http://doi.org/10.22370/pe.2022.12.3317

A panoramic view to the evolution of three scientific communities in chilean academia 2012-2022

Una mirada panorámica a la evolución de tres comunidades científicas en la academia chilena 2012-2022

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Abstract
The scientific community (or the academic profession) is one of the key players in the global and local dynamics of R&D and affects enormously the performance of contemporary societies. Nevertheless, historical, and institutional conditions strongly affect the magnitude and form of scientific and technological production in the various scientific communities around the globe. During the 20th century, the scientific community has been described as Merton's CUDO, followed by Kuhn's notion of paradigm, and finally in terms of post-normal science debates, mode two, and triple helix. This paper compares two measurements (survey-2012, and survey 2022), describing the evolution of a set of characteristics, especially incentives and values, in three scientific communities (astronomers, sociologists, and molecular biologists) as representative of three epistemic practices: exact sciences, natural sciences, and social sciences. After an introduction describing the context of knowledge production in Chile, the paper compares results from both surveys, trying to understand the differences and aspects in common in a transversal way through three dimensions. The results are the outcome of two online surveys applied to a statistically representative of the communities studied.
Keywords: scientific communities, evolution, university research, values & incentives

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Resumen
La comunidad científica (o la profesión académica) es uno de los actores clave en la dinámica global y local de la I+D y afecta enormemente el desempeño de las sociedades contemporáneas. Sin embargo, las condiciones históricas e institucionales condicionan de modo importante la magnitud y forma de la producción científica y tecnológica en las diversas comunidades científicas del mundo. Durante el siglo XX, la comunidad científica ha sido descrita como el CUDEO de Merton, seguida de la noción de paradigma de Kuhn y, finalmente, en términos de los debates científicos modo 2, post-normal y triple hélice. Este artículo compara dos mediciones (encuesta de 2012 y encuesta de 2022), describiendo la evolución de un conjunto de características, especialmente incentivos y valores, en tres comunidades científicas (astrónomos, sociólogos y biólogos moleculares) como representativas de tres prácticas epistémicas: ciencias exactas, ciencias naturales y ciencias sociales. Luego de una introducción que describe el contexto de producción de conocimiento en Chile, el artículo compara los resultados de ambas encuestas, tratando de comprender las diferencias y los aspectos en común de manera transversal a través de tres dimensiones. Los resultados son el producto de dos encuestas aplicadas en línea, estadísticamente representativas de las tres comunidades estudiadas.

Palabras claves: comunidades científicas, evolución, investigación universitaria, valores e incentivos

1. Introduction

The accelerated transformation of society, economy, and culture as an outcome of technological change does not occur homogeneously in today's world. The dynamics vary at the center and the periphery of the international system. But there are undoubtedly elements in common, and one of them is the role of R&D, which causes affects the economy (Solarin and Yen 2016; Jaffe et al. 2013; Lee et al. 2011). The scientific community or the academic profession is one of the key players in the global and local dynamics of R&D. Nevertheless, historical, and institutional conditions strongly affect the magnitude and form of scientific and technological production in the various scientific communities around the globe (Gantman 2012; Gonzalez-Brambila et al. 2016; Kumar et al. 2016; Meo et al. 2013; Walshok and Shragge 2015; Powell et al 2012). During the 20th century, the scientific community has been described as Merton's CUDO (Merton 1973), through Kuhn's notion of paradigm (Kuh 1970) to post-normal science debates, mode two and triple helix. From the socioeconomics thinking, there are various ways of understanding scientific activity but by categories and theories that emerged in the global north. It turns out that scientific communities are frequently conceptualized from Eurocentric frameworks. The result of that implies that there is an important probability to misunderstand the phenomena. In a situation where countries belong to the global North or global South, the gap replicates in countries that belong to the global south as well.

For that reason and others, this paper has its origin in a sort of inductive and empirical way. We have no reason to start with theoretical assumptions about the functioning and development paths of Chilean scientific communities. However, it is obvious that we must consider the knowledge background in the field of sociology of science and STS, because the globalization of scientific entrepreneurs tends to homogenize research practices all over the world, and, indeed, tends to increase collaborations patterns. Nevertheless, is there an alternative interpretation, more pertinent, from the global south?

