Trade Gravity Models for the Factors Affecting Foreign Trade in the Political-Administrative Regions of Chile

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Abstract. Chile is recognized as a highly centralized country, the literature in general and organizations such as the OECD identify Chile with a strong economic dependence on a few regions, where in addition, the OECD itself points out that this centralization and concentration limits Chile's capacity for increase. The main objective of the following research is to analyze the degree of incidence of macroeconomic, social, territorial and political variables that influence the foreign trade of the political-administrative regions of Chile with the World. Evaluating the impact of trade liberalization policies on the development of productive activity in the political-administrative regions of Chile. Regarding the methodology, a formulation of a commercial gravity model will be carried out applying the analysis methodology of panel data, considering for this the regionalized import and export figures, extracted from the customs databases, comprised between the years 2010 and 2019 and information from different national and foreign data sources published as open sources. Thus, it seeks to obtain a regional econometric analysis instrument that identifies the main variables that influence the flow of regional trade in Chile, and consequently measure the degree of territorial deconcentrating achieved from the international trade of Chile's regions as a percentage.

Keywords: International trade · Latin America · Gravity model · Econometric modeling

1 Introduction

At present, Chile and its trade policy are proclaimed as the country with the greatest access to part of world trade (88% of World GDP), data from the Organization for Economic Cooperation and Development (OECD) for 2019, record 29 Free Trade Agreements (FTA), facilitating access to 65 world economies with a total of more than 4.9 billion people. This commercial dynamism made Chile stand out that same year as

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the largest exporter of various products, for example: fresh plums, sea urchins, algae, salmon fillet, iodine and lithium, coniferous cellulose and copper cathodes. Evidence of a diversity of products beyond traditional mining [1], also sensing a productive export dynamic throughout the national territory.

Chile is recognized as a highly centralized country, the literature in general [2–5] and organizations such as the OECD identify Chile as having a strong economic dependence on a few regions, where the OECD itself also points out that this centralization and concentration limits Chile's ability to growth [6].

Chile has an economic model open to the world that favors trade and investment [7], this country economic model has generated in recent decades a growing network of trade agreements and free trade agreements with countries and trade blocs throughout the world, with a total of 29 trade agreements in force [8], and according to the Organization for Economic Cooperation and Development (OECD) Chile has the most powerful network of Free Trade agreements in the world, with access to more than 60% of world GDP [9]. Adding to this, Chile presents a diversity of its exports oriented to Goods and Services with increasing dynamism and according to the Ministry of Foreign Affairs it is one of the keys to the success of our country.

The commercial model implemented in Chile translates into a high degree of dependence on the economy of international trade, showing the dynamism of exports of goods and services through GDP, in 1960 Chilean exports represented 13% of national GDP and in the year 2019 corresponded to 28%.

Considering the export variety of Chile and taking the year 2019 as an example, the productive mining sector corresponded to 51% of the country's total exports, the rest is mainly made up of fruits and fruits, sea products, forestry and their derivatives, viticulture, meats edible oils, cereals, compost and other foods [10].

The 10 main exports made in 2019 and corresponding to 56.7% of all national exports, copper products stand out in general with 45.4% of exports, followed by the export of forestry production 3.6%, of salmon with 2.9% and fruit products with 2.0% of exports. The same document indicates that the main means of outbound transport for national production is by sea, moving 96.5% of cargo and the main destination countries are China with 31.3%, United States 14.9% and Japan 8.7%. Regarding imports from Chile, they mainly involve fuels such as oil, liquefied natural gas and coal, imports of cars, mobile phones and bovine meat also stand out.

The 10 main products imported by Chile and which correspond to 22.4% of total purchases abroad, mainly marked by fuels such as oil, liquefied natural gas and coal, representing 13.9%, then the main import of non-fuel products, cars stand out, representing 5.2%, cell phones 2.0%, and bovine meats with 1.5%. From the same yearbook, it is highlighted that the means of transport for accessing merchandise from abroad is by sea 88.1%, with origins mainly from the American continent 33.3%, from Asia and Europe 17.9%.

