.  
 A total of 4 chains were run. Detailed diagnostic plots available [here](#).

**Table 1:** Poisson Regression: Simulated Posterior Predictions

to be a state-making institution. In particular, the right panel shows that as the relative size of agriculture increases (i.e. as national sectoral contestation *decreases*), the income tax *rises* the death toll within a 1-14 range when the average subnational affected locality is *also* agricultural (lower subnational sectoral contestation). However, in the left panel, the analyses show that the income tax law *decreases* the death-toll within a 8-33 range when the average subnational affected locality is industrial (higher contestation).



**Figure 5:** Interaction Term: Conditional Effect of Income Tax

These results suggest that when the implementation of the income tax reflected the *early foundational sectoral cleavage*, the income tax law expanded the overall Chilean state capacities. The tax was not important because of the new revenue it collected, however. While Humud (1969, p. 154) explains that the income tax generated considerable resources for the Chilean treasury,<sup>106</sup> 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. These compromises were possible due to a situation of inter-sectoral equality, introduced by increasing levels of industrial expansion. While Bahamonde [2017b] finds that industrial expansion fostered fiscal development by accelerating the implementation of the income tax, using the fiscal sociology paradigm he *theorizes* that the tax *made* the state. Here in this paper I provide empirical support for his claim.

All that said, it is important to rule out the possibility that both industrial *and* agricultural localities are shocked by earthquakes in the same fashion. Otherwise, there might be an endogeneity problem: sectors would be self selecting themselves into more/less earthquake-prone zones. Table 1 shows the posterior means of magnitudes by agricultural, industrial and mixed localities. Overall, there does not seem to be substantive evidence to suggest that this is the case. In section V I present a number of graphical evidence to suggest good fit and convergence of the model. Additional diagnostic plots are available [here](#). Overall, the model is robust and convergence is good.

#### IV. FINAL COMMENTS

I theorized that when the income tax was implemented under politically contested circumstances, this institution expanded the overall state capacities, crystallizing a series of reforms that replaced the old institutional order inherited since colonial times. In turn, the econometric analyses suggest that political contestation (in the form of industrial expansion) is associated with lower death-tolls. The core of the results suggest that the income tax causes positive effects on state-capacities only in the presence of sectoral contestation. While the lack of an economic challenger was preventing political contestation, the secular emergence of industrial economic clusters leveraged industrialist elites, giving them more bargaining power. These results combined speak to a general theory of state-capacities and how they can be traced to inter-sectoral conflicts and compromises.

The Chilean case suggested that industrial elites accepted to be income taxed in exchange of being allowed to participate in politics under fairer conditions, and in exchange of *state services*. Importantly, all these elite compromises took place during the formative years of the Chilean state and during a period of structural indetermination, where no elite had a clear economic/military/political advantage. In this sense, the argument and the empirics find support for the fiscal sociology.

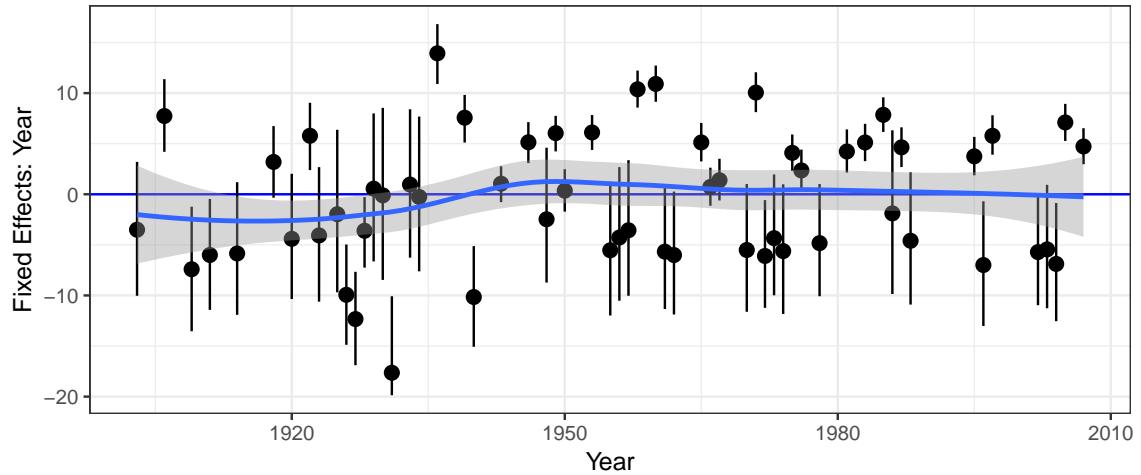
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<sup>106</sup>Bowman and Wallerstein [1982, 451-452].

