What can be done about the dearth of information for local decision-making?
An analysis from the design of a territorial development index based on administrative records

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Abstract

This article addresses the issue of information availability for decision-making at the subregional level. It proposes the construction of a territorial development index (TDI) based on administrative records and comprising 19 variables grouped into 6 dimensions: (i) cultural capital, (ii) social capital, (iii) human capital, (iv) institutional capital, (v) tangible capital and (vi) economic capital. The approach underlying the proposed model centres on territorial development and the structural factors determining it. The variables making up the TDI were selected in consultation with experts and with the use of multivariate statistical analyses. This paper sets out to document many of the phases, procedures and decisions leading to the TDI, as a way of opening up the discussion around this line of research. It concludes by presenting calculations of the TDI for the Chilean municipalities of Angol and Carahue.

Keywords

JEL classification

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I. Introduction

Chile lacks robust information for local decision-making.[2] It was with this assertion that the Outlying Areas Committee of the Chilean Senate opened its session of 6 June 2016.

The way development at all levels (national, regional, territorial and local) is understood has transitioned from approaches concentrating almost exclusively on economic growth towards models of multidimensional, holistic interpretation. On this view, the ability to trigger development processes depends on considerations that yield an understanding of the factors determining these processes and the public or private policy and management decisions that subsequently affect them. This understanding becomes more difficult as the observer delves deeper into the subnational scale and is able to obtain less and less information and data because of a lack of robust periodic series, or finds that such series as do exist, e.g., the National Socioeconomic Survey (CASEN) and the New National Employment Survey (NENE), are unrepresentative. In these circumstances, information presented in a format that describes the development and competitiveness indicators available for the interpretation of phenomena and for decision-making at the local level usually comes from a mix of sources. This means that the secondary information available needs to be reinforced or supplemented with primary information gathered through surveys or interviews. This process adds to the cost of obtaining indicators, so that the scope for reproducing them is limited or dependent on the availability of resources.

This dearth of information for decision-making at the territorial and local level has become a limitation and a challenge for the country. The situation was acknowledged in the report of the Presidential Advisory Committee for Decentralization and Regional Development (2014), which points to a need to create integrated regional systems of territorial information for decision-making, since while plentiful data are available in municipal or sectoral administrative records at the local and territorial level, it is important to determine their availability and reliability. There also needs to be a restructuring to enable data to be better exploited and provide more and better information for subnational public and private policymaking in a way that is more relevant to each territory's complexity and specificity. The growing demand for local and commune-level statistics is a concern that has been addressed since 2011 by the Social Observatory of the Ministry of Social Development (MIDESO), together with the office of the United Nations Development Programme (UNDP) in Chile. In this framework, thought has been put into the development of a methodology for estimating small areas from the data of the 2009 CASEN survey that can be reapplied in subsequent versions (Ministry of Social Development, 2013).

Against this background, the present article aims to make a contribution in at least two areas. First, it seeks to help remedy local information deficiencies by presenting a design for a territorial development index (TDI) constructed exclusively from information in administrative records. Second, it posits an approach to territorial development centred on identification of the structural factors that, as Boisier (2004) argues, are critical to the systemic emergence of development.

With these ends in view, a theoretical framework based on the structural development factors approach was created to provide the underpinnings for the design of the indicator. Currently available subnational indicators applying a territorial approach were reviewed. The TDI was then designed on the basis of the composite index construction methodology laid out in the *Handbook on Constructing Composite Indicators: Methodology and User Guide* published by the Organization for Economic Cooperation and Development (OECD, 2008) and in "Guía metodológica: diseño de indicadores compuestos de desarrollo sostenible" (Schuschny and Soto, 2009). The indicator was tested (i.e., calculated) in Carahue and Angol, two communes in the Araucanía region.

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[2] As Filgueira (2006) puts it, this means the transformation of data into indicators and of these into information providing a means to greater social intelligence and knowledge (evolutionary pyramid of the incorporation of technical knowledge into public policy).

II. Theoretical framework

1. Territorial development and dynamics

As Alburquerque (2013) has noted, the old sectoral polices that used to define the central administration of the State have been giving way to policies designed with a territorial approach. This is because a position needs to be taken in the different local spheres on substantive development issues (e.g., production innovations, human resources and environmental sustainability). In this context, Vázquez Barquero (2007) argues that the development of a territory consists in a process of endogenous changes and transformations driven by the creativity and entrepreneurial capacity already present there. Accordingly, development processes cannot be explained by external mechanisms alone. These processes usually arise endogenously, putting territories' capacities to work by way of the mechanisms and forces that characterize capital accumulation and facilitate economic and social progress.

This particular approach to development seeks to explain how dynamics operate, are manifested, interact and evolve in a given territorial space. This is consistent with the statement by the United Nations Economic and Social Council (2011) that sustaining well-being depends on our ability to ensure that capital stocks (natural, tangible, human and social capital) are passed on to future generations.

In this context, and from the standpoint of complexity theory, Boisier (2004) understands the structure and dynamics of development as the emergence of a complex territorial system. Within this, it is possible to identify subsystems that, in turn, are comprised of more specific elements. Table 1 describes the six subsystems established by Boisier.

Table 1
Boisier's subsystems

(i) Axiological subsystem	A set of universal and singular values that define what it is to belong to a particular territory and that distinguish it from other territories.
(ii) Accumulation subsystem	Includes the accumulation of capital, technical progress and human capital, which are factors in the current theorization of endogenous growth. In the exogeneity of development it is possible to identify the importance of these factors with regard to territory, national political projects, general and sectoral economic policy and external demand (given the greater degree of openness). This makes it necessary to reconsider how public policy is made at the meso (regional) level, while institutions at the subnational level (region, province, commune) could play a proactive role in making these decisions more endogenous.
(iii) Decision-making subsystem	Configured by individual, corporate and collective agents, this is the human expression of the territory. Thus, it is not enough to identify and list all agents. What is necessary, rather, is to accurately identify the projects pursued by each, since disparate visions will have to be reconciled when a political project for development (a territorial development plan, for instance) comes to be settled on.
(iv) Organizational subsystem	This comprises the universe of public and private organizations in the territory. As with the previous dimension, what needs determining is not just the organizational map and its density, but the levels of interrelationship, linkage and synergy of its actions.
(v) Procedural subsystem	This refers to the procedures of the public administration in the territory for service provision, information flow management and actions in support of the territory to optimize its positioning in globalization (opportunities). The entropic (disorderly) characteristics of public information, which increase transaction costs and uncertainty and so act as a hindrance to economic growth, are recognized here.
(vi) Subliminal subsystem	Configured by nine categories of intangible capital, namely cognitive, symbolic, cultural, social, civic, institutional, psychosocial, media and human capital, which are considered key factors in development when this is likewise conceived of as an intangible outcome.

Source: S. Boisier, "Una (re)visión heterodoxa del desarrollo (territorial): un imperativo categórico", *Estudios Sociales*, vol. 12, No. 23, January–June 2004 [online] https://dialnet.unirioja.es/descarga/articulo/2108278.pdf.

There needs to be the greatest possible level of interconnection between these six subsystems, this being what is referred to by the concepts of "neuronal synapsis" and "neuronal synchrony". Without high-density synapses, development cannot arise (Toloza, 2007).

From another point of view, the methodological guide "Marco conceptual, metodológico y operativo de la planificación regional" (González, Sánchez and Araúz, 2011) produced by the Ministry of National Planning and Economic Policy (MIDEPLAN) of Costa Rica and UNDP indicates that the territorial development approach encompasses the dimensions described in table 2.

Table 2
Dimensions according to the United Nations Development Programme

(i) Economic and production dimension	This is associated with decisions and activities affecting the capacity for wealth creation with a territorial connection on the basis of the set of modalities of existing production systems and distribution structures for wealth produced at the territorial level. Dimensions such as investment, the quality and relevance of human capital formation, social capital, productivity, the generation of knowledge and innovation and popular knowledge also need to be taken into account, as they feed through into competitiveness and, especially, into economic inclusion and justice.
(ii) Social dimension	Described as the aspirations and needs of the population belonging to a territory, in the light of its diversity and socioeconomic, ethnic, cultural and age characteristics. In this dimension, inclusion, equity, respect for diversity and social responsibility need to be assured.
(iii) Environmental dimension	This is connected to the principles and strategies of sustainable development and environmental security and encompasses a very wide range of issues, such as care for life, bad social practices that increase the risks associated with climate change, pollution, socioenvironmental risk, salinization of underground reserves, waste management and species predation.
(iv) Cultural dimension	Territories differ from one another and are also socially heterogeneous internally, and this has a cultural manifestation. There are different elements of identity that can generate conflict and risk if not addressed in all their complexity and importance. This differentiation can also turn into inequality and exclusion if differences are not properly understood and addressed, something that is manifested in forms of organization, world views and production methods, among other things.
(v) Political and institutional dimension	Territorial development should be deliberately managed, which means creating scenarios, agendas and strategic roadmaps. It also requires institutional arrangements that give rise to policies, strategies and mechanisms for implementation, oversight and follow-up of actions in the short, medium and long run. All this should take place in a context of dialogue and consensus. Arriving at shared visions, priorities, agreements, responsibilities and areas of coordination requires institutions that can make the proposed strategic design work in practice. For this, it is necessary to ensure that the material, human, cultural and heritage resources available are used to support territorial development.

