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Academic inbreeding and intellectual contributions in Chile

Endogamia académica y aportes intelectuales en Chile

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Abstract

Existing literature shows that academics trained at the same university where they are employed generally exhibit lower academic achievement levels than their colleagues trained at other universities. However, the general validity of this reasoning has recently been questioned. In this line, our results show that the mean level of academic inbreeding in business and economics in Chilean universities is high, with a mean level of 46.4%, quite different from the mean for universities in western countries. We found that for the two top-ranked Chilean universities, some degree of cross-academic inbreeding among them seems justified, at least temporarily. In the other Chilean universities, we observed a statistically significant inverse relationship between academic inbreeding and intellectual contributions. This suggests that self-limitation of inbreeding appears to be highly recommended for most Chilean universities, as it is for the majority of the world's top-ranked universities.

Keywords: Academic inbreeding, Chilean universities, performance, H-index, productivity.

Resumen

La literatura existente muestra que los académicos formados en la misma universidad donde trabajan generalmente exhiben niveles de rendimiento académico más bajos que sus colegas formados en otras universidades. Sin embargo, recientemente se ha cuestionado la validez general de este razonamiento. En esta línea, nuestros resultados muestran que el nivel medio de endogamia académica en negocios y economía en las universidades chilenas es alto, con un valor de 46.4 %, bastante diferente al promedio de las universidades de los países occidentales. Encontramos que para las dos universidades chilenas mejor clasificadas, cierto grado de endogamia académica entre ellas parece justificado, al menos temporalmente. En el resto de las universidades chilenas observamos una relación inversa estadísticamente significativa entre endogamia académica y aportes intelectuales. Esto sugiere que la autolimitación de la endogamia parece ser muy recomendable para la mayoría de las universidades chilenas, como lo es para la mayoría de las universidades mejor clasificadas del mundo.

Palabras clave: Endogamia académica, universidades chilenas, desempeño, índice H, productividad.

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Introduction

Academic Inbreeding (Intellectual Inbreeding) refers to the situation in which professors work at the same university where they previously studied. According to the academic literature, professors who graduated from the same university where they are employed produce fewer research results than those who did not, and the impact of their research is significantly lower (Altbach et al., 2015; Hargens & Farr, 1973). In cases where the result of the research is similar, the quality of the research produced by the native professors tends to be lower. As a result, most researchers conclude that inbreeding is a phenomenon that negatively influences the academic system (Gorelova & Yudkevich, 2015).

Hargens and Farr (1973) finds some evidence in favour of the hypothesis of Pelz and Andrews (1966, pp. 140-53) which affirms that inbreeding scholars lack the degree of exposure to new ideas and techniques that contribute to a higher level of scientific productivity and creativity or that continuing ties to their professors inhibit the development of a sense of independence and personal innovation. Consanguine scholars appear to be less creative, less independent, and less connected to the outside world (Pelz & Andrews, 1966). Lower academic inbreeding would establish a more universal or cosmopolitan mentality (Merton, 1957) versus a closer institutional assimilation of beliefs, norms, and behaviours.

Altbach et al. (2015) find that a surprising number of institutions and countries have a long tradition of academic consanguinity, and this phenomenon is not perceived as a problem by the vast majority of the citizens of these countries. However, the best universities in the world are discouraged from hiring graduates of their own institution, and in some countries, this has been enforced through legislation preventing the inbreeding of more than 50% (in India, Gupta & Gupta, 2017; in Korea, Marshall & Baker, 1998). In France, the need for administrative regulation has been addressed (Goudechot & Louvet, 2008). With regards to Europe, Aghion et al. (2008) point out that it would be judicious if European universities were to endorse a no-endogamy principle for faculty recruitment. In the traditional universities of Latin American countries and Spain, no evidence seeking to limit inbreeding was found, despite the significant amount of criticism in the press due to its excessive prevalence (Diez Ripolles, 2017; Mora, 2015).

Academic inbreeding worldwide

Global evidence suggests that academic inbreeding is now quite limited in American universities, as well as those of the United Kingdom, Germany, and Australia. For the United States, Blanke and Hyle (2000) found that the average percentage of inbred faculty members at the national level was approximately 10%, based on the National Centre for Education Statistics (1998). In Canada, Tizhoosh and Hemmesi (2018) found that the academic inbreeding level is, on average, 23% at Canadian Engineering Schools. Smyth and Mishra (2014) estimate that inbreeding in Australian law schools is 6.3%. On the contrary, Spain, Italy, Portugal, and Latin America experience extremely high levels of academic inbreeding. Borenstein et al. (2022) found that the non-inbred instances comprise the vast majority in Brazil, accounting for approximately 80% of all researchers. Soler (2001) provides estimates for 51 ecology and zoology departments in Europe and concludes that Spain and Portugal register the highest levels of inbreeding, averaging 91% and 88%, respectively, while at the other extreme, the lowest levels are observed in Switzerland (23%), the United Kingdom (5.2%), and Germany (1%); the results of Navarro and Rivero (2001) are compatible.

Based on the above, since the universities of the United States and Canada generally exhibit better average rankings, the inverse correlation between inbreeding and performance seems evident. However, currently, there is some limited empirical evidence that this relationship does not exist in some cases (Horta & Yudkevich, 2016; Wyer & Conrad, 1984).

