

Informes de Movilidad – Telefónica Chile and Universidad del Desarrollo





Executive Summary

In response to the regional lockdowns and mobility restrictions in Chile during the early phases of the pandemic, academic researchers at Universidad de Desarrollo Data Science Institute used anonymized telecommunications data from the company Telefónica to generate reports on mobility in Chile. What started as simply another project developed through a long-standing bilateral partnership rapidly grew into a multi-stakeholder data collaborative that became the primary source of intelligence for the government of Chile's policymaking on mobility restrictions. With its backing by a wide network of subject-matter experts and widespread media coverage, the Informes de Movilidad case study demonstrates how academic-led data collaboratives can go beyond academic publishing by putting research into practice.

Problem at Hand

Although Chile is among the wealthiest countries in Latin America in terms of per capita GDP, it was not spared from the costs of the COVID-19 pandemic.¹ As of December 2020, a similar share of its population

1. World Bank. "GDP per Capita (Current US\$) - Latin America & Caribbean." World Bank Data, https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=ZJ&most_recent_value_desc=true. https://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=ZJ&most_recent_value_desc=true.

had reported cases (1 in 34) as neighboring Argentina (1 in 30) and Brazil (1 in 32), the latter of which has the second-highest death count in the world.²

Spanning over 2,500 miles between the Andes and Pacific Ocean, Chile's 16 main administrative regions have experienced varied case loads, with over 50% of total cases concentrated in Chile's capital, Santiago.³ With such an unequal distribution of cases,

Chile never experienced a national lockdown. Rather, measures have focused on more heavily impacted regions. In Santiago, for example, the government restricted public gatherings on March 13th.⁴

In response to mobility restrictions, a data-science team at the Universidad del Desarrollo (UDD) Data Science Institute used an existing data-sharing research partnership with Telefónica Chile to analyze changing mobility patterns through the early days of the pandemic. The resulting report, published in early April, was among the first studies throughout the world using mobility data to gain situational awareness into the effect of lockdowns, laying a foundation for a burgeoning data collaborative aimed at informing public policy.⁵

Project

In partnership with Telefónica Chile, Cisco, and the Government of Chile's Ministry of Science, the UDD Data Science Institute uses telecommunication data records (x-DR) to analyze mobility patterns within and between Chile's comunas, the smallest of Chile's administrative subdivisions. By analyzing over 50 billion data records that are captured whenever a mobile device connects to a cellular antenna to download or upload information, UDD researchers measure broad patterns of mobility as people's devices connect with different (or the same) cell towers over time.

The use of such data to map mobility patterns is not new to UDD. For the past five years, UDD researchers have partnered with Telefónica Chile on a variety of mobility-related research projects, such as using call detail records to analyze gender inequity in transportation.⁶ Within this context, the UDD research team requested access to anonymized x-DR records from Telefónica. By working closely with collaborators from the ISI Foundation in Italy—which developed a methodology for extracting COVID-specific mobility metrics from mobility data early in the pandemic—the research team was able to develop its initial mobility report.⁷

According to the the UDD research team, shortly after publishing this first report, interest in the work rapidly increased. Following coverage in the Chilean press, the Chilean senate invited the UDD team to present their work to them, leading to the establishment of an official data committee between the Dean

2. Times, The New York. "Coronavirus World Map: Tracking the Global Outbreak." The New York Times, sec. World. Accessed March 10, 2021. <https://www.nytimes.com/interactive/2020/world/coronavirus-maps.html>.

3. Ministerio de Salud. "Casos Confirmados En Chile COVID-19." Ministerio de Salud – Gobierno de Chile, March 10, 2021. <https://www.minsal.cl/nuevo-coronavirus-2019-ncov/casos-confirmados-en-chile-covid-19/>.

4. Reuters Staff. "Chile Bans Large Public Events over Coronavirus Fears, Ahead of Planned Protests." Reuters. March 14, 2020. <https://www.reuters.com/article/us-health-coronavirus-chile-idUSKBN21102N>.

5. Ferres, Leo, Rossano Schifanella, Nicola Perra, Salvatore Vilella, Loreto Bravo, Daniela Paolotti, Giancarlo Ruffo, and Manuel Sacasa. "Measuring Levels of Activity in a Changing City: A Study Using Cellphone Data Streams." Santiago, Chile: Instituto de Data Science, Faculty of Engineering, May 4, 2020. http://datascience.udd.cl/covid_ids_tef_01.pdf.