Source: H. González, O. M. Sánchez and Y. Araúz, "Marco conceptual, metodológico y operativo de la planificación regional: guía metodológica para el diseño de la estrategia de abordaje regional en planificación del desarrollo", Ministry of National Planning and Economic Policy/United Nations Development Programme (UNDP), 2011 [online] https://documentos.mideplan.go.cr/alfresco/d/d/workspace/SpacesStore/8c656860-8f17-47df-a6e1-67cfccf89dff/CPR-001_1.pdf?guest=true.

Accordingly, territorial development is conceived on the basis of a set of elements that enable it to be defined as a multidetermined yet comprehensive theoretical concept taking account of the economic and production, social, environmental, cultural and political and institutional aspects (González, Sánchez and Araúz, 2011).

Requejo (2007) develops a similar perspective from a structure based on five types of capital: natural, tangible-constructed, human, social and image capital (see table 3).

Table 3
Types of capital according to Requejo

(i) Natural capital	The reserve of goods furnished by the environment (land, forests, water, wetlands, etc.) that provide the territory with particular goods and services.
(ii) Tangible-constructed capital	Basic infrastructure, residential buildings, public equipment, production facilities and installations of any other kind, and equipment associated with production, public services and consumption in a territory.
(iii) Human capital	The population's ability to undertake production processes and attain higher levels of well-being and quality of life through the use of knowledge, capabilities and aptitudes.
(iv) Social capital	A society's ability to respond effectively to its needs and organize itself in order to adapt.
(v) Image capital	Recognition of the value associated with a territory's identity.

Source: J. Requejo, "Clases de capital territorial. Clases de capital territorial y desarrollo sostenible", 2007 [online] http://www.atclave.es/publicaciones/descargas/pub_desarrollo/17_clases_de_capital_territorial.pdf.

Analysis of the first part of the methodological guide to territorial economic development titled *Proposiciones para el proceso de construcción y realización de una estrategia de desarrollo económico territoria*l (Chile Emprende, 2005) shows that decentralized management models with a territorial approach (commonly known as territorial development models) are structured on the basis of a multidimensional vision of development that recognizes the existence of different types of territorial capital. These are the whole range of natural, economic, human, institutional and cultural resources that give a territory its identity and special character, influence its competitiveness and represent its endogenous development potential. As with any form of capital, these are not fixed reserves of resources, since part of their essence is their potential to reproduce and expand.

The theoretical framework for territorial capital proposed by Chile Emprende (2005) refers to five dimensions (or types of capital): (i) corporate and labour competitiveness, (ii) tangible capital and land use planning, (iii) institutional capital, (iv) social capital and (v) identity and culture. Table 4 presents these concepts, supplemented and adapted for the purposes of the present design.

Table 4
Types of capital according to Chile Emprende

(i) Human capital	The critical mass of human resources in business, the workforce and academia, people with leadership capacities and their level of competitiveness and development.
(ii) Financial capital	Investments, capital availability, the supply of financing, intermediation instruments, borrowing capacity and financial institutions in the territory.
(iii) Tangible and natural capital	Land use planning to provide the infrastructure needed for development opportunities to be pursued, and also the territory's natural capital and the way it connects to these opportunities.
(iv) Institutional capital	The soundness of institutions in the territory, be they public or private, and standards, laws, programmes and service platforms, among other things.
(v) Social capital	For the purposes of this theoretical model, this means community social capital and the existence of networks, organizational management and cooperation assets, conflicts and the history of conflicts.
(vi) Symbolic capital	A territory's identity and culture, tacit knowledge and traditional lore, among other things.

Source: Chile Emprende, *Guía metodológica del desarrollo territorial*, Santiago, 2005 [online] http://www.dhl.hegoa.ehu.es/ficheros/0000/0243/Chile_Estrategia_de_desarrollo_econ%C3%B3mico_territorial_2009.pdf.

In this context, and from the point of view of territorial development, it is important to be clear about the dimensions of territorial capital that need to be brought into play to capture opportunities and determine the level of relative development currently exhibited by these dimensions. This is a way of attempting to establish which divides and variables might best be dynamized in order to exploit or capture development opportunities in a territory (Chile Emprende, 2005).

Thus, implementing development processes from the perspective of decentralized management models with a territorial approach requires an ongoing effort to accumulate these types of territorial capital. The trigger for the systemic emergence of a territory, on this view, is the pursuit of processes (policies, programmes, projects and actions) aimed at increasing territorial capital inflows while reducing outflows, in order to create a permanent accumulation dynamic.

For the purposes of this study, these last theories based on the six types of territorial capital as structural factors in development are the ones that make the most sense when it comes to constructing a territorial development indicator.

III. Methodology

The methodology was based on the *Handbook on Constructing Composite Indicators: Methodology and User Guide* published by OECD (2008) and on "Guía metodológica: diseño de indicadores compuestos de desarrollo sostenible", the methodology guide for designing composite sustainable development indicators prepared by Schuschny and Soto (2009).

First, setting out from the definition of the types of territorial capital described in the theoretical framework above, the following dimensions of the TDI were defined: symbolic or cultural capital, human capital, social capital, institutional capital, tangible and infrastructure capital and economic capital. It was decided that the pilot communes for estimating the indicator would be Carahue and Angol.[3]

In an initial phase, the working methodology used to construct the TDI was based on workshops, debates and periodic working meetings in which each of the decisions and components making up the model presented here were progressively arrived at.

The first exercise was to form a panel of experts[4] tasked with drawing up a preliminary list of explanatory variables in each dimension. Accordingly, a first workshop was held and 107 initial variables associated with the dimensions specified were established. Identification of the variables at this stage was mainly based on the thematic coverage criterion, meaning that the variables had to have a direct relationship with the operational definition of the dimension.

1. First model adjustment

The 107 variables were put through a filter based on the criterion of data availability in administrative records. This yielded a first adjustment that brought down the number from 107 to 88 (see annex A1).

2. Second model adjustment

Setting out from the 88 variables selected in the first adjustment, a second model adjustment was carried out on the basis of three additional criteria: (i) information quality, (ii) periodicity and (iii) representativeness.[5] In this way, a total of 49 variables were rejected, leaving a somewhat more restricted model with a total of 39 variables, as shown in table 5.

Table 5
Second identification of dimensions and variables for the territorial development index

Dimension	Variable	Operational definition
(i) Cultural capital	1. Cultural events	Number of large-scale cultural events per year, by commune.
	2. Tangible cultural heritage	Number of heritage assets recognized by decree, by commune.
	3. Intangible cultural heritage	Number of intangible heritage assets registered in the Information System for Heritage Management (SIGPA), by commune.
	4. Indigenous communities and associations	Number of indigenous communities and associations, by commune.
	5. Place brands and designations of origin	Number of geographical indications and designations of origin, by commune.
(ii) Social capital	6. Organizations with social aims	Number of organizations with social aims and current legal personality, by commune. These include parents' associations, older adult centres or organizations, sports clubs, neighbourhood committees and other functional groupings.
(iii) Human capital	7. Years of education	Years of secondary education, by commune.
	8. University selection tests (PSU)	Average PSU scores, by commune.
	9. Economically active population (EAP)	Percentage of the population that is of working age (employed and unemployed), by commune.
	10. Employability	Percentage of the EAP that is in work, by commune.

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[3] These communes participate in the University is Territory (UNETE) regional performance agreement operated by the University of the Frontier, which facilitates data collection.

[4] The members were Ismael Toloza, PhD in Economics; Sergio Muñoz, PhD in Statistics; Javier Carrasco, MA in Statistics; Alejandro Henríquez, engineering manager of the office of the National Institute of Statistics (INE) in the Araucanía region; Sergio Sánchez, MA in Research Methodologies; Camilo Rosas, sociologist and lecturer in Social Statistics; Ana María Alarcón, PhD in Anthropology; and Carlos Pineda, Paula Arias and Patricio Gallardo, professionals with the INE technical unit in the Araucanía region.