2. What do "scientific communities" mean today?

The history of science in Latin America is not characterized by the process of creating new ideas or theories and, in general, is a social history, labeled as colonial science. Thus, we do not focus on the process of diffusion of ideas as Kuhn (1970), Latour (1999), Collins (2004), or today´s networks-science frameworks. Our work is closer to Mullins's approach (1972) but not dependent on it.

The conceptualization of scientific communities is broad. A multitude of approaches have been developed. Since Merton's (1973) and Mitroff's (1974) definitions of scientific community are value-based, the discussion has many ramifications. During the sixties, the Kuhnian paradigm arises and opens the window to a variety of interpretations from the sociology of scientific knowledge up until the present as Latour and others have shown. The diffusion problem was one of the favorites in the analysis of S-shaped growth curve, the role of informal communities—sometimes called "invisible colleges" or "coherent groups" in the organization of scientific research (Keuchenius 2021). Since the 2000s, the availability of both data and sophisticated analytical techniques has reinvigorated the field of science studies, allowing researchers to study the development of science on a larger scale in terms of geographical and temporal parameters.

The last element to keep in mind is that the incentives problem is a subject that arises from the literature associated with academic capitalism, which is, in my view, just an expression of neoliberal industrial, educational, and scientific policies. Thus, we are going to utilize the value-incentives approach because, in scientific trends today, it seems that the scientific profession is a kind of mix of vocational ones, related to profound psychological features and socialization issues, and incentives ones, related to neoliberal contexts in a global institutional competition.

The thesis is that the formation of scientific communities in Chile is directly related to the development of Neoliberalism in three ways: a) due to the (individual) demand of the universities to the State to increase advanced human capital to be able to compete better globally (university rankings); b) because the sudden increase in the number of scholarships in global elite universities occurred in 2008 (1), due to an investment calculation of the sovereign funds of the government abroad (it was cheaper to spend abroad than within the country) and, c) because the awarding of grants and prizes for publication had an individual voucher design, without connection with institutional projects or with the industry sector.

This scheme made it possible to double the number of scientific publications between 2007 and 2014, mainly due to a policy of incentives (bonuses) for academics who published in indexed journals and the growing number of fellows who pursued postgraduate studies, where the paper is a requirement of titling and constitutes a positive antecedent for future tenure applications (2).

It is affirmed that the democratic opening and both public (training of advanced human capital) and private (researcher management) policies on the part of the university system, allowed the 21st century to constitute a true network of scientific communities in all the OECD knowledge areas. In 1990, only 2 communities (astronomers and physicians) published more than 100 papers per year; in 2014 there were 34 areas of knowledge where there were more than 100 publications per year and in 2021, the areas of knowledge cultivated in the country with more than 100 publications per year were 92 (WoS). Although it is an indirect measure, the number of publications allows us to affirm that there has been a substantial increase in the *density* of the national scientific community, which probably has all the conceptual requirements to be called that way, namely: it is an extensive set of networks of research groups (university or companies); with well-defined “cognitive” centers in terms of theories, protocols and referential people for the disciplinary field; with well-defined common institutional spaces, with important government support and organized financially and thematically in “Scientific Societies” to develop periodic scientific meetings. Generally, in visual terms, scientific communities are identified today as groups of journal articles dealing with the same topics and citing each other. Thus, such networks show communities characterized by agreement, a common core community with high citation to each other, and many minuscule communities with little structural significance. This contrasts with other communities that are in dispute within a scientific field. Depending on the scientific field, some form " contentious networks " and others "consensual networks ".

The paper is a product that is the result of a complex set of factors. In other words, for the network to exist, it requires an infrastructure and the functioning of a set of operations, which differ depending on each discipline. In the case of biological sciences, laboratories; in the case of astronomers, observation facilities. In the case of the social sciences, additional institutional structure is sometimes required. As indicated by Boianovsky (2021) in the case of the economics, the installation of the United Nations Economy Commission for Latin America (CEPAL), to become part of the transnational economics community, connected through international hierarchical networks. Thus, in this case, it is a broader meaning of "community", formed by different actors: policy-makers, trade union consultants, producers/employers, economic journalists, politicians, philanthropic associations, and government agencies with other professionals involved (sanitarians, educators, engineers). All these actors produce information and are engaged with scientific research results. Also, in all cases, a demand is required either from the economic system or from the political system.