It has also been proposed that certain levels of inbreeding can be reasonably justified, at least temporarily, in the early stages of the development of systems of higher education (Horta et al., 2011). For instance, when there is limited access

to qualified academics in a country or region, either because the other universities do not produce sufficient PhDs of the desired quality or because remuneration and other conditions are not sufficiently appealing in order to attract academics from abroad. In these cases, it would be expected that higher-level universities would exhibit higher levels of endogamy (Berelson, 1960, Yamanoi, 2007), making the consequences of inbreeding less harmful for elite university environments. Altbach et al. (2015) found evidence in this regard, by applying surveys to faculties in several countries and found that the best universities believe their graduates to be undoubtedly the most qualified and find it difficult to recruit outsiders with comparable skills and potential. Bayler and Bakay (2022) interviewed twenty faculty members and discovered that the majority of academics expressed their concerns and difficulties arising from academic inbreeding.

The aforementioned implies that our current understanding of the repercussions of academic inbreeding is quite restricted. This is particularly critical in light of the limited evidence that is available in Latin America, particularly in the context of business and economics schools. To reduce this gap in the literature, we examine the case of business and economics schools in Chile and conduct an in-depth analysis as follows below.

Business schools in Chile

Based on the above, in this study, we analyse the hypothesis that the relationship between inbreeding and productivity can be moderated by the quality of the universities and the access that the universities have to hire quality academics. The case of Chilean universities is particularly intriguing in this regard. Until 1981, there were only eight universities in the country, all of which received government subsidies. As of that year, freedom was given to create private universities, although without direct financing from the government and subject to oversight by traditional universities (Brunner, 2009). Since then, higher education in Chile has undergone exponential growth and has become somewhat competitive. This opening model in universities has been followed to a large extent by other Latin American countries (Rama Vitale, 2006).

Accurately measuring the academic endogamy of several universities is a relatively complex task (Horta, 2022). Mixing different areas of knowledge (fields) adds additional difficulties in making comparisons. Additionally, it requires personal information concerning each full-time professor, including the institutions from which they graduated. In many cases, this information is not readily available on the Internet, and several specific queries must be made. That is why in this study, we will focus on the top-ranked business schools in Chile, which constitute a relatively homogeneous and comparable group.

In broad terms, there are nine business schools in Chile that are considered superior, based on the system of accreditation from the State of Chile (years) and the Scimago Adjusted Ranking Position of 2018. In descending order of quality: U. of Chile (UCh, Public); P. U. Católica of Chile (PUC, Private Traditional); U. of Concepción (UdeC, Private Traditional); U. of Santiago de Chile (USACh, Public); U. Técnica F. Santa Maria (UTFSM, Private Traditional); P. U. Católica of Valparaíso (PUCV, Private Traditional); U. Austral of Chile (UACh, Private Traditional); U. Católica of the North (UCN, Private Traditional); and U. Adolfo Ibáñez (UAI, Private New).

Objective of this study, research question and hypothesis

Continuing with what was previously stated, the objective of this study is to investigate the nature of the relationship between academic inbreeding and the intellectual contribution of full-time professors in Chilean business schools. The main question that this research seeks to answer is the following: To what extent is intellectual inbreeding related to the quality and quantity of the scientific publications that are generated? The answer to this question is relevant since it can help determine whether it is really an important and practical problem and, if necessary, suggest adopting specific measures to reduce it.

We set out to prove the following three central hypotheses:

H1: "In Chilean business schools, there are high levels of academic inbreeding." Currently, there are no estimates of inbreeding levels in Chilean universities. Inglehart et al. (2014) show that Chile is very similar to Spain and Portugal in cultural values. Therefore, one might expect that the Chilean universities may also exhibit similar levels of inbreeding as those of Spain and Portugal. To summarise, H1 asserts that the level of academic inbreeding in Chilean business schools exceeds the global norm.

H2: "Intellectual contributions (IC) in Chilean business schools is explained by existing levels of academic endogamy." Here we seek to evaluate whether the negative (previously reported) relationship also exists in Chile. As mentioned earlier, this relationship should eventually be explained in further detail by some moderating variables, such as the quality of the university. Furthermore, we seek to determine in which university academic inbreeding is most prevalent and, at the same time, seek plausible explanations for this phenomenon. To summarise, H2 proposes that in Chilean business schools, there is a negative statistical correlation between the levels of intellectual contributions and the degrees of academic endogamy.

H3: High levels of inbreeding may be acceptable and even recommendable for those academic departments that exhibit high performance in research in a university system that is not yet fully developed. With this hypothesis, we seek to reconcile the results obtained by several authors, in which no evidence of this relationship is found. We explore the possibility that, where access (by universities) to academics of the highest quality is limited (as is the case in Chile), the negative impact of inbreeding is moderated by the quality of the universities. To summarise, H3 states that in a country with a tiny and underdeveloped university system, it is possible for a Business School to have both a high level of research performance and a significant amount of academic inbreeding.

For this, the methodology used will be detailed; successively, we will show the results of applying this methodology, and finally, this project will conclude with our results and a discussion of said results. Below, we present both an empirical and theoretical contribution to the field by introducing and estimating an econometric model. This model allows us to assess the statistical correlation between intellectual contributions (measured by the H-index) and inbreeding. This work is significant as it enables us to thoroughly investigate the nature of this relationship and simultaneously derive significant consequences.