[5] Namely information quality, meaning the existence of a validated methodology for data generation and recording; periodicity, which concerns the date and frequency with which data are updated; and representativeness, meaning the statistical validity of the data at the communal level.

Table 5 (concluded)

Dimension	Variable	Operational definition
(iv) Institutional capital	11. Municipal Common Fund (FCM) share	Percentage of total municipal revenue that is from the FCM, by municipality.
	12. Municipal revenues	Municipal revenues in millions of Chilean pesos, by municipality.
	13. Municipal spending	Municipal spending per capita in millions of Chilean pesos, by municipality.
	14. Communal Development Plan (PLADECO)	Existence of a current PLADECO, by municipality.
	15. Annual Municipal Education Plan (PADEM)	Existence of a current PADEM, by municipality.
	16. Annual Municipal Health Plan (PASAM)	Existence of a current PASAM, by municipality.
(v) Tangible and infrastructure capital	17. Concrete roads	Kilometres of concrete roads, by commune.
	18. Asphalted roads	Kilometres of asphalted roads, by commune.
	19. Gravel roads	Kilometres of gravel roads, by commune.
	20. Telephone coverage	Percentage fixed-line telephone coverage, by commune.
	21. Internet coverage	Percentage fixed-line Internet coverage, by commune.
	22. Square metres constructed	Square metres constructed and officially certified per capita during the year, by commune.
	23. Drinking water coverage	Percentage drinking water coverage, by commune.
	24. Sewer system coverage	Percentage coverage of sewer system, by commune.
	25. Electricity grid coverage	Percentage coverage of electricity grid, by commune.
	26. Educational establishments	Number of educational establishments, by commune.
	27. Health-care establishments	Number of health-care establishments, by commune.
	28. State-protected wilderness areas	Square kilometres of protected wilderness areas, by commune.
	29. Native forest	Square kilometres of native forest, by commune.
(vi) Economic capital	30. Microenterprises	Number of microenterprises, by commune.
	31. Workers in microenterprises	Number of workers in microenterprises, by commune.
	32. Small enterprises	Number of small enterprises, by commune.
	33. Workers in small enterprises	Number of workers in small enterprises, by commune.
	34. Medium-sized enterprises	Number of medium-sized enterprises, by commune.
	35. Workers in medium-sized enterprises	Number of workers in medium-sized enterprises, by commune.
	36. Large enterprises	Number of large enterprises, by commune.
	37. Workers in large enterprises	Number of workers in large enterprises, by commune.
	38. Investments	Number of projects being implemented, by commune.
(vii) Other variables	39. Poverty	Percentage incidence of poverty, by commune.

Source: Prepared by the authors.

In connection with the above, the document "Indicadores sociales y marcos conceptuales para la medición social" (Cerda and Vera, 2008) describes a number of aspects worth bearing in mind when variables are identified for the design of indices. They include the existence of data, the coverage of geographical areas and data accessibility and comparability.

(a) Consistency analysis

It was necessary to have analysable data to test the structure and functioning of the model, considering that commune-level data are hard to access. Accordingly, and for analytical purposes, it was considered that the most practical option would be to subject the model to a series of multivariate analyses using region-level data, given that more information is available for variables analysed at that level (see annex A2). According to Hair, Anderson and Tatham (1987), one of the advantages of multivariate techniques is that they provide the ability to analyse a whole set of variables for an object simultaneously, yielding results that could not be obtained with univariate methods.

This analysis serves various purposes. In the first place, it aims to confirm that the model is valid, i.e., that the set of variables selected does actually measure an object associated with territorial development. To this end, correlation and regression analyses were carried out (Cuadras, 2007) on

the indicator constructed in relation to poverty and development indicators. In the second place, conglomerate analyses were carried out (Figueras, 2001) with a view to understanding how the data for the set of variables were grouped in relation to the cases (in this exercise, the regions). In the third place, principal component factor analyses were carried out (García, Gil and Rodríguez, 2001) for each dimension with a view to analysing the internal structure of the variables and the way these were grouped into particular factors. Factor analysis aimed at reducing dimensions is important in that it provides a way of evaluating, on the basis of particular statistical proofs, which variables are the most suitable for explaining the behaviour of or changes in a particular object and which might be left out of the model. The aim here is to reduce the dimensionality of the set of initial variables, seeking to retain most of the information provided by the variables observed (Cea d'Ancona, 2002).

The SPSS and R-project statistics package was mainly used in the multivariate data analysis. Unlike other programs, which are more oriented towards descriptive analysis, this software provides a number of advanced methods of statistical modelling and multivariate analysis.

(b) Multivariate analysis

To study the feasibility of summarizing the information and reducing the dimensionality of the polynomial concerned, we first evaluated the relevance of carrying out a factor analysis with extraction using the principal components analysis method and with orthogonal rotation based on the Varimax method. Factor analysis can be used to find combinations of variables from the underlying interrelationships between them. These combinations, called factors, are intended to represent the information contained in the variables in a condensed form. This is achieved by using a smaller number of factors that encapsulate a large part of the information, something that is seen in the percentage variance accumulated by the factors. The principal components method, for its part, can be used to create factors that encompass great variability, reducing the dimension of the data. The Varimax rotation method modifies the representation of the factors, once they have been constructed, to bring out the shares of the variables composing them and make them easier to interpret.

When evaluating the relevance of carrying out a factor analysis, it is necessary to show, for each of the dimensions of the TDI, that the data possess certain characteristics which make its use appropriate. This was done by examining the correlation matrix and determining the degree of interrelationship between the variables being studied. Bartlett's test for sphericity, which indicates whether the observed correlations are significant, was then applied to each dimension. The Kaiser-Meyer-Olkin coefficient, which indicates the extent to which the information contained in these variables can be explained from the other variables, was also calculated. This is appropriate for factor analysis.

Next to be studied were commonalities, which bring out the extent to which the variance of a variable is explained by the factor solution. The rotated factor loadings of the variables were also determined. The analysis carried out for each of the dimensions will now be explained in detail.

i.   The cultural dimension

The cultural dimension is represented by the following variables: cultural events (DC1), intangible cultural heritage (CD2), tangible cultural heritage (DC3), place brands (DC4) and indigenous communities (DC5) (see table 6).

Table 6 shows the correlations between the variables in the cultural dimension. It can be seen that they are strongly related. Thus, for example, the Pearson correlation between cultural events and tangible cultural heritage is statistically significant (p-value < 0.001). The same is true of the correlations between the pairing of the intangible cultural heritage and tangible cultural heritage variables, on the one hand, and the intangible cultural heritage and place brands variables, on the other (p-value < 0.05).

Table 6
Correlation matrix for the cultural dimension

Variable	DC1	DC2	DC3	DC4	DC5
DC1	1.000				
DC2	0.420	1.000			
DC3	0.967***	0.454**	1.000		
DC4	0.398	0.400	0.456**	1.000	
DC5	-0.078	0.303	-0.018	0.037	1.000

Source: Prepared by the authors.
Note: * p-value < 0.01; ** p-value < 0.05; *** p-value < 0.001.

Bartlett's test for sphericity proved significant (sig. < 0.001), which indicates that there are major correlations and thus that it is worth continuing with the analysis. At the same time, the Kaiser-Meyer-Olkin coefficient within the cultural dimension is about 0.6, meaning that factor analysis is not inadvisable (see table 7).

Table 7
Bartlett's proof of sphericity and the Kaiser-Meyer-Olkin coefficient (cultural dimension)

Kaiser-Meyer-Olkin measure of sampling adequacy		0.598
Bartlett's test for sphericity	Approximate chi-squared	40.149
	gl	10
	Sig.	0.000

Source: Prepared by the authors.

The conclusion from all these analyses is that it is appropriate to apply factor analysis to this data series. Accordingly, three factors were selected, accounting between them for 89.714% of the total variance. The first factor accounts for 51.960% of the total variance, the second for 23.757% and the third for 13.997% (see table 8).

Table 8
Explained variance (cultural dimension)

Component	Initial eigenvalues			Sum of squared saturations of rotation		
	Total	Percentage variance	Cumulative percentage	Total	Percentage variance	Cumulative percentage
1	2.598	51.960	51.960	2.598	51.960	51.960
2	1.188	23.757	75.717	1.188	23.757	75.717
3	0.700	13.997	89.714	0.700	13.997	89.714
4	0.485	9.705	99.419			
5	0.029	0.581	100.000			

Source: Prepared by the authors.

Lastly, analysis of the rotated component matrix shows that the cultural events and tangible cultural heritage variables alter in the same direction and are grouped into the first component (some might be left out of the polynomial). The intangible cultural heritage variable is not grouped into any component, meaning that it provides information which cannot be summarized in any linear combination of the other variables. The value of the commonalities, which exceeded 69.0%, should also be emphasized (see table 9).

