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# The Effect of Including High School Grade Rankings in the Admission Process for Chilean Universities

# Efecto de la incorporación del ranking de notas en el proceso de admisión a las universidades chilenas

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## Abstract

This paper analyses the effect of including high school grade rankings as a new factor in the admission process to Chilean universities. The paper evaluates the impact of different weighting strategies of the high school grade ranking and identifies socioeconomic and gender characteristics of the students who were benefited and harmed by the inclusion of this new factor. Starting with the weightings of the different factors considered in the Admission Process for 2012, we simulate, using a selection algorithm, alternative weightings for high school grade rankings in the 2013 Admission Process. We also evaluate the effect of the actual increase in the weighting of grade ranking in the 2014 admission process. Even though the impact on students' entrance and exit from the selection list is rather small, the introduction of the high school grade ranking into the admission process has an effect on the composition of the students selected, producing greater socioeconomic and gender equality.

***Keywords:*** high-school grade rank, admission process, Chilean university system, fairness

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## Resumen

Este trabajo analiza el efecto de la incorporación del *ranking* de notas en la selección de estudiantes para la educación universitaria en Chile, identificando las características del grupo de estudiantes beneficiados y perjudicados con la medida. En particular, se evalúa el efecto que tienen distintas estrategias de ponderación del ranking de notas en la composición de los estudiantes seleccionados en los planteles de educación superior. Para ello, partiendo de las ponderaciones de los factores de selección utilizados en el proceso de admisión 2012, se simulan, utilizando un algoritmo de selección, distintas ponderaciones en el proceso 2013 para el ranking de notas y el resto de los factores utilizados. Asimismo, se evalúa el efecto del aumento efectivo de la ponderación del ranking de notas en el proceso de admisión 2014. Si bien el efecto de entrada y salida de estudiantes del sistema no es de gran magnitud, es posible concluir que el ranking de notas sí logra inducir un cierto grado de equidad de género y por nivel socioeconómico en el acceso a la educación superior.


***Palabras clave:*** ranking de notas, proceso de selección universitaria, sistema universitario chileno, equidad

Selection processes aim to obtain information about a group of individuals regarding some specific proficiency, such as skills or knowledge, through a scoring system. An example is the higher education application process, which utilizes a series of instruments that help with decisions about applicants and the degree programs or universities where they apply.

It is crucial that selection mechanisms are properly designed, since their inadequacy could result in significant harm to applicants, who may fail their studies sooner or later.

For this reason, evaluating the effectiveness of the mechanisms currently in use is important to ensuring the selection processes' quality. Effectiveness is understood as the extent to which the evidence and theory support the mechanisms' ability to select students with the greatest potential to perform well in a higher education setting.

However, from an integral evaluation perspective, a selection mechanism's predictive efficacy is a necessary, but non-sufficient condition on which to base its legitimate usage. Thus the social consequences that accompany the application of that mechanism must also be evaluated. International standards, based on the modern conception of measurement, stress the need to evaluate not only the predicative ability of instruments, but also their social consequences (AERA, APA, NCME, 1999; Shepard, 1994).

In this context, the Council of Chilean University Chancellors (CRUCH, according its Spanish acronym) decided to include, starting in 2013, high school grade rank as a new selection factor in the university admissions process. The council's goal was to provide a more inclusive student selection process from a socioeconomic and gender perspective and to improve Chilean universities' capability to admit students with greater potential to succeed at higher education.

The grade rank is a measure of a student's relative position during his or her highschooling-path. According to the Central Admissions System (SUA, according its Spanish acronym), the grade ranking score serves two purposes as a selection factor: to help select the best students for university education and to improve the fairness of access to the university system (Sistema Único de Admisión, 2014b).

The inclusion of this factor is intended to recognize students' efforts in high school, independent of the type of institution they attended and their socioeconomic situation.

The incorporation of this new factor into the student selection process has raised a series of questions. In first place, it has revived the debate over which are the best predictors of academic success to use in the admission systems at Chilean universities. There have also been doubts over whether the introduction of grade rank will achieve its goal of improving inclusiveness and fairness at SUA. Finally, one last question is what is the best methodological strategy for incorporating grade rank into the selection system, thus, in order to choose the students with the greatest potential for academic success at a university level and to improve the fairness of the admissions process.

This paper analyzes the impact of incorporating grade rank into the university admissions process and identify the characteristics of groups who were benefited and harmed by the change. In particular, it evaluates the effects of different weighting strategies for grade rank on the composition of students admitted to higher education institutions. Based on the weightings factors used in the 2012 admissions process, we simulate different weightings for grade rank and the other factors used in the 2013 process. In this regard, we assume that the weighting strategies for the different degrees and institutions were not affected by the inclusion of rank in the process. This latter assumption implies that the simulations carried out did not totally capture the instrument's effect, since the possible impact of its inclusion in the student application process was not taken into account.

In addition, in order to evaluate the impact of weightings for grade rankings and the other factors employed in the 2014 admissions process, we carried out a simulation that used the 2013 weighting while keeping all other variables fixed (scores, student preferences, restrictions established by the system, etc.). This simulation allowed to evaluate the validity of the simulations carried out for the 2013 admission process in terms of the students who were benefited.[1]

The paper is organized as follows: The next section provides the background context for Chile's university admissions system. After that, we present a review of the literature on this topic, followed by the methodology used in this paper. Finally, the last two sections present our results and conclusions, respectively.

## Background

### Chilean University Admission System

Chile has a centralized admission system for its traditional universities, implemented by the Department of Educational Evaluation, Measurement and Records (DEMRE, according its Spanish acronym) at the University of Chile and managed by the Central Admission System at CRUCH. Since 2003, the 25 traditional universities of CRUCH have used the group of tests that comprise the University Selection Exam (PSU®, according its Spanish acronym)[2] and the average of students' High School Grades (NEM, according its Spanish acronym)[3] to select the students for admission.

Starting in 2011, eight non-traditional private universities have joined the PSU admission system.
Each university must set the guidelines, requirements and selection factors for admittance to the different degree programs it offers, as well as choose the weightings it deems appropriate in accordance with the rules established by CRUCH.

The score of an applicant to a degree program is calculated by applying the weightings to his or her results for each selection factor. Once the final score is calculated, the candidates for each degree course are placed into a strictly decreasing order based on their scores. Then, the degree programs proceed to fill their vacancies by starting with the applicant ranked first on the list, following a rigorous order of precedence until they fill all vacant spots. Applicants who are selected for their first choice are eliminated from the lists of their remaining choices. Applicants who are not selected for their first choice are placed on a waiting list and move on to compete for a spot in their second-choice degree programand so forth.

In recent years, there have been concerns over whether the university admissions system is leading to an underrepresentation of students from lower socioeconomic backgrounds, since very few of them are admitted to the universities that participate in the centralized selection system. These concerns have also focused on female access to the university system. Figures 1, 2, 3 and 4 show the percentage of students selected according to income bracket (in thousands of pesos), type of institution of origin, curriculum type at institution of origin, and gender, respectively, for the 2014 admissions process.

1 The validity of the simulation is given by the fact that the students selected with the different weightings coincide with students selected in a real-life scenario with similar characteristics.
2 Hereon referred to as the PSU.
3 In Chile, the grading scale is from 1.0 to 7.0. The minimum passing grade is 4.0. The admissions system uses a score based on the final average that students obtain during their four years of high school education.

As Figure 1 shows, only 25.8% of students from the lowest income bracket who participated in the 2014 process were selected, compared to 73.3% of students from the highest gross household income bracket. Figure 2 shows that 30% of students from municipal/public schools who participated in the 2014 admissions were selected, compared to 73.3% of students from private schools. This same effect is observable for curriculum types: just 17% of students from technical-professional schools were selected, compared to 47% from scientific-humanities institutions. Furthermore, the percentage of females who participated and were selected is smaller in comparison to males (37% and 41%, respectively). In summary, there are underrepresented groups in terms of household income levels, the type of school and curriculum at the students' school of origin, and, to a lesser degree, the student's gender.

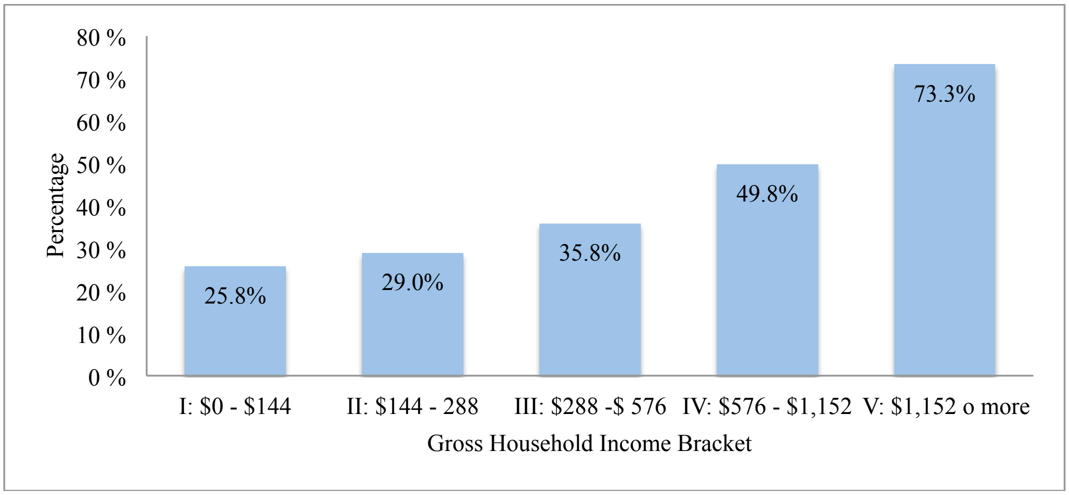



Figure 1. Percentage of students selected in 2014 admissions process, according to gross household income bracket (thousands of pesos). Source: Authors' elaboration with data from SUA.

