Chilean Universities and Universal Gratuity: Suggestions for a Model to Evaluate the Effects on Financial Vulnerability

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Abstract: Financial vulnerability can be understood as the risk of an organisation being unable to carry out routine its normal operations due to financial restrictions. Models to estimate financial vulnerability have mainly been developed for profit-making organisations, while few exist for non-profit organisations (NPOs). One example is higher education institutions, which have experienced important changes in Latin America through gratuity policies for student tuition. This study proposes a model to estimate the effects of gratuity on financial vulnerability, as previous studies have focused on the effects of enrolment. A binary logistic regression model is proposed, considering the following variables: debt, income concentration, operating margin, administration costs, and square metres of rooms per student. We applied this model to 54 universities between 2013 and 2019. The results showed that the model is relevant for the debt, size, and operating margin variables. Additionally, we observed that on average, all universities were negatively affected. This result is particularly true for state-owned universities because of certain management restrictions. A limitation of this study is the unavailability of other sources of non-financial information, such as each university’s business model and stock of strategic resources, which could improve our model, as this information is more related to control than to management.

Keywords: gratuity; logistic regression; financial vulnerability; higher education; Chile

1. Introduction

Financial vulnerability can be understood as the risk of an organisation being unable to carry out routine operations due to financial restrictions [1,2]. Models to estimate financial vulnerability have primarily been developed for profit-making organisations, with limited existing research centred on non-profit organisations (NPOs) [3–7], despite the importance of these organisations to social and economic development [8–10].

In profit-making institutions, financial vulnerability can be observed through bankruptcy [11]. However, bankruptcy does not occur for NPOs, as these organisations do not distribute their future benefits between members. For clarification, we understand NPOs to be entities organised for public ends that govern themselves and do not distribute their surplus [12,13]. It is possible to classify the majority of NPOs as small and medium enterprises [12,14]. For this reason, such organisations are not immune to economic cycles and financial bubbles [5,12]. Therefore, negative financial situations or crises can also affect the financial health of NPOs and their financial vulnerability [14–16].

These factors have made the defining of an adequate measure of financial vulnerability complex [17]. Consequently, researchers have sought to develop alternative industry-specific measures of financial vulnerability for NPOs using proxies [4,5,17–20]. In 2016, NPOs in the United States employed almost 7% of the labour market and represented 5.6% of the gross domestic product (GDP) [12,21].
One example of an NPO is higher education, which has been affected by significant changes since the 1990s due to inspiration from public management [22]. This situation has highlighted challenges in funding higher education, particularly in times of crisis [23]. Plans to reduce public funding have been presented [24,25], affecting the financial health of higher education institutions and generating important debates [26].

In recent decades, higher education in Latin America has been subjected to new demands, especially with changes in the paradigm of revaluing education as a public good due to the growing resources coming from the state and the introduction of new regulations and quality controls [27]. Specifically, Chilean higher education has been exposed to a series of transformations [28–31] that have substantially affected competition between institutions. An example of these transformations is the role of the state and its responsibility in financing students through a public policy of universal gratuity. This policy originates from the understanding of higher education as a public good and a mechanism to promote equity and social mobility [32,33].

The contribution of this study is its creation of a model for estimating the probability of financial vulnerability that any Chilean higher education institution can utilise, as no prior studies have analysed the financial effects of gratuity policies on such institutions.

To determine how gratuity policy affects the financial vulnerability of higher education institutions, we used a binary logistic regression model. The results show that the model is relevant for indebtedness, size, and operating margins. In addition, all universities, on average, were negatively affected, particularly the state ones, due to specific management restrictions. One such limitation corresponds to the unavailability of other sources of non-financial information, such as the institutions’ business models and the stock of their strategic resources, which could improve our model since this information is more related to control than to management. Finally, the resulting model was validated using a group of universities that ceased operation due to financial insolvency during the study period.

The remainder of this study is organised as follows. Section one provides an introduction, and Section two presents a Literature Review. The Data and Methods are described in Section three, with the descriptive statistics and results reported in Section four. Finally, Conclusions are presented in Section five.

2. Literature Review

2.1. Financial Vulnerability and Non-Profit Institutions

Financial vulnerability refers to an organisation’s bankruptcy risk due to financial problems that impede its normal operation [1,2]. Thus, financial vulnerability is a concern for all stakeholders of an organisation [34,35].

Since their introduction in 1965, mathematical and statistical models have been used to estimate an organisation’s financial vulnerability, including those proposed in [36–38]. In the 1970s, the models outlined in [39,40] were most important, followed by those in [41–43]. However, the estimation of the probability of financial vulnerability among NPOs suffers from measurement difficulties and challenges compared to estimations of profit-making organisations. For this reason, researchers have sought to define alternative measures [17].

The authors of [44] indicated that NPOs could suffer financial stress and increased financial vulnerability if their financing primarily depends on donations. Due to the instability of donation-based income, the authors proposed that NPOs are less vulnerable when a more diversified income structure is available, which can be measured using the Herfindahl index based on income.

The authors of [4] defined an organisation as financially vulnerable if the cost of its programs decreased over three consecutive years. The proxy used in [44] for program delivery was program expenditure, derived from accounting data and thus annulling the obligation to divide the data into quintiles. The authors’ analysis of a sample of 3151
organisations over four years sought to determine financial vulnerability based on four key ratios: total equity/total revenues, revenue concentration/total revenues, total expenses/total revenues, and administrative costs/revenues. The authors found that the proposed ratios of revenue concentration/total revenues, total expenses/total revenues, and administrative costs/revenues were statistically significant. Their model correctly predicted 65% of financially vulnerable organisations and 58% of all organisations as financially vulnerable or not.

