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Guest editorial: Innovation, entrepreneurship and knowledge

This special issue focuses on research that examines a diverse set of determinants that can influence innovation and business performance while optimising social welfare and utility. The research in this special issue covers a range of topics, including individual and learning factors such as interpersonal competencies and employee behaviour, business factors such as brand attractiveness and organisational excellence, as well as regional factors and their effect on the global business environment.

In the future, innovation gaps will be evident and pronounced in various sectors and economies (Sharma *et al.*, 2022). Market trends are influencing the behaviours of organisations and individuals. Moreover, Nyagadza (2022) highlights the dynamic and intense nature of the changes happening in technology globally and the specific market environment in which business organisations operate. The development of business models that focus on innovative progress remains an unresolved issue due to the need to define the functions and responsibilities of participants in the ecosystem (Krasyuk *et al.*, 2021). In that sense, organisational effectiveness and innovation have become global priorities (Naveed *et al.*, 2022).

In order to achieve success in the global market, it is necessary for a firm to align and manage its resources effectively in response to dynamic market conditions (Bashir *et al.*, 2022). In particular, authors such as Porter and Kramer (2006) propose new relationships and considerations between business and society that make it possible to identify the social consequences of their actions and to determine the opportunities in the environment. In turn, others such as Rico and Cabrer-Borrás (2019) highlight the relationship between the level of knowledge and innovation and regional economic growth. Accordingly, companies attempt to effectively navigate the competitive landscape by crafting an appropriate strategy (Garrido-Vega *et al.*, 2021). As a result, in order to maximise the benefits and minimise the negative impact, many business strategies are being modified.

Society has been involved in various changes over the last few years, generating vulnerabilities and risks for organisations. Vulnerability has various meanings ranging from direct damage from disasters to indirect factors (Kim *et al.*, 2021). Therefore, it is essential to analyse the variables derived from the constant changes in today's world and to consider other elements such as innovation and business management for the success and

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As Guest Editors, we would like to thank the Editor-in-Chief, Enrique Bigné, for his support of this special edition and for his invaluable guidance throughout the process. We are also grateful to the reviewers for their thorough and insightful feedback, which has greatly enhanced the quality of the articles. Finally, we express our appreciation to the authors of the scientific articles for their hard work and dedication in researching and composing their contributions.

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sustainability of companies. Sustainability has become one of the primary objectives of a plethora of companies, due to the growing concern for environmental preservation and social responsibility (Zavadskas *et al.*, 2016). However, achieving objectives in line with society's needs is no easy task. Therefore, a combination of skills, experience and knowledge is required. Thus, the knowledge generated in this regard is essential for innovation and business management, as it enables companies to keep abreast of the latest trends and developments. This can generate a competitive advantage that will allow organisations to act proactively to market changes, thus avoiding risks.

Social change is evident and so is the concern of modern society to maximise profit and care for the environment. Business sustainability is accompanied by economic, natural and social management (Pongrácz, 2009) that considers the optimisation of resources and allows for innovation in structures. In this way, the board of directors' audit committee supervises financial reporting and guarantees accurate financial statements and high-quality reporting (Ferris and Liao, 2019). However, in modern society, it has become essential to take care of the environment and manage resources optimally. Thus, these changes also have the capacity to have an impact on the way companies are created, the value of the brand and the perceived usefulness to society. Along these lines, non-governmental organisations (NGOs) and their contribution to society should be highlighted due to the impact they generate. In this sense, NGOs help the community to empower itself and can influence sustainable development because of the different programmes and functions they provide (Nikkhah and Redzuan, 2010).

At the individual level, there have also been several trend changes. Soft skills are interpersonal qualities that are currently highlighted for their relevance in the organisation (Robles, 2012). Being outstanding attributes, the different skills are enhanced as innovative models of growth and impetus for personal and professional development. In this sense, techniques such as mindfulness have been considered linked with learning and educational topics (Langer and Moldoveanu, 2000) and in the business field (Jamieson and Tuckey, 2017) since it allows a conscious development and treatment of the challenges in which society is immersed. Thus, there are different business trends focused on innovation and the provision of differential value, as leaders must consider developing a portfolio of competences at both the individual and team level in the organisation which enable business innovation (Liedtka *et al.*, 2022).

Taking into account the contribution made by Bigné Alcañiz (2016), who points out that over time different approaches have been presented in research and recent changes in access to data pose challenges to current research, this special issue presents some of the outstanding contributions in the field of innovation and social change, covering different management approaches, data analysis and processing. The authors have provided essential knowledge for innovation and business management, and their work is of great importance for the advancement of these fields.

Synopsis of the articles

In the first article, Mao, H. and Ostaszewski, K. focus on the optimal design of reinsurance contracts. A substantial body of research literature exists concerning the optimal design of an insurance contract, in general, but most of this research seeks optimisation from the perspective of the purchaser of insurance (which for a reinsurance contract would be the original insurer, i.e. the ceding company). In this work, instead, mutual benefit of both the ceding company and the reinsurer are considered in an integrated model. The paper presents an optimal contract design and pricing of the contract, obtained via numerical optimisation. The model is also applicable to optimal design of a regular insurance contract, as a consumer seeking insurance also retains some risk, in a manner similar to an insurance company

seeking reinsurance. The complexity of the model prevents obtaining a closed form solution, and only numerical optimisation results are obtained. However, the procedure presented may be applicable in real world applications, and further research on simplified solutions is possible and suggested. They note that in view of governments resolving recent financial crises in a manner analogous to acting as a reinsurer of last resort, the model may be applicable to optimal design for public policy aimed at the best possible approach to resolving financial crises.

In the second scientific contribution, Samagaio, A. and Felício, T. identify internal audit as a key element of corporate governance, which allows an accurate picture of organisations to be assessed and to take actions to improve their efficiency and effectiveness. The quality of internal audits is influenced by characteristics of the organisation itself, but also by internal auditors' individual factors, as how they perceive the support of the organisation or their risk profile, among others. This paper focuses on some of these characteristics to analyse their impact on internal audit quality, measured by reduced audit quality practices (RAQP). This study found some relations between some of these variables on internal audit quality. Therefore, theoretically this paper contributes to the stream of research regarding the determinants of internal audit quality, a topic with few studies, to evidence the factors that shape the effectiveness of the internal audit function, focus on the internal auditor perspective, a current of research that has been little observed in the literature and emphasise the relevance of researchers also focussing on internal auditors' ethical skills. Methodologically, the authors developed a literature-based scale to measure RAQP. By showing that the auditors recognise RAQP, this study contributes to practice by highlighting the importance of quality assurance in these departments, showing which variables affects RAQP and to evidence the relevance of the Audit Committee to the improvement of internal audit quality.

In the third paper, Hebles, M., Yániz-Álvarez-de-Eulate, C. and Villardón-Gallego, L. analyse best practices in the actual implementation of debriefing in organisations, using the guidelines set out in the procedure as criteria. The aim of the method is to improve performance and learning through feedback and consists of three phases: (1) reflection; (2) data review and information exchange; and (3) goal setting and action planning. To develop the research, a debriefing session was observed in different organisations and four categories related to debriefing were identified and characterised: self-analysis, debriefing, planning and team development orientation. This research has different implications for business leaders, and the authors recommend the appropriate use of debriefing in organisational settings, as it can have a positive impact on both team effectiveness and team members' ability to work as a team.

In the fourth paper, Rios Romero, M.J. *et al.* present an innovative model for assessing the brand equity of NGOs based on the donors' perspective. The objective is to propose a novel donor-based brand equity model that takes into consideration the special characteristics that donors confer to NGOs that demand higher moral capital. The proposed model includes three dimensions: familiarity (recall, brand strength, brand identification), associations (authenticity, reputation, differentiation) and commitment (attitudinal, emotional) which differ from those used in previous models of brand equity for NGOs and consumers. For the research, they developed a questionnaire distributed online with 131 valid responses. The analysis is carried out using the partial least square (PLS) method. As a result, these academics highlight that due to the increased competition for donations, it is essential for NGOs to have a strong brand to improve the attractiveness of NGOs to donors and to promote increased donations and donor engagement. This model can be useful for NGOs when planning marketing strategies to strengthen their NGO's brand equity.

In the fifth research article, Lucero-Romero, G. and Arias-Bolzmann, L.G. position mindfulness as a key element for decision-making in today's uncertain environments.

This study experimentally determines the degree of influence that mindfulness training has on the learning ability of graduate students from a university. The research was carried out in the context of the COVID-19 pandemic, so it was also possible to evaluate the behaviour of alternative teaching-learning systems, online and hybrid, and contrast them with face-to-face mechanisms. The main contributions are the following. First, since previous research has been mostly observational or relational in nature, a quasi-experimental methodology was applied here to establish possible causal relationships between the application of mindfulness and the effect studied. Second, various practical consequences were identified within postgraduate university environments that guided students, teachers and administrative staff to optimise their performance within training programmes and academic interactions. Thirdly, the involvement of the participants in reflection, learning and understanding of the importance of perfecting soft skills to facilitate the teaching-learning processes and face the uncertain living conditions of this century is promoted. Fourthly, it was verified that the application of an unconventional mechanism such as mindfulness to promote the teaching-learning processes generates important benefits not only for the students involved in the study but for the entire university community. Finally, the need for companies to have collaborators with solid technical and human skills is met, which benefits society as a whole.

The sixth paper, by Beccarello, M. and Di Foggia, G., frames the relevance of the scale and scope of the business models used in municipal solid waste (MSW) management. The authors compare the efficiency of different MSW management models in Italy. Data from the municipal waste cadastre of the Italian National Institute for Environmental Protection (ISPRA), as well as data available from the public balance sheets of the city of Milan, were used for the analysis. The aim of the study is to examine the factors affecting the efficiency of MSW management, either through a single contractor or through multiple suppliers. As a main result, they conclude that the allocation of MSW management to a single contractor may be more cost-efficient due to organisational issues and transaction costs. The scale of service and operational issues were found to be important factors in the optimisation of MSW management service costs. As a novelty, these authors have analysed and tested the same hypothesis under different conditions, often neglected in previous studies on efficiency MSW management.

In this framework, these contributions provide new ideas and solutions essential for organisational and societal progress and management. These results offer valuable insights to researchers, practitioners and policy makers who seek to understand and improve organisational performance, support the conscious use of resources and mitigate negative impacts on society.

Conclusions

From a global perspective, the articles in this special issue illustrate the role of knowledge management and innovation in various geographical and organisational contexts. In conclusion, the special issue highlights the relevance of adapting organisations to the trends and demands of today's society, taking into account the changing needs in terms of technology and training. Thus, this research provides a better understanding of some of the major issues in today's world by providing detailed and rigorous information. Moreover, the results provided by the authors allow the information provided to be used for decision-making in changing environments. In short, it will be essential to take these approaches into account in order to promote conscious management of organisations.

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Pricing reinsurance and determining optimal retention based on the criterion of maximizing social expected utility

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Abstract

Purpose – The authors consider the mutual benefits of the ceding company and reinsurance company in the design of reinsurance contracts. Two objective functions to maximize social expected utilities are established, which are to maximize the sum of the expected utilities of both the ceding company and reinsurance company, and to maximize their products. The first objective function, additive, emphasizes the total gains of both parties, while the second, multiplicative, accounts for the degree of substitution of gains of one party through the loss of the other party. The optimal price and retention of reinsurance are found by a grid search method, and numerical analysis is conducted. The results indicate that the optimal solutions for two objective functions are quite different. However, optimal solutions are sensitive to the change of the means and volatilities of the claim loss for both objective functions. The results are potentially valuable to insurance regulators and government entities acting as reinsurers of last resort.

Design/methodology/approach – In this paper, the authors apply relatively simple, but in the view significant, methods and models to discuss the optimization of excess loss reinsurance strategy. The authors only consider the influence of loss distribution on optimal retention and reinsurance price but neglect the investment factor. The authors also consider the benefits of both ceding company and reinsurance company to determine optimal premium and retention of reinsurance jointly based on maximizing social utility: the sum (or the product) of expected utilities of reinsurance company and ceding company. The authors solve for optimal solutions numerically, applying simulation.

Findings – This paper establishes two optimization models of excess-of-loss reinsurance contract against catastrophic losses to determine optimal premium and retention. One model considers the sum of the expected utilities of a ceding company and a reinsurance company's expected utility; another considers the product of them. With an example, the authors find the optimal solutions of premium and retention of excess loss reinsurance. Finally, the authors carry out the sensitivity analysis. The results show that increasing the means and the volatilities of claim loss will increase the optimal retention and premium. For objective function I, increasing the coefficients of risk aversion of or reducing the coefficients of risk aversion of will make the optimal retention reduced but the optimal premium increased, and vice versa. However, for objective function 2, the change of coefficient of risk aversion has no effect on optimal solutions.

Research limitations/implications – Utility of the two partners: The ceding company and the reinsurance company, may have different weights and different significance. The authors have not studied their relative significance. The simulation approach in numerical methods limits us to the probability distributions and stochastic processes the authors use, based on, generally speaking, lognormal models of rates of return. This may need to be generalized to other returns, including possible models of shocks through jump processes.

Practical implications – In the recent two decades, reinsurance companies have played a great role in hedging mega-catastrophic losses. For example, reinsurance companies (and special loss sharing arrangements) paid as much as two-thirds of the insured losses for the September 11, 2001 tragedy.

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Furthermore, large catastrophic events have increased the role of governments and regulators as reinsurers of last resort. The authors hope that the authors provide guidance for possible balancing of the needs of two counterparties to reinsurance contracts.

Social implications – Nearly all governments around the world are engaged in regulation of insurance and reinsurance, and some are reinsurers themselves. The authors provide guidance for them in these activities.

Originality/value – The authors believe this paper to be a completely new and original contribution in the area, by providing models for balancing the utility to the ceding insurance company and the reinsurance company.

Keywords Reinsurance, Optimization, Social expected utility, Retention and price of reinsurance, Mutual benefit

Paper type Research paper

1. Introduction

Two kinds of pricing models, mean-variance and expected utility models, are often used in research on reinsurance pricing. The former is focused on seeking optimal retention which minimizes the ceding company's risk, and the latter is focused on seeking optimal retention which maximizes the ceding company's utility. Kremer (2002) discusses the limit-determination for the excess-of-loss cover with a simple retrocession treaty. Gajek and Zagrodny (2004) derived optimal forms for stop-loss contracts when the insurer attempts to minimize the probability of ruin. Centeno (2005) studied the optimal excess-of-loss retention limits for two dependent risks. They established the expected utility of wealth with respect to the exponential utility function and adjustment coefficient of the retained aggregate claim amount and found optimal retention limits by means of the optimization objective function. Bai *et al.* (2010) studied the optimal strategies of excess-of-loss reinsurance and dividends by maximizing the expected total discounted dividends received by shareholders until the time of ruin. The problem was formulated as a stochastic impulse control problem and explicit solutions were obtained. The transaction costs and taxes were considered in calculation of dividends. Froot and O'Connell (2008) examined the equilibrium catastrophe reinsurance price when maximizing the values of primary insurers. They concluded that a reinsurance company should charge a price greater than required by a "fair" return. Cao and Xu (2010) assumed that investment funds follow the logarithm-normal distribution. They derived the proportional and excess-of-loss reinsurance contracts, and formulated the convex combination of the insurer and reinsurer's returns exceeding a constant value at a probability. The premium was determined based on the equivalence principle. Zhao *et al.* (2013) studied the optimal excess-of-loss reinsurance and investment problem for an insurer with a jump-diffusion risk model. They established the objective function for maximizing the expected exponential utility of the terminal wealth of a reinsurer. Liang and Bayraktar (2014) considered the optimal reinsurance and investment problem in an unobservable Markov modulated compound Poisson risk model, where the intensity of the jump size distribution is not known but must be inferred from observations of claim arrivals. They established an optimal model using stochastic control theory.

These existing models only consider the benefits of ceding companies but have not considered the mutual influence between ceding and reinsurance companies. Reinsurance companies play an important role in hedging catastrophic losses and reducing the disruption of insurance markets after a mega-catastrophic event (see Cummins, 2007). If their benefits have not been considered, the reinsurance company will be reluctant to provide catastrophe coverage. Baton and Lemaire (1981) analyzed a dynamic game in a multicriteria situation in which players attempt to maximize their payoffs but also try to enter a "stable coalition in the frame of discretion." Mao and Wen (2018) stated that, "In all of the existing systems, [an] appropriate amount of capital is required for insurance companies to hold, in order to remain financially sound with certain probability during a

specified period. However, this does not necessarily guarantee maximal social welfare, and thus is not derived from an economically optimal design under social planning." This issue has already drawn some interest from academia. For example, Dasgupta and Nanda (1993) presented the asymmetric Nash bargaining outcomes based on the optimal capital structure, which maximize the product of the weighted exponent of the insurer's profit and consumer surplus (also note Thomson, 1981). Mao and Ostaszewski (2007) discussed pricing models for a deferred annuity, in which cooperative game theory is applied to formulate different pricing models according to customers' preferences about benefits and risks to maximize social welfare. Huang and Tzeng (2007) showed that the policymaker can select a tax deduction rate to maximize the weighted average of the insured's expected utility and the insurer's expected value. Zanjani (2010) derived prices that are consistent with a social optimum based on an insurance company's capital allocation and the consumer-level capital allocation. Nevertheless, all of the abovementioned studies only discuss one decision variable in the optimization problem, such as price, tax, or capital structure to maximize social benefit. Mao and Wen (2018) explored the optimal price, default ratio and capital for insurance companies under social welfare maximization from regulators' perspective. Traditional reinsurance pricing only considers the benefit to the ceding company. However, a firm's success depends not only on the price charged, but also on how a reinsurance company and its competitors respond.

Li *et al.* (2014) assumed that the claim process is described by a Brownian motion with drift, the insurer can purchase proportional reinsurance, and that both the insurer and reinsurer can invest in risk-free and risky assets. By taking both the insurer and reinsurer into account, they aim to maximize the expected product of the insurer and the reinsurer's exponential utilities of terminal wealth. Ya *et al.* (2018) studied a robust optimal reinsurance-investment problem for a general insurance company that holds the shares of insurance and reinsurance companies. That work utilized assumptions similar to those of Li *et al.* (2014) regarding the claim and investment processes. Moreover, the general insurance company's manager is an ambiguity-averse manager who worries about model uncertainty in model parameters. The ambiguity-averse manager's objective is to maximize the minimal expected product of the insurer and reinsurer's exponential utilities. Zhao *et al.* (2017) studied time-consistent solutions to an investment-reinsurance problem under a mean-variance framework. They considered the weighted average of the interests of both an insurer and reinsurer jointly in the decision-making process. The claim process of the insurer that they utilized was governed by a Brownian motion with drift. A proportional reinsurance treaty was considered, and the premium was calculated using the expected value (equivalence principle for net premiums). Both the insurer and reinsurer were assumed to invest in a risky asset, driven by a constant elasticity of variance model. Li *et al.* (2017) considered an equilibrium excess-of-loss reinsurance and investment strategy. They assumed that the surplus process follows the classical Cramér-Lundberg model and that there is both a risk-free and risky asset available for investment. Under the framework of mean-variance and game theory, the equilibrium solutions were obtained.

Existing studies on optimal excess-of-loss strategy are focused on the determination of optimal retention assuming the reinsurance premium is given. The reinsurance premium is generally determined based on the historical data. However, in a situation where there is no historical data on reinsurance claims, it is difficult to determine the reinsurance premium. Since the retention and reinsurance premiums mutually affect one another, the optimization problem must take both the retention and reinsurance premiums into account simultaneously; it is necessary to consider both the reinsurance premium and retention as decision variables. Moreover, analysis of reinsurance and investment strategy established based on stochastic control theory or stochastic differential game theory is generally quite complicated, and optimal solutions are only obtained by approximate numerical method. In

our opinion, the value-added effect of investment and the dynamic consideration of random variables for short-term catastrophic, property and liability insurance are very limited, especially in China; however, some nonlife insurance companies have purchased investment-linked nonlife products in recent years, but the maturities of most of these products are limited to intermediate periods, generally, three to five years (Liu and Zhang, 2007). Furthermore, as reported by Sina Finance of Sina Web (2017) [1], the Banking and Insurance Supervision Committee of China declared the suspension of investment-linked products for nonlife insurance companies.

In this study, we apply relatively simple, but in our view significant, methods and models to discuss the optimization of excess-of-loss reinsurance strategies. We only consider the influence of loss distribution on optimal retention and reinsurance prices but neglect the investment factor at this time, leaving this issue for later studies. We also consider the benefits of both the ceding and reinsurance company to determine the optimal premium and retention of reinsurance based on the maximization of social utility, by considering the sum or product of the expected utilities of the reinsurance and ceding companies. The approach of considering benefits to the insurer and reinsurer in combination is relative rare in the existing literature. Syuhada *et al.* (2021) consider only specific types of contracts: combined stop-loss and quota-share, reinsurance and present conditional tail expectation (CTE)-based optimization from the joint perspective of the insurer and reinsurer. Chen (2021) studied the optimal reinsurance contracts that minimize the convex combination of the conditional value-at-risk (CVaR) of the insurer and reinsurer's losses over the class of ceded loss functions such that the retained loss function is increasing, and the ceded loss function satisfies the Vajda condition. Moreno *et al.* (2022) provided an interesting perspective on studying the soundness of insurance firms. We also note the work of Gong *et al.* (2021) and Marinakis and White (2022) providing the perspective of the trading markets and price discovery, as well as sustainability.