All this commercial flow to and from Chile with various economies in the world, has generated economic growth that has been highlighted by different organizations specialized in finance, in this context the World Bank explains about Chile: "Chile has been one of the economies of more rapid growth in Latin America in recent decades,

which has allowed the country to significantly reduce poverty. However, more than 30% of the population is economically vulnerable and income inequality remains high" [11].

In addition to the above, Chile is among the most centralized countries in the OECD and in South America [12–14], territorial inequality in Chile has been growing, especially since the 19th century. Its main manifestation is the concentration of the population in the Metropolitan Region [15].

The inequality of income and spatial economic distribution of these throughout the national territory has been a constant occupation of the State of Chile, which for many years has tried to decentralize the administration in processes of powers and resources from a central government to the administrations sub-nacionales o unidades más pequeñas, entregándoles autonomía en la toma de decisiones y poder decisorio local acerca de materias delimitadas por la misma autoridad central, consecuente con lo anterior, Chile está suscrito junto a otros 192 países al programa de la ONU 2015–2030 "Agenda 2030 para el Desarrollo Sostenible", esta agenda entre sus lineamientos de acción plantea que "La dimensión territorial es clave en las trayectorias de desarrollo de los países, es el eje de la organización político - administrativa del Estado y la base material de la actividad económica" [16].

Uniting the country policies that Chile has planted, an economic model opens to the world and decentralization as country development, it seems interesting to evaluate the joint impact of these State policies. [2] affirm that authors such as [17, 18] have pointed out that trade liberalization policies favor territorial deconcentrating, [2] state "because the Export-oriented companies that depend on imports for the purchase of inputs will not have incentives to locate in the national center, where their chains are weak and they face diseconomies of agglomeration. The commercial opening would therefore lead to a deconcentrating process that reduces the primacy and generates more balanced urban systems". In accordance with the above, the idea of analyzing the effect of the commercial liberalization applied by the State and the effects of the economic model in the national territory is proposed, investigating the commercial flow of each of the political-administrative regions of the country. For this, it is proposed to use a trade gravity model that characterizes the impact of Chile's trade policies at the level of Chile's regions and the territorial impact that it could have stimulated.

Thus, Chile has become one of the most active countries in international trade agreement policies, [19] identifies the identity of Chile since its founding has had what he calls "multilateral intuition", the author that has developed a set of principles and values that have facilitated an involvement in the international community and have guided our multilateral action in different contexts, has participated in negotiations and persists in the search for convergence with other countries to generate dynamics that allow multidimensional advancement.

In an inclusive and globalized social context, the trade agreements made by Chile as a whole, based on social connections that provide dynamism and commercial liberation, play a role in human development, poverty reduction, the reduction of inequalities and inclusion. social.

"International trade does not take place in a vacuum, but the possibilities of taking full advantage of its benefits depend not only on the internal policies adopted by a country, but very fundamentally on those adopted by the countries with which it trades" [20].

This open policy has resulted in a commercial liberalization, expanding and facilitating transactions of goods and services with the whole world. According to information from the Undersecretary of International Foreign Relations, the trade opening strategy has evolved from the unilateral reduction of tariffs, towards a wide network of bilateral, as well as plurilateral and multilateral trade agreements, thus establishing a model of growth and development. country based on imports of goods and services and at the same time, an increase in foreign investment in the national territory and the investment of Chilean companies abroad.

Considering the unilateral opening of Chile, a sample of the actions taken is the MFN (Most Favored Nation) tariff, which has remained constant since 2003 at 6%, this has allowed to build the basis of international trade opening. For a small country like Chile, unilateral opening contributes to a more adequate resource allocation and consequently, maximizes the general welfare of the entire country [21–23]. In the same way, Chile's trade policy does not discriminate, there are no protectionist policies that restrict trade, not applying, for example, import licenses, nor subsidies for the export of agricultural products.