The XX's century notion of science as a collective enterprise is characterized by quality standards and an autoregulation system in which research agenda and criteria for resources allocation for scientific activity are decided by the research community itself. This was one of the features of Kuhn's concept of "normal science." In the words of Michael Polanyi's (1962) concomitant article, the scientific community should work as a "Republic of Science", with its own rules to produce knowledge. In Latin American countries, many scientific communities developed by copying this ideological framework, but their distance to the main centers of knowledge production made the task enormously arduous. Adoption, adaptation, and creation of knowledge were paramount difficulties.

Now, what forces set a scientific community in motion? The discussion in the first half of the 20th century put the accent on collective values, then in the second half of that century on institutional determinants, and today, on organizational incentives and individual motivations. All these accents can complement each other. Even today. But undoubtedly, they are influenced by the demographic, political, and economic characteristics of each period or cycle, especially within the university institution. Furthermore, not all these characteristics functioned in the same way in all geographic-political contexts: the center operates very differently from the periphery, which is cognitively dependent and colonized.

Since the beginning of the republic in the 19th century, there were scientists in Chile dedicated to government advisory work, later moving on to professional and technical education at the end of that century and during the beginning of the 20th. Small scientific research groups only appeared in the middle of the 20th century and their development was cut short by the 1973 coup d'état. Therefore, it can be affirmed that the scientific community emerged in Chile thanks to Neoliberalism, globalization, and the massive use of Internet, starting in the mid-nineties, and consolidating less than 10 years ago (Gibert 2011). Is the Chilean scientific community one of "excellence"? This question is very difficult to answer because excellence is not a value-free term because "it is highly contested and has acquired a set of specific meanings determined by dynamic interplays between science policy, funding instruments, research culture, performance assessment methodologies, internationalization of science, and public accountability regimes" (Kraemer-Mbula et al 2020, 5). However, the data indicates that there is a consistent strengthening trend over time. The paper explores some characteristics of this consolidation in three disciplines from different OECD areas.

3. Dimensions of evolution

In this paper, we only consider three dimensions of scientific communities' evolution: human capital features, scientific productivity, and values and incentives of the scientific profession.

Our primary focus in 2012 was the size and characteristics of the community. Due to the Chilean scholarship program (named Becas-Chile), and the greater support to universities from the democratic governments since the 90s, the community's size increased considerably. In the second place, we consider the increasingly higher productivity of researchers. Thirdly, we consider the beliefs of researchers in terms of value and the factors that function as incentives to get the job done. In this sense, we considered two aspects that 40 interviews clearly indicated. First, individuals involved in scientific activities seem to exhibit a strong intellectual engagement developed since an early age. We might call this Vocational Orientation, constituted by beliefs with values. This made us hypothesize that, in some way, they were in touch with scientific cultural background, probably within their families. Respect and appreciation of science constituted a deep value for them. However, other values such as innovation, autonomy and humanism were important to them. Second, while context pressures to raise money for their institutional budgets were important, researchers were indifferent to these pressures and more concerned about country issues or personal ones. In our 2022 collected data, we repeat the main questions to compare data, allowing us to see the difference that occurred over the last 10 years.

The number of researchers is a precise indicator although it is a difficult measurement. In 2012, we include all faculty even if they have not won a research grant at all. In 2022, we use a restricted sample of researchers who have won at least a one-time national research grant. The second aspect is the participation percentage of women in scientific activities given the fact that science in peripheral countries is still principally a male-identified profession. The third indicator is age average because it determines a kind of energy and novelty results for a national scientific community as a hypothesis. The percentage of researchers with foreign graduate certificates may indicate how strong or weak graduate studies offered in local universities are, and how attractive this offer can be to applicants.