We believe our approach in this study is more general than those recent papers and can shed new light on the practice of reinsurance, as well as the relatively new approach of considering the benefits of the contract in aggregation with the perspectives of the two contract parties.

During periods of significant financial or economic stress, regulators and governments often assume new duties in their supervision of insurance markets, which often amount to the provision of special kinds of reinsurance for unexpectedly large losses due to shocks such as credit crises or pandemics. Such interventions are typically enacted as ad-hoc mechanisms designed to prevent a large systemic financial crisis but not with the perspective of maximizing welfare or social benefits or all sides of these transactions. We hope that our model can serve as guidance for regulators finding themselves in such stressful situations seeking not only to provide relief from current stress, but also longer-term benefits, such as financial stability, thus reducing the need for sudden reinsurance-like interventions.

We believe our work brings about a new contribution in the field, while building on the existing body of literature.

The remainder of the paper is organized as follows:

(1) Section 1 presents a model for determining the optimal price of reinsurance and optimal retention in the reinsurance contract. This section begins with a subsection discussing the main hypothesis.

(2) Section 2 presents model applications for specific utility functions, some theoretical results that supplement that application, as well as the results of numerical analyses, including graphical representation.

(3) The following section is a discussion.

(4) The paper ends with conclusions, summarizing the results and discussing possible future research.

2. Model for determining optimal price and retention of excess-of-loss reinsurance

Main hypothesis of the research: Our main hypothesis proposes that when the combined benefit of the ceding insurance company (i.e., an insurance company purchasing an insurance contract) and the reinsurance company (i.e., the insurance company selling that insurance contract) are considered, optimal pricing and contract structure vary, and sometimes vary significantly, when compared with pricing and structure when only the perspective of the ceding company is adopted (the dominant perspective in the existing literature). We verify this hypothesis in this research. It should be noted that our results are numerical and based on optimization in MATLAB, not closed form solutions, due to the complexity of the problem. We hope that this research will be furthered, improved upon or even perfected in future work.

2.1 Maximizing the sum of the expected utilities of a reinsurance company and ceding company (objective function I)

To simplify the analysis, we assume that there is only one ceding company and one reinsurance company. Let X be the claim of the catastrophic loss. By bargaining between the ceding and reinsurance company, they reach the following reinsurance contract: If the claim X is less than or equal to the retention M, the ceding company will pay the claim; if the claim X is larger than the retention M, the ceding company will pay M and the reinsurance company will pay the excess part of the claim. We assume that both the ceding and reinsurance company are risk averse.

Let the ceding and reinsurance companies sign their reinsurance contract at time $t = 0$; the claim loss is paid at the end of the year and the discounting factor is approximately offset by the investment factor. In this way, we can simplify our analysis. We assume that the information is complete and that there is no problem of moral hazard or adverse selection caused by private information. Let the cumulative distribution function of the claim X be $F(x)$, and its density function be $f(x)$, with $0 < x < \infty$. Let the contract premium of reinsurance be P. The net benefit obtained by the reinsurance company is

$$Y_1 = \begin{cases} P & \text{when } 0 \le X \le M, \\ P - (X - M) & \text{otherwise.} \end{cases} \tag{1}$$

The expected utility of the reinsurance company is

$$E(U_1(Y_1)) = \int_0^M U_1(P) f(x)dx + \int_M^{+\infty} U_1(P - (x - M)) f(x)dx. \tag{2}$$

For the ceding company, its benefit is

$$Y_2 = \begin{cases} E(X) - X - P \text{ when } 0 \le X \le M, \\ E(X) - M - P \text{ otherwise.} \end{cases} \tag{3}$$

The assumption is that its own pricing of the product is based on the equivalence principle so that $E(X)$ is the premium collected by the ceding company. Its expected utility is

$$E(U_2(Y_2)) = \int_0^M U_2(E(X) - x - P)f(x)dx + \int_M^{+\infty} U_2(E(X) - P - M)f(x)dx \quad (4)$$

where $E(X)$ is the expected value of the claim loss.

We establish the objective function to maximize the social utility or the sum of the expected utilities of the reinsurance and ceding companies as follows:

$$\begin{aligned} &\text{Max}\, E(U(Y)) = E(U_1(Y_1)) + E(U_2(Y_2)) - \\ &= \int_0^M U_1(P)f(x)dx + \int_M^{+\infty} U_1(P - (x - M))f(x)dx \\ &+ \int_0^M U_2(E(X) - x - P)f(x)dx + \int_M^{+\infty} U_2(E(X) - M - P)f(x)dx \end{aligned} \quad (5)$$

2.2 Maximizing the product of the expected utilities of a reinsurance company and ceding company (objective function II)

One of most important characteristics of reinsurance is co-fatality, that is, the fatality of the reinsurance and ceding companies is bound together for good or ill. It is especially incisive when using the product rather than the sum of the expected utilities of the reinsurance and ceding companies, since the expected utility of any of them equals zero; the total expected utility of social expected utility equals zero. Moreover, the expanding or shrinking function of the expected social utility is much more obvious because of the effect of the multiplier.

Using the same definitions of the benefits of the reinsurance and ceding companies, Y_1 and Y_2, the objective function to maximize the product of the reinsurance and ceding companies can be written as

$$\begin{aligned} &\text{Max}\, E(U(Y)) = E(U_1(Y_1)U_2(Y_2)) = \\ &= \int_0^M U_1(P)U_2(E(X) - x - P)f(x)dx + \int_M^{+\infty} U_1(P - x + M)U_2(E(X) - P - M)f(x)dx \end{aligned} \quad (6)$$

3. Model applications, analysis supporting those applications and results of numerical optimization

We assume that the ceding and reinsurance companies are risk averse. Let

$$U_1(Y_1) = Y_1 - \frac{{Y_1}^2}{2\gamma_1} \quad (7)$$

and

$$U_2(Y_2) = Y_2 - \frac{{Y_2}^2}{2\gamma_2} \quad (8)$$

where Y_1 and Y_2, satisfying equations (1) and (3), respectively, and γ_1 and γ_2 are the risk aversion coefficients of the reinsurance and ceding companies, respectively. We use the example in Mao *et al.* (2016) to illustrate its application. In a manner similar to Example 1 in Mao *et al.* (2016), we consider a lognormal loss distribution with parameters $\mu = 9.294$ and $\sigma = 1.627$. In this case, the loss density is

$$f(x) = \frac{1}{x\sigma\sqrt{2\pi}} e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}, x > 0. \tag{9}$$

Using equations (7), (8), (9), and the objective function (5), we have the following:

$$\begin{aligned}
&\operatorname{Max} E(U(Y)) = E(U_1(Y_1)) + E(U_2(Y_2)) = \\
&= \int_0^M U_1(P) f(x)dx + \int_M^{+\infty} U_1(P - x + M) f(x)dx \\
&+ \int_0^M U_2(E(x) - x - P) f(x)dx + \int_M^{+\infty} U_2(E(x) - P - M) f(x)dx \\
&= \int_0^M \left(-\frac{P^2}{2\gamma_1} + e^{\mu+\frac{1}{2}\sigma^2} - x - \frac{(\mu - x - P)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_M^{+\infty} \left(e^{\mu+\frac{1}{2}\sigma^2} - x - \frac{(P - x + M)^2}{2\gamma_1} - \frac{(\mu - P - M)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&= -\frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{1}{2}\sigma^2} - P\right)^2}{2\gamma_2} \\
&+ \frac{\left(e^{\mu+\frac{1}{2}\sigma^2} - P\right) e^{\mu+\frac{1}{2}\sigma^2}}{\gamma_2} \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right) - \frac{e^{2(\mu+\sigma^2)}}{2\gamma_2} \Phi\left(\frac{\ln M - \mu}{\sigma} - 2\sigma\right) \\
&+ \frac{P e^{\mu+\frac{1}{2}\sigma^2} \left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)\right)}{\gamma_1} - M\left(\frac{P}{\gamma_1} - \frac{e^{\mu+\frac{1}{2}\sigma^2} - P}{\gamma_2}\right)\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma}\right)\right) \\
&- \frac{e^{2(\mu+\sigma^2)}}{2\gamma_1}\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - 2\sigma\right)\right) + \frac{M e^{\mu+\frac{1}{2}\sigma^2}}{\gamma_1}\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)\right) \\
&- M^2\left(\frac{1}{2\gamma_1} + \frac{1}{2\gamma_2}\right)\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma}\right)\right)
\end{aligned} \tag{10}$$

Similarly, applying equations of (7), (8), (9), and the objective function (6), we obtain the objective function as follows:

$$
\begin{aligned}
&Max\,E(U(Y)) = E(U_1(Y_1)U_2(Y_2)) = \\
&= \int_0^M U_1(P)U_2(E(X) - x - P)f(x)dx \\
&+ \int_M^{+\infty} U_1(P - x + M)U_2(E(X) - P - M)f(x)dx = \\
&A\Phi\left(\frac{\ln M - \mu}{\sigma}\right) + Be^{\mu+\frac{\sigma^2}{2}}\Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right) \\
&+Ce^{2(\mu+\sigma^2)}\Phi\left(\frac{\ln M - \mu}{\sigma} - 2\sigma\right) + D\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma}\right)\right) \\
&-Ee^{\mu+\frac{\sigma^2}{2}}\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)\right) - Ge^{2(\mu+\sigma^2)}\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - 2\sigma\right)\right),
\end{aligned}
\tag{11}
$$

where

$$
A = P\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)\left(1 - \frac{e^{\mu+\frac{\sigma^2}{2}} - P}{2\gamma_2} - \frac{P}{2\gamma_1} + \frac{P\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{4\gamma_1\gamma_2}\right),
$$

$$
B = P\left(-1 + \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} + \frac{P}{2\gamma_1} - \frac{P\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{2\gamma_1\gamma_2}\right), C = -P\left(\frac{1}{2\gamma_2} - \frac{P}{4\gamma_1\gamma_2}\right),
$$

$$
\begin{aligned}
D = (P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)\Bigg(1 - \frac{e^{\mu+\frac{\sigma^2}{2}} - P - M}{2\gamma_2} - \frac{P+M}{2\gamma_1} \\
+ \frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)}{4\gamma_1\gamma_2}\Bigg),
\end{aligned}
$$

$$
\begin{aligned}
E = e^{\mu+\frac{\sigma^2}{2}} - P - M - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_2} - \frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)}{2\gamma_1} \\
+ \frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_1\gamma_2},
\end{aligned}
$$

and $G = \frac{e^{\mu+\frac{\sigma^2}{2}} - P - M}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{4\gamma_1\gamma_2}$.

Derivation of the above results is presented in the Appendix.

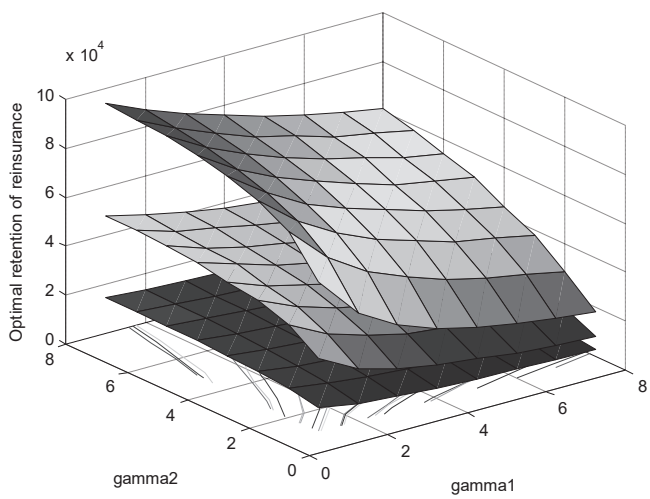
We obtained optimal solutions of (M^*, P^*) by solving objective functions (10) and (11) numerically with the help of MatLab software. The first objective function, additive, emphasizes the total gains of both parties, while the second, multiplicative, accounts for the degree of substitution of gains of one party by the loss of the other party.

The objective functions (10) and (11) show that there are no optimal solutions if $M = 0$ or $M \to +\infty$. Otherwise, we can have optimal solutions if γ_1 and γ_2 take the values, satisfying both the first and second order conditions.

From the objective functions of (10) and (11), we find that both have explicit expressions. Although we cannot directly obtain the optimal explicit solutions by analytical method, we can find approximate optimal solutions with the help of the grid search method in MatLab software.

Figures 1 through 4 display the change patterns of optimal retention and premium when the mean and volatility of claim loss change by $\pm 10\%$ with objective function I. Figures 5 through 8 describe the change patterns of optimal retention and premium when the mean and volatility of claim loss change by $\pm 10\%$ with objective function II. Figures 1 through 4 indicate that an increase (decrease) of the means and the volatilities of claim loss will increase (decrease) the optimal retention and optimal premium. The sensitivities of optimal solutions to the change of the mean are much greater than those to the change of the volatility of claim loss, especially in situations where the mean of claim loss increases by 10%. Figures 1 through 4 also show that increasing the coefficients of risk aversion of γ_1 or reducing the coefficients of risk aversion of γ_2 reduce the optimal retention but increase the optimal premium. Figures 5 through 8 illustrate that the increase (decrease) of the mean and the volatility of claim loss increase (decrease) the optimal retention and optimal premium. Unlike in the case of objective function I, the case with objective function II shows that the coefficients of risk aversion have no effect on the optimal solutions, regardless of the changes to the mean and volatility of the claim loss. It is important to note that both the optimal retention and premium are sensitive to the change of the mean and the volatility of claim loss, unlike in the case of objective function I.

The curve (flat) surfaces on the top and bottom of Figures 1 through 8 correspond to situations where the mean or volatility of claim loss increase or decrease by 10%, respectively. The curve (flat) surfaces in the middle of the figure correspond to situations where the mean or volatility of claim loss are at the levels obtained by estimating them from empirical data.



Note(s): Objective Function I

Source(s): Authors' calculation

Figure 1.
The patterns of change of optimal retention when $\mu_1 = \mu(1 \pm 10\%)$

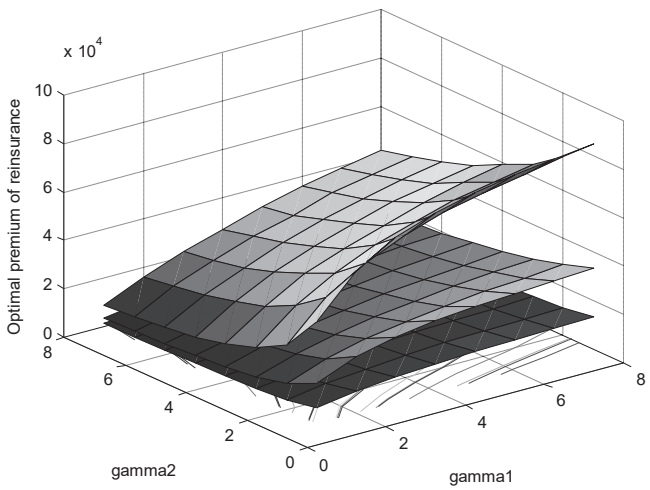


Figure 2.
The patterns of change of optimal premium when $\mu_1 = \mu(1\pm10\%)$

Note(s): Objective Function I
Source(s): Authors' calculation

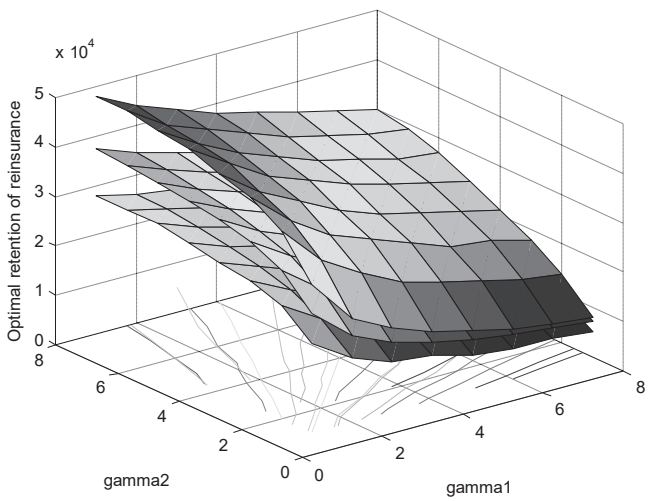
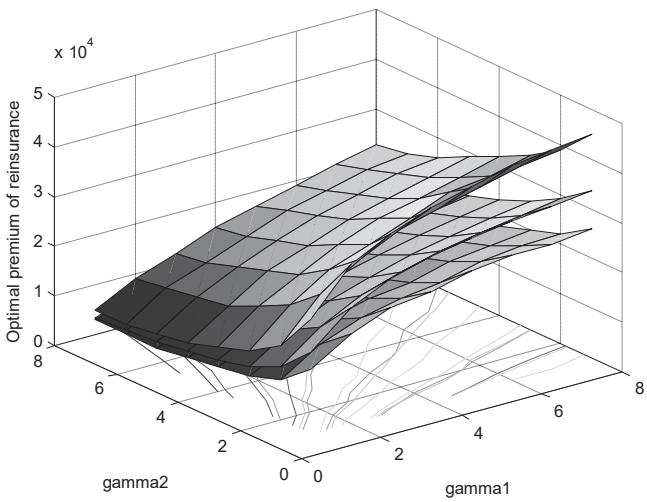


Figure 3.
The patterns of change of optimal retention when $\sigma_1 = \sigma(1\pm10\%)$

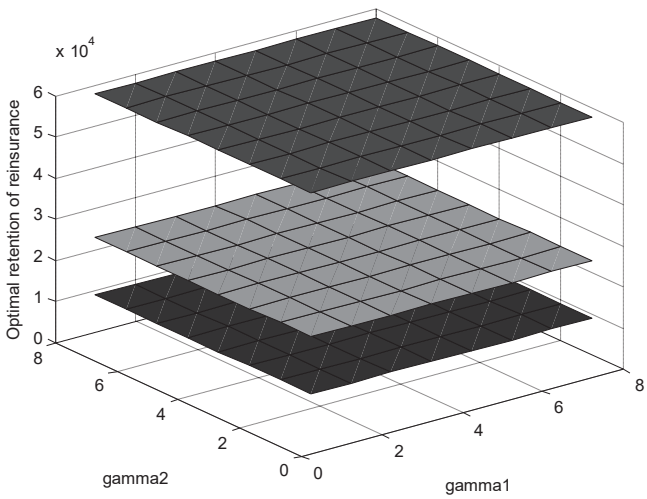
Note(s): Objective Function I
Source(s): Authors' calculation

Table 1 presents the results of optimal solutions with two different situations: one is that the reinsurance premium is given, and the other is that the reinsurance premium (not given) is obtained by optimization. The results in Table 1 indicate that the optimal expected social benefits are greater if the reinsurance premium is determined by optimization rather than by being given for both objective function I and II. The increased optimal expected social benefits are greater for objective function II than for objective function I.



Note(s): Objective Function I
Source(s): Authors' calculation

Figure 4.
The patterns of change of optimal premium when $\sigma_1 = \sigma(1 \pm 10\%)$

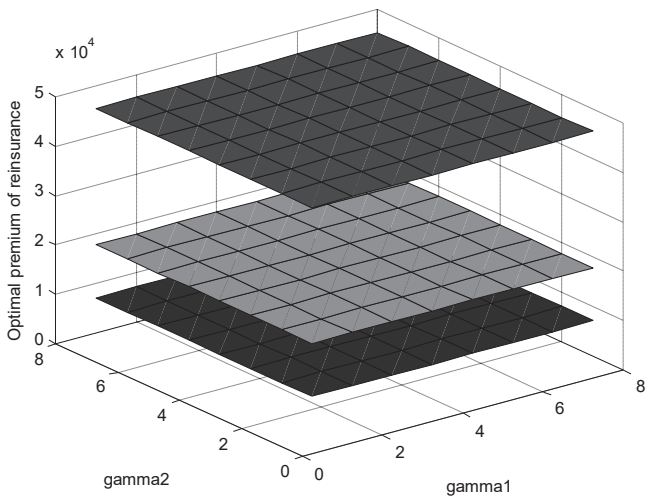


Note(s): Objective Function II
Source(s): Authors' calculation

Figure 5.
The patterns of change of optimal retention when $\mu_1 = \mu(1 \pm 10\%)$

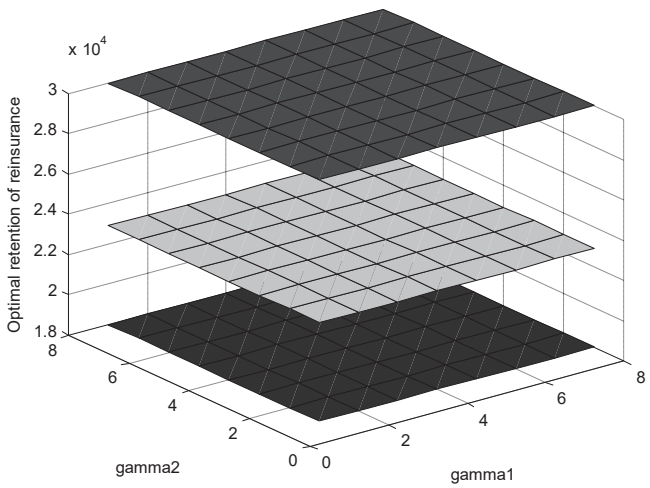
4. Discussion

In excess-of-loss reinsurance practice, it is commonly necessary to set the upper limit of covered claim loss. In this section, we discuss the joint optimization of the retention, premium and upper limit of claim loss. Let the upper limit of claim loss in the reinsurance contract be M_1. The net benefit obtained by the reinsurance company is



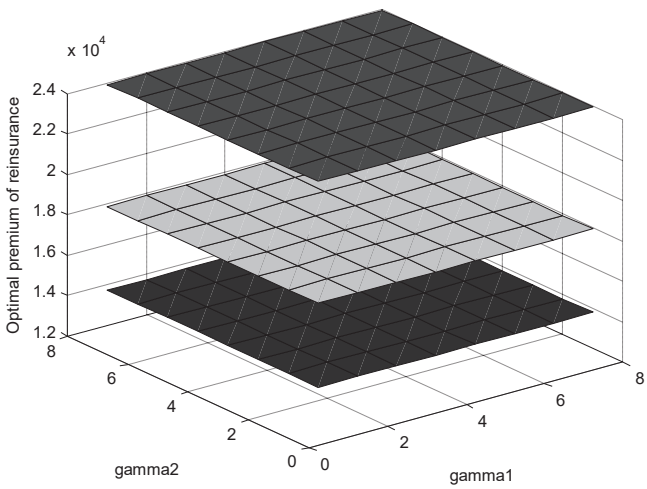
Note(s): Objective Function II
Source(s): Authors' calculation

Figure 6.
The patterns of change of optimal premium when $\mu_1 = \mu(1\pm10\%)$



Note(s): Objective Function II
Source(s): Authors' calculation

Figure 7.
The patterns of change of optimal retention when $\sigma_1 = \sigma(1\pm10\%)$



Note(s): Objective Function II
Source(s): Authors' calculation

Figure 8.
The patterns of change of optimal premium when $\sigma_1 = \sigma(1\pm10\%)$

$$Y_1 = \begin{cases} P & \text{when } 0 \le X \le M, \\ P - X + M & \text{when } M \le X \le M_1, \\ P - X + M_1 & \text{otherwise.} \end{cases} \tag{16}$$

The expected utility of the reinsurance company is

$$E(U_1(Y_1)) = U_1(P)f(x)dx + \int_M^{M_1} U_1((P - x + M))f(x)dx + \int_{M_1}^{+\infty} U_1((P - x + M_1))f(x)dx. \tag{17}$$

For the ceding company, its benefit is

$$Y_2 = \begin{cases} E(X) - X - P \text{ when } 0 \le X \le M, \\ E(X) - P - M \text{ otherwise.} \end{cases} \tag{18}$$

where $E(X) - P - M = 0$ based on the equivalent principle.