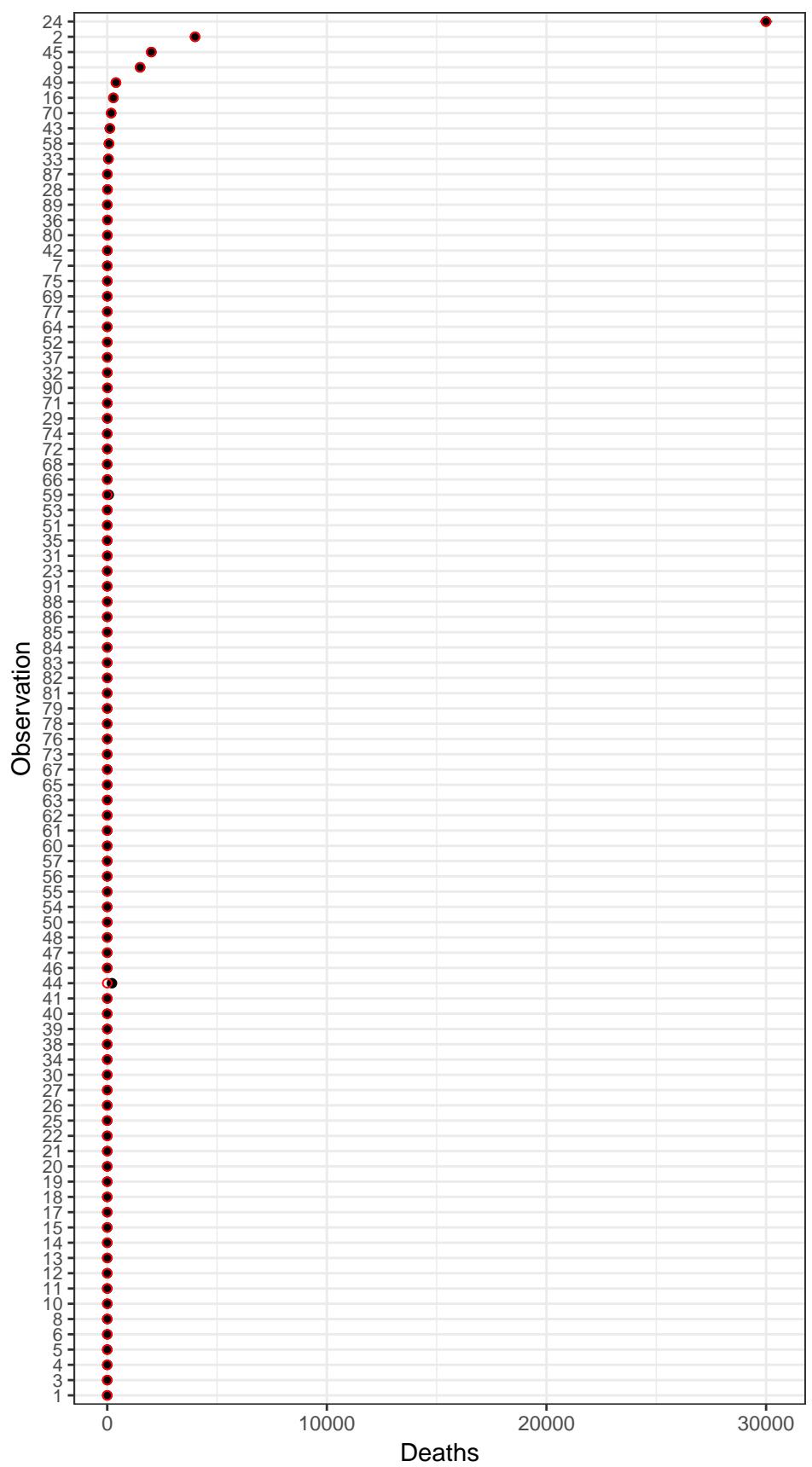
Critically, low levels of inter-sectoral inequality led both elites, as the major tax payers, to agree on having the state meddling with their incomes. In turn, the *praxis* of converting private income into public property gave the *tax state* the capacity to enforce other institutions throughout the territory. That is, the capacity the state had of taxing its subjects *diffused* to other state institutions via spillovers. In this paper I identify one such institution, building codes and construction regulations.