The productivity dimension contains three indicators. The first is the number of publications in the last 10 years which give us an approximate picture of the system's dynamics. The metrics evacuated by informational multinational platforms are accurate and allow segregated data which allows several calculations. One of the most valuable data provided by our both surveys is the year of the first WoS published paper, and the year of the first grant obtained by researchers. Given the variety of funding, it is difficult to obtain data without truly scientific respondents.

The third dimension constitutes values and incentives. The conceptualization of values can be reached through Merton's CUDEO, analytical sociology's BDO, or Boudon's framework as well many other approaches but, in this preliminary research, we made a typology of values and incentives according to scientists themselves. Even though academic literature emphasizes the importance of work values to job satisfaction and commitment, some researchers separate values from incentives while others treat them as multidimensional, often identified as having extrinsic and intrinsic elements (Gesthuizen et al 2019). Here, we prefer to distinguish values from incentives.

Boudon has said that explaining values is a major question for the social sciences and philosophy. The first statement in his 2017 book is "We spend a good deal of time wondering whether or stating that "X is good, fair, legitimate ... "or rather "bad, unfair, illegitimate": These value statements, these axiological beliefs regulate our social life. They are a basic ingredient of our personal identity" (Boudon 2017, 1). The discussion is embedded in at least three intellectual traditions: Philosophical with Nietzsche; sociological with Marx, Durkheim, and Weber; and psychological with Freud. Our approach is sociological, in terms that we suppose that "we believe that X is good because it serves our class/community/group interests and routines". Indeed, many older authors tend to see values as functional illusions for certain purposes, sometimes transcendent, sometimes pedestrian. In this sense, the values of the scientific community as they have been conceptualized as part of their personal and social identity, refer to questions of beliefs. In the case of the values of the scientific community, we can understand that the Mertonian CUDO (communism, universalism, disinterestedness, and organized skepticism) possesses strategic and procedural rationality which, as Weber had already warned, insists heavily on the role of rationality, immoral life, and history.

On the other hand, incentives refer to external issues, factors that can facilitate or hinder the achievement of objectives related to our main activity. “Incentive” comes from the Latin word *incentivum*, which means stimulant or goad. It was also associated with the instrument that gives the tone, which became “that which provokes or excites to start something”, an instigating tool of any nature. In the context of our work, an incentive could be equivalent to an expected reward. Since expectations are the atom of social life, they are connected by the history of the actors, but also by the vision of the future that they have built. In particular, the vision for the future that the researchers must obtain a reward.

However, values (axiologically speaking) tend to be controversial. In this sense, our investigation does not establish a fixed dogmatic or operational definition but is oriented to the identification and description of those beliefs that inspired the emergence of scientific activity in an individual (which motivated their decision to pursue the scientific profession) and those opportunities provided by the immediate environment that allows the maintenance and development of the individual scientific activity.

The analytical sociology approach can be useful for such purposes since its basic model is the triad of beliefs, desires, and opportunities, the BDO approach (Hedström and Swedberg 1998; Manzo 2014). In our semantics, beliefs can be values and opportunities can be translated as incentives. Unfortunately, we cannot develop this optic in this preliminary work.

Therefore, in terms of values and incentives, we only elaborated a list of each one provided by the scientific community itself. That list was made after 40 interviews with outstanding colleagues from these three disciplines in a preliminary stage of our research project. The results show only the main values and incentives which inspire researchers in their own words. Thus, we divide values into scientific values such as knowledge production and vocational values (scientists say: I was born to do this). These latter values or high cultural values, characteristics of well-educated people, include autonomy, sense of achievement, innovation, and humanitarian or ecological concerns. Finally, we define traditional values as security, fun, money, and a search for empowerment.

Incentives were listed in the same way as values. Also, we divide them into three types. First, personal incentives (curiosity, research derived from their doctoral dissertations); second, professional (main issues from disciplinary topics, scientific prestige); and third, national issues, such as development problems to be solved, the interest of the government and private local agencies or industrial research.

4. Data and method

The population under study is made up of researchers from three scientific disciplines who have developed academic research (2012 survey) and FONDECYT projects in the period from 2015 to 2020 (survey 2022). The disciplines are the following: astronomy/astrophysics; biology, and sociology. Each one of them is representative of larger academic tribes: exact sciences, natural sciences, and social sciences.