The expected utility of the ceding company is

$$E(U_2(Y_2)) = \int_0^M U_2(E(X) - x - P)f(x)dx + \int_M^{+\infty} U_2(E(X) - P - M)f(x)dx \tag{19}$$

where $E(X)$ is the premium income of the ceding company based on the equivalence principle.

We establish the objective function to maximize the social utility or sum of expected utilities of the reinsurance and ceding companies as follows:

Maximizing the sum of the benefits of the insurer and reinsurer
$\mu = 9.294, \sigma = 1.627, \gamma_2 = 2$

γ_1	2	4	6	8
P^*	16,600	23,200	26,800	29,100
M^*	24,200	17,600	14,000	11,700
$E^*(Y)$	-0.5375×10^{10}	-0.2706×10^{10}	-0.1810×10^{10}	-0.1360×10^{10}
P	10,000	10,000	10,000	10,000
M^*	30,846	30,846	30,846	30,846
$E^*(Y)$	-0.5389×10^{10}	-0.2735×10^{10}	-0.1823×10^{10}	-0.1367×10^{10}

Maximizing the sum of the benefits of the insurer and reinsurer
$\mu = 9.294, \sigma = 1.627, \gamma_2 = 4$

γ_1	2	4	6	8
P^*	10,700	16,600	20,500	23,200
M^*	30,100	24,200	20,300	17,600
$E^*(Y)$	-0.5339×10^{10}	-0.2688×10^{10}	-0.1799×10^{10}	-0.1353×10^{10}
P	10,000	10,000	10,000	10,000
M^*	30,846	30,846	30,846	30,846
$E^*(Y)$	-0.5339×10^{10}	-0.2694×10^{10}	-0.1813×10^{10}	-0.1367×10^{10}

Maximizing the product of the benefits of the insurer and reinsurer
$\mu = 9.294, \sigma = 1.627, \gamma_2 = 2$

γ_1	2	4	6	8
P^*	22,900	22,900	22,900	22,900
M^*	17,946	17,946	17,946	17,946
$E^*(Y)$	3.8017×10^{15}	1.9004×10^{15}	1.2667×10^{15}	0.9498×10^{15}
P	10,000	10,000	10,000	10,000
M^*	30,846	30,846	30,846	30,846
$E^*(Y)$	2.7892×10^{15}	1.3941×10^{15}	0.9290×10^{15}	0.6965×10^{15}

Maximizing the product of the benefits of the insurer and reinsurer
$\mu = 9.294, \sigma = 1.627, \gamma_2 = 4$

γ_1	2	4	6	8
P^*	22,900	22,900	22,900	22,900
M^*	17,946	17,946	17,946	17,946
$E^*(Y)$	1.9004×10^{15}	0.95×10^{15}	0.6332×10^{15}	0.4748×10^{15}
P	10,000	10,000	10,000	10,000
M^*	30,846	30,846	30,846	30,846
$E^*(Y)$	1.3944×10^{15}	0.6969×10^{15}	0.4644×10^{15}	0.3482×10^{15}

Table 1.
Optimal solutions with two different situations

Source(s): Authors' calculation

$$\begin{aligned} &\text{Max}\, E(U(Y)) = E(U_1(Y_1)) + E(U_2(Y_2)) \\ &\int_0^M U_1(P) f(x)dx + \int_M^{M_1} U_1(P - x + M) f(x)dx + \int_{M_1}^{+\infty} U_1(P - x + M_1) f(x)dx \\ &+ \int_0^M U_2(E(X) - x - P) f(x)dx + \int_M^{+\infty} U_2(E(X) - P - M) f(x)dx \end{aligned} \tag{20}$$

The first order condition with respect to M_1 is:

$$\frac{\partial E(U(Y))}{\partial M_1} = \left(M - M_1 + \frac{P(M - M_1)}{\gamma_1} - \frac{(M - M_1)^2}{2\gamma_1} \right) f(M_1) - \int_{M_1}^{+\infty} \frac{P - x + M_1}{\gamma_1} f(x)dx = 0 \quad (21)$$

If $f(M_1)$ is the density function of lognormal distribution, equation (21) holds when $M_1 \to +\infty$. Therefore, the optimal strategy of reinsurance is not to set an upper limit of reinsurance; this case reduces to the case of objective function 1.

5. Conclusions

In the last two decades, reinsurance companies have played a significant role in hedging mega-catastrophic losses. For example, reinsurance companies (and special loss sharing arrangements) paid as much as two-thirds of the insured losses for the September 11, 2001 tragedy. Furthermore, large catastrophic events have increased the role of governments and regulators as reinsurers of last resort.

This study establishes two optimization models of excess-of-loss reinsurance contracts against catastrophic losses to determine optimal premiums and retention. One model considers the sum of the expected utilities of a ceding company and reinsurance company's expected utility; another considers their products. Using an example, we find the optimal solutions of the premium and retention of excess loss reinsurance. Finally, we conduct a sensitivity analysis. The results show that increasing the means and volatilities of claim loss will increase the optimal retention and premium. For objective function I, increasing the coefficients of risk aversion of γ_1 or reducing the coefficients of risk aversion of γ_2 will reduce the optimal retention but increase the optimal premium, and vice versa. However, for objective function II, the change of the coefficient of risk aversion has no effect on optimal solutions.

While our research makes what we believe to be a valuable contribution to the field, there exists significant potential for future research in this area. For example, we consider a ceding company and reinsurer, but of course both companies operate in a market where the ceding company offers the original insurance product. An expanded model could consider the welfare of the customers of the ceding insurance company, in addition to the insurer/reinsurer pair. Furthermore, the previous three decades have seen substantial growth of insurance derivatives replacing traditional reinsurance, for example, catastrophe bonds, sidecars or exchange-traded option spreads. An interesting and very natural question is whether the insurance derivatives that replace reinsurance can benefit from designs based on the models proposed in our study, or models built based on it. However, we must admit that models including interactions of more than two entities, as well as large numbers of market participants, become challenging and complex. We hope that such research can be developed in the future.

Specifically, we hope that our work can serve as an inspiration for the following:

(1) The regulatory supervision of reinsurance. Individual firms pursue their own objectives, especially the profit objective and can scarcely be expected to optimize overall social welfare, but regulators can respond through the process of financial supervision.

(2) The systematic or ad hoc reinsurance activities of governments. Examples of such activities include financial bailouts or the restructuring of financial institutions. Those activities are often conducted out of political necessity, or for other policy reasons, but could, and in our view should, benefit from consideration of the welfare of all stakeholders in the process.

Note

1. http://finance.sina.com.cn/money/insurance/bxdt/2017-03-21/doc-ifycnpvh5134470.shtml

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(The Appendix follows overleaf)

Appendix

This appendix presents certain proofs and examples. We begin by presenting a proof of equation (5):

$$
\begin{aligned}
&E(U(Y)) = E(U_1(Y_1)) + E(U_2(Y_2)) \\
&= \int_0^M \left(-\frac{P^2}{2\gamma_1} + e^{\mu+\frac{\sigma^2}{2}} - x - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - x - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_M^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - x - \frac{(P-x+M)^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&= \int_0^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - x - \frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_0^M \left(\frac{x\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} - \frac{x^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_M^{+\infty} \left(\frac{(x-M)P}{\gamma_1} + \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)M}{\gamma_2} - \frac{(x-M)^2}{2\gamma_1} - \frac{M^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx
\end{aligned}
\tag{A1}
$$

Let $y = \frac{\ln x - \mu}{\sigma}$, then $dy = \frac{dx}{x\sigma}$. The left-hand side of Equation (A1) can be written as:

$$
\begin{aligned}
E(U(Y)) &= \int_0^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - e^{y\sigma+\mu} - \frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dy \\
&+ \int_{-\infty}^{\frac{\ln M-\mu}{\sigma}} \left(\frac{e^{y\sigma+\mu}\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} - \frac{e^{2(y\sigma+\mu)}}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dy \\
&+ \int_{\frac{\ln M-\mu}{\sigma}}^{+\infty} \left(\frac{(e^{y\sigma+\mu} - M)P}{\gamma_1} + \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)M}{\gamma_2} - \frac{(e^{y\sigma+\mu} - M)^2}{2\gamma_1} - \frac{M^2}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dy
\end{aligned}
\tag{A2}
$$

Example: Let $\mu = 9.294, \sigma = 1.627, \gamma_1 = \gamma_2 = 2$. Then, optimal solutions are

$$P^* = 16600, M^* = 24200, E^*(Y) = -0.5375 \cdot 10^{10}.$$

Here, we present a proof of equation (6):

$$= \int_0^M \begin{pmatrix} P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)\left(1-\frac{e^{\mu+\frac{\sigma^2}{2}}-P}{2\gamma_2}-\frac{P}{2\gamma_1}+\frac{P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{4\gamma_1\gamma_2}\right) \\ P\left(1+\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{\gamma_2}+\frac{P}{2\gamma_1}+\frac{P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{2\gamma_1\gamma_2}\right)x \\ +P\left(\frac{1}{2\gamma_2}-\frac{P}{4\gamma_1\gamma_2}\right)x^2 \end{pmatrix} \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x}dx$$

$$+\int_M^{+\infty} \begin{pmatrix} (P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)\left(1-\frac{e^{\mu+\frac{\sigma^2}{2}}-P-M}{2\gamma_2}-\frac{P+M}{2\gamma_1}+\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)}{4\gamma_1\gamma_2}\right) \\ -\left(e^{\mu+\frac{\sigma^2}{2}}-P-M-\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{2\gamma_2}-\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)}{\gamma_1}+\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{2\gamma_1\gamma_2}\right)x \\ -\left(\frac{e^{\mu+\frac{\sigma^2}{2}}-P-M}{2\gamma_1}-\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{4\gamma_1\gamma_2}\right)x^2 \end{pmatrix} \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x}dx \tag{A3}$$

Let $y=\frac{\ln x-\mu}{\sigma}$, then $dy=\frac{dx}{x\sigma}$.

The left-hand side of Equation (A3) can be written as:

$$E(U_1(Y_1)U_2(Y_2)) =$$

$$= \int_{-\infty}^{\frac{\ln M-\mu}{\sigma}} \begin{pmatrix} P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)\left(1-\frac{e^{\mu+\frac{\sigma^2}{2}}-P}{2\gamma_2}-\frac{P}{2\gamma_1}+\frac{P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{4\gamma_1\gamma_2}\right) \\ P\left(1+\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{\gamma_2}-\frac{P}{\gamma_1}+\frac{P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{2\gamma_1\gamma_2}\right)e^{y\sigma+\mu} \\ +P\left(\frac{1}{2\gamma_2}-\frac{P}{4\gamma_1\gamma_2}\right)e^{2(y\sigma+\mu)} \end{pmatrix} \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}}dy +$$

$$+ \int_{\frac{\ln M-\mu}{\sigma}}^{+\infty} \begin{pmatrix} \begin{pmatrix} (P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)\left(1-\frac{e^{\mu+\frac{\sigma^2}{2}}-P-M}{2\gamma_2}-\frac{P+M}{2\gamma_1}+\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)}{4\gamma_1\gamma_2}\right) \\ -\left(e^{\mu+\frac{\sigma^2}{2}}-P-M-\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{2\gamma_2}-\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)}{\gamma_1}+\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{2\gamma_1\gamma_2}\right)e^{y\sigma+\mu} \end{pmatrix} \\ -\left(\frac{e^{\mu+\frac{\sigma^2}{2}}-P-M}{2\gamma_1}-\frac{\left(e^{\mu+\frac{\sigma^2}{2}}-P-M\right)^2}{4\gamma_1\gamma_2}\right)e^{2(y\sigma+\mu)} \end{pmatrix} \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}}dy \tag{A4}$$

$$= A\Phi\left(\frac{\ln M-\mu}{\sigma}\right)+Be^{\mu+\frac{\sigma^2}{2}}\Phi\left(\frac{\ln M-\mu}{\sigma}-\sigma\right)+Ce^{2(\mu+\sigma^2)}\Phi\left(\frac{\ln M-\mu}{\sigma}-2\sigma\right)$$

$$+D\left(1-\Phi\left(\frac{\ln M-\mu}{\sigma}\right)\right)-Ee^{\mu+\frac{\sigma^2}{2}}\left(1-\Phi\left(\frac{\ln M-\mu}{\sigma}-\sigma\right)\right)-Ge^{2(\mu+\sigma^2)}\left(1-\Phi\left(\frac{\ln M-\mu}{\sigma}-2\sigma\right)\right),$$

where

$$A=P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)\left(1-\frac{e^{\mu+\frac{\sigma^2}{2}}-P}{2\gamma_2}-\frac{P}{2\gamma_1}+\frac{P\left(e^{\mu+\frac{\sigma^2}{2}}-P\right)}{4\gamma_1\gamma_2}\right),$$

$$B = P\left(-1 + \frac{e^{\mu+\frac{\sigma^2}{2}} - P}{\gamma_2} + \frac{P}{2\gamma_1} - \frac{P\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{2\gamma_1\gamma_2}\right),$$

$$C = -P\left(\frac{1}{2\gamma_2} - \frac{P}{4\gamma_1\gamma_2}\right),$$

$$D = (P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)\left(1 - \frac{e^{\mu+\frac{\sigma^2}{2}} - P - M}{2\gamma_2} - \frac{P+M}{2\gamma_1} + \frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)}{4\gamma_1\gamma_2}\right),$$

$$E = e^{\mu+\frac{\sigma^2}{2}} - P - M - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_2} -$$

$$-\frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)}{2\gamma_1} + \frac{(P+M)\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_1\gamma_2},$$

and

$$G = \frac{e^{\mu+\frac{\sigma^2}{2}} - P - M}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{4\gamma_1\gamma_2}. \tag{A5}$$

Example: Let $\mu = 9.294, \sigma = 1.627, \gamma_1 = \gamma_2 = 2$. Then, optimal solutions are

$$P^* = 22900, M^* = 17946, E^*(Y) = 3.8017 \times 10^{15}$$

Here, we present the proof of equation (20):

$$\begin{aligned}
&E(U(Y)) = E(U_1(Y_1)) + E(U_2(Y_2)) \\
&= \int_0^M \left(-\frac{P^2}{2\gamma_1} + e^{\mu+\frac{\sigma^2}{2}} - x - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - x - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_M^{M_1} \left(-x + M - \frac{(P-x-M)^2}{2\gamma_1} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_{M_1}^{+\infty} \left(-x + M_1 - \frac{(P-x+M_1)^2}{2\gamma_1} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx \\
&+ \int_M^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - M - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P - M\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx
\end{aligned} \tag{A6}$$

$$= \int_0^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - x - \frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx$$

$$+ \int_0^{M} \left(\frac{x\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} - \frac{x^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx$$

$$+ \int_M^{M_1} \left(M + \frac{P(x-M)}{\gamma_1} - \frac{M^2}{2\gamma_1} + \frac{xM}{\gamma_1} - \frac{x^2}{2\gamma_1} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx$$

$$+ \int_{M_1}^{+\infty} \left(M_1 + \frac{P(x-M_1)}{\gamma_1} - \frac{M_1^2}{2\gamma_1} + \frac{xM_1}{\gamma_1} - \frac{x^2}{2\gamma_1} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx$$

$$+ \int_M^{+\infty} \left(-M + \frac{M\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} + \frac{M^2}{2\gamma_2} \right) \frac{e^{-\frac{(\ln x-\mu)^2}{2\sigma^2}}}{\sqrt{2\pi}\sigma x} dx$$

Let $y = \frac{\ln x-\mu}{\sigma}$, then $dy = \frac{dx}{x\sigma}$. The left-hand side of Equation (A1) can be written as:

$$E(U(Y)) == \int_0^{+\infty} \left(e^{\mu+\frac{\sigma^2}{2}} - e^{y\sigma+\mu} - \frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)^2}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dx$$

$$+ \int_{-\infty}^{\frac{\ln M-\mu}{\sigma}} \left(\frac{e^{y\sigma+\mu}\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} - \frac{e^{2(y\sigma+\mu)}}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dx$$

$$+ \int_{\frac{\ln M-\mu}{\sigma}}^{\frac{\ln M_1-\mu}{\sigma}} \left(M + \frac{P(e^{y\sigma+\mu} - M)}{\gamma_1} - \frac{M^2}{2\gamma_1} + \frac{e^{y\sigma+\mu}M}{\gamma_1} - \frac{e^{2(y\sigma+\mu)}}{2\gamma_1} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dx$$

$$+ \int_{\frac{\ln M_1-\mu}{\sigma}}^{+\infty} \left(M_1 + \frac{P(e^{y\sigma+\mu} - M_1)}{\gamma_1} - \frac{M_1^2}{2\gamma_1} + \frac{e^{y\sigma+\mu}M_1}{\gamma_1} - \frac{e^{2(y\sigma+\mu)}}{2\gamma_1} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dx$$

$$+ \int_{\frac{\ln M-\mu}{\sigma}}^{+\infty} \left(-M + \frac{M\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)}{\gamma_2} - \frac{M^2}{2\gamma_2} \right) \frac{e^{-\frac{y^2}{2}}}{\sqrt{2\pi}} dx$$

$$
\begin{aligned}
&= -\frac{P^2}{2\gamma_1} - \frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)^2}{2\gamma_2} \\
&+\frac{\left(e^{\mu+\frac{\sigma^2}{2}} - P\right)e^{\mu+\frac{1}{2}\sigma^2}}{\gamma_2}\Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right) - \frac{e^{2(\mu+\sigma^2)}}{2\gamma_2}\Phi\left(\frac{\ln M - \mu}{\sigma} - 2\sigma\right) \\
&+M\left(1 - \frac{P}{\gamma_1} - \frac{M}{2\gamma_1}\right)\left(\Phi\left(\frac{\ln M_1 - \mu}{\sigma}\right) - \Phi\left(\frac{\ln M - \mu}{\sigma}\right)\right) \\
&+\frac{Me^{\mu+\frac{1}{2}\sigma^2}}{\gamma_1}\left(\Phi\left(\frac{\ln M_1 - \mu}{\sigma} - \sigma\right) - \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)\right) \\
&-\frac{Pe^{\mu+\frac{1}{2}\sigma^2}\Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)}{\gamma_1} \\
&-\frac{e^{2(\mu+\sigma^2)}}{2\gamma_1}\left(1 - \Phi\left(\frac{\ln M_1 - \mu}{\sigma} - 2\sigma\right)\right) + \frac{M_1 e^{\mu+\frac{1}{2}\sigma^2}}{\gamma_1}\left(1 - \Phi\left(\frac{\ln M_1 - \mu}{\sigma} - \sigma\right)\right) \\
&+\frac{Pe^{\mu+\frac{1}{2}\sigma^2}}{\gamma_1} + M_1\left(1 - \frac{P}{\gamma_1} - \frac{M_1}{2\gamma_1}\right)\left(1 - \Phi\left(\frac{\ln M_1 - \mu}{\sigma}\right)\right) \\
&+\frac{Me^{\mu+\frac{1}{2}\sigma^2}}{\gamma_2}\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma} - \sigma\right)\right) - M\left(1 + \frac{P}{\gamma_2} + \frac{M}{2\gamma_2}\right)\left(1 - \Phi\left(\frac{\ln M - \mu}{\sigma}\right)\right)
\end{aligned}
\quad . \quad \text{(A7)}
$$

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The determinants of internal audit quality

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Abstract

Purpose – This study aims to understand the behavior of internal auditors towards quality and analyze if some organizational and individual factors influence internal audit quality.