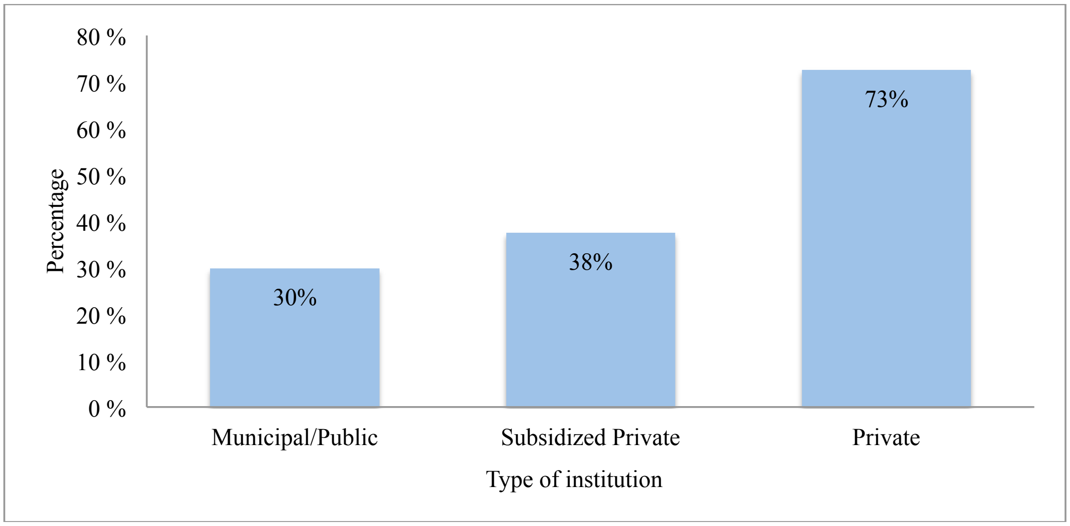



Figure 2. Percentage of students selected in 2014 admissions process, according to type of school of origin. Source: Authors' elaboration with data from SUA.

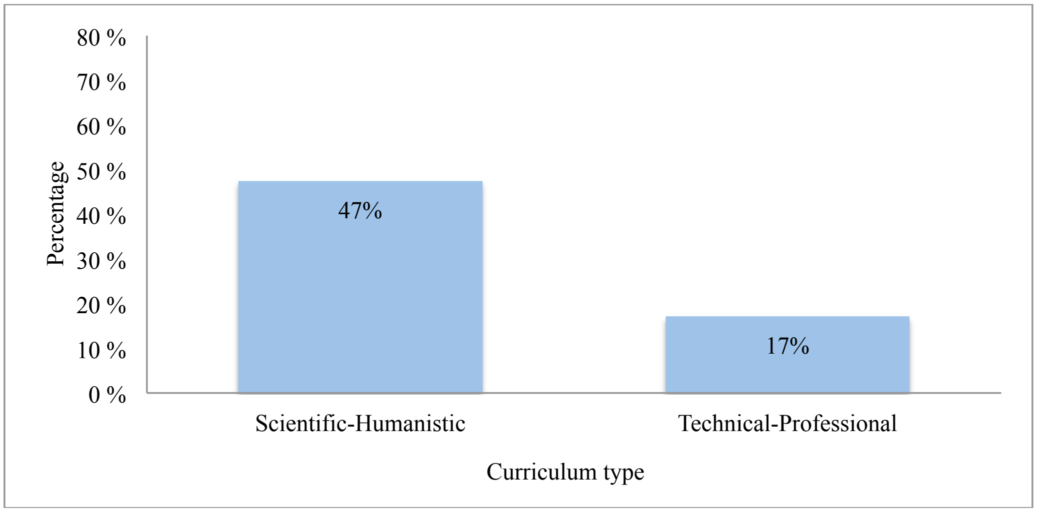



Figure 3. Percentage of students selected in 2014 admissions process, according to the curriculum at school of origin. Source: Authors' elaboration with data from SUA.

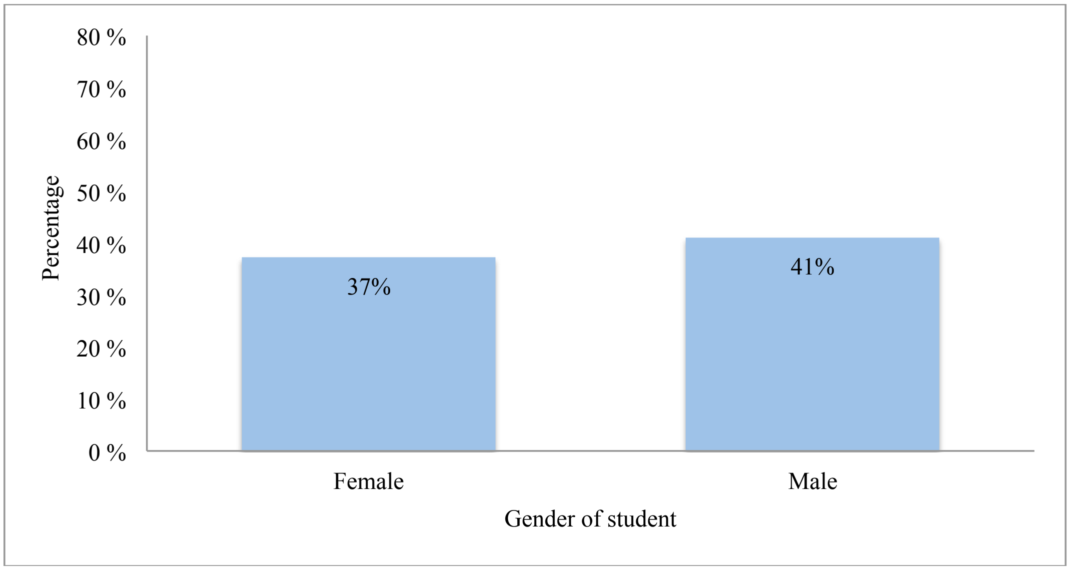



Figure 4. Percentage of students selected in 2014 admissions process, according to gender. Source: Authors' elaboration with data from SUA.

In the case of gender underrepresentation, this could be a result of female registering lower average PSU scores than male. For instance, during the last four admissions processes, females who enrolled scored almost 30 points lower than males on the mathematics test, despite having a higher NEM score (see Table 1).

Table 1
Average scores of students enrolled in the last four admissions processes, according to gender

| Admissions process | Language and Communication | | Mathematics | | NEM | | Rank | |
|---|---|---|---|---|---|---|---|---|
| | Male | Female | Male | Female | Male | Female | Male | Female |
| 2014 | 504 | 499 | 517 | 487 | 527 | 549 | 546 | 572 |
| 2013 | 505 | 498 | 516 | 488 | 526 | 548 | 542 | 568 |
| 2012 | 501 | 501 | 515 | 489 | 527 | 550 | - | - |
| 2011 | 502 | 501 | 518 | 487 | 522 | 548 | - | - |

Source: Authors' elaboration with data from DEMRE.

## Inclusion of grade rank

Seeking, in part, to correct this inequality, as well as to select the best students for university education, in 2013 CRUCH included high school grade rank as a new factor in the selection process, complementing the PSU exam results and NEM scores. This decision was based on evidence showing that high school grades have less negative impact than *standardized tests* on the selection of more disadvantages students for higher education (Geiser & Santelices, 2007).

The grade ranking score calculation considers two specific values for each educational institution: the historical average ($N_C$), which covers the last three graduating classes; and the historical maximum ($Max_C$), which corresponds to the average of the highest grade from each of the last three graduating classes. With the aforementioned, the grade ranking score is calculated based on three cases:

1. Students whose final grade average is less than or equal to $N_C$ receive a grade ranking score equal to the score obtained for their high school grade (NEM).
2. Students whose final grade average is greater than or equal to $Max_C$ receive a grade ranking score of 850 points (the maximum score).
3. Students who have a final grade average between $N_C$ and $Max_C$ receive a grade ranking score that is calculated as a linear bonus over the NEM score[1]. Figure 5 shows the grade ranking score as a function of the student's graduating grade, given a historical average of 5.5 and a historical maximum of 6.7.