We used two data sets. A historical one, from 2012 and another from May/June 2022. In the last data collection, we decided to narrow the population to this period since these were the most recent years available and it is highly probable that these researchers are currently active.

According to official numbers of ANID (R&D national agency), the active researchers in 2022's Chile (all disciplines) are 9946, defined by an average paper production of one paper 80% of the time since the researcher is indexed in the DATACIENCIA platform (created in 2008).

Therefore, we extract the 2022 population of 1,080 (641 biologists, 169 sociologists, and 270 astronomers) from people who obtained a FONDECYT grant from 2015 to 2020. After that, we obtained the mail of them and sent each one a letter explaining the survey's objectives and including the connection to a web page containing the questions. The first message was sent on May 15, 2020. Between May and June, the survey was re-sent two more times. The answers were coming gradually until they were 302 at the time of closing. There was thus a 27,9% answer rate that, for this kind of survey, is somewhat above the usual rate which is around 20%. The sample obtained is probabilistic, and statistically representative of the study population, with a 95% confidence level and a 5.65% margin of error.

4.1 Descriptive Data of the Sample Compared to the Study Population

The distribution of cases in the sample in terms of discipline is detailed in the following table, comparing it with the reference population. There is a correspondence between sample and statistically appropriate population.

Table 1. Main researchers for FONDECYT projects, in the population and the sample, by discipline.

DISCIPLINE	STUDY POPULATION 2002–2011 % (freq.)	SAMPLE 2002–2011 % (freq.)	STUDY POPULATION 2015–2020 % (freq.)	SAMPLE 2015–2020 % (freq.)
Exact Sciences ASTRONOMY	10,6 (87)	10,6 (35)	25,0 (270)	16,0 (49)
Natural Sciences BIOLOGY	49,6 (408)	44,5 (146)	59,3 (641)	60,9 (187)
Social Sciences SOCIOLOGY	39,8 (328)	44,9 (147)	15,6 (169)	23,1 (71)
	Total 100.0 (823)	100.0 (328)	Total 100.0 (1.080)	100.0 (307)

5. Results

The main results show a comparative view of how there have been differences between the 2012 and 2022 surveys according to human capital features, productivity, values, and incentives.

Table 2: data of comparative study (three scientific disciplines)

Dimensions	Indicators	2012	2022
Human Capital	Number Of Researchers (3)	823	1.080
	% Of Woman	31.7	37.6
	Average Age	48.3	46.8
	% Of Foreign Graduate	54.3	48.2
Productivity	Publications Last 10 Years (4)	7.462	16.953
	Average Year - First Wos Paper	1999	2004
	Average Year – First Grant	1994	2015
Values (6) And Incentives	% Highest Scientific Value (Knowledge Production)	84	92
	% Highest High Culture Value (Autonomy)	37	64
	% Highest Tradicional Value (Fun)	21	59
	% Highest Personal Incentive (Curiosity)	51	71
	% Highest Professional Incentive (5)	44	80
	% Highest National Incentive (National Need)	46	51

As can be seen, the number of researchers with productivity increased in 10 years, the average age decreased, and female participation improved.

From the point of view of human capital, there was an important shift: the number of graduates from Chilean universities exceeded the number of graduates from foreign universities. This is due to significant support based on government incentives for universities from the Ministry of Education. It is also due to mezzo-level reputational capital accumulation strategies in institutional and micro-level research groups. Obviously, in a competition scheme, it is also explained as a source of financial resources for the institutions.

From the point of view of productivity, it can be said that in the 10 years before 2012, researchers published an average of 0.91 papers per person per year, while between 2013 and 2022 the researchers published 1.57 papers per person per year. Total publications doubled in all three areas. In the national system, the effect was similar because while in 2008 the total number of WoS publications was 5,500, in 2014 it was 9,600 WoS publications, reaching 2020 more than 17,000 papers in more than 200 research areas according to the Web of Science. However, in 2016 there was a break in the citation trend: while in 2008 the total number of citations was 120,000 (adding WoS, Scopus, and Scielo) and in 2014 it reached 158,000, in 2016 it dropped to 145,000 and continued falling to 72,000 in 2018. It may be that time allows the scientific contributions of Chilean papers to be valued, but so far, the trend is towards a decrease in citations and an increase in publications.