Design/methodology/approach – The sample is constituted by Portuguese internal auditors, and the methodology includes the use of partial least squares – structuring equation model (PLS-SEM) to test the hypothesis under study.

Findings – The results show that there is a negative relationship between reduced audit quality practices (RAQP) and organizational commitment and independence. The results found that time pressure positively affect RAQP. There is no evidence that perceived organizational support (POS) and risk profile are determinants of RAQP.

Originality/value – This work contributes by extending the literature about the determinants of internal audit quality, but also to the practice by understanding the factors that influence the behavior of internal auditors and by making recommendations that allow an improvement of the quality of internal auditing.

Keywords Internal audit quality, Reduced audit quality practices, Organizational determinants, Individual determinants

Paper type Research paper

1. Introduction

Internal audit is a very useful and versatile tool for management that allows an accurate picture of the organization to be assessed and to take actions to increase its efficiency and effectiveness (Eden and Moriah, 1996). It is a key element of corporate governance (Vadasi *et al.*, 2021), contributing to fraud detection (Carmeli and Zisu, 2009), risk analysis (Selim and McNamee, 1999) and compliance (Pickett, 2010). Therefore, internal auditing has been regarded as an essential function for an organization to survive and flourish (Anderson *et al.*, 2017). In this context, internal audit quality has become a relevant research topic (Krichene and Baklouti, 2021), and a relatively unexplored research field (Boskou *et al.*, 2019).

The audit quality research has focused mainly on external audit (Francis, 2004; Gandía and Huguet, 2021), with limited research about internal auditing (Abuazza *et al.*, 2015). First, the understanding and operationalization of internal audit quality has been based predominantly on the perspective of the external auditors, ignoring the other governance actors' lenses, namely the internal auditors themselves (Roussy and Brivot, 2016). Secondly, most studies assess the quality of internal audit indirectly through the performance and effectiveness of the internal audit function (e.g. Rudhani *et al.*, 2017) or based on the

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independence of the internal audit department and the internal auditor's competence (Roussy and Brivot, 2016). However, researchers know little about how internal auditors behave in practice (Roussy and Perron, 2018). Thirdly, the high value added of internal auditing highlights the importance of identifying the determinants of its quality (Bota-Avram and Stefănescu, 2009). Few studies examine the determinants of internal audit quality (Krichene and Baklouti, 2021). For example, Ibrani *et al.* (2020) studied professional care and internal auditor competence, Abbott *et al.* (2016) studied internal auditor competence and independence, Rönkkö *et al.* (2018) analyzed the effect of ownership structure characteristics, Singh *et al.* (2021) studied the three internal audit effectiveness building blocks, and Krichene and Baklouti (2021) focused on the attributes of the different profiles of internal auditors.

Bigné (2016) states that time, risk, aversion and an individual's emotions are examples of contemporary issues focused by research in various management fields. To the authors' knowledge, some of the variables studied here (e.g. auditors' risk aversion or perceived organizational support (POS)) have not been studied before in the context of internal audit quality. Further, Trotman and Duncan (2018) and Demeke and Kaur (2021) consider that it is necessary to develop more studies about the internal audit concept and its determinants. Besides all these, global changes, like the global financial crisis or the COVID-19 pandemic, have imposed greater challenges that can affect audit procedures, efficiency and quality (Farcane *et al.*, 2023).

This study addresses a gap in current knowledge regarding the way internal auditors perform their tasks during the different stages of the internal audit process and which factors determine this behavior. The objectives of this paper are: (1) to identify the occurrence of reduced audit quality practices (RAQP) as a measure of poor quality in internal auditing, (2) to analyze if certain organizational factors (organizational independence and time pressure) influence internal audit quality, and (3) to analyze if certain individual factors (organizational commitment, POS and risk profile) influence internal audit quality. The sample is constituted by Portuguese internal auditors, a context that, to the best of our knowledge, has not been the object of empirical research on the present topic and, as the internal audit activity is performed in different environments, with different laws and culture that may affect internal audit practice (IPAI, 2009). The methodology used to test the hypotheses was partial least squares – structuring equation model (PLS-SEM), which has not been used in most previous studies about internal audit determinants (Demeke and Kaur, 2021).

Our work contributes by extending the literature about the determinants of internal audit quality, and to practice by understanding the factors that influence the behavior of internal auditors and by making recommendations that allow an improvement in the quality of internal auditing.

The paper is structured as follows: the next section proceeds with the literature review, covering organizational characteristics and individual factors, the following section presents the methods, the results and their discussion and, lastly, the conclusions, contributions, limitations and future research are presented.

2. Literature review

Auditors with poor job performance are associated with the execution of low audit quality, meaning that they produce substandard auditing (Johari *et al.*, 2019). RAQP relate to several specific behaviors that directly threaten audit quality, such as accepting weak client explanations, failure to research an accounting principle, making only superficial reviews of documents and reducing the work below what the auditor considers reasonable (Otley and Pierce, 1996).

Organizational performance is related not only to organizational characteristics, but also to the performance of individuals. Watkins *et al.* (2004) considers that the auditors' robustness of monitoring relates to the quality of the financial statement information and their reputation

relates to the perceived credibility of the information. Consequently, the role of human resources is essential in an organization (Ridwan *et al.*, 2020). It is important to study some variables related to individual factors, namely, organizational commitment, POS and auditor risk profile, as well as organizational factors, such as organizational independence and time pressure.

2.1 Organizational commitment

Organizational commitment was identified as an important variable to understand the behavior of employees in organizations and was defined as the strength of identification and engagement of an individual with a particular organization, in which individuals are available to deliver something of themselves for the well-being of the organization (Mowday *et al.*, 1979). Commitment is characterized by three factors (Mowday *et al.*, 1979): (1) acceptance of, and identification with, the organization's goals and values; (2) involvement that encourages an extra effort on behalf of the organization; and (3) strong sense of belonging to the organization.

To the authors' knowledge, the relationship between organizational commitment and audit quality has not been studied, but there are some studies that show a relationship between organizational commitment and performance (Ridwan *et al.*, 2020). Other studies reveal a positive relationship between organizational commitment and job performance (Nguyen and Ngo, 2020). So, we define the following hypothesis:

H1. Organization commitment negatively influences RAQP.

2.2 Perceived organizational support

POS is based on the development of employees' global beliefs that the organization values their contributions and cares about their well-being (Rhoades and Eisenberger, 2002), influencing the quality of service delivered to customers (Zumrah, 2015). The perception of the support is built on how the organizations treat employees and their interpretation of that treatment in different situations, namely, mistakes or good performance, and the expected reward in case of meeting organizational goals (Eisenberger *et al.*, 1986), and this influences employees' deviant workplace behavior (Kalemci *et al.*, 2019). Employees reciprocate POS through positive behaviors (Kalemci *et al.*, 2019), like "increased affective commitment to the organization, increased performance and reduced withdrawal behaviors" (Rhoades and Eisenberger, 2002, p. 712).

The scrutiny imposed by audit leads to negative feelings like distress or threat, which can generate resistance and uncooperative behaviors, resulting in possible problems for the organization (Carmeli and Zisu, 2009). These authors studied POS from the point of view of employees and not from auditors' viewpoint and found that it encourages employees to participate in the audit through a feeling of psychological safety.

To the authors' knowledge, there are no studies relating POS to internal audit quality. However, on other topics, Zumrah (2015) found a positive relationship between POS and service quality in Malaysian public sector organizations, suggesting that POS is an important factor to foster service quality. Some authors consider that POS creates feelings of reciprocal obligation towards the organization among employees, influencing their motivation to go beyond the call of duty and leading to an improved individual performance (Ridwan *et al.*, 2020). So, we define the following hypothesis:

H2. POS negatively influences RAQP.

2.3 Time pressure

The implementation of an increasing volume of new and more complex accounting standards, accompanied by a reduction of time deadlines, has increased time pressure

(Sweeney and Pierce, 2004). Johari *et al.* (2019) also highlight the heavy workload, time and social pressure of the auditing profession, which can influence the quality of the audit report (Supriyatin *et al.*, 2019). These time constraints can trigger two types of reactions in auditors: an attempt to work faster or to work more effectively (Low and Tan, 2011).

Some studies (e.g. Sweeney and Pierce, 2004) about time pressure operationalized this variable as time deadline pressure and budget attainability pressure. Time deadline pressure is perceived as a frequent cause of premature signing-off and budget attainability pressure leads to dysfunctional behavior, showing a negative relationship with quality-threatening behavior (Pierce and Sweeney, 2004). The likely response to tight budget is to under report time and reduces quality, instead of asking for a budget increase (Otley and Pierce, 1996).

Previous studies found a positive relationship between time pressure and RAQP. For example, Svanberg and Öhman (2013) related their results to a dysfunctional reaction experienced by the auditor, while Lambert *et al.* (2017) to an increased difficulty in resolving audit adjustments. Amir (2019) has also tested an indirect effect of work stress on this relation and found that it leads to a higher effect of time pressure on the reduction of quality because the auditor performs the work considering the capacity of accomplishing the expected outcome and the time set for its completion. If the time set is not enough to perform the work attributed to the auditors, they will incur RAQP to reach the expected objective. So, we define the following hypothesis:

H3. Time pressure positively influences RAQP.

2.4 Organizational independence

According to the international standards for the professional practice of internal auditing, the chief audit executive has the responsibility to annually confirm to the board the organizational independence of the internal audit activity (IIA, 2017). Organizational independence is a key attribute of internal audit (Al-Twaijry *et al.*, 2003) and is accomplished through a functional report to the board (IIA, 2017). Demeke and Kaur (2021, p. 57) defined organizational independence as the "freedom of internal auditors to include any audit findings in the audit reports". Francis (2004) considers that higher audit quality can be achieved when auditors are competent and independent, characteristics that are often unclear in the literature (Watkins *et al.*, 2004).

Alzeban and Sawan (2013) identified some difficulties that internal auditors face during the audit process, namely, the restricted access not only to meet with the personnel but also to get the relevant information they need to fulfill their responsibilities, claiming that some information is confidential, or some employees have immunity. IIA (2017, p. 4) states that "internal audit activity must be free from interference in determining the scope of internal auditing, performing work, and communicating results"; other services that can compromise the objectivity and skepticism of the auditor must be unacceptable (Francis, 2004), so these interferences must be disclosed and their implications discussed.

Most studies analyze the relationship between internal audit effectiveness and organizational independence (e.g. Rudhani *et al.*, 2017), with very few studies analyzing the relationship between this variable and audit quality. Abbott *et al.* (2016) assume that independence is an important and distinct construct of a quality outcome in internal auditing. Demeke and Kaur (2021) found a nonsignificant relationship of organizational independence and audit quality; however, these authors studied a very specific population from Ethiopia. On the other side, Singh *et al.* (2021) found a positive relationship between organizational independence and audit quality. So, we define the following hypothesis:

H4. Organizational independence negatively influences RAQP.

2.5 Auditor risk profile

To the authors' knowledge, the effect of the auditor risk profile and the quality of internal audit has not been studied. However, Jaffar *et al.* (2011) studied the impact of risk attitude on the ability of external auditors to detect fraud and found an effect between the two variables. They based their findings on the expected utility theory, which defines that the decision made by auditors is based on the utility maximization principle, meaning that the best choice is to retain the client by releasing an audit report without reservations. These results show that risk taker auditors would be more willing to carry out less extensive audit tests, and consequently be less able to detect fraud, just to retain the client.

Byrnes *et al.* (1999) analyzed the relationship between gender and risk taking and reached the conclusion that male participants are more prone to take risks than females. In this line of thought, some studies made the connection between gender, risk aversion and audit quality. So, we define the following hypothesis:

H5. Auditor risk profile negatively influences RAQP.

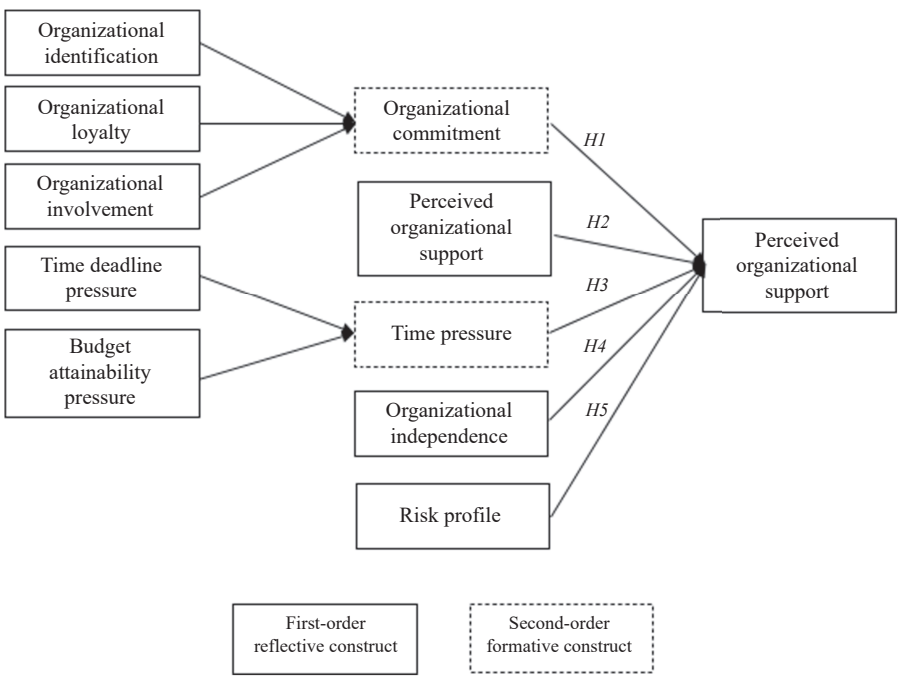
3. Method

3.1 Research model

Drawing on the literature review, this study considers five hypotheses, depicted in Figure 1.

3.2 Data collection and sample

The data were collected through a web-based survey questionnaire that was shared with internal auditors from May to July 2020. The release of the questionnaire was preceded by the



Source(s): Figure by authors

Figure 1.
Research model

application of the translation/back-translation technique of the scales and pretesting with one academic and two professionals. To overcome common method variance, we adopted the following procedures (Podsakoff *et al.*, 2003): (1) a cover letter describing the objectives of the study, informing of the voluntary nature of participation and the total anonymity of the answers, providing the contacts available if any questions arise and requesting honest answers to the questions; (2) we use six- and seven-point Likert scales, labeling the points on each scale; (3) the scales employed are instruments validated in the literature, measurement items were mixed and the latent variable questions were presented on different pages so that respondents did not produce the correlation as expected; and (4) we proceeded to the statistical analysis of the common method bias using the Harman's single-factor test and full collinearity assessment. The exploratory factor analysis with unrotated factor solution yielded 16 factors with eigenvalues greater than 1, explaining about 79.5% of the variance. The first factor accounted for 22.4% of the variance, below the 50% threshold suggested by Podsakoff *et al.* (2003). Additionally, the results of the full collinearity test show that the highest score of the variance inflation factors (VIF) was 1.61, so all factors are below the threshold of 3.3 (Kock, 2015). In summary, the results of the two tests suggest that common method variance was not present.

The target population of this study comprises Portuguese internal auditors. We contacted the Portuguese Internal Auditing Institute to disseminate the questionnaire to its members, as well as sending to some internal audit departments an invitation to participate in the study and we used the LinkedIn network to share the questionnaire with individuals working in internal audit. A total of 187 responses were received, but 75 responses were discarded because more than 10% of the data were missing in the evaluation of the 57 measurement indicators. Thus, our study is based on a non-probability sample composed of 112 responses from internal auditors. Hulland *et al.* (2018) advocate that the convenience sample is sufficient to test theoretical effects based on a research framework. Naturally, this convenience sample limits the potential to generalize from the findings of the sample to the wider population.

3.3 Measurement of the variables

Time Pressure involves budget attainability pressure and time deadline pressure, which were measured using two items adapted from Pierce and Sweeney (2004) on a scale ranging from 1 (never) to 5 (always). Organizational commitment encompasses three dimensions: identification, involvement and loyalty (Cook and Wall, 1980). Organizational identification was measured through six items adopted from Mael and Ashforth (1992). Organizational involvement and organizational loyalty were measured using three items each, adopted from Cook and Wall (1980).

POS was measured with eleven items adopted from Eisenberger *et al.* (1986) and Armeli *et al.* (1998). Risk profile was measured through a three-item scale adapted from Pennings and Smidts (2000). Organizational independence was measured using a fourteen-item scale adapted from Cohen and Sayag (2010) and sometimes modified to meet the needs of this research. Organizational commitment, POS, risk profile and organizational independence were measured using a seven-point Likert-type scale ranging between one (strongly disagree) and seven (strongly agree).

RAQP was measured using 13 items depicting inappropriate practices/behaviors that may have been adopted during the last year in the performance of internal auditor tasks, including eleven items adapted from Coram *et al.* (2003) and Pierce and Sweeney (2004) and two items were added to consider the degree of compliance with International Standards for the Professional Practice of Internal Auditing of the Institute of Internal Auditors (IIA's standards) (IIA, 2017). The items were measured on a six-point Likert scale, from 1 (never) to 6 (always) [1].

The scores of the organizational commitment, organizational independence, risk profile and POS constructs were computed as the participant's mean item response. The scores of the time pressure and RAQP were calculated by summing the scores of the items. We followed the approach of the original scales' authors.

PLS-SEM was used to assess the quality of the measurement variables and test the five research hypotheses, through Smart PLS 3.0 software (Ringle *et al.*, 2015). The reflective measurement model was used for risk profile, POS, organizational independence and RAQP (first-order constructs). Time pressure and organizational commitment are second-order constructs that have been modeled as the reflective-formative type of the hierarchical component model (Becker *et al.*, 2012).

4. Empirical results

4.1 Descriptive analysis

Table 1 describes the descriptive statistics. The average score for organizational commitment was 5.03, with internal auditors showing higher levels of involvement as compared to expressions of loyalty. The results show that affective reactions of these professionals to the characteristics of their employer are not particularly strong. Organizational independence had an average score of 5.32, which indicates that the internal audit function is not "completely free". The internal auditors expressed that sometimes some circumstances interfere with/threaten their performance. The average score for POS was 4.67, which denotes a relatively low degree of agreement on the readiness of organizations to reward internal auditors for increased work effort, to value their contributions and to care about their well-being. Internal auditors show some risk aversion (average of 3.67), showing a remarkable heterogeneity in the respondents' behaviors. The variable time pressure has an average score of 11.59, showing that internal auditors are sometimes subject to some pressure to finish the work by a specific deadline or not to exceed the number of hours planned for each project. Finally, the RAQP variable has a mean score of 19.73, suggesting that misbehaviors in internal auditing are infrequent. Anyway, if we consider the 90th percentile score, we find that there are some internal auditors who recognize that sometimes they do not perform the audit tasks with the expected quality. The data state that the average score of the indicators is

Constructs	Theoretical range	Actual range	Mean	SD	Percentile 10%	Percentile 50%	Percentile 90
OC	1–7	3.08–6.83	5.03	0.65	4.08	5.08	5.73
OID	1–7	2.83–7.00	5.22	0.80	4.17	5.33	6.00
OL	1–7	1.00–6.67	4.07	1.16	2.67	4.00	5.67
OIN	1–7	3.67–7.00	5.61	0.71	4.67	5.67	6.67
IND	1–7	2.96–7.00	5.32	0.72	4.39	5.37	6.12
POS	1–7	1.55–7.00	4.67	1.11	2.94	4.73	6.00
RP	1–7	1.00–7.00	3.61	1.73	1.10	3.67	6.00
RAQP	13–78	13–39	19.73	5.87	13	18	29
TP	4–20	4–18	11.59	2.73	8	12	15
TDP	2–10	2–9	5.65	1.52	4	6	8
BAP	2–10	2–9	5.94	1.60	4	6	8

Note(s): OC = Organizational Commitment; OID = Organizational Identification; OL = Organizational Loyalty; OIN = Organizational Involvement; IND = Organizational Independence; POS = Perceived Organizational Support; RP = Risk Profile; RAQP = Reduced Audit Quality Practices; TP = Time Pressure; TDP = Time Deadline Pressure; BAP = Budget Attainability Pressure

Source(s): Table by authors

Table 1.
Descriptive statistics

low since none of the 13 practices scored above 36% of the maximum possible value (6 = always). Besides that, the three RAQP with a median of 2 were: accepted poor explanations from colleagues working in other departments of the entity, performed superficial revisions to the entity's documents and failure to complete procedures required in an audit program step in ways other than those listed.

4.2 Measurement model

Table 2 presents the item loadings, composite reliability and average variance extracted (AVE), the criteria used to assess the measurement model. The composite reliability of every variable is comprised in the acceptable range of 0.7 to 0.95 (Hair *et al.*, 2019), verifying the internal consistency reliability of all reflective first-order constructs. The convergent validity of the constructs was verified through the standardized factor loadings of the items and the AVE. Following an interactive process, the original scales were refined by retaining the items with outer loadings above the threshold of 0.708, as well as the indicators with outer loadings between 0.4 and 0.708 that implied that the composite reliability or AVE of the constructs did not fall below the suggested threshold values (Hair *et al.*, 2017). The AVE of the first-order constructs exceeds the threshold of 0.5 (Hair *et al.*, 2019).