The Bilateral and Plulateral agreements signed and updated over time by Chile have complemented the unilateral opening and covered the aspects in which it cannot resolve or intervene, this considers preferential Free Trade Agreements, first in In the 1990s, free trade agreements were achieved with geographically close and Spanish-speaking countries, such as Mexico, Argentina, Bolivia, Venezuela, Colombia, Ecuador, Peru, to later reach agreements with Mercosur, as well as geographically distant economies and different languages, such as Canada, United States, Block P4, Japan, China, Turkey, Australia, Hong Kong, Vietnam, among others.

For Chile and its trade policy, the fact of belonging to plurilateral trade blocs allows achieving substantial trade flow results in shorter terms than is feasible at the level of multilateral treaties. In the Multilateral context, Chile is one of the founding members of the World Trade Organization (WTO for its acronym in English), belongs to the Asia-Pacific Economic Cooperation Forum (APEC) and a member of the Organization for Cooperation and Development. Economic (OECD). This multinational context in which Chile is inserted requires reliable external and internal policies, given globalization, regimes are assumed that must be guarantees of peace, development and cooperation, in addition to being subject to rules and agreements established by multinational organizations.

One aspect to consider in Chile's trade policy is its ease of trade integration, it is considered that successful trade integration begins with the ability of a country to move goods across borders reliably, quickly and at low costs [24], given Chile's territorial disposition and active participation in a multilateral context, allows commercial ease, considering that in 2014 an agreement was signed between member countries of the Mundial Trade Organization, which advances in trade facilitation, and on the other hand [25] based on the guidelines of the Asia-Pacific Economic Cooperation Forum, identifying three general aspects for success in trade integration: physical connectivity, institutional connectivity and connectivity between towns.

The main objective of the following research is to analyze the degree of incidence of macroeconomic, social, territorial and political variables that influence the foreign trade of the political-administrative regions of Chile with the World. Evaluating the

impact of trade liberalization policies on the development of productive activity in the political-administrative regions of Chile.

The proposed research raises the following specific objectives: to formulate a foreign trade gravity model that identifies Chile's regional trade relations with the World; to empirically validate the macroeconomic, social, territorial and political variables that are statistically significant in the foreign trade of the Chilean regions; to characterize the effect of the trade agreements applied by the State of Chile in the foreign trade flow of the regions; measure the impact represented by the geographical distance of Chile's regions on the flow of international trade; relate the foreign trade flow and the existence of maritime ports in the regions of Chile; estimate spatial migrations and population redistribution in the political-administrative regions of the country based on regional trade flows and their effect on territorial deconcentrating.

To comply with these proposed objectives, a commercial gravity model will be formulated applying the analysis methodology in panel data, considering for this the regionalized import and export figures, extracted from Customs databases, comprised between the years 2010 and 2019 and information from different national and foreign data sources published as open sources.

2 Methodology

Regarding gravity models, these have been widely used in the literature to predict international trade flows [26–32], this type of methodology has normally been used for trade flows between countries, although there are few investigations carried out at the Latin American and regional level, this work is expected to have an analytical instrument that quantifies the flows of foreign trade and the possible impact on the regions of Chile, contributing to the economic decentralization of the country, a consequence of the economic opening in force for more than two decades in the country.

Since the works of Jan Timbergen [33–35], economic science uses the gravity model, which is an analytical tool for the study and prediction of trade flow. This econometric model is based on the analogy from a model of theoretical physics and classical mechanics to economics, particularly econometrics, using Isaac Newton's Law of Universal Gravitation, as a trade model that predicts flows. of trade between two economies as gravitational forces in direct function of their mass (GDP, economic income of the country or its population) and inversely proportional to the square of the distance between them.