[1] For more details on the formula used to calculate the grade ranking score, see Sistema Único de Admisión (2014a).

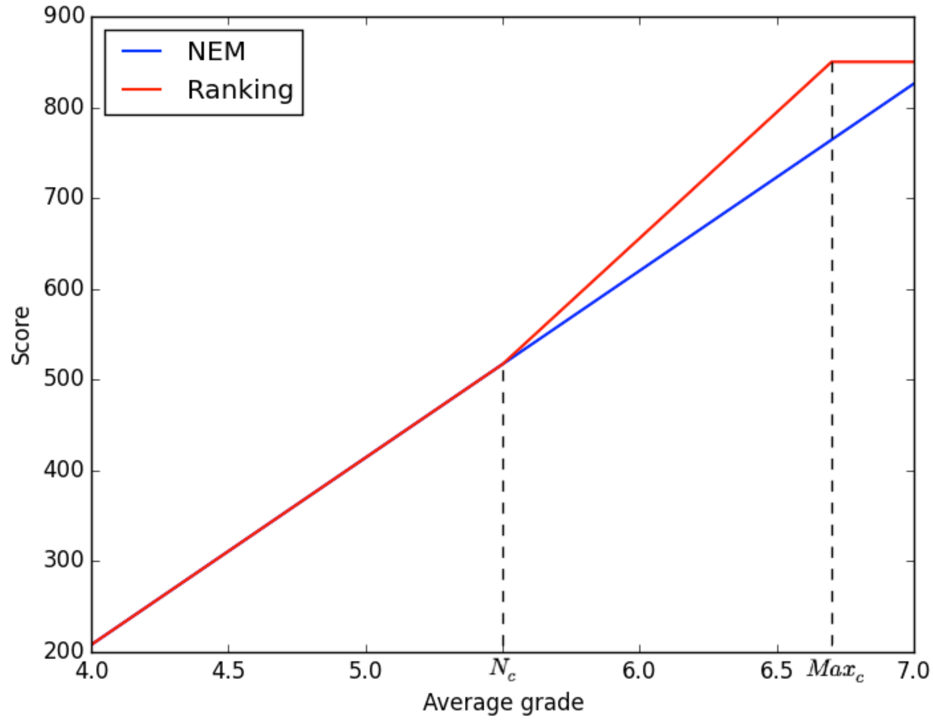



Figure 5. Formula for calculating grade ranking scores. Source: Authors' elaboration with information obtained from DEMRE's website.

The first time this new selection factor was applied, a fixed weighting of 10% was assigned to all degree programs and universities, while universities were free to modify the weightings for the other factors (PSU and NEM). Some universities reduced the weighting of the NEM factor, others lowered the PSU exam's weighting, and still others reduced both. For the 2014 admissions process, CRUCH agreed to change this rule and allows universities more freedom to determine the weighting assigned to the grade ranking factor. As a result, each of the 33 universities in the SUA individually determined the weightings for this and the other selection factors, with the following restrictions:

- The weightings for each of the tests that comprise the PSU have a minimum of 10% and maximum of 40%, taking into account the mandatory tests (language and communication, and mathematics) and the specific tests (science, or history and social sciences) required for each degree program.
- The sum of the weightings for the mandatory and specific tests cannot be less than 50%.
- The weightings for grade rank and NEM have a minimum of 10% and a maximum of 40% each.
- Given the restrictions on the PSU tests, the sum of the weightings for grade rank and NEM cannot exceed 50%.

With these restrictions, each institution of higher education determined the weightings for each factor. The majority of the universities increased the weighting for grade rank, with an average boost of 12% in 2014 versus the 2013 admissions process. However, the NEM weighting diminished almost 7% on average among the 33 universities in the SUA. Figure 6 shows how the different universities modified the sum of the NEM and grade rank weightings between the 2013 and 2014 processes. In this figure, we observe that most of the universities increased the combined weighting of these factors, resulting in an average increase of almost 5%.

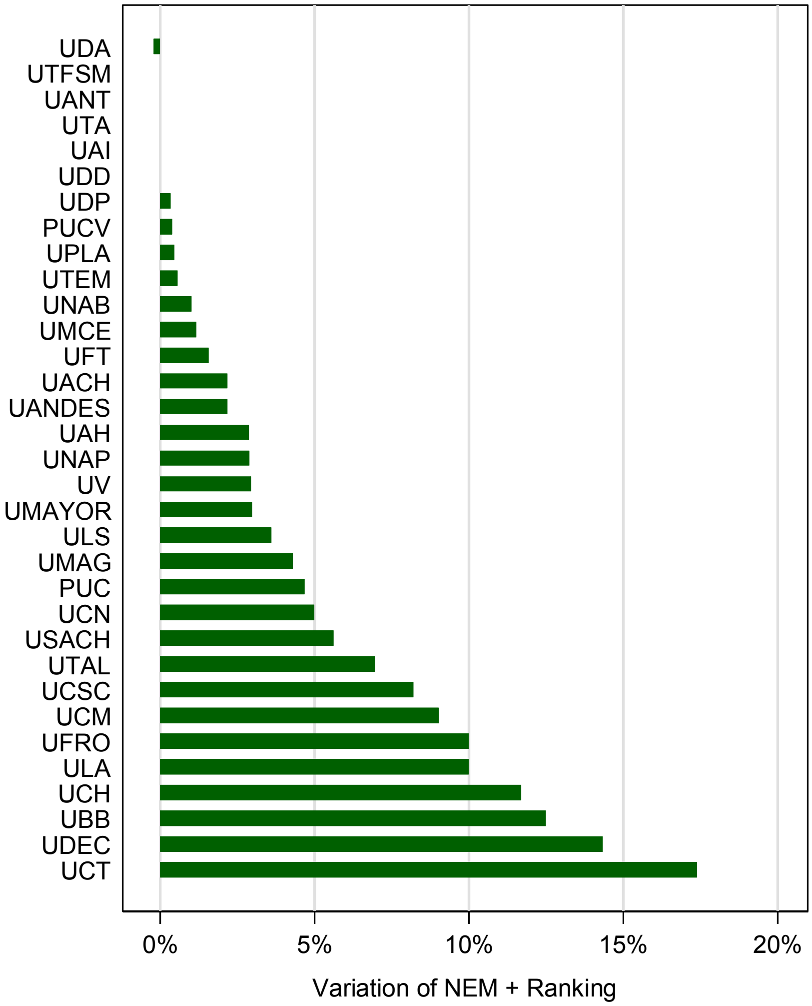



Figure 6. Change in the sum of 2014 weightings for NEM and grade ranking scores, in comparison to 2013.
Source: Authors' elaboration with data from SUA.

## Literature review

Socioeconomic differences found in the admissions system for Chilean universities are explained, to a large extent, by what occurs during school education. Segregation by socioeconomic status leads to the segregation of the educational results measured by standardized tests (the SIMCE[5] system), based on the type of school (private, private subsidized, or public) that students attend (Mizala & Torche, 2012).

It is argued that the current higher education selection system, by basing itself on a standardized test of knowledge such as the PSU, may be reinforcing the differences derived from schooling standards. This could happen because the PSU, as a test based around a school curriculum, may negatively affect students from schools that serve lower-income populations, mainly because these schools can be unable to cover the full curriculum. Students from technical-professional schools do not cover all of the topics included in the PSU test either, which is based on the scientific-humanist curriculum (Koljatic & Silva, 2010)[6]. It could also occur because lower-income students do not have access to pre-university programs, which prepare students for the test. In summary, our central point is that intelligence, aptitude for study and effort are uniformly spread out in society, but knowledge is not equally distributed.

[5] Sistema de Medición de la Calidad de la Educación [System of Measurement of the Quality of Education].
[6] 40% of high school students attend technical-professional schools; 65% of them come from the poorest 40% of the population.

The result is an underrepresentation of students from lower socioeconomic backgrounds in the university system; according to the 2011 CASEN[7] survey, 13% of students enrolled at CRUCH universities belonged to the poorest 20% of the population, while 29% belong to the richest 20%[8].

This situation is undesirable from a social equity perspective, as well as for the quality and improvement of higher education institutions. A lack of access to higher education produces a significant wage gap in the future labor market, since the rate of return for higher education in Chile is almost 20%, while the rate of return for high school education is just under 10% (OECD & Banco Mundial, 2009).

Moreover, the quality of higher education institutions could be strengthened and improved by a greater diversity of viewpoints, both from an educational perspective, as students can learn to interact with classmates of different social and cultural backgrounds, and from a research perspective. In effect, researchers' ability to formulate questions and uncover answers increases in more diverse environments. Furthermore, our explanations and responses to the different challenges we face as a society will incorporate different perspectives and succeed in being more complete and robust.

The latter point is also valid regarding the gender differences in access to higher education, in particular female access to certain degree programs (Blickenstaff, 2005). Females tend to score lower on standardized achievement tests like the PSU. One explanation for this is the fact that females are less successful than males in competitive environments, despite performing similarly to their male counterparts in non-competitive situations (Gneezy, Niederle, & Rustichini, 2003).