Table 9
Rotated component matrix and commonalities (cultural dimension)

Rotated component matrix				
Variable	Component			Commonality
	1	2	3	
DC1	0.973	-0.015	0.173	0.977
DC2	0.415	0.572	0.443	0.695
DC3	0.956	0.040	0.232	0.969
DC4	0.218	0.020	0.950	0.950
DC5	-0.091	0.940	-0.037	0.892

Source: Prepared by the authors.

ii.   The human capital dimension

The human capital dimension is constituted at this stage by the following variables: years of education (DE1), average score in university selection tests (PSU) (DE2), labour force participation rate (DE3), employment rate (DE4), regional revenues (DE5) and regional expenditure (DE6).

As regards correlations, there is a strong relationship between the labour force participation rate and the employment rate and a correlation between regional revenues and expenditure (p-value < 0.01) (see table 10).

Table 10
Correlation matrix for the human capital dimension

Variable	DE1	DE2	DE3	DE4	DE5	DE6
DE1	1.000					
DE2	0.058	1.000				
DE3	0.552**	0.316	1.000			
DE4	0.557**	0.302	0.915***	1.000		
DE5	0.382	0.747***	0.290	0.299	1.000	
DE6	0.383	0.750***	0.298	0.307	0.999***	1.000

Source: Prepared by the authors.
Note: * p-value < 0.01; ** p-value < 0.05; *** p-value < 0.001.

Similarly, Bartlett's test for sphericity proved significant (sig. < 0.001), while the Kaiser-Meyer-Olkin index within the dimension was 0.673, making it relevant to carry out the factor analysis (see table 11).

Table 11
Bartlett's test for sphericity and the Kaiser-Meyer-Olkin test (human capital dimension)

Kaiser-Meyer-Olkin measure of sampling adequacy		0.673
Bartlett's test for sphericity	Approximate chi-squared	127.581
	gl	15
	Sig.	0.000

Source: Prepared by the authors.

In this dimension, three factors accounting for 95.602% of the total variability of the dimension were selected. The first represents 56.922% of total variance, the second 27.080% and the third 11.601% (see table 12).

Table 12
Explained variance (human capital)

Component	Initial eigenvalues			Sum of squared saturations of rotation		
	Total	Percentage variance	Cumulative percentage	Total	Percentage variance	Cumulative percentage
1	3.415	56.922	56.922	3.415	56.922	56.922
2	1.625	27.080	84.002	1.625	27.080	84.002
3	0.696	11.601	95.602	0.696	11.601	95.602
4	0.180	2.993	98.595			
5	0.084	1.402	99.997			
6	0.000	0.003	100.000			

Source: Prepared by the authors.

The results of the rotation show that the average PSU score, regional revenues and regional expenditure variables have been grouped into the first factor, while the participation rate and employment rate are grouped into the second. The third factor is composed mainly of years of education (see table 13).

Table 13
Rotated component matrix and commonalities (human capital dimension)

Variable	Component			Commonalities
	1	2	3	
DE1	0.149	0.385	0.887	0.958
DE2	0.878	0.267	-0.265	0.912
DE3	0.151	0.945	0.198	0.955
DE4	0.152	0.938	0.215	0.949
DE5	0.950	0.091	0.263	0.979
DE6	0.950	0.100	0.260	0.979

Source: Prepared by the authors.

The commonalities of all the variables were in excess of 90.0%.

Thus, the results indicate that the dimensionality of educational capital can be reduced, given the strong correlation between the variables and the direction of their variability.

iii. The tangible dimension

The tangible dimension was initially constituted by the following variables: concrete roads (DF1), asphalted roads (DF2), gravel roads (DF3), earth roads (DF4), telephone coverage (DF5), Internet coverage (DF6), drinking water coverage (DF7), sewer system coverage (DF8), electricity grid coverage (DF9), educational establishments (DF10), health-care establishments (DF11) and square metres constructed per year plus services (DF12) (see table 14).

The correlation matrix shows a strong relationship between the variables. For example, there is the statistically significant correlation (p-value < 0.001) between telephone coverage and Internet coverage and between drinking water coverage and sewer system coverage (see table 14).

For this same reason, Bartlett's test for sphericity is statistically significant (sig. < 0.001). However, the Kaiser-Meyer-Olkin index value, at 0.438, is low (see table 15).

Table 14
Correlation matrix for the tangible dimension

Variable	DF1	DF2	DF3	DF4	DF5	DF6	DF7	DF8	DF9	DF10	DF11	DF12
DF1	1.000											
DF2	-0.337	1.000										
DF3	0.350	0.318	1.000									
DF4	-0.442**	0.527**	0.209	1.000								
DF5	0.123	0.159	-0.188	-0.291	1.000							
DF6	0.120	0.196	-0.174	-0.287	0.998***	1.000						
DF7	0.098	-0.105	-0.499**	-0.298	0.191	0.200	1.000					
DF8	-0.128	-0.256	-0.620**	0.049	0.244	0.241	0.591**	1.000				
DF9	-0.664**	0.176	-0.308	0.549**	-0.338	-0.346	0.154	0.220	1.000			
DF10	0.169	0.441	0.185	-0.227	0.877***	0.894***	-0.053	-0.130	-0.426	1.000		
DF11	0.191	0.543**	0.350	-0.127	0.788***	0.808***	-0.116	-0.244	-0.419	0.977***	1.000	
DF12	0.126	0.151	-0.143	-0.273	0.995***	0.991***	0.099	0.196	-0.365	0.888***	0.800***	1.000

Source: Prepared by the authors.
Note: * p-value < 0.01; ** p-value < 0.05; *** p-value < 0.001.

Table 15
Bartlett's test for sphericity and the Kaiser-Meyer-Olkin coefficient (tangible dimension)

Kaiser-Meyer-Olkin measure of sampling adequacy		0.438
Bartlett's test for sphericity	Approximate chi-squared	260.302
	gl	66
	Sig.	0.000

Source: Prepared by the authors.

In this dimension, a selection has been made of four factors that between them account for 89.919% of the total variance of the dimension. Details will now be given of the values associated with each of the factors individually and the percentage variance between them (see table 16).

Table 16
Explained variance (tangible dimension)

Component	Initial eigenvalues			Sum of squared saturations of rotation		
	Total	Percentage variance	Cumulative percentage	Total	Percentage variance	Cumulative percentage
1	5.040	42.001	42.001	5.040	42.001	42.001
2	2.697	22.472	64.473	2.697	22.472	64.473
3	2.259	18.823	83.295	2.259	18.823	83.295
4	0.795	6.623	89.919	0.795	6.623	89.919
5	0.508	4.615	95.460			
6	0.294	2.674	98.134			
7	0.149	1.352	99.486			
8	0.036	0.331	99.817			
9	0.018	0.165	99.982			
10	0.002	0.016	99.998			
11	0.000	0.002	100.000			

Source: Prepared by the authors.

The main variables composing the first factor are telephone coverage, Internet coverage, educational establishments, health-care establishments and square metres constructed per year. The second component centres on the drinking water coverage and sewer system coverage variables. The concrete roads variable is grouped positively into the third factor and the electricity grid coverage variable is grouped negatively. The fourth factor combines the asphalted roads and earth roads variables (see table 17).

Table 17
Rotated component matrix and commonalities (tangible dimension)

Variable	Component				Commonalities
	1	2	3	4	
DF1	0.050	0.032	0.918	-0.177	0.878
DF2	0.310	-0.144	-0.157	0.864	0.887
DF3	-0.071	-0.596	0.525	0.491	0.877
DF4	-0.247	-0.091	-0.448	0.710	0.773
DF5	0.970	0.183	0.030	-0.090	0.984
DF6	0.976	0.188	0.042	-0.058	0.993
DF7	0.033	0.927	0.157	-0.007	0.885
DF8	0.076	0.826	-0.242	-0.155	0.771
DF9	-0.362	0.264	-0.704	0.322	0.800
DF10	0.951	-0.137	0.178	0.166	0.983
DF11	0.883	-0.218	0.243	0.314	0.984
DF12	0.976	0.100	0.023	-0.105	0.974

Source: Prepared by the authors.

With these results, and given the strong commonality of the variables represented by the components selected, the inference is that it is possible to reduce the number of variables within the dimension. This can be achieved by representing them in constructs that take account of the thematic concept relating them, or by removing variables that are redundant in respect of the direction of the variability they express.

iv. The economic dimension

The last dimension analysed was the economic dimension, the initial proposal for which included the following variables: microenterprises (DEc1), small enterprises (DEc2), medium-sized enterprises (DEc3), large enterprises (DEc4), workers in microenterprises (DEc5), workers in small enterprises (DEc6), workers in medium-sized enterprises (DEc7), workers in large enterprises (DEc8) and investments (DEc9).