The interpretation of this may be due to several factors. The return of new Ph.Ds because of the Chile Scholarships (2008) generated such dynamism that, strictly speaking, we could speak of the creation of a national academic market. Most of the returned fellows exhibited a habitus of paper-oriented intellectual activity and the exclusive dedication to postgraduate studies during the duration of the fellowship generated productivity that, on average, is unsustainable later once integrated into the activity. university labor that includes classes, management tasks, extension, and connection with the external environment. This productivity, in my opinion, gave rise to draconian contracts where new hires were required to have similar productivity to what they had during their postgraduate studies, which forced researchers to use various survival strategies such as a) *paper salami* (preparing several papers by chopping the original material into many parts, b) the *re-fried*, that is, writing the same paper many times, changing the semantics and paraphrasing, and c) the *copy -paste paper*. Rapid synthesis of already known material with small new flavors. The result of this could well explain the drop in citations during the last 6 years. That is the hypothesis. A variant (which can be mixed with what has already been said) is that the existence of economic incentives was the reason for the entry of new researchers into the various fields. That is, academics who did not publish before, even though they had the training to do so, began to publish to earn publication bonuses. Thus, a greater competition was generated by economic incentives for publications, going from " publish or perish " that had a strictly academic and reputational meaning to " publish for money " or " publish or get fired ", which is nothing more than a case of anomalous professionalization, as a survival strategy or an economically inspired short-term tactic.

A change of pre-eminence of values to a change of pre-eminence of incentives in interaction with values, depending on equations such as career stage, type of disciplines, and others that are not addressed in this study and remain as future research projects. Naturally, the external factor may be the most important: the tendency of platform capitalism for metrics and data accumulation allows for the incessant increase in the number of scientific journals titles, and an increasing number of editorial boards with aspirations to be included in the most recognized indexes such as WoS, Scopus, and others. An idea of the large volume of published papers can be obtained from Ulrich's global series directory which lists more than 260,000 scholarly and academic Journals. Added to this is China's growing interest in publishing regular scientific journals. On the other hand, the existence of a competition for local and international students by universities in all parts of the globe feeds on international rankings, for which institutions recruit researchers with greater public visibility on academic and non-academic platforms, including Google scholar and Twitter. The publication generates visibility that results in reputation and finally in hiring or a rotation of Science-Stars among universities, whether they are elite.

On average, the 2012 sample published their first paper in 1999. If the average age of the sample was 48, that means that they published their first WOS paper at approximately 35 years of age. In contrast, the 2022 sample published their first paper in 2004. If the average age of the sample was 47, then they published their first paper. WoS at 29 years old. They are communities socialized in the research and publication process earlier than 10 years ago. Probably, it is due to the pressure of the media through their tutors or to postgraduate training micro strategies more oriented to training in the publication of articles as a prerequisite to the master or doctoral thesis.

The same time reduction is observed in the award of the first research fund. While the 2012 sample on average wins its first grant at age 30, the 2022 sample wins its first grant at age 40. This may be due to the dynamics of greater competition in contexts of growing institutional budget reductions. Today there are more applicants to research grants, applicants are more qualified, and grants competitions have higher entry requirements. Additionally, the massiveness of the university system has meant that internal support for research has decreased in the context of growing budget restrictions, especially in the public university system, which obtains less than 15% of financial support from the State for its operation, reaching in some cases 5%. Institutions increasingly ask their researchers to compete in national or international grant competitions.

On the other hand, the relationship between both events changed direction: while in the 2012 sample, the average researcher first won a grant and 5 years later published their first WoS paper, in the 2022 sample, the average researcher first published a WoS paper and 9 years later won their first grant.