Anderson [27], made one of the first theoretical explanations to the gravity equation for trade flows based on economic theory, showing that it can be derived from the properties of expenditure models in a context of differentiated goods, using the assumption of Armington [36], differentiating unique goods by country of origin. From the theoretical definition proposed by Anderson, a series of theoretical approaches to economic gravity models followed one another based on international trade specifications, relying on the summary of works that have contributed to the theoretical foundation applied to trade models, carried out by [37], a brief summary of the methodological milestones of the theoretical evolution of the model is presented. [38], based his approach on models of monopolistic competition, [23], they developed their theory of the gravity model on

assumptions of product differentiation and economies of scale, [39] showed that different theories of standard trade converge on the general gravity equation and [40] specify the multilateral resistance to coefficients, which helps to interpret the results from the trade gravity equation, regarding the adequacy and improvement of the gravity equation as a modeling tool for trade flows, over time econometric specifications have been made to the gravity equation and the inclusion of new variables such as, [41].

The gravity equation applied to international trade is documented in summaries and guides of organizations such as the WTO, which cover theoretical aspects of the model, analysis and techniques of application of the model, mentioning some [42].

On the other hand, in the Latin American context, the application of the gravity model according to [24], has increased in recent years the articles that use the gravity model to explain the export behavior of Latin American countries, these include Chile in an indirect and significant way, but there are no specific publications on Chile's foreign trade applying a gravity model.

From the literature review carried out considering the last 10 years, the following works that include Chile and apply a gravitational trade model are recognized: [43] evaluate the effects of trade facilitation among a set of countries including Chile, estimating the main variables associated with trade facilitation and the pattern of trade, estimating a gravitational model for the period 2003–2006 using Panel data with fixed effects. [44] analyze the effect of internationalization and technology in the Mercosur block relative to trade, estimating the impact of direct foreign investment and the internal variables of the countries through a gravity model, applying a joint regression model for the period 1992–2008 by estimation of Ordinary Least Squares (OLS). [45] analyzes the exporting and regionalist behavior as an enhancer of the industrialization of Latin American countries during the period 1996–2005, estimating the influence of certain variables that facilitate the Latin American bilateral trade flow, applying a gravitational model with an OLS estimation. [46] estimate variables that characterize bilateral trade between Latin American economies, using a triple severity model indexed and estimated by OLS with fixed effects over time. Consider the period 1990–2014 for 20 countries.

It is estimated [24] as the first specific study for Chile that applies a gravity model, this analyzes the effects of trade facilitation on Chilean exports using a gravitational model expanded by pool and data static panel effects with fixed, random and dynamic effects. Among the results obtained by the applied gravitational model, geographic distance, common border, common language, and real exchange rate are not significant in the model. The study suggests increasing the size of the ports and number of ports in Chile to reduce freight costs, access more adequate logistics chains according to products, also considering that the ports of southern Chile have better maritime accessibility conditions, being able to attract more number of shipping companies to the southern areas of the country.

Then, [47] study the Chilean production of molybdenum, influence and export behavior through a gravitational model expanded to export behavior according to the Chilean reality and the world molybdenum market, the results of the model indicate that the geographic distance variable positively influences the flow of trade as well as the model makes up the direct relationship between the GDP of the importing country

and the export, and that the common border variable presents a negative coefficient, not contributing to trade.

3 Conclusions

The main results of the research will be able to respond with the proposed objectives, in addition, it seeks to obtain a regional econometric analysis instrument that identifies the main variables that influence the flow of regional trade in Chile, and thus measure the degree of territorial deconcentrating achieved from the international trade of the regions, to generate an instrument that is useful for regional governments in decision-making.

To meet the objectives of the study, the volume of bilateral international trade of the Chilean regions will be modeled with the countries that generate the flow of exporting and importing trade in a period of time, for this an econometric analysis is proposed through a gravitational model of trade that contains the main variables that explain trade, it is intended to estimate the effect of these variables on the volume of trade in the regions of Chile. The panel data method will be used as an analysis tool, considering that the gravity models are based on the exporter and importer data characterized in time and these are generically represented in a panel data structure.

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