The authors of [6] considered the previous research in [44] and [4], which proposed a logit regression model to estimate financial vulnerability. An NPO is defined as vulnerable if its net assets decrease by 20% or more over three consecutive years, in addition to incorporating measures of financial leverage and organisation size. In this work, the authors proposed utilising organisation size as a relevant variable for the organisation’s sector, which was measured as a logarithm of the assets, as larger NPOs are considered more stable, more efficient, and less financially vulnerable than smaller NPOs.

In addition, financial leverage, measured as total liabilities/assets, was considered to determine if high leverage levels reduced an organisation’s ability to raise more debt to fund programs. The proposed predictive model considered the application of a logit model to estimate the probability that an organisation would be classified as vulnerable. The proposed model provided statistically significant predictions, which the authors advised would be more useful as a warning method than to predict an organisation’s demise.

The authors of [20] proposed a vulnerability index to measure the financial viability of a functioning NPO. This model was based on five metrics that analyse debt, income concentration, operating margins, administrative cost ratios, and institution size. Additionally, the authors proposed that non-financial information should be incorporated to achieve a better evaluation. Against this background, the authors of [5] complemented the concepts of financial vulnerability by incorporating metrics and considering an NPO to be insolvent when it reduces its net assets and/or budget for spending on social programs by 25%. The authors of [1] extended the work proposed in [44] and proposed evaluating financial vulnerability in the short and long term by estimating the insolvency of the organisation as a continuum over time. The authors of [13,45] considered the previous work in [44] and proposed an index of financial vulnerability that incorporates the effect of inflation, profitability of assets, return on assets, months of spending, and mark-up.

The authors of [46] found that NPOs with greater assets had greater operating reserves, although there were some differences between the non-profit sub-sectors. From these results, we posit the hypothesis that, in general, it is more likely that larger NPOs will meet our indicator of financial state, maintaining at least three months of expenses in reserve.

Similarly, in [6,47], the authors found that larger organisations managed their resources better in times of crisis or when their incomes were diminished, compared to smaller organisations. The authors of [48] showed the importance of an organisation’s age, as financial risks generally remain high in the initial years and then diminish as a product of asset accumulation, experience, and public trust. The authors of [46,49] reported similar results but noted that younger and smaller organisations may require more resources or net reserves to develop their operations. The authors of [50] confirmed that older, larger organisations tended to have greater stability and growth but less financial vulnerability.

Despite the development of new predictive models for financial vulnerability among NPOs, reduced development in higher education organisations has been observed [51]. The financial vulnerability of NPOs is a relatively new area of study [4–6,18], despite the importance of such organisations to social and economic development [8–10].

2.2. Higher Education as Non-Profit Institutions

Higher education faces significant pressure from the government sector regarding the financing of academic activities, forcing relevant institutions to become increasingly competitive and efficient [52,53] to ensure their sustainability [54].
These reductions in public funding for higher education institutions can be observed internationally and are justified by a greater awareness of the need to balance budgets with the conviction that the universities themselves must be responsible for guaranteeing their sustainability [55–58].

Higher education has two primary funding mechanisms. The first is the charging of fees (private costs), and the second is the direct and indirect contributions that these institutions receive from the state (public spending) [59,60].

The OECD observed a decrease in public spending for higher education, which was substituted by private tuition, mainly paid by the families of students [61,62]. This situation agrees with the proposition that the cost of higher education is a private good and must be assumed by the person who benefits from it [63]. The constant decrease in public resources and growing demand for funding from universities have encouraged the search for sources of funding apart from subsidies or fiscal aid [64].

The authors [65] highlighted the situation in Australia where, until 1973, the families of students assumed the funding of higher education, despite the availability of a system of academic merit scholarships. This system was then modified through a model of gratuity in higher education that was later abandoned in 1989 and replaced with a system of scholarships and credit. The authors [66,67] highlighted that the benefits of gratuity are currently under discussion globally and that arguments in favour of policies of gratuity are generally political (i.e., university as a public good, avoiding exclusion, and favouring equal opportunities), rather than being related to the efficient use of public spending.

In the last decade, gratuity in higher education has been increasingly discussed due to the significant resources invested in this type of social policy. The Philippines and New Zealand developed gratuity policies in the last decade, while Canada and Chile developed policies of selective gratuity [68]. This policy is discussed when per capita national income is relatively high to allow the State to obtain the necessary permanent resources [68,69].

Many countries in Latin America promote access to higher education through free policies. In 2008, Ecuador established free policies in public higher education, while Mexico designed a gradual gratuity policy starting in 2022, thus joining other countries in the region where such a policy already existed, including Argentina, Uruguay, Venezuela, and federal universities in Brazil. The Ecuadorian case highlights that the benefit of free education is associated with meritocracy [70].

2.3. Higher Education in Chile and Its Financing

The higher education industry presents characteristics like those of a service industry [71–73] since it produces an intangible and heterogeneous service [72]. This structure means that higher education institutions must adapt to changes in the environment [74], demonstrate quality in their academic processes [75], and achieve high levels of quality through creating value and continuous improvement of their organisational processes [76,77]. The Chilean higher education industry has been exposed to a series of transformations [28,29] that have substantially changed the competition between higher education institutions.