In this dimension, it can be seen that there is a high degree of correlation between all the variables except the last (DEc9), which does not have significant correlations with the rest (see table 18).

Table 18
Correlation matrix for the economic dimension

Variable	DEc1	DEc2	DEc3	DEc4	DEc5	DEc6	DEc7	DEc8	DEc9
DEc1	1.000								
DEc2	0.991***	1.000							
DEc3	0.978***	0.997***	1.000						
DEc4	0.964***	0.990***	0.998***	1.000					
DEc5	0.995***	0.995***	0.985***	0.975***	1.000				
DEc6	0.997***	0.997***	0.987***	0.978***	0.998***	1.000			
DEc7	0.986***	0.999***	0.998***	0.994***	0.991***	0.994***	1.000		
DEc8	0.959***	0.987***	0.996***	0.999***	0.971***	0.975***	0.992***	1.000	
DEc9	0.277	0.361	0.399	0.420	0.318	0.307	0.373	0.431	1.000

Source: Prepared by the authors.
Note: * p-value < 0.01; ** p-value < 0.05; *** p-value < 0.001.

In turn, Bartlett's test for sphericity and the Kaiser-Meyer-Olkin measure of adequacy indicate the relevance of continuing with the factor analysis and studying the reduction of dimensionality within the dimension (see table 19).

Table 19
Bartlett's test for sphericity and Kaiser-Meyer-Olkin test (economic dimension)

Kaiser-Meyer-Olkin measure of sampling adequacy		0.745
Bartlett's test for sphericity	Approximate chi-squared	495.949
	gl	36
	Sig.	0.000

Source: Prepared by the authors.

In the same way, it can be seen that just two factors explain 99.304% of total variance in the dimension. The first factor accounts for 89.940% of total variability and the second for 9.364% of the remaining variance in the dimension concerned (see table 20).

Table 20
Explained variance (economic dimension)

Component	Initial eigenvalues			Sum of squared saturations of extraction		
	Total	Percentage variance	Cumulative percentage	Total	Percentage variance	Cumulative percentage
1	8.095	89.940	89.940	8.095	89.940	89.940
2	0.843	9.364	99.304	0.843	9.364	99.304
3	0.055	0.616	99.920			
4	0.004	0.048	99.968			
5	0.002	0.021	99.989			
6	0.000	0.005	99.994			
7	0.000	0.004	99.999			
8	0.000	0.001	100.000			
9	0.000	0.000	100.000			

Source: Prepared by the authors.

Lastly, and as was to be expected given the analysis of the correlation matrix, the first eight variables associated with enterprises are grouped into the first factor, while the second absorbs the investment variable (DEc9). Thus, the conclusion is that the dimension can be explained with two components. The first is a linear combination of the first eight variables, while the variable associated with investment, when modified in another direction, is represented by the second component. The high value of the commonalities should be emphasized. These indicate that practically all the information contained in the variables is encompassed by the factors (see table 21).

Table 21
Rotated component matrix and commonalities (economic dimension)

Variable	Component		Commonalities
	1	2	
DEc1	0.983	0.135	0.98
DEc2	0.978	0.209	1.00
DEc3	0.970	0.238	1.00
DEc4	0.960	0.257	0.99
DEc5	0.982	0.160	0.99
DEc6	0.985	0.160	1.00
DEc7	0.976	0.215	1.00
DEc8	0.957	0.263	0.98
DEc9	0.196	0.980	1.00

Source: Prepared by the authors.

(c) Ranking of variables

A final validation stage was implemented as a supplement to the multivariate analysis for the reduction of variables and as a form of methodological triangulation enabling qualitative and quantitative technical and theoretical criteria to be integrated. This stage dealt with the weighting of criteria and the ranking of variables on the basis of Saaty's (1980) analytical hierarchy method.

This type of procedure is particularly suitable when decisions have to be made about the selection of particular elements. In this case, the objective of the application was to select a final list of variables, setting out from the definition of particular criteria. The method proposed by Saaty involves establishing a matrix of comparison between pairs of criteria and comparing the importance of each with the rest. The next step is to establish the main vector. This determines the weights, which in turn provide a quantitative measure of the consistency of value judgements between pairs of factors (Saaty, 1980).

Operationally, and in accordance with what the methodology suggests, the procedure included the following stages:

(i)   Delineation of the problem:

How can a set of variables be selected to construct a TDI?

(ii)   Identification of the objective:

Rank a list of variables for the construction of a TDI by identifying criteria and subcriteria of different kinds.

(iii)   Determination of criteria and subcriteria:

The analytic hierarchy methodology was used to establish the criteria and subcriteria described below:

(a) Conceptual criterion: concerns the theoretical and conceptual aspects of the indicator.

- Conceptual definition subcriterion: whether the variable fits the theoretical definition of the dimension.
- Thematic coverage subcriterion: whether the variable is able to encompass some or all of the theoretical definition of the dimension.

(b) Statistical criterion: concerns the methodological and statistical aspects of the indicator.

- Factor analysis subcriterion: whether the variable brings variability to the dimension.
- Comparability subcriterion: whether the variable is present in the different communes and thus comparable.
- Quality subcriterion: whether the variable has the requisite statistical quality at the commune level.

(c) Management criterion: concerns the impact of public policy on changes in the indicator.

- Planning subcriterion: whether the variable may be affected by the operation of territorial plans or programmes.
- Influence-dependency subcriterion: whether the variable exerts a relationship of influence or dependency on other variables (or vice versa) in the polynomial.

(iv)   Assessment methodology:

The assessment was carried out on the basis of paired comparisons of criteria and subcriteria. The intention is for the assessor to make a determination of one criterion's importance relative to another.[6]

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[6]   The panel of experts comprises three researchers from the Institute of Local and Regional Development of the University of the Frontier and five analysts from the National Institute of Statistics in the Araucanía region.

Each comparison of paired criteria was scored. In this case there are more than two scorers (eight in total), so that the final value of each paired combination will be equivalent to the average of the scores awarded by each of the scorers, both at the first hierarchical level (criteria) and at the sublevels (subcriteria).

The next step is to estimate the relative rates of the "v" criteria on the basis of the scores given in matrix "A". These relative weights are the particular vectors of matrix A. The method is based on the Perron-Frobenius theorem, which yields local priorities by solving the following optimization problem:

$$max\ Av = \ \lambda v\ \ s.a\ \sum_j jv_j = 1 \tag{1}$$

(v)   The rating scale:

The criteria are evaluated using the scale proposed by Saaty (1980), which has nine rating levels. On this scale, 1 means that A is of the same importance as B, and 9 that A is of extreme importance relative to B. Table 22 presents details of the scale values and their definitions.

Table 22
Rating scale for the ranking method used

Value	Definition	Comments
1	Equal importance	Criterion A is as important as B.
3	Moderate importance	Experience and judgment slightly favour criterion A over B.
5	Strong importance	Experience and judgment strongly favour criterion A over B.
7	Very strong importance	Criterion A is much more important than B and its dominance is demonstrated in practice.
9	Extreme importance	Criterion A is irrefutably more important than B.
2, 4, 6, 8	Intermediate values expressing shades between the above.	
	The inverses of these values are used to express reciprocity.	

Source: Prepared by the authors.

(vi)   Results of the rating:

Once the calculations had been carried out and the weights assigned to each of the criteria and subcriteria, the list of variables was ranked. Variables receiving low scores on the criteria assigned were discarded, reducing the model from one with 49 variables to a more restricted one with a total of 19 variables.

3.   Third model adjustment

Subjecting the model to the different tests and methodologies and reducing as many dimensions as possible led to the identification of six types of capital for measuring the development of a territory. These capital types or dimensions are taken to include the variables that are most important or best explain the dimension. Table 23 describes the third model adjustment with the dimensions and variables needed for the final calculation of the proposed index.