6. Gauvin, Laetitia, Michele Tizzoni, Simone Piaggese, Andrew Young, Natalia Adler, Stefaan Verhulst, Leo Ferres, and Ciro Cattuto. "Gender Gaps in Urban Mobility." *Humanities and Social Sciences Communications* 7, no. 1 (June 17, 2020): 1–13. <https://doi.org/10.1057/s41599-020-0500-x>.

7. Pepe, Emanuele, Paolo Bajardi, Laetitia Gauvin, Filippo Privitera, Brennan Lake, Ciro Cattuto, and Michele Tizzoni. "COVID-19 Outbreak Response, a Dataset to Assess Mobility Changes in Italy Following National Lockdown." *Scientific Data* 7, no. 1 (July 8, 2020): 230. <https://doi.org/10.1038/s41597-020-00575-2>.

of UDD and Chile's national ministry of science.

Broad media exposure also attracted the attention of the private sector, including the multinational technology company Cisco, which provided significant funding UDD to help them scale their work as a corporate social responsibility objective. With this support, the UDD team created big data infrastructure and pipelines capable of efficiently producing aggregate mobility reports on a bi-weekly basis. These reports are made available to the public both through UDD's website⁸ and the ministry of science's GitHub repository as CSV files.⁹ These aggregated datasets are used by policymakers within the Government of Chile to inform public policy around issues such as mobility restrictions and reopening.

Data Assets

The mobility reports utilize anonymized x-DR provided by Telefónica Chile, with an average of 200 million records per day. As one of Chile's largest telecommunication companies, Telefónica subscribers represent roughly one third of Chile's population. Similar to Call Detail Records, x-DRs are generated when an internet-enabled mobile device connects to a nearby cellular antenna in order to download or upload information through the internet. Unlike Call Detail Records, in which there are two parties involved, x-DRs typically only contain metadata represented by an anonymized device ID, the ID of the fixed-location cellular antenna, and a timestamp.

A data dictionary is used in parallel which contains the latitude and longitude for each cellular antenna ID, enabling data scientists to infer a device's location based on the radius of coverage of each antenna. When the device connects to various antennas through time it is possible to infer mobility patterns as the device owners move. In this way, researchers at UDD are able to measure mobility patterns within and between areas, such as Comunas in Chile.

While alternative mobility datasets—such as Google's COVID-19 Community Mobility Reports and Apple's COVID-19 Mobility Trends Reports—are made available for Chile, the UDD team decided not to use each datasets for different reasons. Google's reports are only available at the province level, precluding the analysis of movement within and between comunas, and Apple's mobility reports are derived from iPhone owners, which in Chile would create a sampling representativeness issue biased towards middle to upper classes.

Analysis & Insights

Through their initial report published in April 2020, UDD and its collaborators discovered that the first mobility restrictions—such as closing schools and prohibiting large social gatherings— caused overall mobility patterns to appear similar to trends often observed on Saturdays during pre-pandemic times, with fewer inter-comuna trips and greater presence of devices in residential areas than commercial areas.

Once the scope of the data collaborative expanded through the involvement of Cisco and the Government of Chile, the research team began to produce additional indices, including:

- Neighborhood level analyses within and between neighborhoods of Santiago;
- Economic reopening indices, for example to inform the safe reopening of commercial shopping centers;

8. "Movilidad IDS UDD Home Page." Accessed March 10, 2021. <https://datascience.udd.cl/movilidad/>.

9. Ferres, Leo, and Bravo Loreto. "MinCiencia/Datos-COVID19." GitHub. Accessed March 10, 2021. <https://github.com/MinCiencia/Datos-COVID19>.

- School reopening and safety analysis;
- Socioeconomic analyses to glean insights into how the pandemic and mobility restrictions affect different socioeconomic segments of society; and
- Internal migration indices for inter-commune and inter-regional population movement measures.

Design

The data collaborative behind the Informes de Movilidad was designed to provide timely mobility insights while preserving privacy and embedding principles of responsible data sharing. The methodology for inferring mobility patterns from telco records is well established in academic literature, the specific methodologies utilized by the UDD data collaborative were also peer-reviewed through their previous works,¹⁰ and through the COVID-19 related analyses from its co-collaborators, such as the ISI Foundation.¹¹

Nonetheless, considering that the Chilean Government relies on the reports in order to set policies and restrictions that have consequential impacts on society, the research group continuously applies statistical tests to their datasets in order to ensure that they are representative and highly correlated with ground-truth observations. The Informes de Movilidad are generated through the following process:

- Telefónica compiles all XDR generated within the previous 48 hours, anonymizes the data, and shares batched data with UDD researchers every Tuesday and Friday;
- The data is combined with publicly available census data and aggregated into indexed values through an automated process;
- UDD performs quality checks on process data; and
- A new report is made available on UDD's website and through the Ministry of Science every Tuesday and Friday.