Methodology

Data was collected from the Schools of Economics and Business belonging to the foremost Chilean universities. The requirement was that they have a high international ranking as a university and also have good rankings as business schools. Using these criteria, we built a database with all the full-time professors of the nine top-ranked Chilean business schools who meet the following criteria: i) they are the best-ranked universities according to the national system of accreditation (Chile); ii) they are included in the Scimago Adjusted Ranking 2018; and iii) they are top-ranked in the areas of business and economics in the America Economia Ranking 2017. Since we are interested in university full-time professors (tenured positions), we exclude those who teach part-time, and we prefer to use the term "professors" instead of "faculty" or "academics."

Based on this, Table 1 shows that the Universidad de Chile (UCh) and the Pontificia Universidad Católica de Chile (PUC) both maintain performance levels relatively superior to other universities. Historically, these two universities have challenged each other consistently for first and second place in the country with regard to international rankings, and at a local level, they are widely recognised as elite universities. Other traditional Chilean universities can also be found on the list. The case of the U. Adolfo Ibáñez (UAI) is quite different since it is a relatively new, privately-owned university that is smaller than the others. Despite this, it has

Table 1. Universities whose schools of business and economics are studied here

Universities	Owner	Accreditation (1)	Scimago Adjusted Ranking 2018 (2)	AmericaEconomia Ranking 2018 (3)
U. de Chile (UCh)	Public	7 years	507	#1
P. U. Católica de Chile (PUC)	Private (traditional)	7 years	701	#3
U. de Concepción (UdeC)	Private (traditional)	7 years	1510	non top-10
U. de Santiago de Chile (USACh)	Public	6 years	1382	#4
U. Técnica Federico S. María (UTFSM)	Private (traditional)	6 years	1158	#6
P. U. Católica de Valparaíso (PUCV)	Private (traditional)	6 years	2042	#7
U. Austral de Chile (UACh)	Private (traditional)	6 years	1756	non top-10
U. Católica del Norte (UCN)	Private (traditional)	6 years	2475	#9
U. Adolfo Ibáñez (UAI)	Private (new)	5 years	2858	#2

(1) Accreditation of the Chilean universities by the State of Chile, National Accreditation Commission (CNA). The higher the number of years, the higher the overall quality of the university.

(2) Scimago international ranking (Scimago Institutions Rankings) for a large number of universities throughout the world. This ranking is based on three factors: research (50%), innovation (30%), and society (20%). Scimago uses a ranking system of 1223, and we have converted it to the 1224 system.

(3) The AmericaEconomia 2017 ranking gives the positions for specific programmes. We used the ranking of the Ingenieria Comercial (Business Administration) degree in Chile. Two universities (UdeC and UACh) are not among the top 10 (no information is available), and we have been assigned position #15.

achieved good positioning in the rankings as a business school.

These nine universities on the Table have different forms of governance, explained partially by the different ownership structures. All Chilean universities owned by the State have direct voting systems for the rector (university president), deans, and department directors. In the case of Catholic Chilean universities, in recent years, there has been a move towards corporate models, but only for the designation of the rector since a direct voting system for deans and department directors has been maintained. On the contrary, in the new private Chilean universities (i.e., those created after the 1981 reform), the corporate system predominates (Zuniga & Sjoberg, 2021).

To build the database, we consider that some universities have multiple campuses where the same courses are taught. These campuses are geographically distant and relatively independent of each other, and we then aggregate all this information at the level of each university. We included only active, full-time professors as of the end of 2018. Part-time academics were excluded. We have classified all full-time professors in one of two areas, according to their field of specialisation: business or economics. In most Chilean universities, there are separate departments for these fields, which facilitate the classification. In other cases, finance, statistics, econometrics, and quantitative methods were included within the economics group. Departments of accounting, management-control, tourism, and computational systems were not included in the study because they were not considered to be essentially either business or economics. Regarding the information on where academics completed their degree studies to determine inbreeding, we generally checked the websites of business schools. In the absence of data, we conducted a search for professional resumes online or sought

assistance from the individuals themselves or a coworker who had close interaction with them.

Academic inbreeding measurement

Inbreeding is measured as the percentage of academics in business or economics who have been appointed as full-time professors at a university and have previously graduated from the same university. Unlike the approach of Navarro and Rivero (2001), this approach is more difficult to measure but more precise since it includes all the professors of a given department and not only those whose scientific work has been published in mainstream journals. To achieve this, we examined where each one of the professors carried out their undergraduate studies, which in many cases was quite a difficult task. In Chile, the Ministry of Education does not have a system that allows for the consultation of professional degrees in the areas of economics and business; therefore, this was performed by way of collaboration with colleagues from those universities. For clarity, and to account for potential variations in the definitions of "graduate" and "undergraduate" across different nations, we define undergraduate studies as any advanced studies undertaken prior to obtaining a PhD and/or master's degree. Therefore, we conclude that academic inbreeding occurs when a professor who works full-time has obtained their undergraduate degree from the same university.

Intellectual contributions (IC)

The central hypothesis of this research concerns the relationship between inbreeding and intellectual contributions. It should be noted that we use the terms "intellectual contributions," "scientific productivity," or "research performance" interchangeably to refer to a statistic that measures the number of publications produced by faculty members. This entails performing a bibliometric analysis seeking relevant parameters for each of the scholars. Here we have used the H-index (Hirsch, 2005) of the Web of Science (WoS, core collection) as a measure of intellectual contribution (Inanc & Tuncer, 2011; Tyrrell et al., 2016). The Web of Science gives access to multiple databases that reference cross-disciplinary research, allowing for in-depth exploration within a scientific discipline. In order to correctly identify the names of the academics, we used ResearchID, Open Researcher and Contributor ID (ORCID), and the Chilean Dataciencia (https://datacienciа.conicyt.cl). This task became a rather slow process since few academics have consolidated their publication record into the WoS.