The policy response to this situation has been to include other indicators of merit and skill that were not previously measured, in particular grade rank. The goal is to design a process that properly selects students who will succeed in their higher education studies and that, at the same time, is more just and fair. In that sense, the socioeconomic status and gender of each applicant will not determine their access to higher education.

Although the inclusion of ranking scores is a recent practice in Chile, there is evidence on both the national and international level about the use of relative ability in secondary school as a factor to select students for tertiary education.

In some US states (Texas, California and Florida), students who fall within a certain performance percentile at their educational institution are guaranteed admission to university (Horn, 2012). This type of admission system is known as a *percent plan*. In other countries – for example, in Australia (through the *Australian Tertiary Admission Rank* – a student's performance percentile is used as a score and constitutes the main selection factor for tertiary education (The Universities Admission Centre, 2013). This selection factor is used as a direct criterion for university admission, or is weighted with other selection factors.

Horn (2012) mentioned that the presence of a percent plan increases students' expectations and motivates them to apply for and attend higher education institutions (Lloyd, Leicht, & Sullivan, 2008). Long and Tienda (2010) found that percent plans have increased the applications of underrepresented minorities. While the evidence shows that the impact of these policies on boosting school diversity (ethnic and racial) has been small (Horn, Flores, & Orfield, 2003), percent plans do have a positive impact on the admission of students from more vulnerable institutions with higher proportions of minorities (Atkinson & Pelfrey, 2004; Long, Saenz, & Tienda, 2010).

In general, the international literature endorses the inclusion of relative measurements of skill in selection processes for their strong predictive power regarding students' subsequent academic success. Baron and Norman (1992) and Niu and Tienda (2009) indicated that a student's high school ranking is a better predictor of good university performance than that student's results on standardized tests.

Complementarily, Geiser and Santelices (2007) determined that, in addition to being a better predictor of academic success, the use of high school grades as an admission criterion has a less negative impact than

[7] Encuesta de Caracterización Socioeconómica Nacional [National Socio-Economic Characterization Survey].
[8] The equivalent figures for non-traditional private universities are: 8.4% of students belonged to the poorest 20% and 33.8% to the richest 20% in 2011.

standardized testing on the selection of students who are more disadvantaged and from underrepresented minority groups. Flecher and Tienda (2012) found that minorities perform better than white students who graduated from the same high school, although their performance varies depending on the quality of the school.

Another effect studied in the literature is the higher level of involvement (better grades, more time invested in academic purposes) and attachment to their institution (greater participation) among students admitted through *percent plans* (Brint, Douglass, Flacks, Thomson, & Chatman 2007).

There are also experiences on a national level with the use of grade rank as a selection factor, although not necessarily with the same formula used by CRUCH. In this regard, the Universidad de Santiago de Chile has, through its college preparatory program, pioneered the implementation of this factor in the admissions process (Gil & Del Canto, 2012). This program was analyzed by Koljatic and Silva (2013), who concluded that participants managed to overcome the academic gap in the second year of the degree program and graduated just one year behind. In parallel, Gil and Del Canto (2012) stated that students in the top 10% grade ranking of their class get better grades in university and graduate earlier than peers from similar socioeconomic backgrounds but who do not fall within the top 10%.

These results coincide with the experiences of other select universities, such as the Pontifica Universidad Católica de Chile (Gil, Paredes, & Sánchez, 2013), the Universidad Católica de Temuco, and the Pontificia Universidad Católica de Valparaiso (Contreras, Gallegos, & Meneses, 2009).

So far, no studies have analyzed the applicant groups who benefit from and are harmed by the inclusion of grade rank in relation to their degree preference or the university where they are admitted.[9] The issue is particularly relevant considering that this factor was incorporated to serve not only as a mechanism to select the best students and increase their probability of success in tertiary education, but also as a tool to improve fairness of access to the university system. For this reason, it is important to analyze the groups of students who benefited from the inclusion of grade rank, in order to evaluate its effectiveness in increasing the system's fairness.

## Methodology

This section presents the methodology used for this study. Firstly, we describe the selection algorithm employed and the different simulations carried out. Then, we describe the categories used to compare the effects associated with each simulation.

### Selection algorithm

To solve the issue of admission associated with each simulation, we used the selection algorithm described by Ríos, Larroucau, Parra and Cominetti (2014), which is an extension of the *matching* algorithms proposed by Gale and Shapley (1962). This algorithm is modeled based on the work of Baïou and Balinski (2004), considering draw in last place and flexible vacancies if these happen, just as the Chilean selection system requires.

### Simulations

In order to quantify the impact of introducing grade rank to the admissions process and evaluate the effect of other ways of incorporating this factor into the weightings, we carried out a series of simulations based on the 2013 admissions process. For each of these simulations, we modified the weightings associated with the PSU exams and the NEM and ranking scores, while leaving constant the scores themselves, the student preferences and the degree course requirements. To ensure the feasibility of the options evaluated, we considered to the system's restrictions on the minimum and maximum permitted weightings, as described previously.

[9] The present study is based on two previous reports prepared by the authors: Larroucau, Ríos and Mizala (2013) and Sistema Único de Admisión (2014b).

The following simulations were carried out:

- 2012 Simulation: This evaluated all the components of the 2013 admission process with the selection factor weightings used in 2012. For degree programs that were offered for the first time in 2013, DEMRE was asked to estimate the weightings that these programs would have prior to the ranking score's introduction.
- 10% Ranking vs. NEM simulation: This evaluated a ranking score weighting of 10% for all degree programs (just as the 2013 admission process). This percentage was obtained by taking the weightings from the previous process and subtracting 10% from the NEM.
- Ranking vs. PSU simulation: In this category, two simulations were carried out. In both cases, starting with the weightings from 2012, the PSU was reduced to incorporate the ranking score. Specifically, weightings of 10% and 20% were used for the ranking score, to the detriment of the PSU. To recalculate the weightings for the different PSU exams, the following rule was used:
  1. For PSU exams with a weighting greater than 10% in the 2012 process, select the smallest weighted exam whose weighting has not been previously modified (a valid condition from this algorithm's second iteration). Make sure that the weighting is greater than 50%. Otherwise, select the NEM weighting.
  2. Remove 5% from the weighting of the exam selected in Step 1 and reassigned it to the ranking score.
  3. At the end of each iteration, one of the following possibilities occurs: a) if the weighting for the ranking score still does not reach the target value (10% or 20%) and there are still tests whose weightings have not been modified, return to Step 1; b) if the weighting for the ranking score still does not reach the target value and all of the PSU tests' 2012 weightings have been modified, return to Step 1 and repeat the process, starting once again at the exam with the lowest weighting; and c) if the weighting for the ranking score reach the target value, then the algorithm ends.

Additionally, we analyzed the impact of the weightings used in the 2014 admissions process on students' selection. To do so, we carried out a simulated admission process with the weightings used in 2013, while the remaining variables were taken from the 2014 process (scores, preferences, vacancies, requirements, etc.).

In each case, once the weightings to evaluate were defined, we used the previously described selection algorithm to solve the associated admissions process problem.

### Groups of analysis

To analyze the simulation results and compare them with the base cases (the 2013 and 2014 admissions processes), we created different groups of analysis: students who were accepted into a degree program because of the new weightings (*winners*); students who were not accepted due to the new weightings (*losers*)[10]; students who were accepted both in the base case as well as the simulation, but in different universities; and students who improved, remained the same, or did worse in their choice of degree program/university, compared to the base case selection results

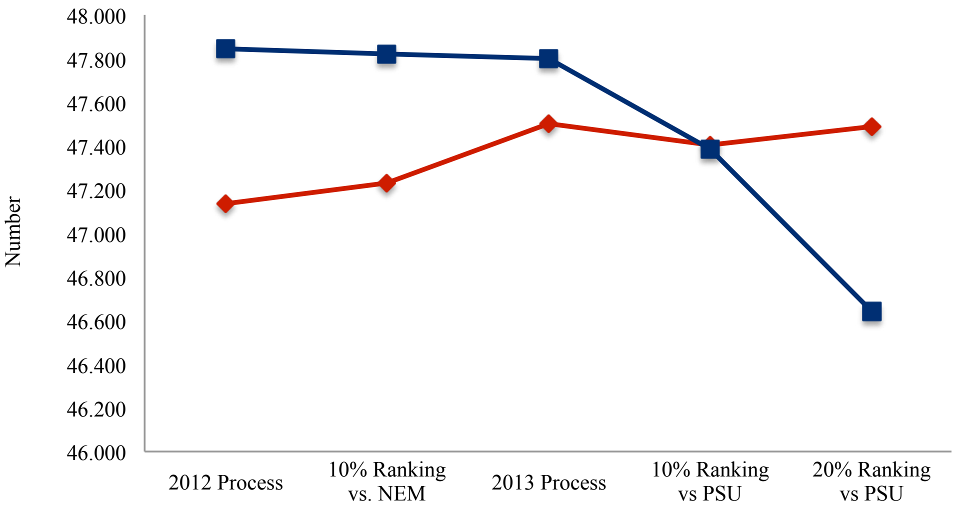
## Results

### Simulation of 2013 admissions process

In Figure 7, we see that the total number of selected students remains practically constant throughout all the simulations, with the 2013 admission process registering the maximum (95,300) and the *Ranking 20% vs. PSU* simulation the minimum (94,130). However, when the student compositions are analyzed by gender, it is indeed detected a significant effect: as the ranking score weighting increases and the PSU weighting decreases, the percentage of female selected increases and the number of male decreases. This effect is consistent with the higher NEM and ranking scores among the female students compared to the male students.