In 2011, a massive student movement began in Chile that paralysed schools and universities [78], with the phrase “free quality education for all” as its catchphrase and principal demand [79]. Among the explanatory causes of this movement were the high profits of higher education institutions and the costs that families must assume through a high level of debt, in which the state plays a very minor role [78].

In a 2009 report, the OECD concluded that the fees of Chilean higher education were above those of other countries with higher per capita incomes, such as England, Italy, the Netherlands, Austria, Spain, Belgium, Australia, Canada, Japan, and South Korea [80–82]. The gratuitous funding of access to Chilean higher education, hereafter referred to as gratuity, corresponds to state resources assigned to pay fees and support the basic enrolment rights of students in academic programs that qualify for this benefit [83,84].
The process of implementing gratuity has not been free from criticism. Critics suggest such a policy could negatively affect the financial sustainability of higher education institutions due to new regulations and greater dependence on fiscal spending, making such institutions more sensitive to economic cycles and state spending and more dependent on public policies [85].

2.4. Hypotheses

The authors of [32,68,84,85] estimated that universal gratuity could negatively affect the financial sustainability of universities affiliated with gratuity. Furthermore, these authors posit that the new model of proposed funding, regulated tuition, would not cover the entirety of the real tuition, thus generating a funding gap that would have to be covered by universities with the potential risk of affecting the institution’s solvency. Thus, we should understand regulated fees as a form of price fixing by the state.

The authors of [68,86] noted that as a product, gratuity has faced several problems in its implementation, such as financial deficits, tuition fixing, and a regulated increase in total enrolment. Another negative effect of gratuity is associated with the over-duration of students who possess gratuity, as the law terminates the benefit at the end of the duration of the program. Moreover, suppose a student exceeds the nominal duration of the program. In that case, the university can only charge 50% of the regulated fee during the first year and a maximum of 100% starting from the second year. Considering that the regulated fee covers only up to 89% of the real fee, in the first year of delay, there would be an average deficit of 55.5% per student, and from the second year, a deficit of 11% per student.

Therefore, affiliation with gratuity in higher education institutions allows these organisations to periodically receive fee payments from students affiliated with gratuity from the state, but this fee is regulated by the state, which limits higher education institutions in adjusting the amount of fees. This point is relevant because the growth rates of the fees of current and new enrolments are adjusted by a lower algorithm than the growth of the cost structure of higher education institutions. This factor, in turn, affects the diversification of incomes, the net margins of the organisation, and the organisation’s capacity to manage its operations. In addition, the growth rate of the offering is regulated among the institutions affiliated with gratuity based on the offerings of programs, as well as current and new enrolments. Accordingly, the following hypotheses are proposed:

**H1:** The implementation of a public gratuity policy negatively affects the probability of financial vulnerability in universities affiliated with this benefit.

**H2:** Among higher education institutions, state-owned universities are least affected by the implementation of a public gratuity policy because they are mainly funded by public funds.

3. Methodology

3.1. Model and Data Utilised

The methodology of this research considers the following points:

(a) To classify higher education institutions as vulnerable or not vulnerable, we followed the model proposed in [6].

(b) The model proposed in [6] was modified by incorporating variables of the higher education system itself.

(c) The probability of vulnerability was determined for higher education institutions.

(d) We classified higher education institutions as public or private, institutions belonging to the CRUCH, and private institutions not belonging to the CRUCH.

Models that predict financial difficulties are used to classify higher education institutions as vulnerable. Through statistical analysis based on financial and non-financial information, such models can determine financial vulnerability and identify its possible
causes [87,88]. Models for predicting financial difficulties have become a relevant aspect in organisations’ financial management. Some of the most used methodologies are discriminant analysis, logistic regression models, and neuronal networks [89–94].

For this reason, and to achieve the objectives of this research, variables that affect the financial situation of higher education institutions were identified in the literature and evaluated in a logistic regression model to determine the probability of vulnerability. Financial logistic regression models are statistical models used to describe the relationship between a variable of a categorical-type response, bankruptcy, or no bankruptcy, which can be explained using a set of categorical or continual explicative variables [95,96]. For this reason, the methodology used to discriminate between organisations that fail and those that do not encourages the use of binary logistic regression models, which are a particular type of conditional probability model requiring the dependent variable to be classified as categorical for financially vulnerable universities (or not) [97,98]. The logistic regression model is represented by a logistic function [99,100] and has a distribution of $S$ that lies between 0 and 1. For more details, refer to (1):

$$P_i = \text{Prob} (Y_i = 1/X_1, X_2, ...X_n) = \frac{1}{1 + e^{-Z}}$$  \hspace{1cm} (1)

where $e$, is the base of natural logarithms, and $Z$ is a linear function of the logistic regression model. For more details, refer to (2):

$$Z_i = \beta_i \times X_i + \varepsilon_i$$  \hspace{1cm} (2)

where $\beta_i \times X_i$, is a vector of independent variables whose respective regressors correspond to the observed or systematic component, a known function of the different variables observed, and $\varepsilon_i$ is the error. For logistic regression models, a normal standard distribution is assumed [100,101]. A logistic regression model was used to classify the universities into financially vulnerable and non-vulnerable institutions. This model allowed us to estimate the probability that institutions belonged to one of the two groups. To do this, the proposed model had to adequately estimate the effects of the explanatory variables on the probability that $Y_i$ will take a value of 1 when $P_i > 0.5$ and will take a value of 0 otherwise.