Discriminant validity has been validated. First, the square root of the AVE for each of the constructs should be greater than the highest correlation of any other construct (Fornell and Larcker, 1981). The results show that the Fornell and Larcker criterion is satisfied for all constructs (Table 3). Second, Table 3 shows that the heterotrait-monotrait ratio (HTMT) values of all the conceptually different constructs are below 0.85 (Hair *et al.*, 2019). The constructs time deadline pressure and budget attainability pressure have a high level of similarity. In this case, the HTMT value between the two constructs is below the threshold of 0.90 (Hair *et al.*, 2019). Thus, the HTMT criterion provides additional evidence of discriminant validity.

To validate the second-order formative constructs, we adopted two procedures outlined in Hair *et al.* (2017). First, we checked for potential collinearity issues between the first-order constructs that form the time pressure and organizational commitment constructs. Table 4 shows that the VIF values are below the conservative threshold of 3 (Hair *et al.*, 2017). In the second step, we assessed the significance and relevance of the relationship between the first-order components and the respective constructs. The results show that the weights of the relationships between the variables are statistically significant, and in some cases the relationship is relatively strong or moderate. Overall, the results support that the measurements of time pressure and organizational commitment match with the reflective-formative type of second-order hierarchical component models.

4.3 Structural model

The assessment of the structural model was preceded by the analysis of the presence of a collinearity issue between the independent variables. The VIF values were between 1.021 and 1.771, which was below the indicative critical value of 3 (Hair *et al.*, 2019). The R^2 criterion allows the evaluation of the model's explanatory power measuring the variance of the dependent variable that is explained by the independent variables, showing the model's predictive quality. The R^2 value for RAQP was 0.266, exceeding 10% (Falk and Miller, 1992). Although it is considered a low score, Hair *et al.* (2017) warn that values above 0.20 may be considered high in behavioral issues. Afterward, we computed the Stone-Geisser's Q^2 metric to assess the predictive relevance of the model, using a blindfolding procedure with an omission distance of 9. The Q^2 value was 0.135, and since it is greater than zero, there is evidence of the small predictive relevance of the model (Hair *et al.*, 2017).

Table 2.
Evaluation of the measurement model

Construct	Item	Loading	Composite reliability	AVE	Construct	Item	Loading	Composite reliability	AVE
IND			0.898	0.597	RP			0.897	0.814
	IND4	0.694				RISK1	0.903		
	IND5	0.758				RISK2	0.901		
	IND6	0.864			TDP			0.808	0.678
	IND7	0.855				TDP1	0.844		
	IND8	0.736				TDP2	0.803		
	IND14	0.713			BAP			0.880	0.785
OID			0.836	0.561		BAP1	0.883		
	OID1	0.715				BAP2	0.889		
	OID3	0.754			RAQP			0.901	0.566
	OID4	0.790				RAQP6	0.694		
	OID5	0.735				RAQP7	0.759		
OL			0.774	0.636		RAQP8	0.687		
	OL1	0.900				RAQP10	0.803		
	OL3	0.680				RAQP11	0.827		
OIN			0.863	0.759		RAQP12	0.742		
	OIN2	0.872				RAQP13	0.745		
	OIN3	0.870							
POS			0.939	0.659					
	POS1	0.816							
	POS3	0.796							
	POS4	0.787							
	POS5	0.836							
	POS6	0.826							
	POS9	0.775							
	POS10	0.882							
	POS11	0.769							

Source(s): Table by authors

	OID	OL	OIN	POS	RAQP	RP	BAP	TDP	IND
OID	*0.749*	0.433	0.460	0.455	0.440	0.205	0.224	0.227	0.382
OL	0.290	*0.798*	0.536	0.683	0.385	0.230	0.071	0.554	0.354
OIN	0.334	0.287	*0.871*	0.446	0.392	0.175	0.115	0.245	0.277
POS	0.398	0.483	0.363	*0.812*	0.275	0.141	0.202	0.504	0.583
RAQP	−0.350	−0.237	−0.313	−0.275	*0.752*	0.181	0.287	0.350	0.390
RP	−0.027	−0.157	−0.098	−0.112	0.151	*0.902*	0.069	0.271	0.072
BAP	−0.121	−0.040	−0.053	−0.167	0.233	0.039	*0.886*	0.869	0.236
TDP	−0.132	−0.276	−0.142	−0.358	0.242	0.169	0.540	*0.824*	0.192
IND	0.309	0.249	0.222	0.525	−0.353	−0.063	−0.164	−0.134	*0.773*

Note(s): The italic face scores on the diagonal are the square root of AVE. HTMT ratio above the diagonal and correlations between the constructs below the diagonal

Source(s): Table by authors

Table 3.
Discriminant validity

2nd order construct	1st order construct	Weight	*t* statistics	VIF
Time pressure	Time deadline pressure	0.512	15.408	1.411
	Budget attainability pressure	0.626	17.820	1.411
Organizational commitment	Organizational identification	0.696	12.018	1.180
	Organizational loyalty	0.247	4.612	1.143
	Organizational involvement	0.366	6.794	1.178

Source(s): Table by authors

Table 4.
Measurement properties of formative constructs

Finally, we found that some independent latent variables contributed to explain the variance of the dependent latent variable, since the standardized beta values of paths coefficients reached statistically significant levels (Table 5). The results show that RAQP are negatively influenced by organizational commitment and organizational independence. Time pressure has a significant positive effect on the propensity for internal auditors to misbehave. Looking at the magnitude of the path coefficients, we found that organizational commitment is the most impactful determinant of internal audit quality, followed by organizational independence and time pressure. Finally, the results do not provide evidence that POS and risk profile are determinants of audit quality.

4.4 Discussion of the results

The purpose of this paper was to understand the effect of individual and organizational factors on internal audit quality. H1 posits that organizational commitment negatively influences RAQP. The results indicate that it is supported, which is in line with the findings of

Structural relations	Path coefficient	Standard errors	*t* statistics	*p* values	Test
H1: OC → RAQP	−0.340	0.115	2.968	0.003	Accepted
H2: POS → RAQP	0.097	0.120	0.809	0.418	Rejected
H3: TP → RAQP	0.185	0.080	2.310	0.021	Accepted
H4: IND → RAQP	−0.244	0.120	2.031	0.042	Accepted
H5: RP → RAQP	0.095	0.085	1.108	0.268	Rejected

Source(s): Table by authors

Table 5.
Structural model assessment

Nguyen and Ngo (2020), who found a positive relationship between organizational commitment and job performance. Internal auditors who nurture a greater sense of belonging to the organization are less likely to engage in misconduct that negatively affects internal audit quality. Organizational commitment is a multidimensional construct. Our finding should prompt increased attention in managing matters that impact the identification, involvement and loyalty of internal auditors.

The first focus should be on the symbiosis between the organization's culture and the specific values of each auditor. The organizational culture represents the values, beliefs and behaviors shared by a group of people. Culture affects the ethical behaviors of internal auditors and is often a decisive element in attracting and retaining these professionals (Rittenberg, 2015). The promotion of a strong ethical culture may become an important element to reduce the risk of RAQP. For this purpose, the adoption and effective internalization of a code of conduct or orientation and training programs may be relevant formal instruments to increase internal auditors' identification with ethical behaviors.

Second, the results suggest that audit quality benefits from full absorption of the activities performed by internal auditors. The willingness to invest personal effort for the sake of the organization is synonymous with full involvement (Cook and Wall, 1980). In internal auditing, there are several initiatives that are likely to show the level of involvement impacting job performance. The results of the latest international survey of IIA reveal that professional standards are sometimes not applied due to their complexity and inadequate internal audit staff (Bailey, 2015). These barriers can be overcome if internal auditors do not give up, seek knowledge to demystify complexity or invest in their own development. Harrington and Piper (2015) point out that, internal auditors cannot simply wait for the training provided by employers, especially in smaller internal audit departments. Proactivity on behalf of the organization is also shown by the effort made to understand the desires of the stakeholders and what needs to be done to fulfill them. In practice, this involves aligning the assurance, insight and objective advice activities performed by internal audit with the strategic objectives of the organization. In this way, internal auditors add value, which is a strong, positive sign of their involvement with the organization. Highly involved internal auditors are less likely to engage in acts that undermine stakeholder confidence or lead to non-compliance with professional standards. Alternatively, involved internal auditors seek to work more energetically, creatively and committedly for the organization and its goals (Turner, 2015).

Third, the results suggest that the mental attachment to the organization (loyalty) decreases RAQP. Retaining good team members is one of the current imperatives of the profession (Harrington and Piper, 2015). This aspiration involves the use of instruments that promote job satisfaction and the desire to stay in the organization. Feeling the organization as their own motivates employees to want the best for it. In the case of internal auditing, this motivation involves performing their professional duties more zealously, raising to higher levels the exercise of appropriate professional care required by the IIA's standards (IIA, 2017). Careful auditors are less likely to carry out ad hoc procedures, not clearly document their work, neglect to monitor the work or ignore the client's needs and expectations. The more loyal internal auditors are to the organization, the better the internal audit quality.

The estimated coefficient does not allow us to prove H2. The literature suggested that the individual's perception that the employer supports and values their work would boost job performance and reduce withdrawal behaviors (Rhoades and Eisenberger, 2002). As POS variable reached a mean score of 4.67 (moderate value), consequences would be expected for internal audit quality considering two specific circumstances. First, the motivation of internal auditors can be developed by intrinsic and extrinsic rewards, which should encompass the various forms of intrinsic rewards (Turner, 2015), but there is still a long way to go in internal audit departments. Second, the proficient and careful development of professional activity

does not always earn the support of the management/audit committee (Ramamoorti and Siegfried, 2015), and in some cases is the reason for the nonadoption of professional standards (Bailey, 2015). Despite this context, our H2 was not supported, which may be understood through the intrinsic characteristics of individuals. According to Rittenberg (2015), the profession usually attracts individuals who have high personal values and ethical standards. Awareness of the importance of internal auditing in improving organizational governance may encourage internal auditors not to react adversely in their profession because of the lower recognition they may be subjected to. The altruism of internal auditors probably makes their professional pride in performing their tasks effectively and efficiently more relevant than the value placed on their work by others.

H3 predicts a positive relationship between time pressure and RAQP and is supported by data. The dysfunctional behaviors of internal auditors are related to the pressure to comply with a time target or not exceeding the hours budgeted. Internal audit activities are not entirely predictable; the dynamic business environment and organizational changes require a frequent adaptation of the audit plan (Abdolmohammadi *et al.*, 2015). Although internal auditors are challenged to perform an increasingly diverse range of tasks, the internal audit staff size is not always what is needed to comply with the standards (Bailey, 2015), and the technology used does not support the audit processes in a meaningful way (Cangemi, 2015), namely computer-assisted audit tools and techniques (Samagaio and Diogo, 2022). These factors increase the risk that internal auditors will not be able to meet time deadlines. Our finding highlights the importance of organizations thinking through the role and strategy of internal audit to make it explicit, continuously monitored and communicated throughout the entity.

In general, increasing audit quality may involve organizations investing more time in carrying it out (Pierce and Sweeney, 2004), as some of the activities performed by internal auditors, such as detecting and investigating fraudulent schemes, take a significant amount of time (Araj, 2015). Since financial resources are finite in organizations, it is natural that the performance evaluation metrics of the internal audit function include various inward-facing indicators related to budgeted time attainment (Seago, 2015). Thus, a potential conflict could emerge between the need to keep the time budget under control and the requirement to maintain high levels of compliance with auditing standards. Our finding suggests that internal audit work plans should allow an adequate amount of time to cover all tasks that enhance and protect organizational value and assist organizations in carrying out their mission and achieving their goals. The IIA's 2010 standards (IIA, 2017) require that the chief audit executive should establish a plan that prioritizes the activities consistent with the organization's goals. However, almost half of the internal audit departments do not have their audit plan based on the strategic plan (Harrington and Piper, 2015), and do not always update it in a timely manner. The increasing interaction with stakeholders (e.g. audit committee), and the complexity and demanding challenges posed to internal auditors (e.g. cybersecurity risk) make the issue of time management a critical factor for internal audit quality. In summary, our study shows that internal auditors may engage in actions or make decisions that threaten audit quality just to avoid compromising the target time for the task or failing to deliver their outputs on time.

The data support H4, confirming the findings of Cohen and Sayag (2010): organizational independence improves audit quality. This suggests that the quality of internal auditing is boosted when internal auditors can perform their work without threats of self-interest, intimidation or otherwise. The IIA's 1100 standards (IIA, 2017) require that internal audit activity must be independent, expressed in the absence of conditions that threaten the ability of internal auditors to perform their tasks in an impartial manner. Internal auditors are almost always employees of the organization they audit, which can raise problems in the freedom of analysis and action, reporting of findings and relations with other people inside the

organization. Furthermore, internal auditing performs assurance, insight and objective advice activities (Seago, 2015). The repercussions of the results of these activities sometimes arouse internal auditors' fears and compromise their independence. The results of the latest international survey by the IIA reveal that 24% of auditors are frequently pressured to change their audit findings (Rittenberg, 2015). Resistance to pressure has various implications, such as exclusion from meetings, transfer to other positions, pay cuts, etc (Rittenberg, 2015). Our finding reinforces the proposition that organizational independence is a cornerstone in internal audit. Organizations that create conditions and establish structures that support internal audit activity can achieve higher levels of quality in the performance of internal auditors.

Finally, we could not prove H5 empirically. In many situations, internal auditors are required to use professional judgment in the performance of their tasks (IIA, 2017), which may be affected by individuals' perception of risk. The theory of planned behavior states that the attitude toward a behavior is a function of the individual's beliefs about the probable consequences of the action and assumes that the intentions to perform an action are directly linked to its accomplishment (Ajzen, 1991). The results of this study show that misconduct (risk behavior) is not dependent on the individual risk propensity attitude of internal auditors. Trotman and Duncan (2018) claim that internal audit quality is affected by personality traits, with risk propensity being associated with the profile of an extroverted, open, neurotic, agreeable and conscientious individual (Nicholson *et al.*, 2005). Our finding highlights the importance of further examining the impact of human capital attributes on internal audit performance, namely, personality traits, soft skills, training or experience. Moreover, the results suggest that internal auditors are idiosyncratic and heterogeneous productive resources, capable of determining audit quality differentially.

5. Conclusion

The results of this study show that there is a positive effect of organizational commitment and organizational independence on internal audit quality. Moreover, the propensity to incur RAQP increases when internal auditors are under time pressure. However, the results do not provide evidence that POS and risk profile are determinants of audit quality. These findings provide support that internal audit's capacity to create value and improve the organization's operations is constrained by factors associated with the individual and the entity.

5.1 Research implications

The theoretical implications of this study are fourfold. First, this paper contributes to the stream of research regarding the determinants of internal audit quality, a topic with few studies. Except for organizational independence, this study is pioneering in examining the effect of risk profile, POS, organizational commitment and time pressure on internal auditors' performance. Moreover, the results show that organizational commitment is the most impactful determinant of internal audit quality, followed by independence and time pressure. Thus, our work shows that the organizational environment and the internal auditors' characteristics are drivers of internal audit quality. Second, the effectiveness of the internal audit function is shaped by a mix of factors that drive stakeholders to demand audit quality and by the concerns and regulation of regulators. This study fits into a third dimension by identifying factors that drive internal auditors themselves to supply audit quality. Third, audit quality is a complex concept, interpreted differently by governance actors. This study focuses on the perspective of internal auditors in carrying out their activities, a current of research that has been little observed in the literature. On the other hand, internal auditors' perceptions of their misconduct offer an alternative way to measure the quality of their work against other metrics such as internal audit effectiveness. Fourth, several items on the RAQP

scale suggest ethical concerns in the professional judgment and actions of internal auditors. Our results emphasize the importance of researchers not only focusing on experience, education or technical skills as components of internal audit quality but also including the ethical skills of internal auditors.

Regarding the methodological implications, we developed a literature-based scale to measure RAQP, with the measurement model identifying several items with satisfactory levels of reliability. The RAQP metric is used in the external audit quality literature. To the best of our knowledge, this study is pioneering in adapting this metric in the internal audit field. Moreover, we used the PLS-SEM method, which is a second-generation data analysis technique that allows for robust estimations of second-order constructs as well as better understanding of more complex structural and measurement models. Previous studies have used conventional statistical methods (e.g. ordinary least squares regression).

This study is relevant for a more fruitful management of internal audit departments. Internal auditors recognized that they did not always perform as desired. This finding has a threefold implication. First, it reinforces the importance of internal audit departments developing and maintaining quality assurance and improvement programs prescribed in the IIA's 1300 standard. The Common Body of Knowledge 2015 (O'Loughlin and Swauger, 2015) reports that about two-thirds of internal audit departments do not conform with professional standards related to internal audit quality. Our finding shows the immediate need to introduce ongoing monitoring activities, periodic self-assessment or external assessments, to mitigate RAQP. Second, our study provides useful information on the determinants of internal auditors' performance that can be addressed in organizations to improve internal audit quality. For example, the development of upstream policies that positively impact organizational commitment or reduce time pressure could be alternative tools for improving internal audit quality, particularly in small internal audit departments. For example, organizations may implement wisdom management practices that, according to Jakubik and Müürsepp (2021), involve ethical issues, social values and value judgments linked to knowledge of best internal auditing practices. Third, the audit committee uses the internal audit work to make better-informed decisions in terms of improving internal control, risk management and governance. In this regard, the performance of internal auditors should be sufficiently articulated with the interests of the audit committee. The results of our study reveal how vital the preparation and implementation of internal policies by the audit committee is to minimize the risk of the RAQP occurrence. These policies may include more effective and interactive planning, the promotion of soft skills of auditors to mitigate the effects of stress, and provision of a budget compatible with the functions of internal audit, among others. A high-quality internal audit is an element of assurance, advice, a valuable resource in the improvement of corporate governance systems and driving value on what really matters in the company. Finally, this study has policy implications. The results show that organizational independence positively impacts internal audit quality. Internal audit findings are often inconvenient for the board of directors and internal auditors do not always report functionally to an internal committee composed of independent individuals. The Common Body of Knowledge 2015 (Rittenberg, 2015) reports that internal auditors are subject to significant pressures to change or suppress audit findings. Regulators and governments should create standards that improve corporate governance by strengthening the status of the internal audit department inside organizations to mitigate resistance to the role and duties of internal auditors. Additionally, the regulators of the companies with the greatest impact on the economy may institute mandatory external quality control of internal audit works carried out by an individual/team from outside the organization. This could reinforce the perception that internal auditors need to be truly professional. Consequently, the primacy of internal audit quality brings internal auditors closer to identifying and addressing the most critical issues in the organization.

5.2 Limitations and future lines of research

A limitation of this study was that "political correctness" may have influenced the measurement of the items. Future studies could control social desirability direct effects on responses by using the social desirability scale. Moreover, examination of other factors, such as the personality and training of internal auditors, or the ethics culture and career opportunity in the entity, may be fruitful avenues for future research.

Notes

1. The measurement items of constructs used in this study are available upon request from the authors.

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How to carry out organisational debriefing for team learning

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Abstract

Purpose – The debriefing is a procedure based on intra-team feedback, which has frequently been applied in university formation in health but has been less used in business. The aim of this research is to analyse best practices in the actual implementation of debriefing in organisations, based on criteria the guidelines for carrying out each stage established in the procedure.

Design/methodology/approach – To achieve these goals, working teams from different organisations carried out 19 group-debriefing sessions on an authentic work problem. These sessions were observed and analysed following a qualitative approach.

Findings – After observing a debriefing session in 19 organisations, four categories related to its implementation have been identified: Self-analysis, information, planning and orientation of the development of the team.

Research limitations/implications – It is important to mention some limitations to this work. The major limitation was the lack of published literature related to the debriefing in the area of organisational management. The qualitative and exploratory nature of the study limits the generalisation of the results.

Practical implications – The research has practical implications as the characterisation and description of each phase favours the transfer to implement the debriefing technique adequately in different types of organisations.

Social implications – It has been observed that all forms of debriefing have a common purpose in learning and, team and employee development, due to the powerful transferability and usefulness of debriefing in different contexts. Therefore, knowing the correct use of debriefing is a breakthrough in this area. In addition, including this type of practice will not just facilitate a better performance, it will also help teams to learn to work in a team from their own experiences.

Originality/value – It has been characterised by the process of debriefing from the correct implementation of each phase through the analysis of the narratives that arise in the debriefing sessions carried out.

Keywords Debriefing, Team learning, Reflection, Teamwork

Paper type Research paper

1. Introduction

Organisations are adapting to changes in the economy constantly, and those that adapt best have the greatest possibilities to be sustainable (Bouncken *et al.*, 2022; Pascucci *et al.*, 2022; Bernal-Conesa *et al.*, 2016). Working teams contribute to speeding up processes and improving the performance of organisations (Hebles *et al.*, 2019). The efficacy of an organisation depends to a great extent on the efficacy of teams to give a fast, flexible and innovative answer to the challenges (Fernando and Wulansari, 2020), integrating a diversity of knowledge, experiences and abilities from its members. Likewise, working teams favour effectiveness as they allow for the sharing of the workload, integrating of different areas of

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experience, mutual supervision and the finding of complex and innovative solutions to problems (Torrelles *et al.*, 2015).