Academic inbreeding vs. intellectual contributions

We have estimated a Negative Binomial Regression (NBR) to evaluate the relationship between inbreeding and productivity. This specification is recommended when the dependent variable (H-index) has two characteristics: it comes from counting (i.e., from the number of publications produced by each author), and second, it exhibits a tendency towards overdispersion since it can be seen repeatedly that a tiny proportion of researchers exhibit very high levels of H-index. The NBR, therefore, seems to be the correct approach to calculating the estimates (Cameron & Trivedi, 1998). This approach was also used by Inanc and Tuncer (2011) and Karadag and Ciftci (2022) to measure the effect of academic inbreeding on scientific effectiveness in several Turkish Technical Universities.

We utilised Stata (StataCorp, 2023) to run a negative binomial regression model (the NB2 model) for a dependent variable that consists of nonnegative counts. The count dependent variable is hypothesised to be generated by a Poisson-like process, but with the possibility of higher variation than a true Poisson distribution (overdispersion). The model is as follows:

$$\ln\left(\mu\right) = \beta_0 + inbreeding\ \beta_1 + error$$

The variable "hindex" represents the H-index (Hirsch, 2005) of the Web of Science core collection. It is a nonnegative count dependent variable with a mean denoted by $\mu>0$.

inbreeding is a binary variable that indicates whether a full-time professor has graduated from the same institution (1) or from a different university (0).

The parameters were estimated by maximising the appropriate log-likelihood function

(Zwilling, 2013). Four models were used for the econometric estimates: Model 1 is the baseline specification for the entire sample. Model 2 is the baseline excluding the U. of Chile (UCh). Model 3 is the baseline model only for Group 1 (top-ranked universities). Model 4 is the baseline model only for Group 2.

Limitations

As was already indicated, there are numerous approaches to define academic inbreeding. For us, we gauged it based on the locations of full-time professors completing their undergraduate studies. This measure seems reasonable for the state of the Chilean business schools, but it can make comparison with other research challenging where the graduate level is given more importance. For instance, if inbreeding is defined as academics working for another university where they earned their PhD. Conversely, the fact that we focused just on Chilean business schools is also a drawback. We thus present purely a limited picture of Chilean academic inbreeding, and our findings cannot allow us to draw conclusions for other Faculties or Schools.

Results

On Table 2, we report most of the estimates in two groups of universities: the two top-ranked universities (Group 1) and the others (Group 2). There are 364 full-time professors, classified by field and by university. The data includes academics from all campuses of each university. On Table 2, it can be noted that in both groups of universities, the number of professors in the business area is greater than in the economics area, although this difference is considerably more significant in the universities of Group 1. On the other hand, it is also observed that there are two universities in Group 2 with a fairly high number of students compared to the number of teachers (UACh and UdeC).

Academic inbreeding

Table 3 shows whether the academics obtained their undergraduate degree at the same university as where they currently work (inbreds) or from a different university (non-inbreds). The academic inbreeding average in business is 50.8% and relatively lower in economics (41.3%), while the overall inbreeding mean is 46.4%. This result allows for the testing of H1, concluding that Chilean business schools exhibit high levels of university inbreeding, which are levels considerably higher than those found

Table 2. Full-time academics from the main Chilean universities, by university and field (year 2018)

		Business	Economics	Total	Business	Economics	Enrolled	Enrolled/ Total
Group 1	UCh	32	22	54	59,3%	40,7%	416	7,7
	PUC	42	29	71	59,2%	40,8%	422	5,9
	Subtotal	74	51	125	59,2%	40,8%	838	6,7
Group 2	UdeC	7	10	17	41,2%	58,8%	286	16,8
	PUCV	9	12	21	42,9%	57,1%	124	5,9
	UTFSM	9	6	15	60,0%	40,0%	329	21,9
	UACh	10	9	19	52,6%	47,4%	171	9,0
	UCN	19	21	40	47,5%	52,5%	228	5,7
	USACh	17	17	34	50,0%	50,0%	285	8,4
	UAI	52	41	93	55,9%	44,1%	662	7,1
	Subtotal	123	116	239	51,5%	48,5%	2085	8,7
	Total	197	167	364	54,1%	45,9%	2923	8,0

Table 3. Academic inbreeding in the main Chilean universities by field (business and economics)

		Inbreeds	Non-inbreeds	Total Inbreeding	Inbreeding in Business	Inbreeding in Economics
Group 1	UCh	36	18	66,7%	56,3%	81,8%
	PUC	42	29	59,2%	73,8%	37,9%
	Subtotal	78	47	62,4%	66,2%	56,9%
Group 2	UdeC	14	3	82,4%	85,7%	80,0%
	PUCV	17	4	81,0%	88,9%	75,0%
	UTFSM	7	8	46,7%	33,3%	66,7%
	UACh	9	10	47,4%	60,0%	33,3%
	UCN	22	18	55,0%	57,9%	52,4%
	USACh	9	25	26,5%	35,3%	17,6%
	UAI	13	80	14,0%	21,2%	4,9%
	Subtotal	91	148	38,1%	41,5%	34,5%
	Total	169	195	46,4%	50,8%	41,3%

at the top-ranked universities of the world, as we reported in the introduction.