3.2. Data Utilised

To determine the proposed model, we considered 54 Chilean higher education institutions that met the requirements defined in this research, as follows: maintaining their registration in the higher education system of the National Education Council (CNED) until the end of 2019, reporting their financial situation for at least the last three years, and not being in the process of closing or liquidation.

Once the model was defined, it was applied to higher education institutions that were free of charge for a total of 31 institutions, 16 public and 15 private. In addition, 25 of these institutions belonged to the Council of Rectors (CRUCH) and were subdivided into 16 public and 9 private institutions. The data considered ranged from 2013 to 2019 and were extracted from the Chilean Ministry of Education (MINEDUC), the Higher Education Information Service (SIES), the National Council of Education (CNDE), and the web pages of the universities. The estimates in this research were produced using the SPSS 24 software.

3.3. Variables

The authors of [102] maintained that an adequate analysis of the financial vulnerability of an NPO must be based on five dimensions: operational, leverage, liquidity, organisational performance, and prestige or reputation. The operational dimension is defined as the variation in net assets over time [5,6,19,20,103,104] and is associated with variation in income and expenditure. The leverage dimension measures the capacity of the
organisation to meet its debt payments, calculated using the proportion of total assets in relation to debt. Other authors have also considered this variable [5,13].

The liquidity dimension is centred on analysing the entity’s capacity to service its short-term liabilities. This dimension was analysed among NPOs in vulnerable situations to determine the ability of such entities to reduce their assets (i.e., current, or non-current assets) when their income is insufficient [5,13]. The operational performance dimension refers to a broad analysis of whether an entity has a positive relationship between its input and output, measuring the adequate application of available resources to reach its objectives. Finally, the reputation dimension, as a social construct, is an important aspect of the organisation, as it influences the perception of organisational effectiveness and fundraising. Similarly, variables were selected considering the following criteria (for more detail, see Table A1):

- The popularity or use in the literature of variables that permit an adequate classification of success or failure among NPOs.
- Relevant variables used in previous studies on the quality control of administrative, organisational, and financial management in educational institutions and other NPOs [20,34,101,102,105–107].
- An incorporated variable that measures the proportion of students with gratuity among the total enrolment (Mat_Grat), which indicates the relative volume of students with gratuity and whether the university is affiliated with gratuity.
- Additionally, variables were considered to capture each university’s institutional and structural characteristics. Property (D1_Privada) is a fictional variable that takes a value of zero if the university’s property belongs to the state and one if it is private. D2_Cruch is a fictional variable that takes a value of zero if the higher education institution does not belong to the CRUCH and one if it does. D3_Tamaño is a fictional variable that takes a value from one to five according to the range of the total number of students enrolled.

4. Results and Discussion

4.1. Statistical Description of the Data

To classify the higher education institutions as vulnerable or non-vulnerable, we followed the model in [20] and the criteria proposed by [68]. A prior classification of the universities was carried out using (3) and (4):

\[
\text{Probability of vulnerability: } P = \frac{1}{(1 + e^{-Y})}
\]

\[
Y = 0.7754 + 0.9272 \times \text{Debt} + 0.1496 \times \text{Conc} - 2.8419 \times \text{Mgdp} + 0.1206 \times \text{Adm} - 0.1665 \times \text{Size}.
\]

This prior classification allowed us to generate two groups, one with 18 non-vulnerable institutions and one with 36 vulnerable institutions. Using these groups, we obtained a model incorporating new significant explicative variables into the original model suggested in [20]. Once higher education institutions were classified as vulnerable or non-vulnerable, relevant variables from the higher education system were incorporated, allowing for an adequate measurement of each variable.

Table 1 presents the mean and standard deviation of each of the proposed explicative variables according to the classification of the universities, which were considered either vulnerable or non-vulnerable. In addition, the Kolmogorov–Smirnov test was applied to hypothesise the data distribution. As a result of this test, the hypothesis of normal distribution for each institution was rejected, and the use of the mean as a parameter of classification between the study groups was invalidated. For this reason, it is not advisable to use parametric tests. Therefore, the Mann–Whitney non-parametric test for independent \( U \) samples was used to ensure that the sum of the ranges for non-vulnerable entities was
always significantly different from those for vulnerable entities in 12 ratios. Accordingly, the hypothesis of equality of means for $p < 0.05$ was rejected.

**Table 1.** Means and standard deviations by variable according to the level of vulnerability.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Vulnerable</th>
<th>Non-Vulnerable</th>
<th>Sample</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
<td>Mean</td>
</tr>
<tr>
<td>Mat_Grat</td>
<td>0.19</td>
<td>0.25</td>
<td>0.42</td>
</tr>
<tr>
<td>Debt</td>
<td>0.47</td>
<td>0.22</td>
<td>0.26</td>
</tr>
<tr>
<td>Apal_Total</td>
<td>1.41</td>
<td>4.53</td>
<td>0.40</td>
</tr>
<tr>
<td>Liq</td>
<td>1.73</td>
<td>2.91</td>
<td>2.12</td>
</tr>
<tr>
<td>Rot_Act</td>
<td>0.73</td>
<td>0.37</td>
<td>0.50</td>
</tr>
<tr>
<td>Mg_Op</td>
<td>0.02</td>
<td>0.11</td>
<td>0.05</td>
</tr>
<tr>
<td>Conc</td>
<td>0.76</td>
<td>0.22</td>
<td>0.51</td>
</tr>
<tr>
<td>Size</td>
<td>24.34</td>
<td>1.28</td>
<td>25.90</td>
</tr>
<tr>
<td>Adm</td>
<td>0.29</td>
<td>0.10</td>
<td>0.23</td>
</tr>
<tr>
<td>Ef_Matric</td>
<td>28.13</td>
<td>13.79</td>
<td>22.70</td>
</tr>
<tr>
<td>Sobred</td>
<td>1.55</td>
<td>0.60</td>
<td>1.70</td>
</tr>
<tr>
<td>A_Acred</td>
<td>3.11</td>
<td>1.97</td>
<td>5.17</td>
</tr>
<tr>
<td>Var_Matric</td>
<td>0.03</td>
<td>0.19</td>
<td>0.04</td>
</tr>
<tr>
<td>Cal_Acad</td>
<td>0.59</td>
<td>0.17</td>
<td>0.70</td>
</tr>
<tr>
<td>PSU</td>
<td>477.06</td>
<td>176.72</td>
<td>574.54</td>
</tr>
<tr>
<td>Al_m2salas</td>
<td>1.27</td>
<td>0.84</td>
<td>0.86</td>
</tr>
<tr>
<td>Ret_1er</td>
<td>0.72</td>
<td>0.21</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors.