The paper also introduced a novel earthquake dataset where I leveraged 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 to enforce these institutions is in fact a projection of its *overall* state capacities. This measurement is neutral to other issues related to policy preferences (such as protection of property rights), and hence protecting the population from earthquakes is an activity that *all* states should pursue. The measurement is not confounded with levels of economic growth or type of regime either. It would be hard to think of a state with high capacities that is unable to enforce construction codes at the local level. Not only democratic leaders should care about this essential state activity, but dictators too. Regardless of the type of legitimacy any leader has, *all* leaders levy taxes. Should the state fail to norm the construction of infrastructure, earthquakes will cause higher levels of looting and instability. Under these circumstances the state's taxing endeavors will be the first to fall. The measurement has a number of limitations. However, it serves as a good proxy for state capacities. Future research should apply this measurement to other countries, and if possible, with a larger time span.

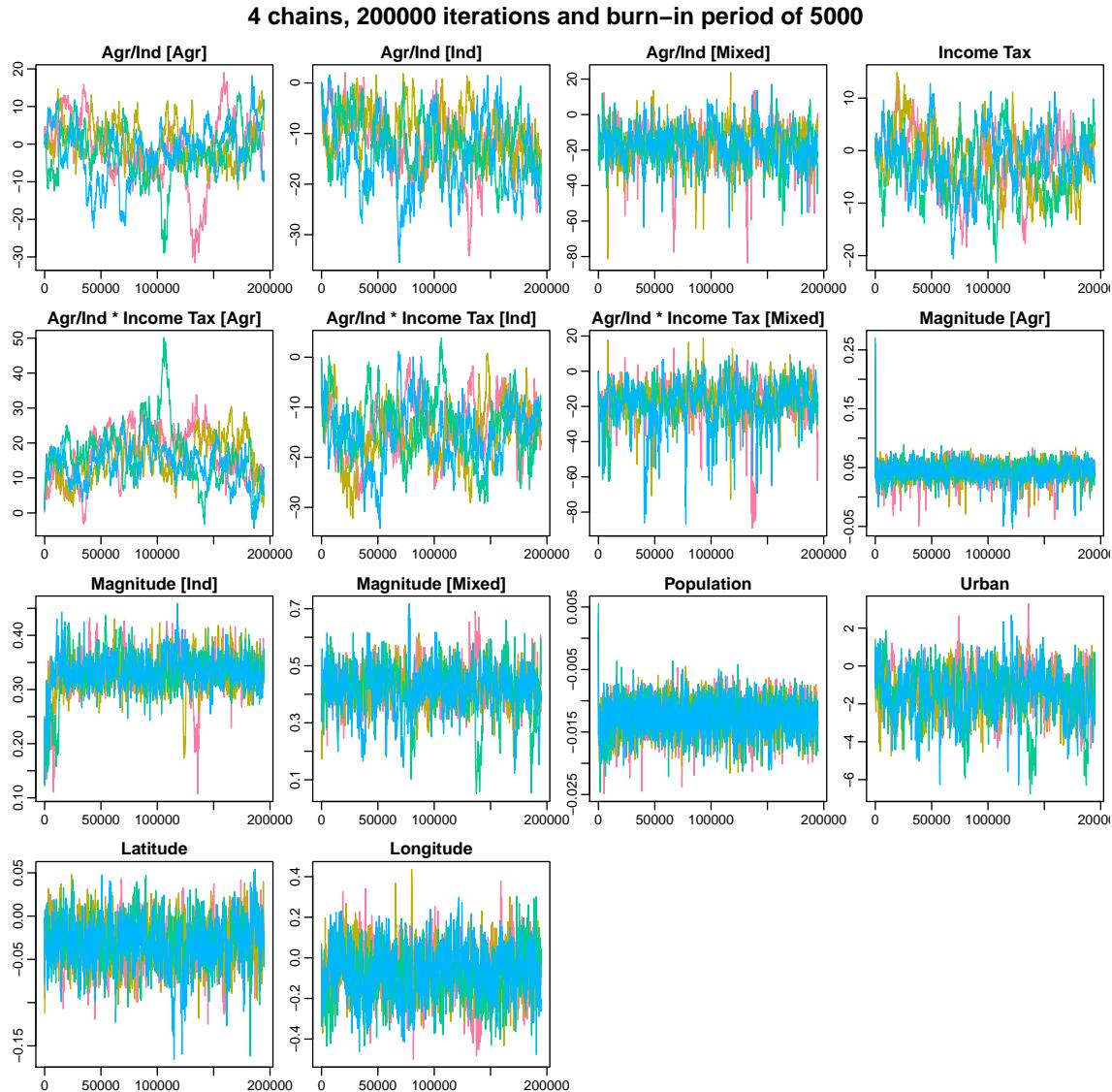
## V. APPENDIX



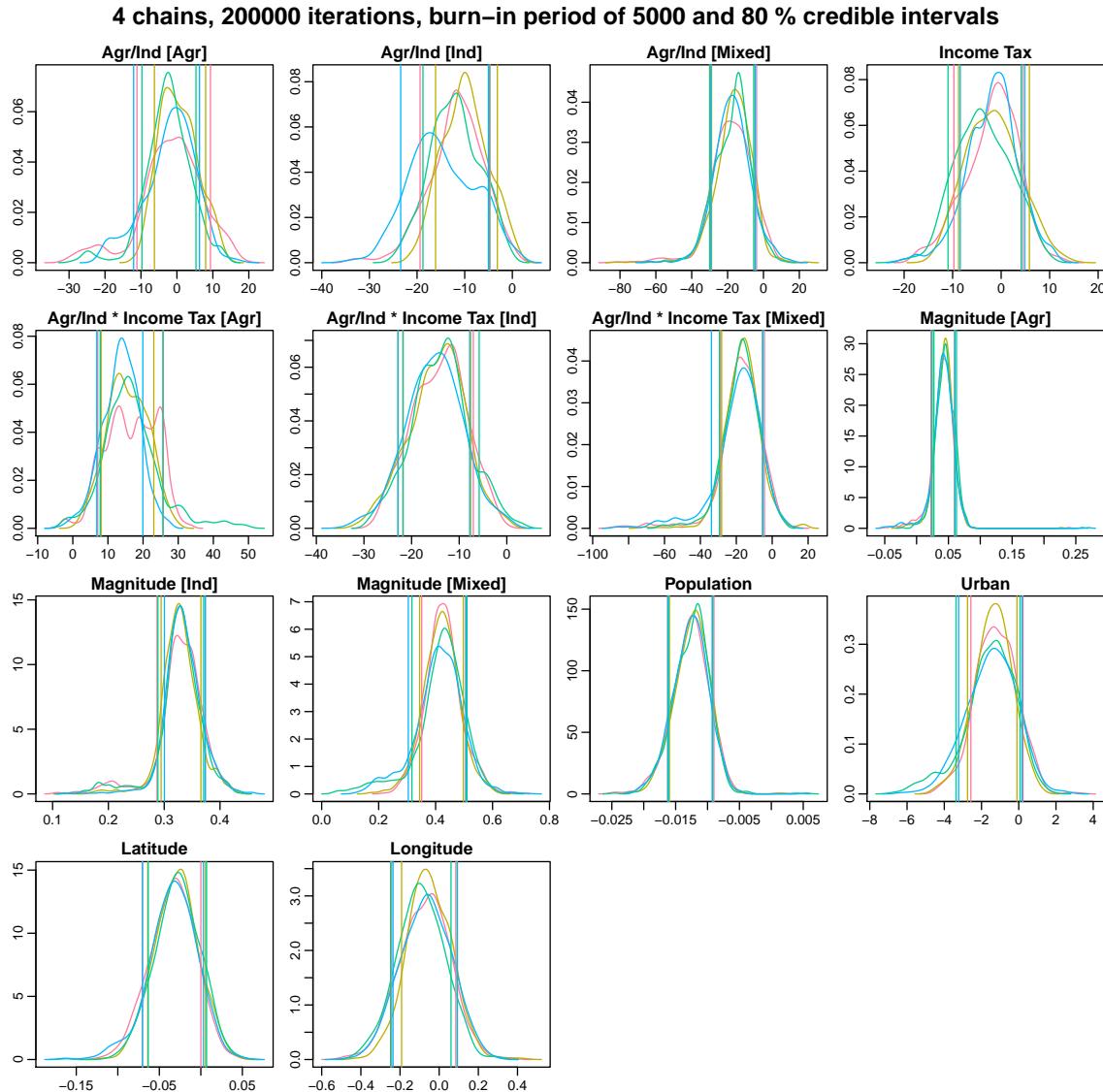
**Figure A1:** Year Fixed Effects



**Figure A2:** Assessing Model Fit



**Figure A3:** Trace Plots



**Figure A4:** Density Plots

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