[10] These labels were created for the sole purpose of identifying each analysis group in simple manner, and as such the terms used should not be subject to any other interpretation.

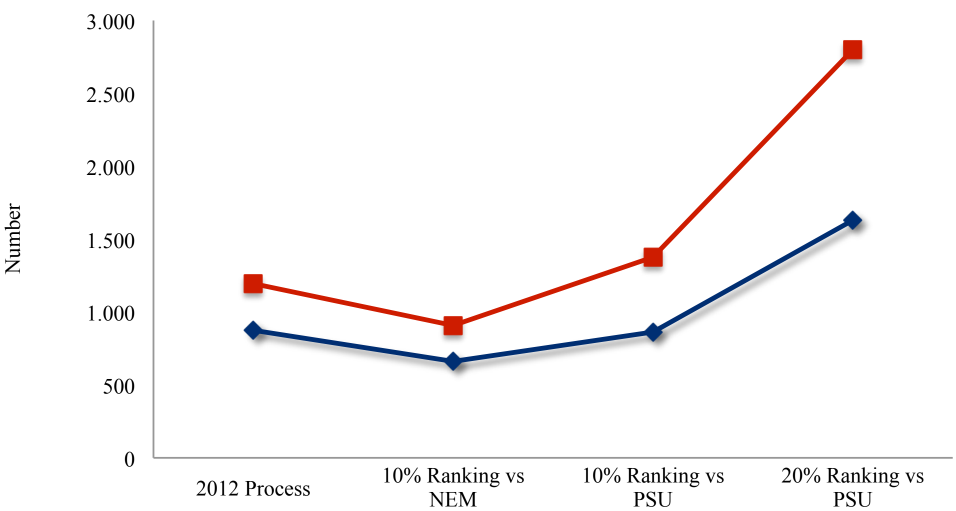
It is worth noting that the total number of students diminishes as the simulation increases the ranking score weighting in comparison to the base case. This effect is due to the fact that students preserve their applications from the 2013 process and do not adjust them to the new weighted scores obtained in each simulation.[11]




| | 2012 Process | 10% Ranking vs. NEM | 2013 Process | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|---|
| Female | 47.135 | 47.231 | 47.501 | 47.404 | 47.488 |
| Male | 47.846 | 47.822 | 47.799 | 47.386 | 46.642 |

Figure 7. Students selected in each simulation.

The decrease in the total number of selected applicants can be explained by examining the variations in the total *winners* and *losers,* as presented in Figure 8.




| | 2012 Process | 10% Ranking vs NEM | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Winners | 875 | 661 | 865 | 1.628 |
| Losers | 1.194 | 908 | 1.375 | 2.798 |

Figure 8. Variation in the total number of *winners* and *losers* in each simulation (comparison case: 2013 admissions process).

[11] The decrease in the total number of selected students should not be interpreted as an outcome itself, but rather as the result of simulating any type of change to the applicants' weighted scores.

Given that the inclusion of new applicants (*winners*) and the exclusion of previously selected students (*losers*) are small in relation to the total number of accepted candidates (less than 3%), the global composition of the system remains stable.

Table 2 shows the composition of students selected in each simulation. We see that in terms of institution type, gross household income bracket, and school vulnerability index (IVE, according its Spanish acronym), the composition varies very slightly. In terms of the average scores of the selected students, the *Ranking 20% vs. PSU* simulation shows a higher average weighted score (6 points), average NEM score (6 points) and average ranking score (4 points) than the 2012 simulation (without including rank). It also presents a slightly lower (1 point) average PSU score (language and communication, and mathematics). On the other hand, when comparing the average of the *Ranking 10% vs. NEM* and the *Ranking 10% vs. PSU* simulations, we see that incorporating rank while reducing the PSU exam weightings produces a more marked effect than increasing the ranking weightings while reducing the NEM score. However, this effect does not substantially modify the overall system's composition.[12]

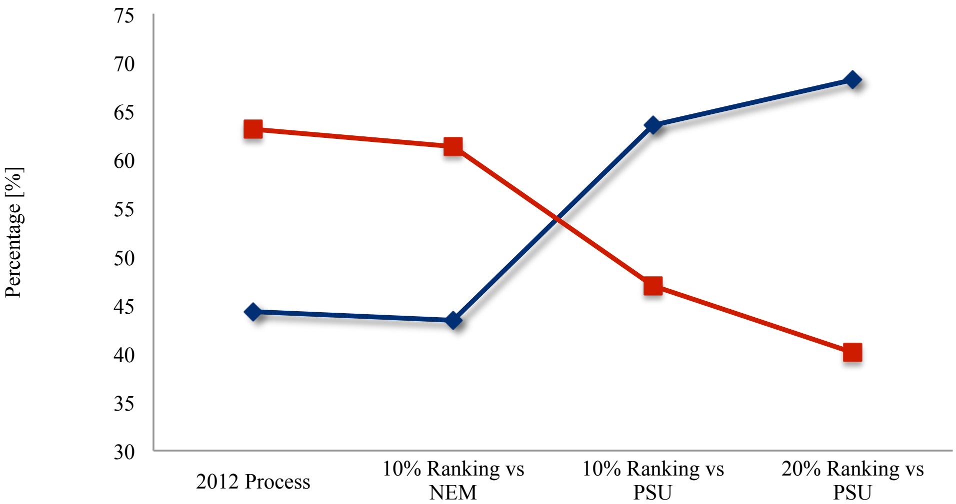
Table 2
Average results for students selected in each simulation

| | 2012 Simulation | 10% Ranking vs. NEM | 2013 Process | 10% Ranking vs. PSU | 20% Ranking vs. PSU |
|---|---|---|---|---|---|
| Total selected | 94,981 | 95,053 | 95,300 | 94,790 | 94,130 |
| Average scores | | | | | |
| Weighted | 596 | 599 | 599 | 599 | 602 |
| PSU[1] | 590 | 590 | 590 | 590 | 589 |
| NEM | 618 | 619 | 619 | 621 | 624 |
| Ranking | 594 | 595 | 595 | 597 | 598 |
| Institution type (%) | | | | | |
| Municipal/Public | 23.3 | 23.3 | 23.5 | 23.4 | 23.4 |
| Subsidized Private | 55.1 | 55.1 | 55.2 | 55.2 | 55.4 |
| Private | 20.9 | 20.9 | 20.8 | 20.8 | 20.5 |
| Gross Household Income Bracket (%) | | | | | |
| I: 0-$144.000 | 9 | 9 | 9 | 9 | 9.1 |
| II: $144,001 - $288,000 | 25.3 | 25.3 | 25.4 | 25.4 | 25.6 |
| III: $288,001 - $576,000 | 26.4 | 26.5 | 26.4 | 26.4 | 26.5 |
| IV: $576,001 - $1,152,000 | 19.4 | 19.4 | 19.3 | 19.3 | 19.3 |
| V: $1,152,001 or greater | 19.9 | 19.9 | 19.8 | 19.8 | 19.6 |
| School Vulnerability Index (IVE)[2] | 42.1 | 42.1 | 42.2 | 42.3 | 42.5 |

[1]Average of language and communication and mathematics tests.
[2] 0: minimum vulnerability, 100: maximum vulnerability of school of origin.
Source: Authors' elaboration.

**Winners and losers.** Although the number of *winners* and *losers* did not significantly affect the system's average, it is important to analyze whether the two groups differ substantially in their compositions. Figure 9 shows the variation in the percentage of female students in the *winner* and *loser* groups. Here we observe that as the weightings decrease for PSU and increase for rank, the proportion of female *winners* rises. Specifically, in the *20% Ranking vs. PSU* simulation, the difference between the percentage of female *winners* and *losers* is 28.1%. This outcome shows that female applicants are one of the main groups to benefit from the ranking factor's incorporation.