For the group of non-vulnerable universities, the variables associated with good financial conduct are highlighted, as they provided superior results. The same was true for the variables Conc and Size. The variables A_Acred, Var_Matric, Cal_Acad, PSU, and Ret_1er were found to be in line with expectations, indicating better conduct among non-vulnerable universities. The variables $E_f_{matric}$ and $A_L_{m2salas}$ were not found to be within the range of expected results. However, it is important also to consider aspects such as teaching quality, which is assumed to improve with fewer students per instructor and greater surface area available per student, not only through the efficient use of resources, as would be expected with a more significant number of students per instructor and square meters of available classroom. However, greater values for the variables $Mat_Grat$ and $Sobred$ were observed in non-vulnerable universities, despite the possible expected negative effects.

4.2. Regression Results and Discussion

Logistic regression models must meet certain suppositions related to the independence of their residuals, for which the Durbin–Watson statistic is used [100]. Such models must also be able to avoid potential multicollinearity problems in their variables, for which the variance inflation (VIF) test, the empirical rule of VIF > 10 [108], and the correlation matrix [109] are used. When estimating the Durbin–Watson test, self-correlation was not observed, but the VIF test showed a greater index than suggested. Consequently, all variables with a VIF above 10 were eliminated.

Table 2 presents the variables used in the model along with their coefficients, the value of the Wald statistic, and the statistical significance. The financial variables Debt and Mg_Op are associated with the financial and operational management of the institution. These results are congruent with those proposed in [6,20,46,49].
Table 2. Differences in the variables of universities according to their level of vulnerability.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Vulnerable</th>
<th>Non-Vulnerable</th>
<th>p-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mat_Grat</td>
<td>0.00</td>
<td>0.46</td>
<td>0.003</td>
</tr>
<tr>
<td>Debt</td>
<td>0.42</td>
<td>0.23</td>
<td>0.000</td>
</tr>
<tr>
<td>Apal_Total</td>
<td>0.72</td>
<td>0.30</td>
<td>0.000</td>
</tr>
<tr>
<td>Liq</td>
<td>1.16</td>
<td>1.64</td>
<td>0.002</td>
</tr>
<tr>
<td>Rot_Act</td>
<td>0.65</td>
<td>0.51</td>
<td>0.013</td>
</tr>
<tr>
<td>Mg_Op</td>
<td>0.039</td>
<td>0.035</td>
<td>0.620</td>
</tr>
<tr>
<td>Conc</td>
<td>0.81</td>
<td>0.45</td>
<td>0.000</td>
</tr>
<tr>
<td>Size</td>
<td>24.74</td>
<td>25.64</td>
<td>0.000</td>
</tr>
<tr>
<td>Adm</td>
<td>0.27</td>
<td>0.21</td>
<td>0.036</td>
</tr>
<tr>
<td>Ef_Matric</td>
<td>24.56</td>
<td>21.91</td>
<td>0.056</td>
</tr>
<tr>
<td>Sobred</td>
<td>1.42</td>
<td>1.68</td>
<td>0.322</td>
</tr>
<tr>
<td>A_Acred</td>
<td>4.00</td>
<td>5.00</td>
<td>0.000</td>
</tr>
<tr>
<td>Var_Matric</td>
<td>0.02</td>
<td>0.03</td>
<td>0.115</td>
</tr>
<tr>
<td>Cal_Acad</td>
<td>0.62</td>
<td>0.70</td>
<td>0.019</td>
</tr>
<tr>
<td>PSU</td>
<td>522.16</td>
<td>574.33</td>
<td>0.004</td>
</tr>
<tr>
<td>Al_m2salas</td>
<td>1.07</td>
<td>0.91</td>
<td>0.054</td>
</tr>
<tr>
<td>Ret_1er</td>
<td>0.80</td>
<td>0.83</td>
<td>0.158</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors.

Belonging to the CRUCH (D2_Cruch) reduces the probability of financial vulnerability and, among other advantages, enables access to public resources unavailable to institutions not belonging to the CRUCH. The proposal for grouping the data is in line with that proposed in [70], which identified two groups of higher education institutions: selective and non-selective. In our case, the selective institutions belonged to the CRUCH.

The volume of enrolment (D3_Tamaño) is inversely related to financial vulnerability, as institutions with greater size obtain greater income and can better manage the available human and material resources. These results are consistent with those proposed in [6,53,54,70].