However, the simple fact of bringing people to work together does not guarantee the efficacy of the team and for this reason, different academic and organisational practices have been encouraged for teams to learn to work as a team (Hebles *et al.*, 2019). Teamwork training carried out in an organisational context tends to be more effective but is costly and requires a lot of time (Salas *et al.*, 2008).

In definite terms, both learning to work in a team and learning as a team make up an important asset for organisations. Organisations seek to promote learning in the workplace, but research shows that the acquisition of competencies in organisations, following their own programs of training, is scarce, concluding that organisations should find ways of accelerating learning through the experience of teams (Eddy *et al.*, 2013).

Learning in teams positively influences individuals, teams and the organisation and is the result of the construction of shared knowledge that is developed in the team itself (Raes *et al.*, 2015). The exchange of information, the dialogue and the discussion are team processes for the generation of new, shared meanings and reflection facilitates this learning (Raes *et al.*, 2015).

In this sense, group debriefing is a reflection technique that is promising for learning about teamwork and for learning in the team about other relevant issues for effective performance in organisational processes. It consists of the members of the team holding a dialogue based on the reflection and analysis of the team dynamic, thus favouring group learning from experience (Eddy *et al.*, 2013). However, for the debriefing to contribute those benefits, it is necessary for the session to be directed by a moderator (Eddy *et al.*, 2013) and have a psychologically safe environment. Lack of psychological safety during a debriefing session may negatively affect learning (Turner and Harder, 2018). This aspect is one of the concerns of the facilitators of this technique, for example, research conducted by Kang and Min (2019) showed that students did not share their point of view during debriefing sessions because of the anxiety caused by the observation of their errors. In view of this, the need arises to contribute with the preparation to facilitate this technique. However, the scarcity of people prepared to correctly facilitate a debriefing dynamic has been shown (Reiter-Palmon *et al.*, 2020), in addition to studies that permit the identification of the characteristics of a good debriefing and the valuation of conducts that favour learning, through direct observation of the dynamic (Raes *et al.*, 2015). For this reason, the objective of this qualitative study is to better understand team members' experiences with group debriefing to identify how best practices of debriefing are developed. In order to achieve this, the verbal interactions between members of the team during the dynamic have been analysed.

2. Theoretical framework: debriefing: a tool that favours team learning

According to Marks *et al.* (2001), learning in a team is expressed through the processes of interaction between members of the team that allow it to integrate the interdependent contributions of each one, starting from cognitive, verbal and behavioural actions, to organise the teamwork and create a shared and valuable result for all.

For the shared cognitions generated by the team to result in better-perceived performance, the process of a team is emphasised (Boon *et al.*, 2013). Marks *et al.* (2001) highlight transition processes as important in the work of a team. These are produced when a team moves from one performance to another, and its members consider it retrospectively to reflect on how it has functioned. The reflection of the team facilitates the learning behaviour of the team (Raes *et al.*, 2015).

To facilitate a cycle of active learning, teams can carry out reflection meetings after a work experience or performance episode (Tannenbaum and Cerasoli, 2013). Debriefing, in this sense, is an effective tool for increasing organisational learning and performance. Its correct use allows for self-correction of team members in such a way as to not only improve their performance, but also their enthusiasm for working in the team (Lacerenza *et al.*, 2015).

Tannenbaum *et al.* (2013) propose three relevant phases in the implementation of a debriefing: (1) Analysis and Reflection; (2) Verification of Information, Feedback and Information Exchange; and (3) Establishment of Objectives and Planning.

Each member of the team reflects on his or her own intervention and contribution to the team. *Reflection* consists of analysing the experience, comparing the results obtained with the desired results, analysing the process followed and evaluating the consequences of this process.

The objectives of the second *Information* phase are to verify the correction of the data being considered, correct erroneous personal beliefs, evaluate the process carried out more precisely and align the explanation of the situation, coordinating the comprehension of all the participants. This phase encourages the team to make well-founded decisions and adjust tasks to be carried out, improving their performance.

The third *Planning* phase is about establishing agreements about objectives or action plans. This is to say, the comprehension of the previous experience is integrated with the planning for the next activity. The establishing of goals allows for the improvement of the actions themselves, above all when these goals are shared with the team as, in this way, commitment is increased (Gardner *et al.*, 2017).

The debriefing technique has been widely used in the formation of health professionals (Conoscenti *et al.*, 2021; Mundt *et al.*, 2020), frequently combined with a simulation methodology (Paige *et al.*, 2021). Less frequent is the application of this technique in business management, be it for the evaluation of processes or for the improvement of the efficacy of the teams. However, it is considered an adequate resource to favour team learning and organisation development. Thus, the objective of this research is to analyse best practices in debriefing in different organisations in order to know how it is to be adequately applied in this type of organisation. This characterisation of best practices can be transferred to different types of organisations and teams to improve their functioning.

3. Methodology

To achieve the objective of this study, working teams from different organisations carried out 19 group-debriefing sessions on an authentic work problem. These sessions were observed and analysed following a qualitative approach.

3.1 Participants

In total, 25 teams were contacted for convenience, as one of their members was pursuing graduate training at the university with one of the researchers. Although 25 teams carried out their debriefing sessions, following a criterion of theoretical saturation (Draucker *et al.*, 2007), 19 were selected for the analysis. A total of 84 working people participated in teams of between three and six members. The companies are in the Bio Bio region (Chile). Table 1 includes information about the workplace, team area, problem dealt with, session duration and year of realisation.

3.2 Instrument

Each session was observed by two independent observers. To guide the observation of both, an *ad hoc* observation scale was designed from the recommendations of Tannenbaum *et al.* (2013)

Organisations code	Organisations market	Area	Problem/issue to deal with[1][2][3]	Year/ Duration
E01	Auditing services	Auditing team	1	2018/50 min
E02	Producers of potable water	Department of general services and asset protection	1	2018/30 min
E03	Manufacture of paint for homes and industry	Sales team	2	2018/45 min
E04	Stationers and Photocopies	Administrative area	2	2018/30 min
E05	Education	Accounting department	1	2017/30 min
E06	Producers of potable water	Control of operational management department	1	2017/50 min
E07	Printing Service	Sales and purchasing team	2	2017/30 min
E08	Sporting and other Recreation Activities	Accounting section	2	2017/1 hour
E09	Paper manufacturer	Finance department	1–2	2017/50 min
E10	Health	Training department	1	2018/40 min
E11	Textile Manufacturing Company	Accounting department	1	2018/1 hour 30 min
E12	Accounting Consultancy	Tax operation team	1	2019/30 min
E13	Professional formation	Administration department	1	2019/30 min
E14	Education	Postgraduate management	3	2019/45 min
E15	Port Operations	Accounting department	1–2	2019/1 hour
E16	Commerce	Company Bank Team	3	2019/40 min
E17	Steel production	Accounting unit	2	2019/1 hour
E18	Legal	Department of prosecutions	2–3	2018/32 min
E19	Real Estate	Accounting department	1	2021/50 min

Note(s): 1 Failure to meet deadline
2 Errors of results
3 Failure to meet goals
Source(s): Table by authors

Table 1.
Characteristics of the participating teams and organisations

for the adequate development of the debriefing technique. The procedure had several phases in its elaboration. Firstly, the three researchers independently created a bank of items, proposing three items for each dimension. Then, by consensus, the items were selected, avoiding overlapping and in accord with the criteria of clarity and relevance in the dimension to configure the observation scale. Thirdly, the scale was applied in a debriefing session to test its adequateness and applicability.

The instrument is composed of three dimensions that coincide with the stages of the procedure: Analysis and reflection (ANAL) composed of 4 items, Information and feedback (INFO), formed with 3 items and Planning (PLAN) with 3 items. The options for the responses are 0 (Not done) 2 (Deficiently done) 4 (Done sufficiently well) and 6 (Done excellently). Table 2 gathers the content of the items for each dimension.

3.3 Procedure

Training in debriefing was carried out for students in a post-graduate program in business administration. This training had a duration of 5 h and consisted of a theoretical presentation of the debriefing technique and the carrying out of a practical activity to apply the knowledge. The activity consisted of the organisation of 30-min debriefing sessions in which a team applied the debriefing, and the other team evaluated the dynamic through the

Analysis and reflection: Reasons for one or several events or problems are analysed, contrasting implicit suppositions
1. Before beginning, meeting objectives are presented (information to prepare for a job or to analyse a specific performance)
2. The person, or people, that lead self-evaluate, generating an environment of trust to express opinions that are necessary to face different topics
3. Each member of the team self-evaluates, analysing even not evident aspects, which promotes a group reflection about why the team acted or acts in a certain way
4. A fluid and coordinated dialogue is formed, with each member expressing his or her opinions, enquiring or arguing
Information (Verification, feedback and information exchange): Information is contributed to contrast personal beliefs
5. Shared objectives are revised to establish team priorities
6. Information is exchanged and updated
7. Individual and team strengths are recognised, evaluating the individual contribution, etc.
Establishing of goals and planning: The participants share their goals with respect to their own improvement in terms of their contribution to the team and they commit to them
8. The role of each one in the team is agreed on, making their functions explicit to meet the objectives
9. Possible eventualities are discussed and strategies to face them are proposed
10. Agreements are established and confirmed about change in conduct and commitment of each one with the task

Table 2.
Dimensions and items of the observation scale

Source(s): Table by authors

observation scale. The roles of the teams rotated so that all the students had the opportunity to practice the debriefing technique and they could all develop skills for observation and evaluation.

Once the students were trained, 19 organisations were contacted and informed of the research, requesting their voluntary collaboration and permission to record the session. The debriefing session consisted of analysing a recently occurred team problem. One of the post-graduate students guided the session and the other observed. The subject teacher exercised the role of the second observer. The sessions were recorded and transcribed for later analysis (14 h of recording were registered). Afterwards, both observers completed the observation scale independently.

Data collection began in the year 2017 and ended in 2021 when the saturation point was reached because no new additional categories were found (Draucker *et al.*, 2007). The extended duration of data collection period was due to the participating students (and their teams) being from different academic years. The duration of the session, the year and the type of problem dealt with are specified in Table 1.

3.4 Data analysis

The data analysis was done in two stages: (1) the selection of best practices; and (2) the analysis of best practices.

3.4.1 Selection of best practices. For the selection of best practices, the two independent observers filled out the observation scale for the session transcribed. The inter-rater agreement was measured through Kappa. For the total of the scale, the agreement is moderate ($K = 0.537$; $p < 0.01$) as it is for the dimension REF ($K = 0.444$; $p < 0.01$) and for the dimension PLAN ($K = 0.483$; $p < 0.01$). The inter-rater agreement for the INFO dimension is high ($K = 0.707$; $p < 0.01$).

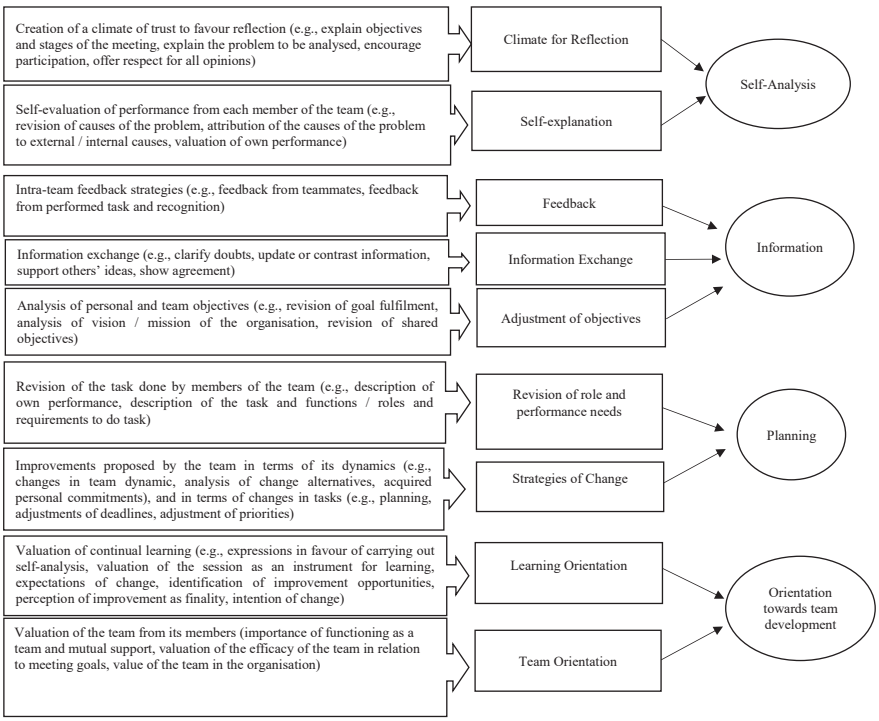
In each dimension, those teams with an average score of 5 or over were selected as best practices.

3.4.2 Analysis of best practices. In order to describe in detail how the teams apply each phase of the debriefing in selected cases, a qualitative approach was used to analyse the content of the interactions. For the data analysis, MAXQDA 12 software was used. A first inductive analysis was done based on the recommendations of Thomas (2006). In this phase, an open codification was carried out, establishing a first-order code matrix. Then, the common elements among the primary codes were identified and constant comparisons between them were done to elaborate the category tree (Figure 1). In the second phase, a deductive analysis was done to group the codes based on the previously reviewed literature. This gave significance to the narrative of the discourse of the teams, considering each stage of the debriefing. To reach a deeper level of analysis in relation to the correct use of the debriefing tool, the relationships between the categories were analysed in a third phase in order to define a conceptual and theoretical model for the phenomenon under study.

To improve the reliability of the data (Vallejo and Finol de Franco, 2009), methodological triangulation was carried out using two distinct analysis techniques: analysis of the narrative content of the debriefing and the application of the valuation scale of the implementation of the debriefing.

4. Results

The results of each of the stages of the analysis are presented.



Source(s): Figure by authors

Figure 1.
Tree of codes

4.1 Selection of best practices

Table 3 includes the organisations whose team sessions were selected as best practices in each of the dimensions, as well as the average score obtained.

In total, 11 companies of the 19 have been considered best practices in some dimension. Only two companies, E06 and E11 have been selected as best practice in all the dimensions. In the Self-Analysis dimension, seven companies have met the criteria to be considered as best practices. In the Information dimension, there are five best practices, the same number as in Planning.

4.2 Analysis of best practice

The analysis of the interactions in debriefing sessions led to the identification of a set of codes that show the development of this technique in large stages: Self-analysis, Information and Planning. In addition, a set of codes describe members' attitudes towards the development of the team as a transversal line that favours the efficient attainment of this reflexive dynamic. Figure 1 collects the tree of the codes with their definitions.

Following this, the results of each of the categories identified are described, illustrating the content of the interactions with verbatim quotes from the participants. The letter E with a number indicates the code of the participant and the letter p indicates the number of the paragraph where the quote is located.

4.2.1 Self-analysis. In this first phase of the debriefing session, the participants reflect on both their individual and team performance. At this moment, two fundamental aspects arise: the generation of a safe climate that favours shared reflection and the development of individual self-evaluation. In most of the cases analysed as best practice, a moderator facilitated the dialogue. In some cases, that person was the group leader, and in others, it was a member of the team with the prior formation in debriefing: *"debriefing helps the performance of the teams, the idea is to talk, to have trust, to talk to each other and improve things" (E14, p11).*

The leader or facilitator of the session helps to generate a climate of trust. Firstly, it is important to explicitly differentiate a debriefing session from other types of planning or task-coordination meeting: *"The objective of this meeting is to identify . . . not only weaknesses and strengths of the process, but also there is an attempt to generate synergies . . . identify needs . . . anticipating future eventualities. Basically, it is about identifying opportunities to improve the next activity" (E06, p4).*

Year	Organisation	REF	INFO	PLAN
	E05	5,0	4,0	5,3
	E06	*6,0*	*5,3*	*5,3*
	E08	3,5	4,7	*6,0*
2018	E02	*5,0*	4,0	4,7
	E01	*6,0*	4,0	2,0
	E11	3,5	*5,3*	*5,3*
2019	E13	*5,0*	2,0	4,7
	E14	3,0	*5,3*	4,0
	E16	3,0	*5,3*	4,7
	E10	*5,0*	2,7	2,0
2021	E11	*5,0*	*6,0*	*5,3*

Note(s): The values of the best practices are shown in italics
Source(s): Table by authors

Table 3. Organisations selected as best practices in each dimension

Then, the performance issue to be dealt with should be clearly presented: *"I have called you to this meeting because about a week ago we were informed that we had not reached the accounting closure for a second time" (E05, p7).*

The presentation of the problem allows the meeting to be channelled and encourages the team to focus on analysing its causes. Once the topic is presented, the moderator must maintain the conversation focussed on the topic and encourage the participation of all members of the team: *"María . . . I would like you to give us your point of view . . ." (E05, p53).*

In the following step, the explanation of each member of the team should be promoted, encouraging them to recognise their mistakes in the performance of the team's tasks. Starting with his/her own explanation, the leader offers an example encouraging other members to reflect on their own practice: *"I, as a leader, did not do adequate monitoring of this situation . . ." (E13, p10).*

After the leader's self-explanation, each member of the team explains the reasons for his or her behaviour and how this affected the teamwork, offering details about the performance aspects he or she wishes to improve: *"My mistake was not checking and controlling on time the documents . . ., . . . and on some occasions I did not give the correct instructions because . . . I was not sufficiently clear in explaining to them what they had to do" (E01, p10).*

The leader helps the realisation of the self-evaluation of the members by asking: *Why do you think you get behind? Is there something else you find difficult? (E01, p12).*

4.2.2 Information. This phase of the debriefing has three main objectives: to give and receive feedback between members, to exchange information and to adjust objectives.

The participants offer different forms of *feedback*, considering the point of view of the team as well as the task undertaken. The feedback is centred on recognising the contribution of each of the workmates in the team to the collaborative task, in addition to indicating the aspects that must be improved: *". . . in my opinion, you dedicate a lot of time to your clients and for that reason you lose focus" (E16, p61).*

The feedback referring to the task itself emerges from the experience of having done that task. Indeed, the task itself offers useful information for improving execution and analysing its requirements. *"I have 10 clients, and this is the weakest part because I can't focus on everything . . . Finally I review the issues that I know the leader in charge of the project is going to ask me about" (E01, p34).*

In turn, the proficient performance of each team member is recognized, highlighting the individual achievement to show the group the importance of individual performance for team performance: *"Lucia has several important individual characteristics, such as her manner with people, her kindness, her management of providers . . . these are strengths that we have to highlight as they contribute to the area functioning better" (E13, p36).*

On occasion, the feedback of the team members is focused on the recognition of the team's abilities to achieve the specific objectives or on the recognition of the team's value for the organisation: *". . . the control of operational management has to be the referent in the providing of information and we have done that very well" (E06, p58).*

Information exchange is transversal across the debriefing session. However, this second phase centres specifically on updating information and clarifying doubts about the performance or requirements of the task. Relevant information for achieving objectives is provided making sure that the whole team has the same information available: "*before, we were in operation, and now, being in finance, we have to see the company as a whole, in other words, Pedro, you have to see other issues that we didn't see before" (E06, p 63).*

Regarding the process of *adjusting objectives*, the members of the team have to confirm the agreement with a shared objective: *"we could share what I understand as the objective or the reason for these internal audits. I would say we do internal audits preparing ourselves for what is coming in March, that would be one of my answers. However, Pepe might have another, and*

so on. Maybe we all don't share the same objective or we don't understand in the same way . . ." (E11, p22).

Once individual beliefs relating to the objective are shared, the team leader should present the work objective, highlighting the importance of this being well-understood by every member. In this way, it is necessary to readjust considering each member's understanding and that which is laid out at an organisational level. *"The objective of our internal audit was to validate our internal requirements and the normative requirements. So, maybe we are lacking transmitting this clearly to everybody . . ." (E11, p22).*

4.2.3 Planning. This last phase of the debriefing session includes reviewing the role and performance needs of each member, predicting possible eventualities and planning strategies for change.

In order for the team to carry out a role review, it is necessary for the members to understand that the work is done interdependently. Therefore, it is essential that everyone knows the functions and roles of their teammates. *"This is to confirm that you are clear what each of us does . . . Juan . . ., what does Juan do?" (E08, p69). "He makes the check deposits . . . So if I give him wrong information, he is wrong and it's a whole chain." (E08, p102).*

During this part of the session, each member describes his or her function in the collective task and the specific requirements that his or her role implies for being performed effectively: *". . . I have to close the financial statements on the 10th of each month, and for that I require that we coordinate our efforts to achieve this goal." (E08, p129).*

In this stage, possible *eventualities* are predicted anticipating the unexpected, for example, changes in the context or in the client or user profile. *"We can have an eventuality in December, it is most likely that we will be overloaded with multiple tasks. As it is the end of the year, lots of requests arrive . . . and often we also have an audit in this month" (E13, p62).*

In this prediction, the review of past and recurring eventualities can help: *"The most recurring eventuality we have is the issue of the models, with button, without button, with zip, with collar, without collar . . ." (E13, p60).*

In the final stages of the debriefing, when the team has already made an analysis of its performance, *strategies for change* are proposed. The teams lay out proposals for change linked to adjusting their dynamics of functioning. Among the most common actions are the review of roles and redistribution of tasks, the incorporation of follow-up meetings and monitoring of achievements, increased participation and improved communication among team members to better understand each other's roles and enable mutual support.