Table 23
Operationalization of variables matrix

Dimension	Variable	Conceptual definition	Operational definition
Cultural capital	1. Tangible cultural heritage	Places, sites, buildings, engineering works, industrial centres, architectural ensembles, heritage areas and monuments of major architectural, archaeological, historical, artistic or scientific interest or value that are recognized and registered as such.	Number of heritage assets recognized by decree, by commune.
	2. Intangible cultural heritage	Living traditions or forms of expression inherited from forebears and passed down to descendants, such as: oral traditions, performing arts, social customs, rituals, festivities, knowledge and practices relating to nature and the universe, and techniques and lore related to traditional crafts.	Number of intangible heritage assets registered in the Information System for Heritage Management (SIGPA), by commune.
	3. Indigenous communities and associations	By an indigenous community is meant any group of people belonging to the same ethnicity who are in one or more of the following situations: (i) they are from the same family stock; (ii) they recognize a traditional headship; (iii) they own or have owned indigenous lands in common; (iv) they are from the same long-standing settlement. By an indigenous association is meant a voluntary functional grouping of at least 25 indigenous persons who join together in pursuit of some common interest and goal.	Number of indigenous communities and associations, by commune.
	4. Place brands and designations of origin	Geographical indications and designations of origin protect products from the country or from a region or local area, provided they have a quality, reputation or other characteristic attributable to their geographical origin.	Number of geographical indications and designations of origin, by commune.
Social capital	5. Organizations with social aims	Non-profit public interest organizations whose aim is to further the general interest, whether in respect of citizen rights, social assistance, education, health, the environment or any other matter of common interest (parents' associations, older adult centres or organizations, sports clubs, neighbourhood committees and other functional groupings).	Number of organizations with social aims and current legal personality, by commune.
	6. Electoral participation	Registered voters (in percentages) participating voluntarily in municipal elections.	Percentage voting out of total enrolled, by commune.
Human capital	7. Years of education	Average number of years spent in the education system. Applies to persons aged 15 and over.	Average years' education, by commune.
	8. University selection tests (PSU)	Average score in the Language and Mathematics university selection tests (PSU).	Average score in PSU, by commune.
	9. Professionalization of municipal personnel	Human capital with a degree or professional qualification employed by the municipality.	Percentage of professional workers employed in the municipality, by commune.
Institutional capital	10. Dependence on the Municipal Common Fund (FCM)	Dependence on the FCM (as the main source of funding) relative to revenues generated by the municipality itself. The FCM is a needs-based mechanism for redistributing financial resources between the country's municipalities with a view to ensuring that they function properly and can attain their purposes. The FCM was designed to benefit poorer districts, particularly those with few options for raising permanent revenues of other kinds for themselves, so that it provides the main source of municipal revenues.	Percentage of total municipal revenues provided by the FCM, by municipality.
	11. Municipal expenditure	Municipal budget item that includes operating, transfer and investment spending, the application of third-party revenues and other expenditure, divided by the population of the commune.	Municipal expenditure per capita in Chilean pesos, by municipality.
	12. Municipal ordinances	Ordinances are binding general regulations applicable to the community. They might include provision for fines not exceeding five monthly tax units (UTM), levied by the relevant local police courts.	Number of municipal ordinances, by commune.
Tangible capital	13. Road network	Concrete roads are made of concrete slabs separated by joints and laid on a properly compacted granular bed. Asphalt roads are made of jointless asphalt concrete wearing courses at least 10 cm thick.	Kilometres of concrete roads and asphalt as a percentage of all roadways, by commune.
	14. Internet penetration	Share of the population with a fixed-line home Internet connection.	Percentage Internet coverage, by commune.
	15. Square metres constructed	Square metres constructed and officially certified during the year. Constructions predating the General Buildings and Urbanization act of May 1931 are exempt from regularization.	Officially certified buildings as an estimated percentage of all buildings in the commune.
	16. Rural drinking water coverage	Share of the rural population with a drinking water supply in the home or on the property or access to a public standpipe or hydrant.	Percentage of rural drinking water coverage, by commune.
Economic capital	17. Workers' remuneration	Average employee remuneration as reported by the Internal Revenue Service (SII), estimated from pay levels and the number of workers.	Reported average monthly wage of employees in Chilean pesos, by commune.
	18. Investment by the National Fund for Regional Development (FNDR)	Implementation of regional investment programmes.	Annual per capita expenditure in Chilean pesos, by commune.
	19. Bank loans	A bank loan is credit in cash that a bank provides to a client, who commits to repaying it gradually in the future in instalments or in a single payment with additional interest to compensate the creditor for the time the money was unavailable.	Number of loans per capita, by commune.

Source: Prepared by the authors.

(a) Weighting of the territorial development index

The criterion of equal weighting of dimensions was used to assign relative weights to the dimensions and the respective variables within them. The benchmark taken was the criteria used by UNDP/MIDEPLAN (2005) in the allocation of weights for the communal human development index (HDI) and in the new methodology for measuring multidimensional poverty in Chile proposed by the Social Observatory of the Ministry of Social Development. Equal weighting means that the dimensions have the same specific weight within the index and that the same weight is applied to variables within each dimension.

According to Alkire and Foster (2011), the selection of weights can be considered a value judgment, open to public scrutiny. There is no definitive formula for allocating weights. Broadly speaking, however, there are at least two equally valid alternatives: (i) giving each variable the same weight, which might mean the dimensions having different weightings if the number of variables per dimension is different, or (ii) giving each dimension the same weight, which might mean the variables having different weightings if the number of variables per dimension is different. The second option is applied for the proposed index.

According to the premise on which equivalent or equal weighting is based, there are no generally accepted arguments justifying or supporting an allocation of different weights to the different dimensions, or variables, as applicable (Ministry of Social Development, 2013). Where the weighting of attitude scales is concerned, Canales (2006) states that, in the absence of any compelling theoretical or empirical reason to assign a greater weight to one question or another, it is best for them all to have the same weight. Thus, for example, institutional capital can be assumed to play as important a role in this case as tangible or social capital in bringing about territorial development processes.

The TDI proposed in this paper comprises a total of six dimensions (types of capital), so that each dimension will have a weighting of 16.6%. As already indicated, the weighting of each variable will depend on the number of variables per dimension. Table 24 describes the weighting of the index in detail.

Table 24
Structure of weights

Capital	Weight of dimension (percentages)	Variable	Weight of variable (percentages)
1. Cultural	16.67	1. Tangible cultural heritage	4.17
		2. Intangible cultural heritage	
		3. Indigenous communities and associations	
		4. Place brands and designations of origin	
2. Social	16.67	5. Organizations with social aims	8.33
		6. Electoral participation	
3. Human	16.67	7. Years of education	5.56
		8. University selection tests (PSU)	
		9. Professionalization of municipal personnel	
4. Institutional	16.67	10. Dependence on FCM	5.56
		11. Municipal expenditure	
		12. Municipal ordinances	
5. Tangible	16.67	13. Road network	4.17
		14. Internet penetration	
		15. Square metres constructed	
		16. Rural drinking water coverage	
6. Economic	16.67	17. Worker remuneration	5.56
		18. Investment by FNDR	
		19. Bank loans	

Source: Prepared by the authors.

(b) Description of the territorial development index

The territorial development index (TDI) is an indicator that draws together a set of variables which are dissimilar in both scale and units of measurement, grouped into six types of territorial capital. The purpose of these variables is to capture the main phenomena associated with development capacity, taking in not only the economic component but all the aspects that interact in the territory, including cultural, social and human capital.

As already discussed, the development factors incorporated into the measurement are: cultural capital, social capital, human capital, institutional capital, tangible capital and economic capital. Between them, they include a total of 19 variables. As explained in the previous section, each of the factors or capital types concerned is equally weighted, and its load is distributed equally between the variables underpinning each of the dimensions.

In other words, the specific weight of each dimension will be determined by the constant $w = \dfrac{100}{n}$, in which n is equivalent to the number of dimensions. Meanwhile, the weighting in each dimension will be specified as follows: $\alpha_i = \dfrac{100}{n*m_i}$, where m_i is the number of variables within the i-th dimension (i=1,2,…,n).

Given the diversity of scales of the variables concerned, and in view of the multiple data standardization alternatives, it was decided to apply the maxima and minima method, which was used by UNDP to standardize the HDI. As explained by the UNDP office in Chile, by establishing fixed floors and targets, the logic of normative minimum and maximum values allows each country, region and commune to be compared with itself. This methodology means, for example, that the absolute value of the HDI of an analysed unit does not depend on the performance of the rest and that it is a useful tool irrespective of any relative comparison (UNDP/MIDEPLAN, 2005). Thus, taking the above into consideration, it was decided to adapt them to a single common range of 0 to 1.

This is achieved by calculating the ratio between the effective distance and the range of variability for each variable. In other words, the following transformation is adopted for the j-th variable:

$$Z_j = \frac{X_j - X_j^{min}}{X_j^{max} - X_j^{min}} \tag{2}$$

Where $X_j^{min} = \min(X_j^k, k = 1, …, 342)$ and $X_j^{max} = \max(X_j^k, k = 1, …, 342)$. Lastly, the calculation of the index in each factor takes the following structure:

$$I_i = \alpha_i \sum_{j=1}^{m_i} Z_j \tag{3}$$

Thus, the general index can be calculated by taking the weighted sum of the indices by factors (equivalently, it is possible to take the sum weighted through the variables). The TDI will be determined by the following functional relationship:

$$I = w \sum_{i=1}^{n} I_i \tag{4}$$

Thus, the variability range of the indicator is between 0 and 1. Values closer to 1 denote greater development of the territory while, conversely, values closer to 0 indicate a lower level of development. The factor components highlight the opportunities and potential that can be exploited in them.