It can be observed that the two top-ranked universities (Group 1) exhibit degrees of inbreeding slightly higher than the others, both in business and economics. This seems to contradict the inverse relationship documented in the literature; however, as we shall see, a more detailed analysis is required to obtain relevant conclusions.

Intellectual contributions (H-Index)

Overall, the intellectual contributions measured by the H-index mean is 1.9 (Table 4), although there is considerable dispersion at the university level (economics and business fields). Productivity is higher in economics compared to business (2.6 vs. 1.3). The UCh is first in economics in the country, with a considerable lead over the other universities. However, in business, the PUC has the highest average results, although quite close to the UCh. We can also observe that for Group 2, the scientific performance in the areas of business and economics seems not to be very much in line with the existing overall university quality rankings (Table 1), as we will see below.

In several departments, we observed that there are a few academics with very high productivity indices. In this case, the representativeness of the mean can be questioned in favour of the use of the median in some cases. Therefore, Figure 1 reports the medians of the H-Index. The figure shows that the UCh and the PUC register the highest values of intellectual contribution and are the only ones that achieve a median higher than 2.0. This seems to confirm the view that these universities are at some distance from the others (Table 1). On a second level, the UTFSM, UCN, and UAI all have medians of 1.0. Finally, the level of lowest productivity in economics and business was exhibited by four traditional universities (UdeC, PUCV, UACh, and USACh), with a median below 1.0 (Figure 1), showing differences in the overall performance of these universities (according to the Scimago international ranking).

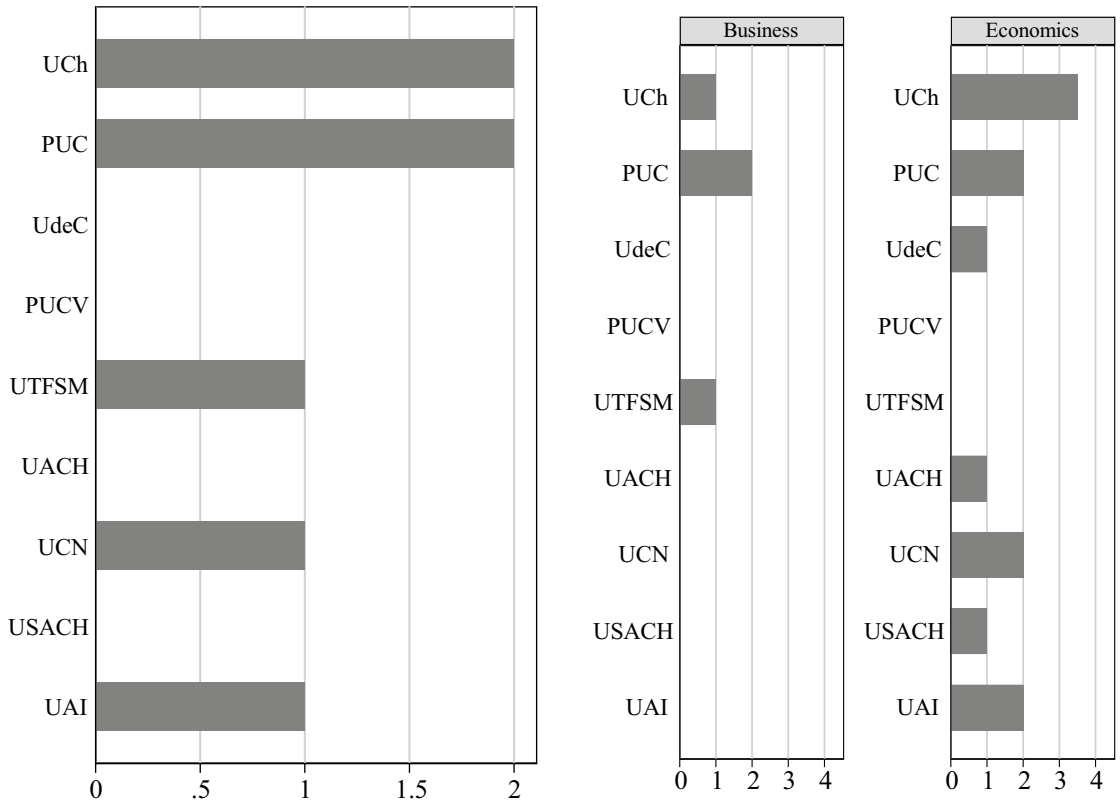
Academic inbreeding vs. intellectual contributions

On Table 4, some relationship between academic inbreeding and intellectual contribution appears: productivity is slightly higher for non-inbreds than for those professors coming from the same university (H-index 2.0 vs. 1.8). This provides some evidence that supports the central hypothesis of this study (Hypothesis 2); however, the difference seems to be small and

Table 4. Mean of intellectual contributions (H-index) across universities and fields