Thus, (5) and (6) are proposed, which can be used to calculate the probability of a university’s financial vulnerability:

$$Z = 12,689 - 6047 \times D2_{Cruch} - 4581 \times D3_{Tamaño} + 39,330 \times Debt - 60,164 \times Mg_{Op}$$

(5)

$$P(Vulnerable) = \frac{1}{(1 + e^{-(12,689-6047\times D2_{Cruch}-4581\times D3_{Tamaño}+39,330 \times Debt-60,164 \times Mg_{Op})})}$$

(6)

The Cox–Snell R² determination coefficients and Nagelkerke R² were found to be adequate, with values of 0.630 (63.0%) and 0.874 (87.4%), respectively. These values were used to estimate the proportion of variation in the dependent variable that was explained by the resulting model [100,110]. Table 3 shows that the model achieved a precision of 94.4% in the prediction of the state of vulnerability among universities in relation to the data observed. Therefore, it is possible to conclude that, among all 54 universities, 51 were well-classified, and 94.4% were correctly classified as vulnerable or non-vulnerable [111].

To evaluate the model’s predictive capacity, sensitivity and specificity were calculated [111,112]. We found that the estimated model offered high specificity and sensitivity (both 94.4%). Thus, the model adequately classified both vulnerable and non-vulnerable universities.
Table 3. Test of equality of medians and means for private universities that do not belong to the CRUCH.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Test Equality Medians</th>
<th>t-Test Equality Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median without Gratuity</td>
<td>Median with Gratuity</td>
</tr>
<tr>
<td>Value Z</td>
<td>12.56</td>
<td>13.35</td>
</tr>
<tr>
<td>P (vulnerable)</td>
<td>0.99</td>
<td>0.99</td>
</tr>
<tr>
<td>D3_Tamaño</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Debt</td>
<td>0.34</td>
<td>0.56</td>
</tr>
<tr>
<td>Mg</td>
<td>0.03</td>
<td>0.04</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors.

The variables proposed in Equation (5) were used to determine the probability of vulnerability for higher education institutions, which allowed us to calculate Equation (6). In the following section, the probability of financial vulnerability is calculated for higher education institutions affiliated with gratuity and to determine if they correspond to public institutions belonging to the CRUCH, private institutions belonging to the CRUCH, or private institutions not belonging to the CRUCH.

4.3. Application of the Model to Universities Affiliated with Gratuity

Financial vulnerability is a condition that negatively affects the management of an organisation [80]. In accordance with this reality, (5) and (6) were estimated for universities affiliated with gratuity. Figure 1 shows that between 2013 and 2019, the number of vulnerable universities increased from 14 institutions in 2013 to 16 in 2019. This analysis was conducted from 2013 to 2015, and the gratuity was found to increase in one institution during each period.

![Figure 1. Number of vulnerable universities affiliated with gratuity.](image)

Figure 2 shows the evolution of the probability of financial vulnerability for universities affiliated with gratuity. During the pre-gratuity period from 2013 to 2015, the average probability of vulnerability was lower than that of the post-gratuity period. This result suggests that the policy of funding higher education negatively affects the financial vulnerability of affiliated universities.
The results shown in Figures 1 and 2 are consistent with those proposed in [62–64], which identified and reinforced the factors that affect financial vulnerability in education institutions. According to the above analysis, the probability of financial vulnerability has increased, on average, for all universities affiliated with gratuity (see Figure 2). Thus, H1 is accepted.

Figure 3 shows the disaggregation of universities by property and membership in the CRUCH. Private universities that do not belong to the CRUCH did not present changes in their classification. Of the six institutions that composed this group, five continued to be financially vulnerable during the period under study. However, the universities belonging to the CRUCH, whether private or state-owned, presented changes in their classification. Of the nine affiliated private universities in the CRUCH, three were vulnerable in 2015, which reduced to two in 2019. Of the sixteen state-owned universities, seven were vulnerable in 2015, and this number increased to nine in 2019.

When considering universities by property and membership in the CRUCH, with the evolution of the probability of financial vulnerability of universities affiliated with gratuity, we found that private universities that do not belong to the CRUCH do not change their probability, which remained at 84%, on average, for the study duration. Private universities belonging to the CRUCH showed a reduction in their vulnerability probability (in 2013, this value was 47.28% and in 2019, it was 23.22%). State-owned universities...
increased their probability of vulnerability over the entire period analysed (beginning in 2013 (31.75%) and ending in 2019 (55.77%); see Figure 4).

![Figure 4. Probability of financial vulnerability by property and membership in the CRUCH.](image)

According to the previous analysis, as shown in Figure 4, the probability of financial vulnerability for state-owned universities was negatively affected, compared to other universities, through affiliation with gratuity.

These results demonstrate that public higher education institutions affiliated with gratuity have business models that are more vulnerable to budget adjustments by the state [113]. Therefore, the funding challenges of these institutions are affected by perspectives on future economic growth [113,114]. As a result, many public higher education institutions globally have increased their fees and enrolment to compensate for this decrease in public funding [43]. However, this type of increase is not permitted by law in the Chilean higher education system. We observed that this probability has increased significantly since 2017. Therefore, H2 was rejected.

### 4.4. Comparison Probability of Vulnerability between Periods before (2013 to 2015) and after (2016 to 2019) the Implementation of Gratuity

The comparison of probabilities was performed using a Mann–Whitney test for medians, given that the variables under study did not meet the assumption of normal distribution and had a null hypothesis of equal medians [112]. Nonetheless, the Mann–Whitney test was complemented with a test of means, assuming a normal distribution with the null hypothesis of equal means [112].