(c) Calculating the territorial development index

The results of the calculation of the indicator in the communes named, i.e., Angol and Carahue, will now be presented (see table 21).

According to the results of the TDI, the commune of Angol is more highly developed than the commune of Carahue. In numerical terms, Angol has a TDI of 0.280, while Carahue has a value of 0.232, giving a development gap of 0.048 points.

This difference can be explained by analysing the results for the territorial capitals. As figure 1 shows, Angol is more highly developed on all the factors measured except economic capital. The greatest differences are in human capital (0.096 points), cultural capital (0.089 points) and tangible capital (0.066 points).

Figure 1
Territorial development index by dimension, communes of Angol and Carahue
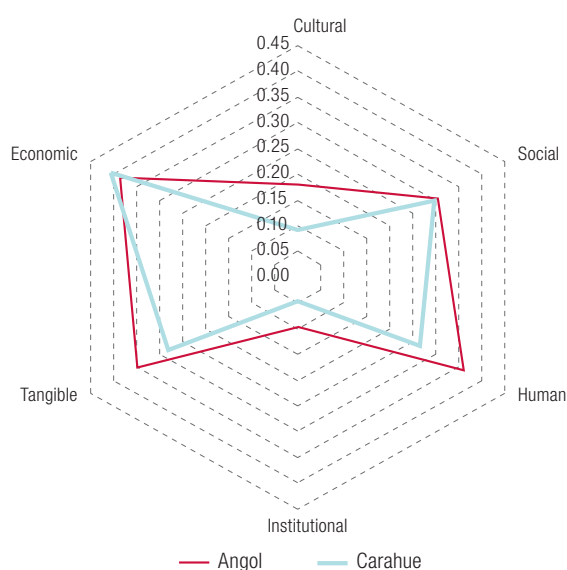
Source: Prepared by the authors on the basis of official statistics.

Angol presents better characteristics than Carahue in the human capital dimension, as it is better positioned on the years of education and PSU variables. However, the commune of Carahue presents a higher percentage of professional municipal personnel.

Regarding cultural capital, the comparative result is defined mainly by the larger number of place brands and of assets registered as intangible cultural heritage in Angol. In the commune of Carahue, these differences are partly offset by the predominance of indigenous communities and of tangible cultural heritage.

Angol again presents a better situation than Carahue where tangible capital is concerned, given that it has greater Internet penetration and a larger surface area of built infrastructure. However, the commune of Carahue has a higher percentage of concrete and asphalt roads in its total communal road network.

The commune of Angol is better placed than Carahue for institutional capital. This is because it is less dependent on the Municipal Common Fund (FCM), per capita municipal spending is higher and there are more municipal ordinances.

No significant differences are observed between Carahue and Angol where the social capital dimension is concerned because while Carahue has fewer social organizations, participation in municipal elections is greater there (see table 25).

Calculation of the territorial development index

Capital	Variable	Angol	Carahue	Min.	Max.	ZAngol	ZCarahue	Angol	Carahue
Cultural	1. Tangible cultural heritage	6.0	32.0	0.0	190.0	0.03	0.17	0.18	0.09
	2. Intangible cultural heritage	8.0	5.0	0.0	61.0	0.13	0.08		
	3. Indigenous communities and associations	0.7	1.4	0.0	11.8	0.06	0.11		
	4. Place brands and designations of origin	1.0	0.0	0.0	2.0	0.50	0.00		
Social	5. Organizations with social aims	692.0	148.0	0.0	4 305.0	0.16	0.03	0.30	0.30
	6. Electoral participation	50.6	56.7	26.8	80.0	0.45	0.56		
Human	7. Years of education	10.0	8.0	7.0	16.0	0.33	0.11	0.36	0.27
	8. PSU	469.8	435.6	362.4	613.5	0.43	0.29		
	9. Professionalization of municipal personnel	0.2	0.3	0.0	0.7	0.32	0.39		
Institutional	10. Dependence on FCM	0.7	0.9	1.0	0.0	0.26	0.11	0.10	0.05
	11. Municipal expenditure	191.0	180.4	65.8	10 531.1	0.01	0.01		
	12. Municipal ordinances	16.0	13.0	2.0	609.0	0.02	0.02		
Tangible	13. Road network	11.2	14.4	0.0	100.0	0.11	0.14	0.35	0.28
	14. Internet penetration	22.9	7.1	0.0	100.6	0.23	0.07		
	15. Square metres constructed	2.1	0.9	0.0	24.1	0.09	0.04		
	16. Rural drinking water coverage	1.0	0.9	0.0	1.0	0.97	0.88		
Economic	17. Worker remuneration	185 833	333 223	46 164	1 703.167	0.39	0.55	0.39	0.41
	18. Investment by FNDR	32.1	85.9	0.0	4950.3	0.01	0.02		
	19. Bank loans	1.8	0.2	0.0	151.2	0.77	0.66		
Total								0.2802	0.2319

Source: Prepared by the authors on the basis of official statistics.

Where economic capital is concerned, lastly, Carahue has better figures than Angol, with higher average worker remuneration and a greater volume of investment devolved by the National Fund for Regional Development (FNDR) because of the major investment projects undertaken in recent times. When it comes to bank lending in the communes, however, Angol presents better figures than Carahue, perhaps because it has a larger bankable population.

IV. Conclusions

This article is the result of extensive work and long sessions of debate by a multidisciplinary team. For three years, the researchers set themselves to design a development index that would reflect how the application of particular types of capital can give rise to territorial development processes at the local level. To this challenge must be added the difficulties associated with the scarcity of information at the subregional level. This meant an intensive effort of review, systematization and selection of secondary data sources that could provide the model with thematic coverage while meeting criteria of representativeness, comparability and periodicity, among others. This was done for the purpose of providing local operators with a system for measuring development that would be workable enough to be reproduced over time.

In addition to all the above, there are other elements that reinforce the work done. The close relationship established between the theoretical, analytical and practical levels should be emphasized here. This is a proposal that sets out by creating a theoretical model (of types of territorial capital). This model brings together elements from the different development theories that define the dimensions of the index. The next step is a series of multivariate statistical analyses whose purpose is to make certain adjustments to the model by reducing the dimensionality of the data (and validating the proposal technically) and thence arrive at a simplified calculation of a TDI for the communes of Angol and Carahue on the basis of administrative records.

Also worth stressing is the importance given in this study to logging the research. In other words, rather than simply showing the results of the final calculation of the indicator, an effort has been made to document the different stages and methodological decisions taken to make adjustments in the indicator leading to a (more or less) definitive version. This is important insofar as this practice allows other researchers to acquaint themselves with more internal details of the process, including the procedures involved, the decisions made and the successes and failures. Ultimately, this type of methodological approach serves to foster open debate about how the requisite knowledge is progressively acquired in a particular scientific field.

The ultimate purpose in constructing an indicator of this nature is that it provides an opportunity to generate detailed information for decision-making. The first aim is to diagnose the underlying or structural factors that make development possible. The second is to supply information about variables that can be influenced by public or private policy decisions in order to improve development conditions (from a multidimensional perspective) in this territorial space.

Another substantive contribution are the theoretical approaches associated with the identification of structural factors that define the ability of a territorial space to cope with the complexity of development. The conclusion is that the approach based on types of territorial capital provides a sound basis for building on the analyses undertaken by Alburquerque, Vásquez Barquero, Boisier, Requejo and institutions such as UNDP. This represents a contribution, for example, to the deliberations involved in territorial management policymaking for underdeveloped areas in Chile.