		Total from	Total from		Business			Economics		
		Non-inbreeds	Inbreeds	Grand Total	Non-Inbreeds	Inbreeds	Total	Non-Inbreeds	Inbreeds	Total
Group 1	UCh	1,9	3,8	3,2	1,5	2,1	1,8	3,5	5,6	5,2
	PUC	2,2	2,7	2,5	2,3	2,0	2,1	2,2	4,6	3,1
	Subtotal	2,1	3,2	2,8	1,8	2,0	2,0	2,5	5,2	4,0
Group 2	UdeC	3,0	0,5	0,9	0,0	0,3	0,3	4,5	0,6	1,4
	PUCV	0,3	0,3	0,3	0,0	0,1	0,1	0,3	0,4	0,4
	UTFSM	1,8	0,7	1,3	2,0	1,3	1,8	1,0	0,3	0,5
	UACH	1,2	0,1	0,7	0,5	0,0	0,2	1,7	0,3	1,2
	UCN	2,3	0,6	1,4	2,0	0,0	0,8	2,5	1,3	1,9
	USACH	0,8	1,2	0,9	0,6	0,3	0,5	1,0	3,0	1,4
	UAI	2,3	0,4	2,1	1,5	0,4	1,3	3,2	0,5	3,0
	Subtotal	1,9	0,5	1,4	1,4	0,3	0,9	2,4	0,9	1,9
	Total	2,0	1,8	1,9	1,5	1,1	1,3	2,4	2,7	2,6

Figure 1. Median of the intellectual contributions (H-index) across Chilean universities by field



requires a more detailed review. The same Table 4 provides more information, although we use Figure 2 to see these results more clearly since it shows the differences in the mean of intellectual contribution between those that come from outside (black bars) and those educated at the same university (white bars). At the level of groups of universities, Figure 2 shows that the production mean in Group 1 is higher for inbreds, both globally and in each field. However, for the universities in Group 2, the exact opposite occurs, and non-inbreds exhibit the highest intellectual contributions, and here the differences are huge, both globally and for the two areas. This suggests that when analysing inbreeding and productivity information, a separate analysis should always be done for each group of universities and that aggregating the data will lead to spurious conclusions.

In Figure 3, we have arranged the information on the inbreeding-axis vs. productivity-axis plane. Because the original data would be distributed here as a cloud of points obscuring relationships, we calculate the averages of both variables by the university and by field. Each line inside the figure represents a university, and the endpoints of each line show the inbreeding situation and the H-index of the business and economics areas of each university. Hence the graph is quite illustrative and allows us to make important implications. First of all, within all universities (except UCh), there is an inverse relationship between inbreeding and productivity. The area of economics tends to be located more up and to the left on the plane. On the contrary, the business area tends to be located to the right and down. Interestingly, this is also true of the PUC, which we had indicated as belonging to Group 1. In addition, excluding the UCh, this relation appears to be globally negative throughout the universities; that is, a line of adjustment on these points would probably have a negative slope. However, the case of UCh's area of economics requires revision since it seems to behave as an outlier compared to the other universities. We will reflect further on this in the discussion section.

Figure 2. Mean of intellectual contributions (H-Index): inbreds vs. non-inbreds by groups of universities

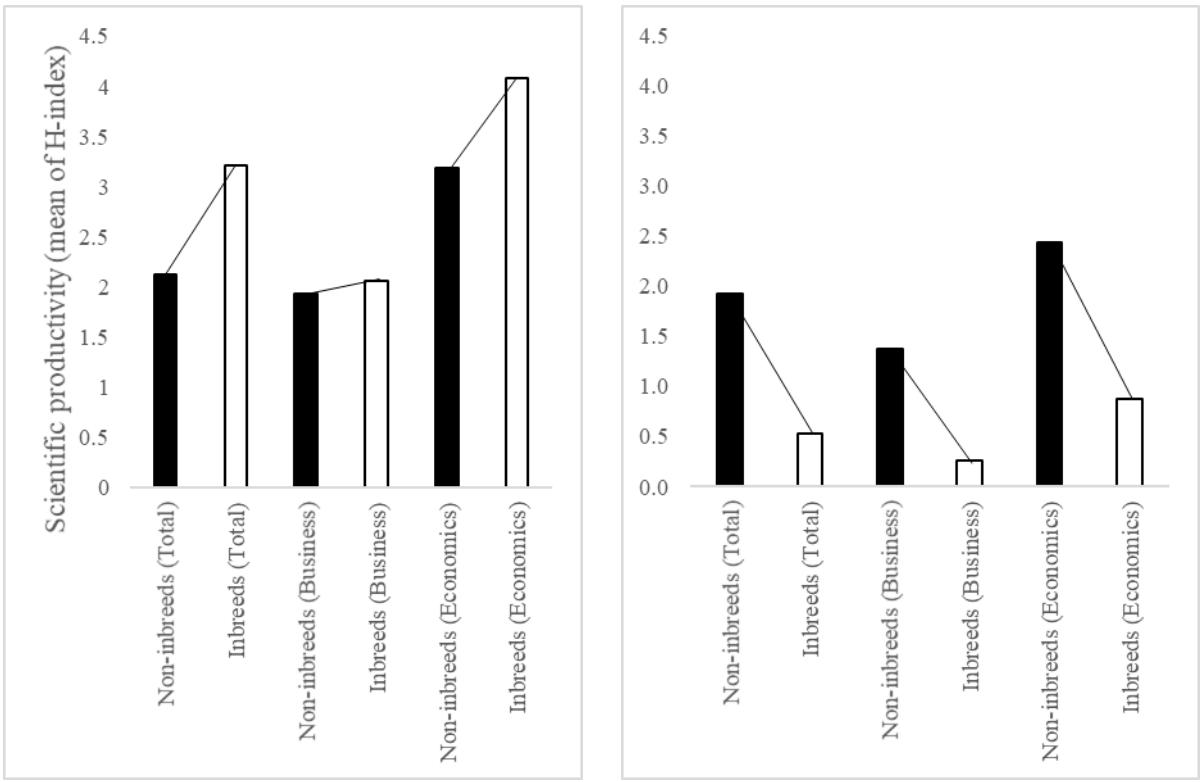
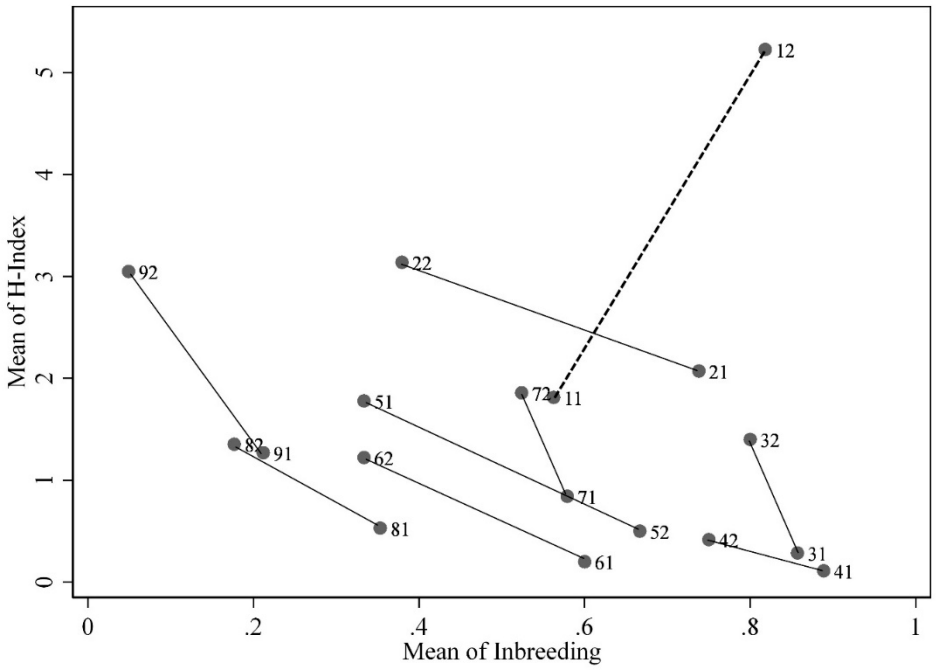