For private universities that do not belong to the CRUCH, the results failed to reject the null hypothesis, showing no statistically significant differences between the medians and means for the probability of financial vulnerability, $P(\text{vulnerability})$, in the study period. Therefore, it is possible to rule out a negative effect of gratuity on financial position, which can be explained as this type of institution not being regulated in terms of fees or enrolments, giving it greater discretion to adjust its business model [113]. Notably, the mean and median in both periods placed these universities in a state of financial vulnerability.

Table 1 outlines the tests applied in detail.

For private universities belonging to the CRUCH, the results of the tests allowed us to reject the null hypothesis for both the medians and means of financial vulnerability. For this reason, it was possible to deduce that the implementation of gratuity did not affect the financial position of private universities of the CRUCH, which maintained a state of non-vulnerability. Table 2 presents details on the tests of differences for the medians and means of each test.
Regarding state-owned universities, the Mann–Whitney test results allowed us to reject the null hypothesis. The difference between the medians corresponded to an increase in the median of probability in the period of gratuity compared to the previous period, which indicated that gratuity negatively affected the financial position of these universities. Furthermore, this increase placed such institutions within the range of vulnerability. The results of Student’s t-test failed to reject the null hypothesis. However, the probability did not have a normal distribution for the data. Thus, the behaviour of the results was reviewed for the value $Z$, which corresponded to the value of the linear function of the logistic regression model and had a direct relationship with the probability of financial vulnerability. In both tests, the null hypothesis was rejected, and considering the values of the medians and means, it was possible to determine that the probability increased with gratuity. Moreover, given the values of $Z$, in the pre-gratuity period, state-owned universities were not vulnerable but passed into a state of vulnerability during the period of gratuity. Thus, gratuity negatively affected the financial position of those institutions.

Tables 3–5 present details for the tests of differences in the medians and means for each test. It is important to analyse the model variables to explain the increase in the probability of financial vulnerability in state-owned universities. After reviewing the tests of the differences of means and medians, we found that the debt variable rejected the null hypothesis of equality between the periods under study and that the difference corresponded to an increase in both the mean and the median. Figure 5 shows the evolution of the debt variable starting from 2013, and the significant increase observed for state-owned universities becomes evident when considering the results of the statistical tests.

**Table 4. Test of equality of medians and means for private universities belonging to the CRUCH.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Test Equality Medians</th>
<th>t-Test Equality Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median without Gratuity</td>
<td>Median with Gratuity</td>
</tr>
<tr>
<td>Value Z</td>
<td>−1.08</td>
<td>−1.78</td>
</tr>
<tr>
<td>P (vulnerable)</td>
<td>0.25</td>
<td>0.14</td>
</tr>
<tr>
<td>D3_Tamaño</td>
<td>4</td>
<td>4.14</td>
</tr>
<tr>
<td>Debt</td>
<td>0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>Mg</td>
<td>0.04</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Source: Prepared by authors.

**Table 5. Test of equality of medians and means for state-owned universities belonging to the CRUCH.**

<table>
<thead>
<tr>
<th>Variables</th>
<th>Test Equality Medians</th>
<th>t-Test Equality Means</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median without Gratuity</td>
<td>Median with Gratuity</td>
</tr>
<tr>
<td>Value Z</td>
<td>−3.43</td>
<td>0.17</td>
</tr>
<tr>
<td>P (vulnerable)</td>
<td>0.03</td>
<td>0.54</td>
</tr>
<tr>
<td>D3_Tamaño</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Debt</td>
<td>0.18</td>
<td>0.24</td>
</tr>
<tr>
<td>Mg</td>
<td>0.03</td>
<td>0.03</td>
</tr>
</tbody>
</table>

Source: Prepared by authors.
Despite not verifying statistically significant changes in the variable for the size of enrolment, D3_Tamaño, in the period analysed, it was necessary to analyse its behaviour briefly over a longer time horizon. The proposed model indicates that this variable has an inverse relationship with financial vulnerability. In other words, when enrolment at the university is reduced, the probability of vulnerability increases. This factor is important, as undergraduate enrolments in Chile, despite showing no signs of stalling or receding, are now peaking [115]. There are two main reasons for this situation. First, Chile has a coverage rate of 87% among the age group able to be in higher education (gross coverage). Second, Chile has few high school graduates, which diminishes the pool of young people who can apply to higher education [115].

Similarly, the authors of [115] noted that while a gratuity provides an incentive for the first quintals, it also imposes limits on such institutions on the growth of the offers they can make. In addition, considering the evolution of the fertility and childbearing rates in Chile since 2011, demographics could explain the stalling enrolments and the low number of high-school graduates. For more details, see Figures 6 and 7.
4.5. Application of the Proposed Model in Higher Education Institutions That Lost Their Recognition as Universities in the Period of 2013–2018

In recent years, the Chilean higher education industry has suffered university closures due to financial stress and insolvency. In total, six universities have closed, and one is in the process of closing, in 2022. Figure 8 depicts the evolution of the Z-value estimated for each year, which corresponds to the value of the linear function of the logistic model and has a direct relationship with the probability of financial vulnerability. A graphical representation of the Z-value was used here, as this representation allowed us to observe the relevant trends. Graphing the probability would only show a straight line close to 100%, which is useless in analysing trends.