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Annex A1

Table A1.1
Initial identification of variables by dimension

Variables identified	
Cultural dimension	1. Number of lof (clans)
	2. Number of indigenous communities
	3. Number of indigenous associations
	4. Kilometres of indigenous development areas
	5. Number of machis (religious healers)
	6. Number of loncos (heads of clans)
	7. Number of heritage assets
	8. Number of designations of origin
	9. Number of place brands
	10. Number of cultural events
Social dimension	11. Number of NGOs
	12. Number of neighbourhood committees
	13. Number of community unions
	14. Number of local committees
	15. Number of older adult clubs
	16. Number of youth groups
	17. Number of sporting associations
	18. Number of cultural associations
	19. Number of health-care organizations
	20. Number of women's groups
	21. Number of churches
	22. Number of charitable organizations
	23. Number of cooperatives
	24. Number of employers' associations
	25. Number of craft associations
	26. Number of student centres
	27. Number of political parties or groupings
Human capital dimension	28. Number of technical and professional workers
	29. Number of postgraduates
	30. Number of students taking university selection tests (PSU) and accepted by universities
	31. Number of professionals from the commune working in other communes
	32. Percentage of population that is of active age
	33. Number of workers by branch of activity
	34. Number of small and medium-sized enterprises
Institutional dimension	35. Number of business licences
	36. Number of municipal ordinances
	37. Existence of a current Communal Development Plan (PLADECO)
	38. Existence of a current Zoning Plan
	39. Existence of a current Institutional Strategic Plan
	40. Existence of a current Annual Municipal Health Plan (PASAM)
	41. Existence of a current Annual Municipal Education Plan (PADEM)
	42. Existence of a communal geographic information system (GIS)
	43. Kilometres of zones of tourist interest
	44. Number of financial services
	45. Number of training services
	46. Number of health-care platforms
	47. Number of transport platforms
	48. Number of telecommunications platforms
	49. Number of professionals per inhabitant
	50. Number of FNDR projects implemented with a favourable technical recommendation

Table A1.1 (concluded)

Variables identified	
Institutional dimension	51. Number of Regional Fund for Local Initiative (FRIL) projects implemented
	52. Number of Urban Improvement Programme (PMU) projects implemented
	53. Autonomous municipal revenue in Chilean pesos
	54. Percentage of budget spent on health
	55. Percentage of budget that depends on the Municipal Common Fund (FCM)
Infrastructure dimension	56. Number of universal access points
	57. Number of telecentres
	58. Number of information centres
	59. Number of libraries associated with BiblioRedes
	60. Percentage coverage of asphalted road networks
	61. Percentage coverage of surfaced road networks
	62. Number of first aid posts
	63. Number of doctor's surgeries
	64. Number of hospitals
	65. Number of complex care beds
	66. Number of dental chairs
	67. Number of X-ray machines
	68. Number of tomography machines
	69. Number of schools
	70. Number of boarding schools
	71. Number of libraries
	72. Percentage housing deficit
	73. Percentage housing materials deficit
	74. Percentage drinking water coverage
	75. Percentage electricity grid coverage
	76. Percentage sewer system coverage
	77. Number of machines for primary production
	78. Kilometres of State-protected wilderness
	79. Kilometres of maritime areas
	80. Kilometres of lake areas
	81. Kilometres of river areas
	82. Presence of volcanos
	83. Presence of metal mining resources
	84. Presence of non-metal resources
Economic dimension	85. Projected communal investments in Chilean pesos
	86. Square metres constructed
	87. Number of building permits
	88. Exports from the commune in Chilean pesos

Source: Prepared by the authors.

Table A1.2
Matrix of regional data for multivariate analysis

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	RM	XIV	XV
1. Cultural events	46 376.0	41 641.0	11 800.0	45 069.0	396 987.0	74 410.0	41 794.0	135 672.0	63 229.0	101 367.0	10 900.0	4 500.0	2 231 020.0	20 544.0	100.0
2. Tangible cultural heritage	73.0	100.0	41.0	56.0	176.0	71.0	99.0	80.0	98.0	74.0	21.0	61.0	426.0	41.0	36.0
3. Intangible cultural heritage	67.0	27.0	73.0	59.0	217.0	259.0	142.0	237.0	176.0	212.0	54.0	58.0	230.0	109.0	47.0
4. Indigenous communities and associations	364.0	151.0	124.0	14.0	85.0	7.0	24.0	501.0	2 867.0	767.0	39.0	35.0	201.0	610.0	240.0
5. Place brands and designations of origin	1.0	-	1.0	-	4.0	1.0	-	1.0	1.0	2.0	1.0	-	2.0	1.0	1.0
7. Years of education	11.2	11.5	10.5	10.5	11.1	10.1	9.3	10.2	9.8	9.6	9.9	11.1	11.4	9.8	11.0
8. University selection tests (PSU)	485.1	493.2	488.4	490.5	492.4	495.3	493.9	493.8	485.3	499.7	493.7	489.3	514.1	482.2	471.1
9. Economically active population	0.6	0.6	0.6	0.6	0.6	0.6	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.6
10. Employability	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.6	0.6	0.6	0.5	0.5
17. Concrete roads	4.0	1.0	2.0	89.0	369.0	207.0	209.0	382.0	311.0	450.0	93.0	171.0	399.0		
18. Asphalted roads	1 253.0	1 560.0	999.0	885.0	812.0	655.0	813.0	1 441.0	833.0	1 223.0	66.0	29.0	788.0		
19. Gravel roads	120.0	1 292.0	1 824.0	538.0	490.0	1 662.0	3 417.0	4 431.0	7 833.0	7 879.0	1 840.0	2 274.0	541.0		
20. Telephone coverage	59 558.0	128 530.0	45 134.0	93 788.0	344 874.0	89 575.0	95 449.0	279 668.0	107 528.0	115 585.0	13 061.0	39 362.0	1 910 206.0	58 429.0	36 169.0
21. Internet coverage	47 196.0	113 127.0	35 807.0	80 641.0	278 140.0	67 541.0	75 531.0	252 142.0	78 863.0	93 381.0	11 572.0	25 507.0	1 253 735.0	45 435.0	32 563.0
22. Square metres constructed	188.0	545.0	1 387.0	5 538.0	13 404.0	7 355.0	12 774.0	11 011.0	6 585.0	2 940.0	1 188.0	1 283.0	11 215.0	1 075.0	34.0
23. Drinking water coverage	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	0.9	1.0	1.0	1.0	1.0	1.0	0.9
24. Sewer system coverage	1.0	0.9	0.8	0.9	0.7	0.7	0.8	0.7	0.7	0.9	1.0	1.0	0.7	0.9	0.9
25. Electricity grid coverage	0.9	0.9	1.0	1.0	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
26. Educational establishments	228.0	241.0	182.0	784.0	1 256.0	696.0	879.0	1 564.0	1 224.0	1 074.0	85.0	90.0	3 061.0	530.0	152.0
27. Health-care establishments	40.0	47.0	42.0	154.0	197.0	143.0	260.0	371.0	289.0	284.0	39.0	28.0	421.0	108.0	23.0

Variable	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	RM	XIV	XV
28. Protected wilderness areas	277 008.0	675 039.3	105 648.3	14 316.0	59 702.8	40 591.0	23 070.0	125 468.0	374 321.0	767 608.0	7 812 407.0	68 746.8	19 064.0	126 572.0	358 312.0
29. Native forest	2 000.0	1.6	519.6	238.6	176 009.0	80 605.1	85 802.1	270 650.3	297 872.7	355 228.6	1 137 503.6	517 892.6	211 139.3	365 293.1	-
30. Microenterprises	12 273.0	19 099.0	10 503.0	26 725.0	66 575.0	36 475.0	47 397.0	71 791.0	33 798.0	34 822.0	5 580.0	7 638.0	248 828.0	15 029.0	10 862.0
31. Workers in microenterprises	8 804.0	12 579.0	13 350.0	18 840.0	59 069.0	37 371.0	33 625.0	48 609.0	23 791.0	31 985.0	4 038.0	7 188.0	226 291.0	12 945.0	6 523.0
32. Small enterprises	3 201.0	6 012.0	2 754.0	5 760.0	16 429.0	8 587.0	9 851.0	15 841.0	7 088.0	8 439.0	1 005.0	2 009.0	88 009.0	3 083.0	1 752.0
33. Workers in small enterprises	27 404.0	42 369.0	22 930.0	65 522.0	161 927.0	114 453.0	123 728.0	166 293.0	78 554.0	81 938.0	9 671.0	18 988.0	751 508.0	30 903.0	23 003.0
34. Medium-sized enterprises	738.0	814.0	326.0	657.0	2 025.0	872.0	1 054.0	1 954.0	792.0	1 017.0	113.0	229.0	15 822.0	312.0	159.0
35. Workers in medium-sized enterprises	25 249.0	38 386.0	17 687.0	40 626.0	101 599.0	65 367.0	73 729.0	126 683.0	46 890.0	58 537.0	6 511.0	11 097.0	757 669.0	18 259.0	10 491.0
36. Large enterprises	364.0	301.0	121.0	248.0	782.0	363.0	325.0	672.0	240.0	373.0	23.0	112.0	9 263.0	88.0	45.0
37. Workers in large enterprises	29 901.0	75 041.0	30 068.0	57 322.0	197 277.0	119 003.0	85 091.0	166 320.0	84 988.0	105 763.0	6 245.0	26 747.0	3 470 327.0	17 164.0	9 139.0
38. Investments	2.0	6.0	6.0	-	-	1.0	1.0	-	2.0	4.0	3.0	3.0	6.0	1.0	-

Source: Prepared by the authors on the basis of official statistics.

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