Figure 3. Chilean business-schools by fields: intellectual contributions (H-Index) and inbreeding



11=UCh_Business 12=UCh_Economics 21=PUC_Business 22=PUC_Economics
31=UdeC_Business 32=UdeC_Economics 41=PUCV_Business 42=PUCV_Economics
51=UTFSM_Business 52=UTFSM_Economics 61=UACh_Business 62=UACh_Economics
71=UCN_Business 72=UCN_Economics 81=USACh_Business 82=USACh_Economics
91=UAI_Business 92=UAI_Economics

Negative binomial regression

We made more formal estimates using regressions based on the negative binomial model, as we explained in the methodology section. We analysed six specifications using the individual H-Index of the academics as a dependent variable. Table 5 shows that in all cases, the likelihood ratio test (the likelihood ratio test comparing this model with a Poisson model) found that the coefficient alpha was non-zero, which strongly suggests that the negative binomial model is more appropriate here than the Poisson model.

In Model 1 (the baseline), we ran the simplest specification for the entire sample. Here it is shown that although the linear relationship sign is negative for the inbreeding coefficient (-0.107), statistically, it is not significantly different from zero. Furthermore, the overall adjusted line is basically horizontal in Figure 3. However, based on our previous results, we have seen that the Department of Economics at UCh behaves very atypically with respect to the rest of the system, and we can consider it as an outlier, excluding it in the next estimation.

Model 2 (excluding UCh) reports a negative slope coefficient (-0.488), which is at the same time highly significant (non-zero at 99% confidence). This coefficient indicates that for the Chilean business school system (economics and business, excluding the UCh), reducing inbreeding by 100 basis points (1%) could increase intellectual contributions by about 50 basis points (0.5%) on average. This provides a more formal proof of Hypothesis 2, evidencing that their levels of university inbreeding statistically explain the scientific productivity (excluding UCh).

Estimation of the relationship for the baseline model for Group 1 (top-ranked universities) is provided on Table 5 in Model 3. The relationship appears to be positive and significant, with a 95% confidence level. This provides a partial explanation for the findings of some studies that discovered positive relationships between certain university groups (Horta & Yudkevich, 2016; Wyer

Table 5. Negative binomial regression for intellectual contributions (H-index)

	Model 1 Full sample	Model 2 Excl. UCh	Model 3 Group 1	Model 4 Group 2
inbreeding	-0,107	-0.488***	0.414**	-1.291***
	(-0.70)	(-2.84)	(2.04)	(-5.66)
_cons	0.678***	0.679***	0.755***	0.652***
	(6.56)	(6.29)	(4.61)	(5.49)
lnalpha	0.454***	0.441***	-0,233	0.445**
	(3.78)	(3.16)	(-1.14)	(2.57)
N	364	310	125	239
Likelihood-ratio test of alpha=0	422.33***	283.75***	118.16***	186.17***

t statistics in parentheses

* p < 0.10, ** p < 0.05, *** p < 0.01

& Conrad, 1984). In part, these results could be due to the fact that estimates were made for universities with very specific characteristics, so some selection effect may exist (Berkson's bias). Furthermore, it should be added that the inbreeding of the professors in these universities is really limited to their undergraduate studies and not to their postgraduate studies since they have doctoral studies in top-ranked universities, generally in the United States.