However, Figures 9 and 10 show the evolution of the variables of the model that explain the increase in the probability of financial vulnerability. The debt variable, Debt, shows a sustained increase, reaching an average of 847%, in 2018; a significant increase from the 78.4% witnessed in 2013. The operating margin, Mg.Op, showed deterioration reaching −96.5% in 2018.

Finally, the variable of enrolment size, D3.Tamaño, showed a notable decrease from an average of 3.25 in 2013 to an average of 2 in 2018. The variable D2.Cruch was not reviewed as none of the closed universities belonged to the CRUCH.
5. Conclusions

This study aimed to propose a model to determine the probability of financial vulnerability for an NPO and a higher education institution. Therefore, we considered the application of this research to the Chilean higher education industry, due to structural changes in the funding system, especially the application of a gratuity policy and the corresponding regulations. In addition, the proposed methodology for evaluating financial vulnerability can be applied to other areas of the education industry and in other countries.

In this novel study, we proposed a model to evaluate the effects of the gratuity policy on the financial vulnerability of higher education institutions, which could undoubtedly affect the normal development of such institutions over time. To achieve this objective, a logistic regression model was used. This model enabled us to estimate the probability of financial vulnerability and its evolution over time in a higher education institution.

The results of applying the model to universities affiliated with gratuities and the statistical tests of the differences in medians and means revealed that in the periods of the gratuity policy, the probability of financial vulnerability among state-owned universities increased, passing from a state of non-vulnerability to one of vulnerability. Thus, gratuity deteriorated the financial positions of these institutions.

For private universities, changes were not observed in the probability of financial vulnerability between the pre-gratuity and gratuity periods, regardless of whether the institutions belonged to the CRUCH.

The inverse relationship between size and financial vulnerability underscores discussions surrounding demographic variables such as birth rate and its relationship with the evolution of enrolment growth. Both show a sustained fall and, together with the gross coverage in higher education (87%), reflect issues in infrastructure investment, geographic coverage, educational models, investments in technology, and other long-term and strategic aspects.
A limitation of this study is the unavailability of other sources of non-financial information, such as university business models and the stock of strategic resources, which could improve our model, as this information is more strongly related to control than to management.

Finally, future research on estimating the possibility of financial vulnerability in nonprofit organisations should recognize certain variables of interest that are typical of corporate governance, such as the influence of the CEO’s leadership and the composition of the board, since these topics have not yet been studied in higher education institutions in emerging markets.


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Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Description and measure of variables.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Abbreviation</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotation of assets</td>
<td>Rot_Act</td>
<td>Total income to total assets</td>
</tr>
<tr>
<td>Operating margin</td>
<td>Mg_Op</td>
<td>Operating margin to total operating income</td>
</tr>
<tr>
<td>Income concentration</td>
<td>Conc</td>
<td>Calculated using Herfindahl and Hirschman index</td>
</tr>
<tr>
<td>Asset size</td>
<td>Size</td>
<td>Natural logarithm of total assets</td>
</tr>
<tr>
<td>Square metres of rooms per student</td>
<td>Al_m2salas</td>
<td>Total students/total square metres of classrooms</td>
</tr>
<tr>
<td>Debt</td>
<td>Debt</td>
<td>Total debt to total assets</td>
</tr>
<tr>
<td>Leverage</td>
<td>Apal_Total</td>
<td>Total liabilities to patrimony</td>
</tr>
<tr>
<td>Liquidity</td>
<td>Liq</td>
<td>Circulating assets to circulating liabilities</td>
</tr>
<tr>
<td>Administration costs</td>
<td>Adm</td>
<td>Administration costs to total operational income</td>
</tr>
<tr>
<td>Enrolment efficiency</td>
<td>Ef_Matric</td>
<td>Total students/total academics</td>
</tr>
<tr>
<td>Years of over-duration</td>
<td>Sobred</td>
<td>Years studied/nominal duration of program</td>
</tr>
<tr>
<td>Years of accreditation</td>
<td>A_Acred</td>
<td>Years of accreditation granted by the CNA</td>
</tr>
<tr>
<td>Annual variation in enrolment</td>
<td>Var_Matric</td>
<td>Percentage of variation in enrolment with respect to previous year</td>
</tr>
<tr>
<td>Students with benefit of gratuity</td>
<td>Mat_Grat</td>
<td>Percentage of students benefitting from gratuity</td>
</tr>
<tr>
<td>Retention first year</td>
<td>Ret_1er</td>
<td>Total student enrolments at end of first year/total student enrolments at beginning of first-year</td>
</tr>
<tr>
<td>---------------------</td>
<td>---------</td>
<td>------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Prestige/reputation dimension</td>
<td>Cal_Acad</td>
<td>Academics with post graduate studies/total academics</td>
</tr>
<tr>
<td>Average entry score</td>
<td>PSU</td>
<td>Average entry score to the institution</td>
</tr>
<tr>
<td>Property and institutional characteristics dimension</td>
<td>D1_Privada</td>
<td>Takes value 0 if state-owned or public; takes value 1 if private</td>
</tr>
<tr>
<td></td>
<td>D2_Cruch</td>
<td>Takes value 0 if it does not belong to the CRUCH; takes value 1 if it does</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Takes value 1 if enrolment is less than 1500; takes value 2 if enrolment is above 1501 and less than 5000; takes value 3 if enrolment is above 5001 and less than 10,000; takes value 4 if enrolment is above 10,001 and less than 20,000; takes value 5 if enrolment is above 20,001</td>
</tr>
</tbody>
</table>

Source: Prepared by the authors.

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