Although strategies to improve team dynamics are proposed, most of the strategies are aimed at improving task execution such as adjusting deadlines and prioritizing tasks and proposals to improve the service or product: *". . . I hadn't thought of that, when submitting the application, we should send it to all organizational levels because we send it specifically to managers, we could call the supervisors directly." (E06, p08).*

As a complement to the change strategies proposed by the team, there are also behavioural commitments by each team member in his or her personal capacity. These commitments are aimed at modifying behaviour in favour of team or performance improvement. They are derived from the analysis carried out by the team, the strategies proposed and the demands of the collective task. *"I am going to start organizing the activities in writing and, in this way, we are going to get the team to integrate all the processes. . . ." (E05, p 200).*

4.2.4 Orientation towards team development. During the three stages of the briefing, attitudes such as learning orientation and team orientation were identified among the members. These attitudes favour the development of the team and the recognition of learning as a mechanism of permanent improvement.

The teams that show a correct development of these stages appreciate the opportunity to carry out a meeting of this type, emphasising the importance of communication between

members. Considering the advantages of this type of session, team members acknowledge the need for these sessions to be held systematically and periodically. *"This meeting has served to see the bad things and for us to realise things we can improve individually and as a group, because sometimes, day to day we can't see in what we are failing. We could do this more often" (E20, p256).*

Learning Orientation is an attitude that is transversally shown in the whole process of reflection. The team recognizes the need for continuous improvement and members show a proactive attitude to contribute to team development. Even while recognising the everyday nature of the error, the members focus on identifying opportunities for improvement:

> It is a tool that allows you to start from yourself, because in work teams there is a tendency to start from the error of the other, but the decision and management of change and of the high-performance teams is in each one of their members . . . The important thing is to generate synergy and generate opportunities for improvement, and that is already appreciated in this session (E06, p82).

In the same vein, the participants show a clear *team orientation*. Indeed, they tend to underline the need to focus on the team as a unit responsible for the tasks. They emphasise the need to support each other to solve problems based on shared responsibility.

> A very important strength is that we are collaborative, when it is necessary to resolve problems, the other is always available to take it on (E16, p58).

Another aspect that displays team orientation is the sense of shared effectiveness. In fact, participants value their team positively, recognising the effectiveness in meeting the proposed objectives and highlighting the role of the team in the organisation. "*We are a highly vital department for the company" (E06, p25). ". . . I have deposited one hundred percent of my trust in the team, that is very efficient . . ." (E14, p26).*

5. Discussion

This article moves forward in the characterisation of the process of the debriefing dynamic as a tool to favour learning in work teams in different organisations. A process of three, interrelated stages is identified that contributes to the team reflecting on their performance and proposing adjustments to improve their functioning and efficacy. In addition, important attitudes are distinguished that favour the implementation of this dynamic; learning orientation and team orientation, as part of the orientation the team has towards its permanent development. These attitudes influence the capacity of learning and reflection from the team and are, in turn, strengthened through a correct execution of the debriefing. Figure 2 integrates the propositions that will be discussed in what follows and summarises the theoretical model of the research.

P1. Strengthening a climate for reflection is associated with a more specific self-explanation.

During a debriefing session, the members of a team reflect on a recent incident, and they talk about what happened and identify opportunities for improvement (Eddy *et al.*, 2013). For this, it is necessary that the members of the group give meaning to the experience, which can imply self-explanation. In this sense, to favour this process we have confirmed the need to develop an adequate climate for the team. According to Parker and du Plooy (2021), a psychologically safe environment is positively related to team learning. Psychological safety is an essential condition for properly conducting debriefs and can even be fostered through the debriefing process (Allen *et al.*, 2018).

Our results are coherent with those of Paige *et al.* (2021) and Gardner *et al.* (2017) about the fact that there are certain strategies to achieve this climate, such as the presentation of the problem to be dealt with and the objectives of the session, as well as the promotion of the

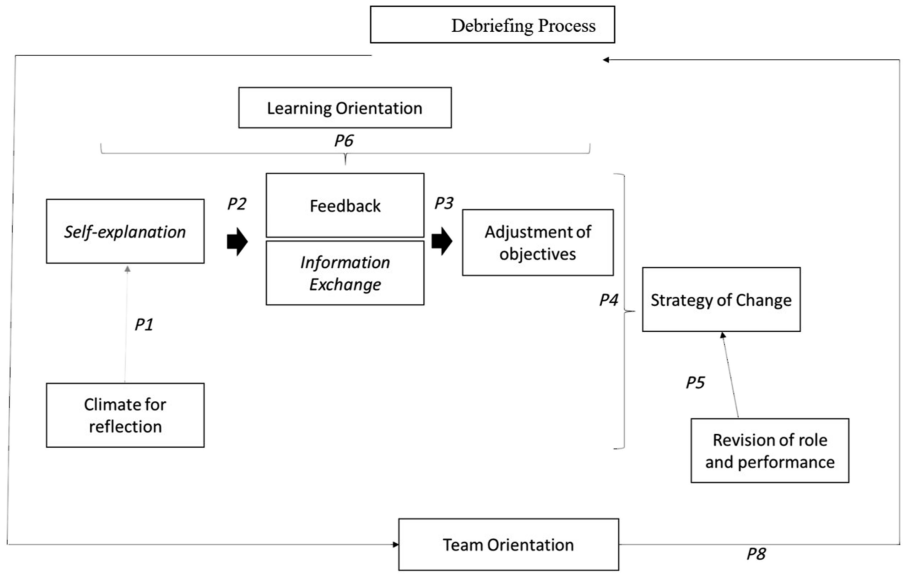


Figure 2.
Theoretical model

Source(s): Figure by authors

sincere and egalitarian participation of all the members, with respect for others' opinions as a principle. Therefore, it is important that the person who moderates the session keeps the elements that favour a climate of trust and respect in mind, promotes the participation of all the members, as well as self-explanation and reflection about the experience and performance themselves. The role of the moderator will be the key to ensuring that the team is able to provide feedback to reconfigure their experience and the information exchange and to allow them a better understanding of the situation to improve decision-making. The systematic review developed by Hall and Tori (2017) confirms the importance of safe surroundings to favour honest and open dialogue. In this sense, confidentiality must be guaranteed and the rules of conduct, such as constructive, honest and respectful feedback, must be made explicit.

P2. A specific and profound self-explanation favours precise feedback and greater consensus in the exchange of information.

We have observed that when the self-correction carried out by the team is specific in relation to concrete performance, useful information for developing good feedback is shared with the team. This valuation from the workmates allows a readjustment of the person's own valuations as the feedback offers the members' information that encourages learning from experience (Johnston *et al.*, 2017). For its part, sharing information and opinions favours high-quality decision-making and, therefore, team performance. In this sense, Eddy *et al.* (2013) propose that all the members of the group participate giving their opinion both to promote the sense of belonging, as well as to have in mind all of the perspectives. This climate created in the debriefing favours the co-creation of the meaning of the experience or the problem dealt with.

P3. A consensual co-reflection favours the adjustment of objectives.

P4. A consensual co-reflection and the adjustment of objectives favour strategies for the concrete and relevant change.

Among the findings with respect to the phase of reflection, it is possible to highlight that when this reflection is profound, it promotes information inside the team that is significant for carrying out an adjustment to the common objectives. This is in accordance with that argued by Raes *et al.* (2015), which teams that practice reflectiveness are not only capable of questioning to what point they have achieved or are achieving their objectives, but also question their objectives, their focus to obtain them, the underlying conditions, and the established way of working together. In this sense, the members of the team talk about the common objectives to understand if there exists consensus or if it is necessary to go back and revise their meaning so they are shared by all. We have observed that by having redefined the objective, the members of the team identify new information that permits them to also adjust their operational strategies, and in this way, the new strategies are concrete for the achievement of these already-revised objectives. The shared reflection favours the adjustment and comprehension of the objectives, promoting, furthermore, an analysis of the internal processes of the team (communication, methods and strategies) (Widmann *et al.*, 2016).

P5. Clarity and knowledge of distinct roles improve the knowledge of the performance in the strategy of change.

Regarding the proposed change strategies, we have found evidence that when teams inform their workmates of their roles, work tasks and function in the analysed incident, precise information is generated about what conduct to offer for a predetermined performance strategy. When the roles are clear, there exists greater knowledge about the requirements of the job and the procedures to meet them, which could be related to better performance (Karkkola *et al.*, 2019).

P6. Learning Orientation is associated with the quality of reflection, information exchange and planning.

P7. Team Orientation favours better quality in the debriefing, and a well-developed process of debriefing, in turn, improves team orientation.

During the three stages of the debriefing, attitudes of learning orientation were identified in the members of the team. These attitudes favour the development of the team and the recognition of learning as a mechanism of permanent improvement. On investigating how the coordination of different knowledge, an essential factor in team learning, is produced in teams. Haddad *et al.*, (2021) allude to the essential role of the processes of interaction for relevant knowledge to be produced. In this way, learning orientation affects performance through reflection (Wang and Lei, 2018). According to Lacerenza *et al.* (2015), learning orientation will encourage members of the team to be actively involved in the meeting, with a better disposition to the ideas and actions of others and will acquire greater shared comprehension.

Another relevant attitude that was observed during this dynamic was team orientation. Our results suggest that when the participants show a clear orientation towards the team, which is expressed in their consideration of the team as the unit responsible for the tasks, they show a greater involvement with the debriefing. They place emphasis on the need to support each other to resolve problems and difficulties, and in the shared responsibility to achieve objectives.

In turn, the experience of the debriefing itself favours a greater team orientation due to the feedback that is generated, in which being centred on the objectives and performance promotes a greater sense of self-efficacy. A positive valuation from the participants towards their team is observed, highlighting its efficacy to meet the proposed objectives and underlining the relevance the team has in the work unit or organisational area. According to

Bipp and Kleingeld (2018), debriefing could be a potent moderator in the development of self-efficacy.

In summary, correct use of debriefing is recommended in organisational surroundings as the debriefing is a technique that positively influences not only team efficacy, but also the formation of its members to work in a team. While we have identified that to carry out a quality debriefing, attitudes of orientation towards the team are necessary, the same act of applying this type of technique contributes to strengthening these attitudes and encourages the participation of members of a team in activities of reflection and analysis. These qualities favour the creation of a good climate for reflection, which is a necessary condition to evaluate oneself and interact with colleagues in a framework of trust and commitment. All of this impacts in a better fit of the objectives and a better adaptation of strategies of change, including role and performance revision, adequate for different eventualities.

6. Conclusion

This research contributes, in the first place, to characterising each phase of the debriefing from an analysis centred in the narratives themselves that arise in the sessions, which is a way to study the dynamic that has been little dealt with (Raes *et al.*, 2015). Secondly, we have determined relevant team attitudes that impact in the correct implementation of this technique and, in turn, we have discovered that the use of debriefing generates a recursive process in the learning, i.e., the teams that have certain favourable attitudes towards teamwork, such as learning orientation and team orientation, are more actively involved in this type of dynamics, but, in turn, the practice of them encourages these attitudes and thus the capacity of the team to learn to work as a team. This is relevant to the field of transfer of learning, which has been studied from academic disciplines such as management and training (Matthews *et al.*, 2020). Our study contributes to show how certain attitudes can be developed in favour of learning that may be related to the motivation to transfer learning to other performances.

6.1 Implications

Our results have practical implications both for the field of organisational performance as for the formation of teamwork, as they show certain processes that must be considered in each phase of the debriefing as well as actions that the moderator can do to facilitate an adequate climate for learning. It has been observed that all forms of debriefing have a common purpose in learning and team and employee development, due to the powerful transferability and usefulness of debriefing in different contexts. Therefore, knowing the correct use of debriefing is a breakthrough in this area, because it allows standardisation of practice. With this analysis of good practices, people interested in the technique have clues on how to implement them, both for their team and organisational development. In addition, including this type of practice will not just facilitate a better performance; it will also help teams to learn to work in a team from their own experiences. Regarding the theoretical implications of our study, our results complement the literature on debriefing methods, specifically on how to develop good practices in face-to-face facilitated group debriefs.

6.2 Limitations and future lines of research

It is important to mention some limitations to this work. The major limitation was the lack of published literature related to the debriefing in the area of organisational management. The qualitative and exploratory nature of the study limits the generalisation of the results. However, the results and conclusions of the study can be considered as an initial step towards the construction of a solid theoretical model that needs to be tested more in-depth through

quantitative focuses or the inclusion of other variables in the analysis with different qualitative techniques. While we have contributed by describing the correct development of the debriefing, it would be convenient to continue with studies to determine what the factors for success are in the use and application of this technique, including in the analysis of different variables such as type of organisation, work functions, the role of leadership in moderation, among others.

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Insights on NGO brand equity: a donor-based brand equity model

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Abstract

Purpose – The growth in the number of nongovernmental organizations (NGOs) worldwide has led to increased competition for donations. A stronger NGO brand equity will make donors more attracted to an organization, compelling them to increase both their donations and their commitment. The goal of this study is to propose a novel donor-based brand equity model. The present study takes into consideration the special characteristics that donors confer to NGOs—specific examples of nonprofit organizations (NPOs) that demand higher moral capital. The suggested framework considers the donor's perspective of NGO brand equity and identifies new dimensions: familiarity (recall, brand strength and brand identification), associations (authenticity, reputation and differentiation) and commitment (attitudinal, emotional) by building on previous NPOs and consumer-based brand equity models.

Design/methodology/approach – Based on the analysis of the literature, the authors propose an NGO donor-based brand equity model, which the authors test with a convenience sample of 137 individuals through partial least squares structural equation modeling.

Findings – The results of this study demonstrate the positive effects of brand reputation, brand differentiation, brand identification and brand commitment on donor-based brand equity.

Practical implications – The novel proposed model will help NGO managers better understand the sources of brand equity from the donor's perspective and more efficiently manage their resources and activities to strengthen their NGO's brand equity.

Originality/value – This paper provides a novel, multidimensional NGO donor-based brand equity model that is oriented to the specific characteristics of NGOs; this orientation distinguishes it from previous NPOs and commercial brand equity models.

Keywords Brand equity, Donors, Nonprofit, NGO, NPO, Charities

Paper type Research paper

1. Introduction

Nongovernmental organizations (NGOs) are a key element in today's society. Their relevance is reflected in the number of these organizations, their millions of beneficiaries worldwide, the employment they generate and the volunteers they mobilize. According to nonprofitaction.org, there are 10 million nonprofit organizations (NPOs) and NGOs globally. The yearbook of International Organizations 2020/2021 suggests that approximately 1,200 new NGOs are added each year. This steady growth in the number of NGOs makes fundraising the main stumbling block in their survival and development (Ha *et al.*, 2022). With this objective in mind, a growing number of NGOs are developing a more strategic approach to build their brands to create a greater social impact (Kylander and Stone, 2012) because a stronger NGO brand will make donors feel more captivated, causing them to increase their donations and their loyalty to the organization. Napoli (2006) validated that

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brand-oriented organizations perform better because they are more sensitive to their stakeholders' needs, which influences people's attitudes toward charity and donation.

In the growing "NGO market", attracting and maintaining donors is an ongoing, critical concern for NGOs (Michel and Rieunier, 2012). NGOs need to differentiate themselves from other NGOs and strengthen their bonds with donors by facilitating their identification with the organization's social objective and, therefore, triggering their intention to donate (Sargeant *et al.*, 2008; Gregory *et al.*, 2020; Wymer *et al.*, 2021). However, the literature on NGO brand management is sparse. One reason for this scarcity is that researchers tend to use the term NPO as an umbrella label for any nonprofit organization, including NGOs. However, we contend that the sources of NGO and NPO brand equity may differ.

An NPO is based on the premise that no net profits from donations or other income from business activities or membership fees will benefit any individual within it. This is common for all NPOs, including NGOs, as well as other NPOs, such as clubs or cultural associations, whose nature differs significantly from that of an NGO. For example, organizations such as the National Academy of Fine Arts, Finnish Defense Forces (FDF) Military Driving School, Red Cross, Save the Children or World Vision are all categorized as NPOs; thus, no distinction on their sources of brand equity has been made in the literature (Venable *et al.*, 2005; Voeth and Herbst, 2008; Laidler-Kylander and Simonin, 2009; Juntunen *et al.*, 2013; Boenigk and Becker, 2016; Gregory *et al.*, 2020). However, superficially, one can easily observe the difference in the nature of the FDF Military Driving School NPO and the NGO Save the Children, for example.

Vakil (1997) describes NGOs as self-governing, private, not-for-profit organizations that are geared toward improving the quality of life of disadvantaged people. This definition is based on Salamon and Anheier (1992) NPO taxonomy, where they indicate that NGOs are a subgroup of NPOs whose most relevant differentiating elements are the type of causes that they address. NGOs are value-based organizations (Stride, 2006) that address social causes such as equality, environmental and animal protection, human rights and empowerment, in turn, influencing socially responsible behaviors in firms (Martínez *et al.*, 2016; Wenqi *et al.*, 2022).

Therefore, NGOs can be described as prosocial organizations known for promoting different moral objectives, such as humanitarian aid and welfare causes or freedom, justice and equal rights. This definition provides NGOs with some characteristics that separate them from other NPOs from a donor's perspective. The most relevant distinction is that donors demand higher moral capital and social legitimacy from NGOs (Kane, 2001) than from NPOs that are focused on other, nonmoral objectives, such as preserving art or maintaining private schools or sport clubs.

According to Kane (2001, p. 10), moral capital is "a resource that can be employed for legitimating some persons, positions, and offices and for delegitimizing others, for mobilizing support and for disarming opposition, for creating and exploiting political opportunities that otherwise would not exist." Since moral capital is core in NGO activity, the management of an NGO brand should be conducted accordingly (Jones *et al.*, 2007). NGO donors must identify with the organizational values represented by an NGO's brand to provide donations (Keller *et al.*, 2009), as the congruence between an individual's moral values and emotions and an NGO's moral objectives influence a donor's support for the NGO (Wymer *et al.*, 2021; Goenka and van Osselaer, 2019).

Taking these considerations into account, we have reviewed the NPO literature through the lens of the most popularly accepted valid and comprehensive brand equity model (Aaker, 1991, 1996; Keller, 1993; Yoo and Donthu, 2001). Having identified the currently studied dimensions of the NPO brand equity model, we propose a new brand equity model for NGOs based on certain particularities.

Our research thus makes two important contributions to the literature. First, it contributes to the NPO literature by filling a gap in NGO brand equity research and proposing a new,

specific brand equity model. Second, our results can help NGO managers better understand their sources of brand equity from a donor's perspective and thus more efficiently manage their resources and activities to strengthen their brand equity.

This paper is structured as follows: First, we present the conceptual background of our study and a narrative review of the NPO brand equity dimensions that have been tested in the literature to provide a reference for the development of our model. Second, we present our NGO donor-based brand equity model and hypothesis. Third, we describe our research method and results. Finally, we discuss our findings and present our conclusions, as well as some future research opportunities.

2. Conceptual background

The brand equity models used in the NPO literature are rooted in consumer-based brand equity models and in the dimensions of brand awareness, brand personality and brand image (Faircloth, 2005; Juntunen *et al.*, 2013; Kashif *et al.*, 2018). However, important dimensions of consumer-based equity models such as perceived quality and loyalty are rarely discussed in the context of NPOs and donor-based brand equity models.

Faircloth (2005) was the first author to develop an NPO brand equity model from volunteers' and donors' perspectives. He proposed a nonprofit brand equity model on the dimensions of brand personality, brand image and brand awareness (recall and recognition). Interestingly, and in contrast to his expectations, he found a negative effect of brand awareness on the brand equity construct, suggesting that recall and recognition of an NPO is not enough to build brand equity, i.e. if the NPO has a negative image, the impact of brand awareness on its brand equity will be negative. Therefore, there is a need to enhance the measurement of brand awareness to properly reflect brand context (Romaniuk *et al.*, 2017).

Concerning the varying spectrum of internal and external NPO stakeholders, Juntunen *et al.* (2013) examined brand equity cocreation in the Finnish Defense Forces (FDF) military driving school, a representation of a nonprofit organization. They measured the impact of brand image and brand awareness on cocreated nonprofit brand equity. Their results validated their positive effect.

In a novel attempt to expand NPO brand equity dimensions, Boenigk and Becker (2016) conceptualized a nonprofit brand equity index from a stakeholder-based perspective with three dimensions: brand awareness, brand trust and brand commitment. Based on this model, they developed a brand equity index for 40 select German NPOs. However, this study did not consider how overall brand equity influences donor intention. Kashif *et al.* (2018) is the only study to adopt a more holistic approach to a donor brand equity model, investigating the moderating effect of brand credibility on the brand equity dimensions; however, albeit in a very specific cultural context, i.e. Islamic religion in Pakistan, they find mixed results.

In summary, the literature on NPO brand equity is sparse and inconclusive, as it presents some controversies and limitations in its empirical results. Moreover, the extant research models omit dimensions that have been shown in the consumer literature to impact brand equity, such as the dimensions of loyalty or perceived quality (Aaker, 1991; Yoo and Donthu, 2001). Nor do the dimensions included in these constructs consider the influence that an NGO's moral objectives may have on the construction of its brand equity.

Therefore, we propose a theoretical model of donor-based brand equity based on the particularities that NGOs present by discussing the classical consumer-based brand equity model and proposing several hypotheses to adapt it to the NGO donor context.