In Model 4, we estimated the baseline model for Group 2 and found results quite similar to those obtained with Model 2, in which UCh was excluded since it exhibits the behaviour of intellectual contributions and endogamy quite differently from the rest of the Chilean system of universities. The result of Model 4 is important since it shows that for the universities in Group 2, the inbreeding-productivity relationship is not only statistically negative at 99% confidence but also has the greatest impact between both variables (slope of -1.291) when compared to all other specifications shown on Table 5.

Conclusion

In this study, we have made estimates of academic inbreeding and intellectual contributions in the schools of economics and business of the top-ranked universities in Chile. Our results indicate that the levels of academic inbreeding are close to 50%. These values may be considered high when compared to those of the United States, Germany, and the United Kingdom, whose universities normally appear among the best-ranked in the world (Soler, 2001). However, values close to 50% can be considered rather low when compared to the levels exhibited by the universities of Spain, Italy, and Portugal.

We also found clear evidence that the relationship between performance and endogamy is different depending on the performance ranking of the academics in their schools. For all Chilean business schools, with the sole exception of the UCh, and in line with most of the international evidence, it was verified that inbreeding negatively affects academic performance. This suggests that, regardless of the myriads of advantages found with the hiring of academic graduates from the same university, the amount and quality of the research are not among those advantages.

For the UCh, a positive relationship between intellectual contributions and endogamy was verified statistically. This relationship is so significant that it even leads to generating a positive relationship between the two universities in Group 1. This is similar to Brazil, where Borenstein et al. (2022) report that on average, non-Inbreds publish fewer papers, perform less supervisions, and write fewer books. Why is the Department of Economics at UCh so special? Historically, this department has exhibited high

levels of productivity and well-earned national and international recognition. The dynamics of this department have allowed it to maintain high levels of organisational stability, identity, and legitimacy. It is a state-owned university, paying relatively low salaries when compared to private Chilean universities and exhibiting high turnover, all of which create difficulties when trying to attract prominent academics from abroad. In order to overcome these inherent challenges, some students are chosen and sent to study abroad, preferably at the best universities in the United States, with the requirement that they return to work in the department for a predetermined period following their studies. The different ways they manage to maintain high levels of intellectual contributions suggest a strong assimilation of institutional beliefs, norms, and behaviours (Horta et al., 2011). For example, the two top-ranked universities (UCh and PUC) frequently hire graduates from each other but very rarely hire graduates from the rest of the Chilean university system. In this sense, inbreeding has been quite effective, as they manage to maintain high levels of scientific production and an environment exposed to high levels of knowledge (Berelson, 1960). Given the aforementioned situation, certain levels of academic inbreeding can be justified and may not even be detrimental, as Wyer and Conrad (1984) and Smyth and Mishra (2014) point out, although when there are several elite institutions, this strategy seems to be fallible.

The results support the hypothesis that when a university system is not yet fully developed, for those academic departments that exhibit high performance in research, high levels of inbreeding may be acceptable and even recommendable. In simple terms, it could be understood that a university system is developed when there is a relatively high number of universities with a high and homogeneous performance among them. On the contrary, a university system in early development is characterised by sustained growth in the number of PhDs awarded by universities in recent years (Tavares et al., 2015). The Chilean university system is one that could be classified as being in the early stages of development. In this case, as shown here, academic inbreeding may not be completely negative (Horta & Yudkevich, 2016), but only for those departments that display the highest level of performance and are (measurably) superior to their peers. If this situation is maintained, it is likely that, over time, inbreeding will continue to increase as those institutions age (Heitor et al., 2014).

We have also observed that most Chilean university research departments that exhibit higher levels of inbreeding and lower levels of intellectual contributions (Group 2) tend to be characterised by a lack of accountability (Nahuelhual, 2011) and opacity of the information (i.e., incomplete information of the academics in web pages). In the case of some Spanish universities, similar characteristics have been reported by Alvarez and Marin (2014). The system of government in traditional Chilean universities has been analysed by Zuniga-Jara and Sjoberg (2021), who report that those universities that elect their rectors via direct voting by their academics are those that also register major drops in rankings. Inbreeding can be encouraged in many cases by professors who hold a position of internal election and whose hiring of students as professors compromises them for future votes (academic clientelism). In this case, improvements in government systems seem to help improve the performance of universities.

The results of this study, although answering some relevant hypotheses regarding academic inbreeding and contributing to previous research reducing the gap in the literature, at the same time raise a series of new quandaries. For example, we found some evidence of uneven development when most universities exhibit high-level research but very low scientific productivity in their schools of business. Also, we observed that the ratio of full-time academics to students is very low in some schools of business in Group 2. That is, some universities may not demand high productivity standards from these departments as long as they provide significant income via student tuition. This and other hypotheses that have arisen here require validation in subsequent studies, most notably by extending the sample.

To conclude, it can be stated that while academic inbreeding at the university level may have little consequence in several countries, it seems to be a central element in explaining the low-level rankings of several universities, specifically in Latin America and southern Europe. The results reported herein may therefore be of interest to several agents linked to the university government. The importance of these findings is especially evident in the present circumstances, as universities face challenges related to internationalisation and financial issues, particularly those situated in low-income countries (Altbach & de Wit, 2020). Furthermore, these findings are relevant when considering the impact of problems in higher education on occupational mobility, which can perpetuate societal inequalities (Blau & Duncan, 1967).

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