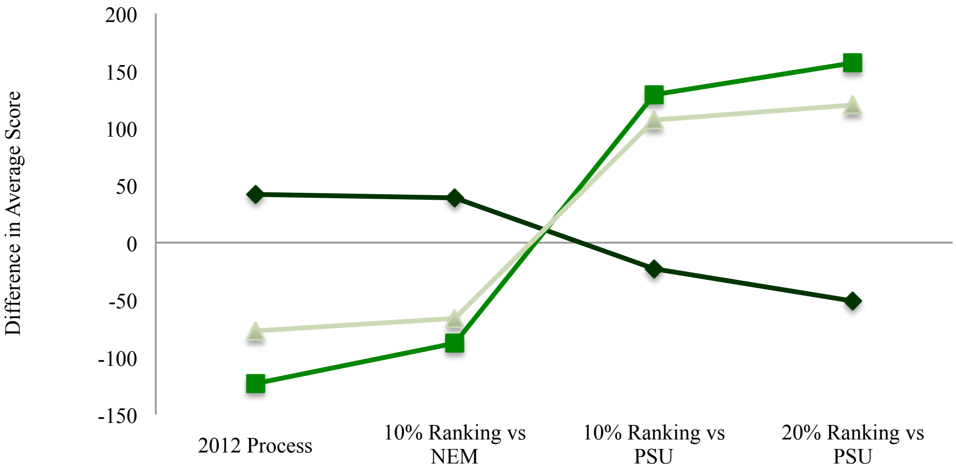
[12] Larroucau, Ríos and Mizala (2013) provide a detailed description of each simulation and analyze the effects on each university.




| | 2012 Process | 10% Ranking vs NEM | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Winners | 44,3 | 43,4 | 63,5 | 68,2 |
| Losers | 63,1 | 61,3 | 47 | 40,1 |

Figure 9. Variation in the percentage of female students in the *winner* and *loser* groups for each simulation.

In line with the results for the general case, when analyzing the differences between the average scores of *winners* and *losers*, one sees that as the weightings increase for rank and decrease for PSU, the average ranking and NEM scores of the *winners* group surpasses that of the *losers*. The opposite occurs for the average PSU scores for language and communication and mathematics (see Figure 10). In the *20% Ranking vs. PSU* simulation, the *winners* have, on average, 120 more points for rank and 51 points less for the PSU scores for language and communication and mathematics, in comparison to the *losers* group.




| | 2012 Process | 10% Ranking vs NEM | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| PSU | 42 | 39 | -23 | -51 |
| NEM | -123 | -88 | 129 | 157 |
| Ranking | -77 | -66 | 107 | 120 |

Figure 10. Variation in average scores differences between *winners* and *losers* for each simulation.

In terms of the students' vulnerability, Figure 11 shows that as the ranking score weighting rises, the average IVE for the *winners'* group increases, while the average IVE for the *losers* group diminishes. From these results, we can infer that the more emphasis given to grade rank, the more it will benefit students from the most vulnerable schools, for example, public or private subsidized schools. This final point is visible in Figures A1 and A2 (Appendix A).

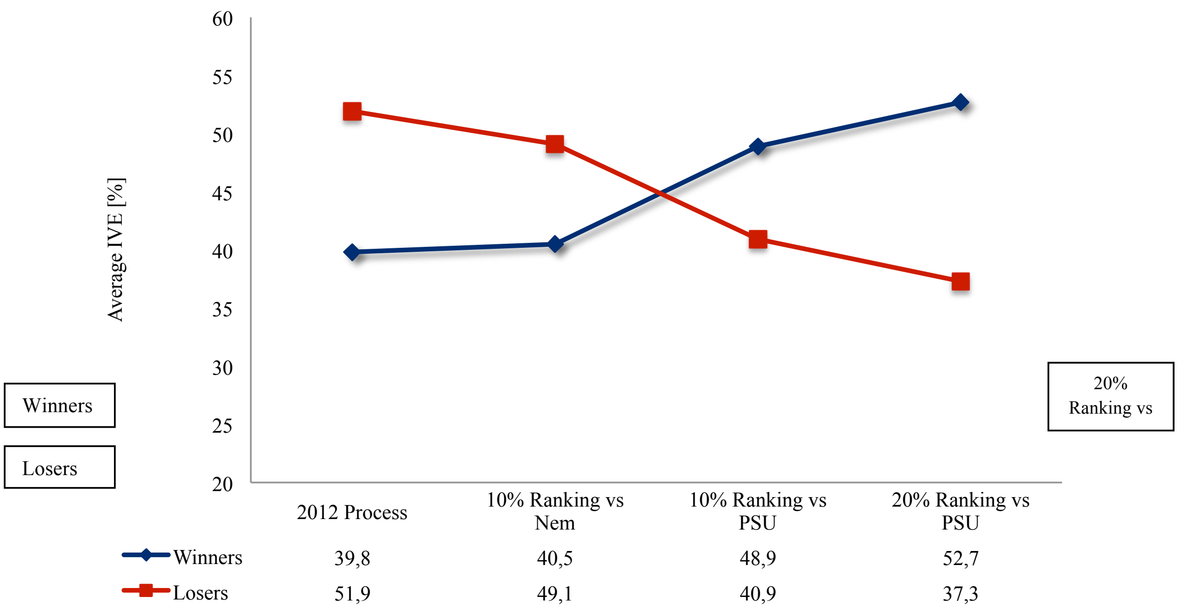



Figure 11. Variation of average IVE among *winners* and *losers* for each simulation.

**Change of university.** While new students are not included in the system on a large scale, we do see a significant effect on the change of the university in which each student was selected. Figure 12 shows the number of students who change the university where they are admitted in each simulation, in comparison to their selection in the 2013 admissions process. The university substitution effect (due to changes in the choice of university or degree course where the students are accepted), is close to 9% of all selected applicants in the *20% Ranking vs. PSU* simulation. In this regard, incorporating rank into the admissions process produces a substantial shift among the students within the system and has minor impact on the inclusion or exclusion of students.

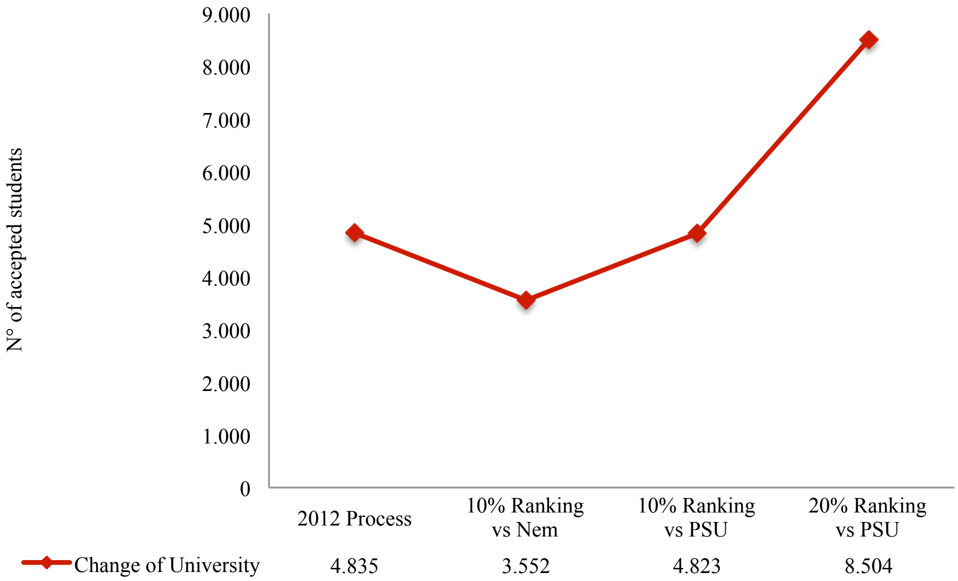
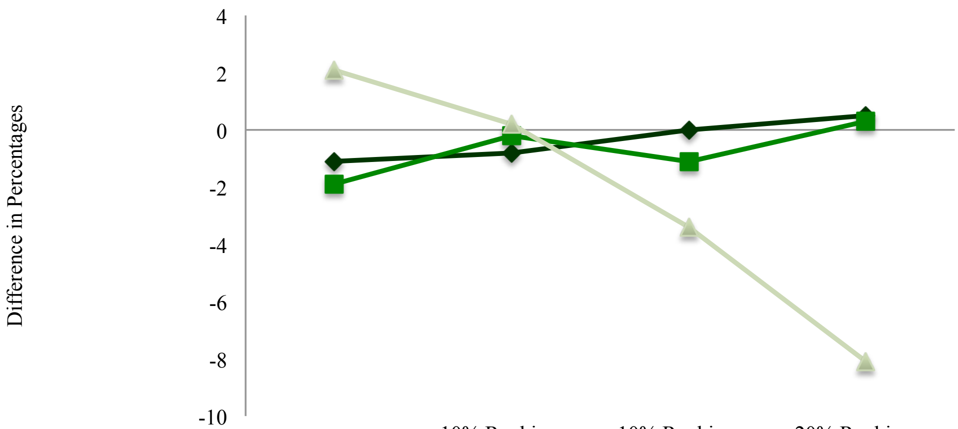



Figure 12. Variation in the number of students who change universities for each simulation.

**Analysis of the preference in which students are accepted.** To analyze the changes produced by incorporating grade ranks from a student viewpoint, we now examine the percentage of admitted students who improved, remained the same, or did worse in their degree program/university chosen in comparison to the 2013 admissions process.