The final output of the mobility indices includes the following schema:

- Region;
- Census ID of the region;
- Comuna;
- Census ID of the Comuna;
- Km2 area of the comuna;
- Normalized value of intra comuna mobility;
- Normalized value of inter comuna mobility;
- Normalized value of total sum inter/intra mobility; and
- Reference date for mobility activity.

Normalizing the mobility data at the commune level and presenting it as an index preserves the privacy of the underlying XDR records, and makes individual devices impossible to re-identify.¹²

10. Gauvin, et al. supra note 6

11. Pepe, et al. supra note 7

12. Ferres, et al. supra note 5

Outputs and Intended Outcomes

Since its inception in March 2020, the Informes de Movilidad data collaborative has resulted in three academic papers, dozens of press features in national media, and hundreds of individual reports providing situational awareness on mobility across Chile's 346 comunas.

The most influential outcome, however, is the data collaborative's impact on the government's public policymaking in Chile as the country's source of truth on mobility. Through the establishment of a direct link with the ministry of science and the government officers of several communes, the data collaborative's outputs inform decision making on a local, regional and national scale. This partnership will serve as the foundation for continued public-sector collaboration through a focus on rebuilding the economy and preparing for subsequent waves of COVID-19 and future epidemics.

Moreover, the exposure in national media has had a snowballing effect for the data collaborative's growth. Beyond partnerships with the government and Cisco, the data collaborative is now building partnerships with additional private sector entities who are themselves data holders. These include Copec, an energy company with a national network of gas stations, with whom they are working on a private transportation index to complement the previous one. Such partnerships will enable the collaborative to apply existing methodologies with new data sources to explore projects beyond COVID-19, such as smart city development, transportation planning, and the integration of diverse big data sets for data-driven public policy.

Lessons Learned

Enabling Conditions

The Informes de Movilidad case study is a model of how data collaboratives can meaningfully impact decision making and public policy at the national level. The success of this data collaborative can be attributed to multiple favorable conditions, four of which are detailed here:

- **Shared Interests:** Telefónica Chile and UDD benefited from a mature data-sharing partnership built on trust and shared interests. Data collaboratives are often borne from collaborations between private companies and research institutions, such as universities. In this case, the supplier provided a highly valuable, real-time big data source to a technologically savvy institution that was able to derive significant insights from the data.
- **Network of Collaborators:** UDD benefited from a strong network of collaborators across different research institutes—such as the ISI Foundation and Northeastern University's Mobs Lab—which were not only experienced using mobility data but also had significant subject-matter expertise in applying mobility data for epidemiological research.
- **Sense of Urgency:** As with all of the case studies within this report, the unprecedented urgency of the COVID-19 pandemic drove this data collaborative to action. There was unparalleled relevance for the research topic and demand for mobility data, specifically.
- **Third Party Representative:** The Data Science Institute at UDD used the university's dean's office and

the Industry Outreach office to represent them in conversations with the government and the private sector. This decision provided the team with a prominent spokesperson to advocate on its behalf, while letting the data scientists focus on their analysis.

- **Media Coverage and Public Awareness:** After the press began covering the Informes de Movilidad in the media, Cisco became aware of the project and, through the outreach office, they became partners and are an integral part of the team that produces the reports

Challenges

As with any public-private partnership, the Informes de Movilidad data collaborative has experienced a moderate level of public scrutiny given its influence on public policies that have a consequential impact on people's lives and livelihoods. However, some level of scrutiny on public-sector decision making throughout the pandemic has been nearly universal, and can be expected within the context of politically polarized societies, such as Chile.

Conclusion / Next Steps

Perhaps the most significant indicator of success for this data collaborative is the fact that its reports are not only being used in the “real world” rather than sitting on a shelf, but that they are being applied to areas like public health and economic development, which have the potential to create lasting social impact.

To verify the accuracy of the content, an early draft of this document was made available to Richard Benjamins (Telefonica Research) and Michele Vespe (European Commission). Dominique Diouf (Open AIR) and Marijana Novak (Circle Economy) provided a peer review to a later version of this case study.