**Downstream Effects: Water Rights and Rural Scarcity in Chile**

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What drives water scarcity? While droughts reduce freshwater supply and population growth increases demand, scarcity often affects some groups more than others within the same region. The appropriation of flows for private uses, with formal allocations that often exceed a basin's capacity, combined with unequal access to infrastructure for pumping underground water, can lead to shortages in rural communities.

In 2021, the Chilean Water Authority declared 184 municipalities to be in a state of extreme water shortage, affecting 47% of the population. Over eight million people were subject to rationing of water. Once recognized as a water-abundant nation, Chile endured the most severe drought in its recorded history during the 2010s, marked by a continuous sequence of dry years with annual rainfall deficits ranging from 25 to 45% (Garreaud et al. 2017). Simultaneously, intensive demands from agriculture, mining, and other economic sectors significantly depleted the nation's numerous rivers, glaciers, and aquifers. This has positioned Chile among the 33 countries projected to confront severe water stress by 2040 (Maddocks et al. 2015).

In this project, I examine the long-run effects of historical water rights allocation in Chile, to understand the role of formal and informal institutions in shaping who experiences water shortages, and measure some of their downstream economic and political consequences. I hypothesize that those water rights allocated to water-intensive industries, in particular large

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mining, agriculture and forestry companies, will have significant impacts on water shortages downstream. I propose that access to expensive water-pumping infrastructure —often subsidized by the government— enables them to extract water from deeper ground, effectively capturing unequal proportions of the streamflow, and leaving the remaining users without access to their share. Additionally, I plan to investigate the accusations related to the illegal extraction of water, with data provided by the Chilean Water Authority.

My main identification strategy relies on variation on the relative position of a rural community within a river basin, with respect to the groundwater rights granted in that basin. Chilean geography, where rivers flow primarily from the Andes Mountains in the East to the Pacific Ocean in the West, allows me to exploit this variation proxying upstream and downstream with longitude coordinates. Similar to Taylor and Druckenmiller (2020), I use an upstream-downstream difference-in-differences approach on more than 28,000 rural entities distributed across 101 river basins. For each rural entity within a basin, I calculate the volume of water rights granted within its jurisdiction, and the total volume of water rights granted upstream (east) of it. I analyze water rights separately for four categories: (i) all water rights, (ii) those belonging to mining, agriculture and forestry companies, (iii) those belonging to 99th percentile of water holders, and (iv) the intersection between (ii) and (iii), i.e. restricting the 99th percentile of owners to those within the companies of interest. In my sample there are 148 mining companies, 2,666 agricultural companies, and 365 forestry companies, and a total of 34,000 groundwater rights.

My first set of outcomes of interest is related to water shortages. As a proxy for water scarcity in

rural areas, I use Census data on the share of households reliant on emergency water tanker trucks in each rural entity. These tanker trucks were adopted as an emergency measure in response to the water crisis, provide 50 liters of water per person per day, and are procured by the regional governments. I will also examine historical streamflow levels, desertification of land, and plan to build a dataset on conflicts over water. My second set of outcomes are development outcomes. I am interested in health outcomes, specifically about water-borne diseases; income, employment, and migration outcomes. Finally, I will analyze the political impacts of water shortages. Water issues have been at the forefront of Chile's fight for a new constitution, with several protests and collective groups arising to fight for their right to water. I plan to analyze the impact of water shortages on voting outcomes during the constitutional process, to understand how unequal access to water generates political discontent.

My preliminary findings show that water rights allocated to companies in water-intensive industries—particularly mining, agriculture, and forestry—significantly exacerbate water shortages in rural communities, measured by reliance on tanker trucks. I plan to extend this research to analyze the mechanisms by which these companies' water rights generate significantly more water shortages. For this, I will incorporate data on irrigation infrastructure subsidies, corporate lobby (against the Water Code Reform), and accusations related to the illegal extraction of water. I also plan to build datasets to analyze the remaining water-related, development, and political outcomes of interest.

References:

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