In terms of values and incentives, the choices made 10 years ago remain the same, but the numbers increase considerably in some indicators. Thus, knowledge production is the main choice of 92% of all respondents. The same happens with autonomy as the most important value of high culture framework, which changes from one-third to two-thirds of the choices. Fun, as a traditional value of a good job, tripled in 2022 the amount of 2012 respondents.

The incentive structure in 2012 was homogeneous because numbers did not show important differences. But in 2022, the inspiration for national needs was much lower in comparison with personal and professional incentives. It could be said that "the republic of science" (Polanyi 1962) it is winning over "science for society" (Bernal 1939) in ideological terms. One difference between the 2012 and 2022 surveys is the professional incentive: while scientific prestige has 44% in 2012, it now is 69%, below the 80% reached by the incentive to work in hot disciplinary topics. These are communities in focus.

Both values and incentives show a strong scientific identity in these three communities under examination.

6. Conclusions

The data set show that Chilean scientific communities have enough researchers. They are highly productive and have detailed scientific routines very similar to consolidated scientific communities from the Global North. External factors that increase the quantitative indicators of researchers move faster than ever such as a larger numbers of scientific journals and the strength of competition between institutions, in developed countries as well in developing ones.

Even if our study is focusing only on three disciplines, data seems to confirm the idea that the national scientific community is larger enough to contribute in paramount importance to the economy, social peace, and culture in Chile. However, greed is imbricated in a few incentives which work at the micro, mezzo, and macro level. Economic incentives and draconian contracts are doing a good job making researchers publish many papers, but with a low impact (and lower quality, as we may suppose).

One open question is to what degree the Chilean scientific communities overlap with already existing scientific networks and communities abroad. This is a dominant question because it shows the robustness and sustainable features of contemporary Chilean scientific research.

Acknowledgements

The paper was read firstly at the annual meeting of the Society for the Advancement of Socio-Economics, SASE 2022. The author wants to thank FONDECYT project N° 1095032 which provided the financial resources to make the 2012 survey. The author also wants to thank the support from the Research Center in Innovation,

Economic Development and Social Policies (CIDEP-UV) to make the 2022 survey.

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Footnotes

1. Between 2008 and 2009, 3,100 scholarships were awarded for postgraduate studies to students with an average age between 29 and 32 years. That amount is almost 10% of the total number of scholarships awarded in Chile from 1980 to date. This leap explains part of the consolidation of the national scientific community.

2. This doubling between 2007 and 2014 is consistent from several perspectives: a) a total number of works with at least one author residing in Chile; b) Total number of works, excluding the most productive area and with the highest levels of collaboration, that is, astronomy/astrophysics; c) a Total number of works with authors from Chilean institutions, excluding the first 100 most important foreign institutions; and d) a total number of papers with authors exclusively from Chilean institutions (Source: WoS). This is the "return/return plan" effect for fellows, which begins around 2010-2011. Of the 36,557 postgraduate scholarships awarded by the system from 1980 to 2022 (www.conicyt.cl/becasconicyt/estadisticas/informacion-general), a total of 26,308 were awarded between 2008 and 2017, more than 70% (Gibert and Pérez 2020). This indicates a defined political will and a public policy with coherent financing.

3. The numbers are not comparable, but they give an idea of the increase in the number of researchers. The 2012 sampling frame was more inclusive since it also considered academics from the respective university departments that had not awarded local grants

(FONDECYT). The 2022 sample frame only considered researchers with FONDECYT awards, which implies that each researcher had an outstanding career and/or productivity.

4. The publications of the last 10 years were extracted from the Web of Science. This take into account publications where at least one of the authors was a resident in Chile. The WoS categories considered were <astronomy/astrophysics> <sociology> <biotechnology applied microbiology> <biochemistry/molecular biology>.

5. The 2022 questionnaire included an extra variant in the question about professional incentives. Thus, while in 2012 "continue with my doctoral research line" reached the highest percentage of responses as an incentive for their work (43.6%), in 2022 the alternative "investigate central topics of my discipline" was added and reached the highest percentage of responses as a professional incentive (79.6%), surpassing by 10% "to continue with my doctoral research line" (69.4%).

6. The alternatives that reached the highest scores in the question about values, both in the 2012 and 2022 questionnaires, were the same.