Figure 13 shows the variation in the total difference between the percentages of applicant who improved and did worse in their selection. The students from public and private subsidized schools improved slightly as the ranking score weighting increased. However, this effect is not significant on an aggregate level.

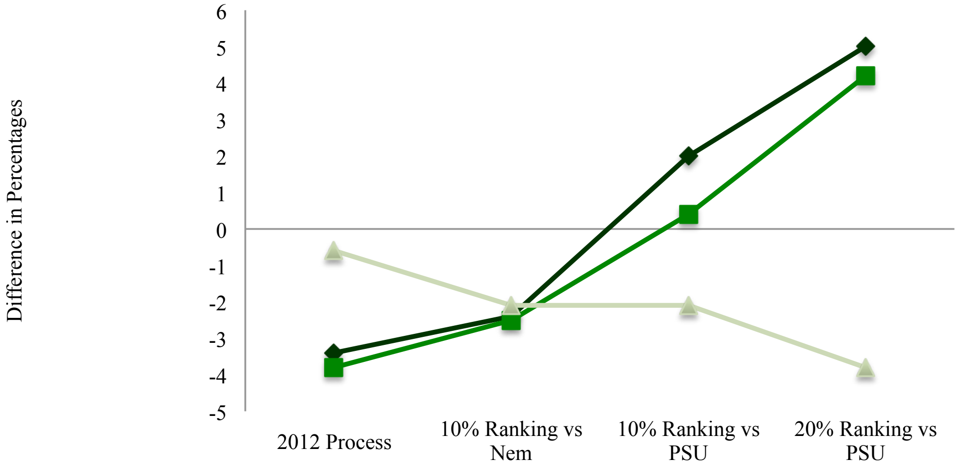
A larger percentage of students from private schools did worse in the degree program/university that accepted them. In the *20% Ranking vs. PSU* simulation, among this group, the difference between those who improved and did worse in terms of choice is -8.1%.




| | 2012 Process | 10% Ranking vs Nem | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Municipal/Public | -1,1 | -0,8 | 0 | 0,5 |
| Subsidized Private | -1,9 | -0,2 | -1,1 | 0,3 |
| Private | 2,1 | 0,2 | -3,4 | -8,1 |

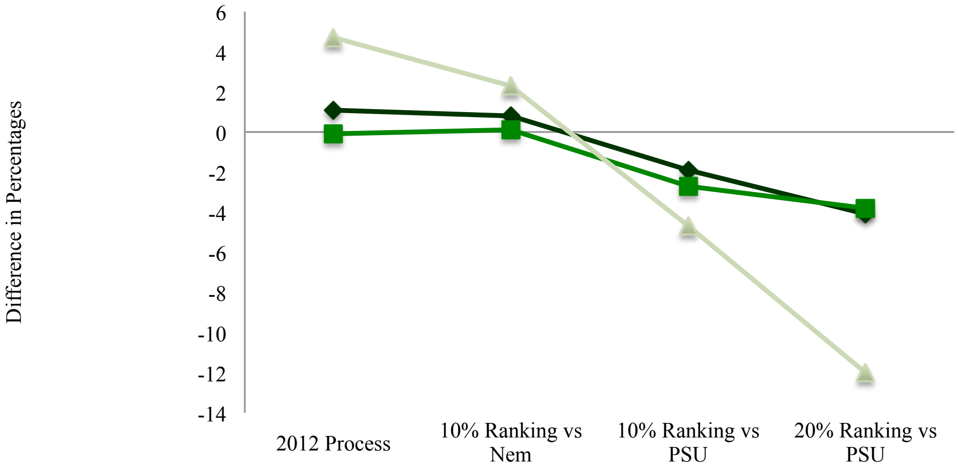
Figure 13. Variation in net percentage of accepted students who improved, by type of institution, for each simulation.

Figures 14 and 15 show the net improvement among female and male students, respectively. It is observed a clear effect on gender combined with the student's educational institution of origin. Female from public and private subsidized schools comprise the group with the highest net improvement in terms of the choice in which they are accepted (5% and 4.2%, respectively, in the *20% Ranking vs. PSU* simulation), while the group with the highest decline are male from private schools (a net decrease of 12% in the 20% *Ranking vs. PSU* simulation).




| | 2012 Process | 10% Ranking vs Nem | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Municipal/Public | -3,4 | -2,4 | 2 | 5 |
| Subsidized Private | -3,8 | -2,5 | 0,4 | 4,2 |
| Private | -0,6 | -2,1 | -2,1 | -3,8 |

Figure 14. Variation of net improvement (%) among accepted female students, by type of school, for each of the simulations.




| | 2012 Process | 10% Ranking vs Nem | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Municipal/Public | 1,1 | 0,8 | -1,9 | -4,1 |
| Subsidized Private | -0,1 | 0,1 | -2,7 | -3,8 |
| Private | 4,7 | 2,3 | -4,7 | -12 |

Figure 15. Variation of net improvement (%) among accepted male students, by type of school, for each of the simulations.

## 2014 admission process

To evaluate the impact of weighting changes between the 2013 and 2014 processes, we simulated the 2014 process with the weightings used in 2013. This simulation allows to estimate the impact from increasing the grade rank weighting (12% over the weighting used in 2013) and to validate the previous methodology. This time the increase is not simulated but genuine and, unlike the 2013 process simulations, it captures the possible effects of rank on students' application strategies.

Since the goal is to evaluate the impact of an increase in the weightings, this time we used as a basis of comparison the simulated 2014 process with 2013 weightings, as a way of analyzing the students who improved or did worse in their choice of degree program/institution due to the increased weighting for rank. In addition, we carried out statistical tests, comparing the different analysis groups, to ensure the robustness of the simulated results.

The results of the 2014 admissions process, when compared to the 2014 simulation with 2013 weightings, are consistent with the results we have already set forth. In essence, the greatest impact of increasing the rank weighting is seen in the redistribution of students among degree programs and universities, while the overall system is not modified substantially. Despite this, 1,350 new students enter into the university system because of the new weightings. These students are mainly female from more vulnerable economic backgrounds who attended public or private subsidized schools, and who have high rank and NEM scores and lower PSU scores in comparison the group of students who were not accepted. All the differences found between the *winners* and *losers* groups were statistically significant with a 95% confidence level,[13] except for the students in the third household income bracket (the intermediate bracket).

Regarding students' change among institutions, 5,484 accepted applicants would have chosen a different university if the 2013 weightings (fixed at 10% for rank) had not been modified. This is consistent with the results of the *10% ranking vs. PSU* simulation, in which the combined weighting for rank and NEM was 30%. This change represents almost 6% of all accepted candidates; in other words, changing the weightings does impact the selection of students.

An even greater impact is evident when the changes are analyzed from a student viewpoint: 9,590 students would not have been accepted in the same degree program if the 2013 weightings had been maintained. This represents almost 10% of all the applicants accepted in 2014. Furthermore, 5,081 students improve their position of admittance in a degree program or university (almost 5% of all accepted students). In this latter group, female from public or private subsidized schools predominate (see Table 3). This coincides with their higher rank and NEM scores and lower PSU scores in comparison to male students.[14]

Table 3
Changes in students' selection during 2014 admissions process (by school type)

| | Municipal/Public | | | | Subsidized Private | | | | Private | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Gender | No. | Improv. | Same | Worse | No. | Improv. | Same | Worse | No. | Improv. | Same | Worse |
| Female | 11,090 | 8.6 | 86.8 | 4.6 | 27,600 | 6.8 | 88.4 | 4.8 | 9,691 | 2.8 | 91.0 | 6.2 |
| Male | 11,523 | 4.6 | 88.1 | 7.3 | 25,685 | 4.7 | 89.4 | 5.9 | 10,567 | 2.1 | 89.8 | 8.1 |
| Total | 22,613 | 6.6 | 87.5 | 5.9 | 53,285 | 5.8 | 88.9 | 5.3 | 20,258 | 2.4 | 90.4 | 7.2 |

No.: number of students accepted in simulation of 2014 process; Improv.: % of students who improved their selection choice; Same: % of students who maintained their selection choice; Worse: % of students who did worse on their selection choice.

These results confirm that the gender effect plays a very important role. This effect is further underscored when analyzing the results by curriculum type, since female in technical-professional schools comprise the group with the highest net improvement according to the weightings of the 2014 admission process (see Table 4).

[13] We carried out tests of difference between two means (with equality of variance) and distributions (Kolmogorov-Smirnov) for all continuous variables analyzed. For categorical variables, we carried out tests of proportions.

[14] The difference between the percentage of students who improved and did worse in their choice of institution/degree program is statistically significant with 95% confidence for all analyzed categories.

Table 4
Changes in students' selection during 2014 admissions process (by curriculum type)

| | Scientific-Humanistic | | | | Technical-Professional | | | |
|---|---|---|---|---|---|---|---|---|
| Gender | No. | Improv. | Same | Worse | No. | Improv. | Same | Worse |
| Female | 43,075 | 5.7 | 88.8 | 5.4 | 5,557 | 11.3 | 86.6 | 2.1 |
| Male | 42,101 | 3.6 | 89.2 | 7.2 | 6,004 | 7.9. | 89.2 | 3.0 |
| Total | 85,176 | 4.7 | 89.0 | 6.3 | 11,561 | 9.5. | 87.9 | 2.6 |

No.: number of students accepted in simulation of 2014 process; Improv.: % of students who improved their selection choice; Same: % of students who maintained their selection choice; Worse: % of students who did worse on their selection choice.

The students who improved their position of preference in which they are accepted mostly came from non-emblematic public schools (the schools considered as emblematic, academically selective, are detailed in Table A1, Appendix A). In the case of emblematic schools, the percentage of students who did worse is higher than the percentage of those who improved their choices.

Table 5
Changes in students' selection during 2014 admissions process (emblematic vs. non-emblematic high schools)

| | Emblematic | | | | Non-emblematic | | | |
|---|---|---|---|---|---|---|---|---|
| Gender | No. | Improv. | Same | Worse | No. | Improv. | Same | Worse |
| Female | 1,343 | 1.9 | 84.2 | 13.9 | 9,751 | 9.5 | 87.2 | 3.3 |
| Male | 2,493 | 1.2 | 82.6 | 16.2 | 9,057 | 5.6 | 89.6 | 4.8 |
| Total | 3,836 | 1.4 | 83.2 | 15.4 | 18,808 | 7.6 | 88.4 | 4.0 |

No.: number of students accepted in simulation of 2014 process; Improv.: % of students who improved their selection choice; Same: % of students who maintained their selection choice; Worse: % of students who did worse on their selection choice.

These results confirm that the schools classified as *emblematic* experience *a* negative impact when the weighting for grade rank is increased.

Finally, it is important to highlight that in the simulations, our modifications focused exclusively on the weightings of each degree program or university for each admission process. Applicant choices kept constants in the processes on which each simulation was built (2013 and 2014). In this sense, the effects we observed correspond to the impact of grade rank on student selection, without taking into account the possible effects this factor's inclusion may have on candidate applications.

One would expect including grade rank will affect the expectations of applicants who have high scores in this aspect (Lloyd, Leicht, & Sullivan, 2008), increasing the proportion of students with high ranking scores who apply to more selective degree programs. Nonetheless, the simulation of the 2014 process captures, to a certain extent, the effect of an increased weighting for rank on student applications due to the real increase in weightings. It demonstrates that both the groups of beneficiary students and the orders of magnitude are similar to the simulations based on the 2013 process. Thus, the effect on applications does not appear to significantly influence the results obtained.

## Discussion and conclusions

It can be concluded that the impact of incorporating grade rank as a factor in the SUA selection system resulted mainly in the rearrangement of students within the system, benefiting those with better scholastic trajectories. These students were accepted into degree programs and universities that ranked highest on their list of preferences.

While the inclusion and exclusion of students in the system did not happen on a large scale, the compositional changes in socioeconomic background and gender of the students who were selected and who lost their spots are relevant and statistically significant.

The groups that most benefited from the incorporation of grade rank include female, mostly from lower-income households, who studied at the most vulnerable schools. Most of them are public and private subsidized schools that have the technical-professional curriculum. The magnitude of this effect is directly related to the weightings that the degree programs/universities assign to the PSU. As the PSU weighting diminishes and the grade rank weighting increases, a larger group of female from lower socioeconomic backgrounds benefit from the change.

As mentioned above, these results suppose that these changes do not alter student preferences for degree programs or universities. Although this assumption could affect the extent of the impact, it should not be so on a large scale, nor alter its direction.

These results are in line with the literature on this issue, because standardized testing based on a high school curricula tends to have a detrimental effect on students from lower socioeconomic backgrounds, since the schools where they study are often unable to cover all the require contents. This is especially true among students at technical-professional schools. In general, this school curriculum-related effect is reinforced by the fact that female students tend to score lower on competitive tests, even when they receive good grades during their school careers.

For these reasons, one can impel a certain level of gender and socioeconomic equality in higher education access by including grade rank as a new selection factor and reducing the importance of standardized tests. This conclusion invites to improve the method of calculating grade rank, in order to strengthen its benefits and avoid the creation of any inappropriate incentives.

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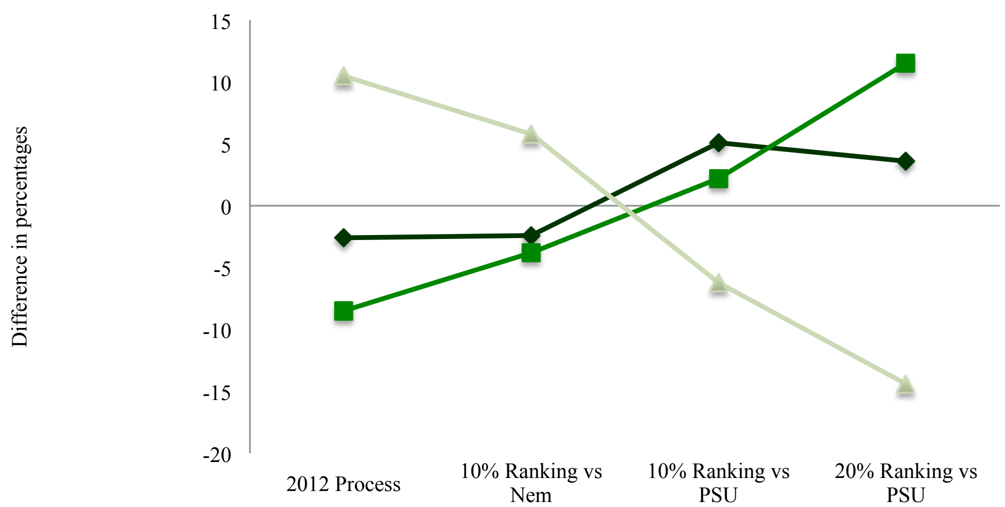
## Appendix A

Table A1
Schools considered emblematic (academically selective)

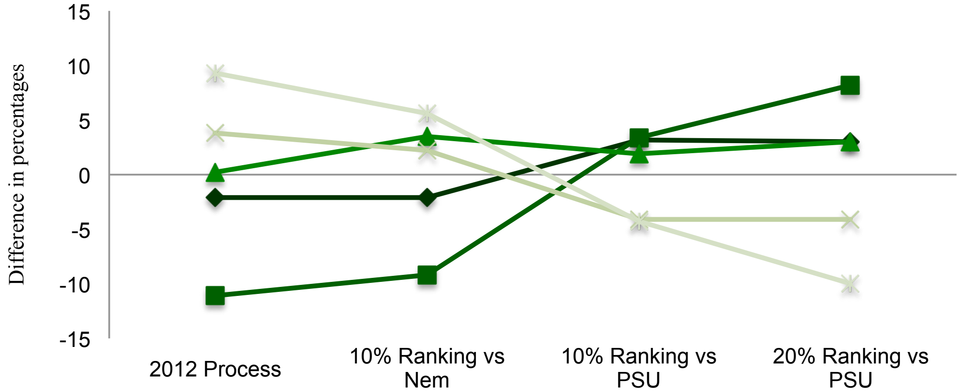
| Schools |
|---|
| Instituto Nacional General José M. Carrera |
| Liceo Nacional |
| Liceo Nº 1 Javiera Carrera (exA-1) |
| Liceo de Aplicación A-9 |
| Liceo A-10 Manuel Barros Borgoño |
| Liceo Siete de Niñas de Providencia (ex A43) |
| Liceo Carmela Carvajal de Prat (ex A-44) |
| Liceo José Victorino Lastarria A-45 |
| Liceo Augusto D'halmar |
| Liceo Polivalente Arturo Alessandri Palma A-12 |

Source: authors' elaboration with data from SUA.




| | 2012 Process | 10% Ranking vs Nem | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| Municipal/Public | -2,6 | -2,4 | 5,1 | 3,6 |
| Subsidized Private | -8,5 | -3,8 | 2,2 | 11,5 |
| Private | 10,5 | 5,8 | -6,2 | -14,4 |

Figure A1. Differences among the *winners* and *losers* groups, according tothe type of school of origin, for different simulations.




| | 2012 Process | 10% Ranking vs Nem | 10% Ranking vs PSU | 20% Ranking vs PSU |
|---|---|---|---|---|
| I | -2,1 | -2,1 | 3,2 | 3 |
| II | -11,1 | -9,2 | 3,4 | 8,2 |
| III | 0,2 | 3,5 | 1,9 | 3 |
| IV | 3,8 | 2,2 | -4,1 | -4,1 |
| V | 9,3 | 5,6 | -4,3 | -10 |

I: 0-$144,000; II: $144,001-$288,000; III: $288,001-$576,000; IV: $576,001-$1,152,000; V: $1,152,001 or greater.

Figure A2. Differences among the winners and losers groups, according to the students' income bracket, for different simulations.