2.1 Brand awareness

Most brand equity models include brand awareness as an antecedent of brand equity, measuring the recall or recognition necessary for brand consideration in consumer

decision-making processes. Keller (1993) suggested that brand awareness is related to the strength of a brand node or trace in memory, reflected in consumers' ability to identify a brand under different conditions.

The importance of brand awareness stems from mere recognition and signal theory (Erdem and Swait, 1998), which posits that brand awareness might be sufficient for triggering consumer choice, either as an impulse or simply as a signal of quality. In the NPO literature, most authors support this view, and thus recall and recognition are the most common approaches to a brand awareness construct.

However, we contend that conceptualizations that define brand awareness as solely brand recall/recognition have limited applicability in the NGO/NPO domain; mere brand recognition is not enough for donors. It is therefore necessary to consider a broader dimension of the traditional brand awareness concept, such as the concept of *brand familiarity,* to incorporate a facet of knowledge magnitude (Keller, 2003) and to determine brand prominence in donor memory (Wymer *et al.*, 2016; Gregory *et al.*, 2020).

The concept of familiarity has been very broadly defined in the literature. While Paço *et al.* (2014) found no significant relationship between NPO familiarity and the intention to donate; Dogan *et al.* (2021) found that familiarity has a positive effect on the intention to donate. This difference may stem from what is included in their measurements of brand familiarity, i.e. whether it is just perceived general knowledge or is closely related to NPO performance.

Therefore, we contend that for an NGO, it is necessary for a donor to exhibit a deeper knowledge of its objectives. Hence, we propose a new brand *familiarity* construct that includes whether NGO donors recognize a brand, to what extent they know what the brand does and whether they recognize and approve of the NGO's moral mission. Thus, our brand familiarity construct includes a *recall* and r*ecognition* dimension (Aaker, 1991; Boenigk and Becker, 2016; Yoo *et al.*, 2000), a *brand strength* dimension and a brand *identification* dimension (Wymer *et al.*, 2016; Gregory *et al.*, 2020), allowing us to determine not only whether an NGO's brand is recognized but also to what extent a donor is familiar with its purpose (Sargeant and Lee, 2002; Wymer *et al.*, 2016).

Thus, we postulate the following hypothesis.

H1. There is a positive relationship between NGO *brand familiarity* and donor-based brand equity.

2.2 Brand associations

Brand associations are perceptions that are linked in memory to a brand and are broadly clustered by product, organization, symbol and personality associations (Aaker, 1991) or as the brand attributes, brand benefits and brand attitudes that form the brand's image (Keller, 1993).

Brand associations are relevant for an NGO because they allow donors to distinguish its brand from those of other NGOs and to establish a donation preference (Venable *et al.*, 2005; Voeth and Herbst, 2008). For NGOs, as they are value-based organizations (Stride, 2006), their brand associations serve as figurative lenses that facilitate their differentiation through their identity and moral objectives, which, in turn, influence donor attitudes. Sargeant and Woodliffe (2007) state that people often choose to donate to organizations that represent how they would like to see themselves, allowing them to improve their identity via donation, as it helps demonstrate—both to themselves and their community—that they are connected to certain values. Accordingly, NGO donors must morally identify with an NGO's brand values to commit to this organization and provide donations (Keller *et al.*, 2009).

Thus, for an NGO, the relevant elements of brand association concern the connection that a donor establishes with the moral objectives of the NGO and the image that the donor projects by being associated with it.

Therefore, we posit that for an NGO, specific associations are necessary to establish its degree of differentiation and to reflect the connection that a donor establishes with its moral objectives. Thus, we propose three dimensions: *brand authenticity, brand differentiation and brand reputation.*

Brand *authenticity* (Akbar and Wymer, 2017) measures the degree to which an organization is perceived as the archetypal example of its category and stands out from similar organizations for its original value. Brand *differentiation* (Wymer *et al.*, 2016) validates whether a donor recognizes the personality or distinctive characteristics of an NGO that allow its differentiation from its competitors. Finally, brand *reputation* implies a value assessment of the organization, i.e. what the organization does and how it acts over time (Balmer, 1998; Bennett and Gabriel, 2003); thus, it is clearly related to the evaluation of an NGO's values and moral objectives.

Hence, in contrast to other NPO brand associations, for an NGO, we focus on the associations related to core values and how they impact a donor's identification with the NGOs' moral objectives. By doing so, we overcome the limitation of existing discrete associations in the literature concerning specific organizations, which are difficult to validate in organizations other than the one for which they were designed.

As a result, we posit the following hypothesis.

H2. There is a positive relationship between *brand associations (authenticity, differentiation and reputation)* and donor-based brand equity.

2.3 Brand commitment

Despite the relevance of brand loyalty to consumer-based brand equity (Aaker, 1991; Oliver, 1997; Yoo and Donthu, 2001), few studies have addressed the issue of brand loyalty in the context of NPOs. One reason for this might be that since donors can simultaneously donate to many NPOs/NGOs, the behavioral measure of loyalty might not be relevant in the NPO context. In addition, donors can donate to an NGO out of a sense of urgency in humanitarian situations without feeling attached to its long-term objective(s) or cause(s) (Gregory *et al.*, 2020). Therefore, the attitudinal dimension of the loyalty construct seems more salient than the behavioral dimension in the context of NPOs or NGOs.

In the NPO literature, we have identified the concept of brand "commitment" *in lieu* of "loyalty" (Sargeant and Woodliffe, 2007; Boenigk and Becker, 2016). Brand commitment reflects a person's attitudes and behaviors toward an organization that are based on a strong belief and acceptance of the organization's goals. Similarly, Sargeant and Lee (2004) believe that when stakeholders become emotionally attached to an NPO brand, they form a relationship with it and develop a sense of commitment that could be assimilated into brand loyalty. A high level of psychological involvement with an NGO will make a donor consider his or her support of the organization a highly vital activity. In the same way, donors who show a low sense of involvement with an NPO are more likely to switch organizations (Bennett, 2009).

When people support NGOs, they do so to act in accordance with their own values and to be true to their own image (Wymer and Akbar, 2019). If the moral objectives an NGO advocates fit a donor's values, he or she will consider donating. If a donor does not have an affinity with the cause(s) and moral values that an organization supports, regardless of its importance in society, it is likely that he or she will not make a donation, except in sporadic emergency situations (Sargeant and Woodliffe, 2007; Gregory *et al.*, 2020; Wymer *et al.*, 2021). Therefore, brand commitment appears to be a more accurate dimension than brand loyalty concerning both NPOs and NGOs. Hence, we propose a brand commitment construct, replacing Aaker's (1991) loyalty dimension by measuring a donor's *attitudinal* commitment (Boenigk and Becker, 2016) and *emotional* commitment to an NGO, which implies the donor's greater identification with the NGO (Boenigk and Helming, 2013). Therefore, we posit the following:

H3. There is a positive relationship between *brand commitment* and donor-based brand equity.

Thus, we propose a novel donor-based brand equity model adapted to the particular characteristics of NGOs. The proposed model is depicted in Figure 1.

3. Methodology

3.1 Research approach and sample

We developed a questionnaire to be distributed online in a random convenience sample. It started with a filter question to check if respondents worked for an NGO to prevent response bias. The first part of the questionnaire aimed to measure the different dimensions of the donor-brand equity model we proposed. The scales used to assess the constructs were adapted from multi-item scales validated in previous research and measured on a five-point Likert scale (5 = "strongly agree", 1 = "strongly disagree"). Table 2 presents these items by construct and the sources of the scales. The last part of the questionnaire included sociodemographic questions (age, gender, education and professional situation). The questionnaire concerned NGOs dedicated to a childhood cause, and the respondents had to answer the questions while considering the organization they were the most familiar with.

Accordingly, our data were collected through an online survey distributed through social media and e-mail. The survey was activated in May 2022 and received 137 responses. The final sample was composed of 131 respondents, as questionnaires with invalid answers were excluded. Table 1 includes a description of the sample's characteristics.

3.2 Measurement of variables

All the scales used in our study demonstrated excellent statistical validity. Table 2 shows the measurement scales and questions used in the study and included in the questionnaire. We followed the double translation protocol: the original scales (in English) were translated into Spanish and then back into English to report their results.

4. Results

4.1 Individual reliability of the indicators

Before carrying out our evaluation of the reliability and validity of the measurement model, we analyzed the individual reliability of each of the items included in the scales to eliminate

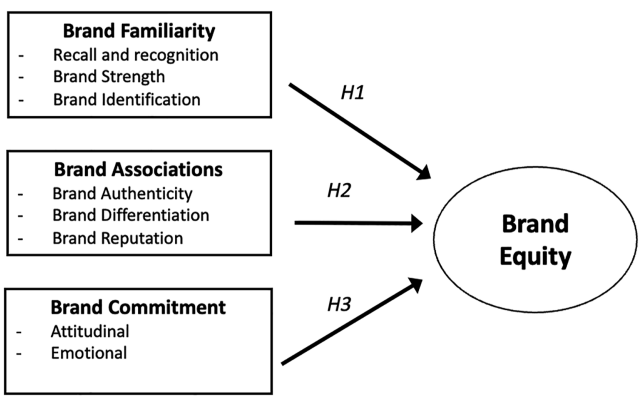

Figure 1.
Donor-based brand equity conceptual model

Category	Count	Percentage (%)
Gender		
Female	75	57.3%
Male	53	40.5%
Not indicated	3	2.3%
Age		
18–24	66	50.4%
25–34	20	15.3%
35–49	15	11.5%
50–65	30	22.9%
Education		
Bachelor's Degree	80	61.1%
Master's Degree	41	31.3%
Secondary	7	5.3%
Primary	3	2.3%
Occupation		
Employed, working for others	48	36.6%
Employed, working as freelancer	18	13.7%
Student	52	39.7%
Other situations	13	9.9%

Table 1. Sample characterization

those indicators that did not represent the same construct or were redundant. We used the criterion proposed by Hair *et al.* (2012), i.e. to accept an indicator as part of a construct, and it must have a factorial load equal to or greater than 0.7. This indicates that more than 50% of the variance in the observed variable (item communality) is shared by the latent construct. After eliminating low-loadings items, we analyzed the correlations of the indicators with their respective constructs and with the rest of the constructs. We performed factorial analysis with IBM SPSS Statistics Version 28.0 to assign the items according to the statistical methods and verified each of them in the context of the study and the dimensions we wanted to measure. Next, the brand familiarity construct was formed with five items belonging to recall and recognition (RR3) and brand strength (BS1, BS2, BS3 and BS4). The items related to brand identification were grouped under the construct of brand association, composed of nine items related to brand reputation and differentiation (BI1, BI2, BD1, BD4, BD5, BR1, BR2, BR3 and BR4). Any authenticity items were eliminated as redundant. For the brand commitment dimension, only BCE2 and BCE5 were removed due to low loadings. Our final donor-based brand equity measurement model is shown in Figure 2.

4.2 Construct reliability and validity

To assess the unidimensionality of the reflective scales of the constructs, we used Cronbach's alpha coefficients, which provide an estimate of reliability based on indicator correlations. As shown in Table 3, the coefficients of all the measurement constructs were greater than 0.7, as suggested by Nunnally (1978). We also evaluated composite reliability (CR) with the criterion that this coefficient must be greater than 0.7 (Werts *et al.*, 1974). CR is considered the best indicator to test the measure of the latent unidimensionality of a scale, especially in works that use partial least squares (PLS). As we verified, the CR values of the four proposed scales were greater than 0.8.

To evaluate the measurement model, we followed Hair *et al.* (2019), assessing convergent validity, discriminant validity and construct reliability. For the reliability of the measurements, we followed Fornell and Larcker (1981), i.e. both the Cronbach's alpha and

Constructs, items and sources	
Brand Familiarity	
Recall and Recognition (based on Yoo et al. (2000) based on Rossiter and Percy, 1987)	
RR1	I recognize the NGO brand as soon as I see it
RR2	I consider that the NGO is well known
RR3	I know what the NGO does
Brand Strength (based on Wymer et al., 2016)	
BS1	I am well informed about the NGO activities
BS2	I am knowledgeable about the work that the NGO does in its projects
BS3	I understand the purpose of the NGO
BS4	I could describe the NGO activities to others
Brand Identification (based on Wymer et al., 2016)	
BI1	I like the NGO
BI2	I have a positive impression when I think of NGO
BI3	I feel that the NGO represents values that are important to me
BI4	I identify with the values of the NGO
Brand Associations	
Brand authenticity (based on Akbar and Wymer, 2017)	
BAU1	NGO is unique
BAU2	NGO is true to itself
BAU3	NGO stands out from other organizations devoted to the same cause
BAU4	NGO is the best of all those dedicated to the same cause
Brand differentiation (based on Wymer et al., 2016)	
BD1	The work that NGO does in its cause is impressive
BD2	No organization is as good as NGO in the cause it addresses
BD3	NGO is extraordinary compared with other NGOs working for the same cause
BD4	NGO has a genuine personality
BD5	The work that the NGO does for its cause is interesting to me
Brand Reputation (based on Bennett and Gabriel, 2003)	
BR1	NGO is highly recognized
BR2	NGO has great achievements at work for its cause
BR3	NGO has a good reputation
BR4	I admire NGO
Brand Commitment	
Attitudinal (based on Boenigk and Becker (2016) based on Sargeant and Lee, 2004)	
BCA1	I feel committed to the NGO
BCA2	My intention is to maintain my relationship with the NGO indefinitely
BCA3	I feel satisfied with the relationship I have with the NGO
BCA4	I like to maintain a relationship with the NGO
Emotional (based on Boenigk and Helming (2013) based on Mael and Blake (1992)	
BCE1	When someone criticizes NGO, I feel it as something personal
BCE2	I am interested in what others think about NGO
BCE3	I consider myself part of the NGO
BCE4	I am pleased to hear praise about the NGO
BCE5	I would be ashamed if bad practices were published about the work of the NGO
Brand Equity	
Intention to donate (based on Hou *et al. (2009) based on Sampath and Henley (2007) and Yoo et al. (2000)*	
ID1	I definitively will donate to the NGO
ID2	It is likely that I donate to the NGO instead of other NGOs that are devoted to the same cause
ID3	It is likely that I will donate to the NGO in the future
ID4	I will recommend family and friends to donate to the NGO
ID5	It is likely that I will continue donating to the NGO in the future
ID6	It is likely that I recommend the NGO instead of other NGOs that are dedicated to the same cause
ID7	For me it makes more sense to donate to the NGO than to other NGOs that are dedicated to the same cause

Table 2.
Measurement scales

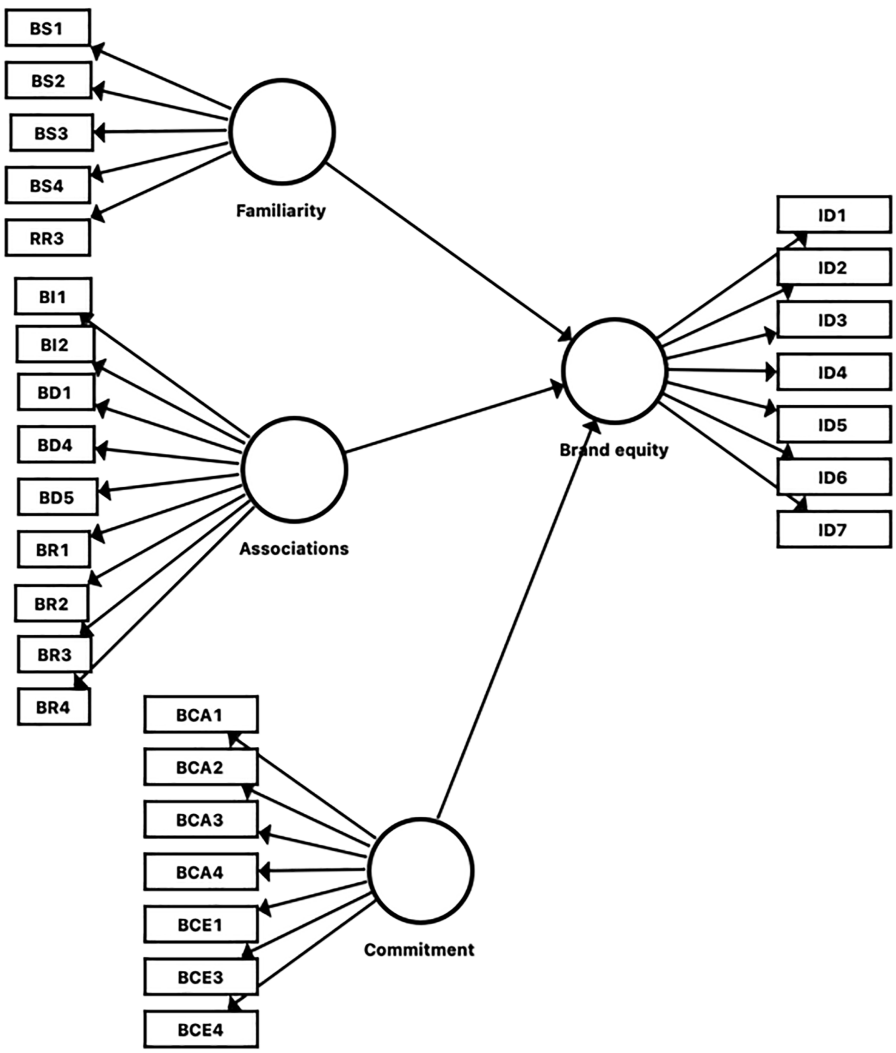

Figure 2.
Donor-based brand equity measurement model

composite reliability (see Table 3) values needed to be larger than 0.7. Concerning convergent validity, we used two measures to assess it: average variance extracted (AVE) and the correlation of each indicator with its construct. The coefficients of the AVE of each of the measurement constructs were larger than 0.5, entailing high convergent validity (Fornell and Larcker, 1981). To check the correlation of each of the indicators with its construct, we used factor loadings. All of them were greater than 0.7, indicating that each set of indicators represented the same underlying construct (see Table 4).

To assess the discriminant validity, we followed Fornell and Larcker's (1981) criterion (see Table 5) and the Heterotrait-Monotrait (HTMT) ratio criterion (see Table 6). Fornell and Larcker (1981) suggest using the AVE as a criterion for convergent validity, i.e. a latent variable should share more variance with its assigned indicators than any other latent

Variable	Item	Outer loadings	Cronbach's alpha	rho_A	Composite reliability	Average variance extracted (AVE)
Familiarity	BS1	0.872	0.868	0.877	0.905	0.657
	BS2	0.855				
	BS3	0.752				
	BS4	0.838				
	RR3	0.724				
Associations	B11	0.826	0.927	0.933	0.939	0.631
	B12	0.834				
	BD1	0.759				
	BD4	0.751				
	BD5	0.841				
	BR1	0.748				
	BR2	0.761				
	BR3	0.796				
	BR4	0.829				
Commitment	BCA1	0.864	0.916	0.926	0.933	0.667
	BCA2	0.894				
	BCA3	0.780				
	BCA4	0.839				
	BCE1	0.756				
	BCE3	0.805				
	BCE4	0.768				
Brand Equity	ID1	0.876	0.932	0.936	0.945	0.713
	ID2	0.839				
	ID3	0.891				
	ID4	0.826				
	ID5	0.866				
	ID6	0.861				
	ID7	0.742				

Table 3.
Internal consistency reliability

variable. According to Henseler *et al.* (2015), all HTMTs should be below 0.90 to establish discriminant validity. The results we obtained for these indicators thus confirmed the discriminant validity of the measurement scales we proposed.

To evaluate the multicollinearity of the indicators, we calculated their variance inflation factor (VIF). All VIF values (Familiarity, 2,186; Associations, 1,902; Commitment, 1,745) were below 3 (Hair *et al.*, 2019), proving that there is no multicollinearity in this study.

4.3 Assessing the structural model

To estimate the relationships in our structural model, we applied the partial least squares method of structural equation modeling (PLS-SEM) via SmartPLS 3.3.9 software. PLS works efficiently for exploratory purposes and is adequate for relatively small samples and complex models (Hair *et al.*, 2012). This multivariate analysis technique has been used in previous research on NPOs, which we have previously cited in this article (e.g. Boenigk and Helming, 2013; Boenigk and Becker, 2016; Kashif *et al.*, 2018).

Figure 3 exhibits our structural model, the inner model path coefficients are marked together with the outer model loadings and the R^2 adjusted values for the dependent variable.

We assessed our structural model by analyzing the determination coefficient indicator R^2 and the standardized path coefficients of each of the constructs to examine the significance of the constructs and their direct and indirect effects. R^2 values of 0.67, 0.33 or 0.19 for endogenous latent variables in the inner path model are described as substantial, moderate or

	Familiarity	Associations	Commitment	Brand equity
BS1	*0.872*	0.442	0.542	0.404
BS2	*0.855*	0.471	0.650	0.473
BS3	*0.752*	0.692	0.376	0.437
BS4	*0.838*	0.572	0.588	0.459
RR3	*0.724*	0.527	0.344	0.329
BA1	0.595	*0.826*	0.531	0.550
BA2	0.525	*0.834*	0.456	0.494
BD1	0.453	*0.759*	0.504	0.572
BD4	0.577	*0.751*	0.497	0.558
BD5	0.556	*0.841*	0.385	0.459
BR1	0.497	*0.748*	0.267	0.336
BR2	0.541	*0.761*	0.343	0.440
BR3	0.516	*0.796*	0.284	0.465
BR4	0.513	*0.829*	0.551	0.627
BCA1	0.555	0.443	*0.864*	0.611
BCA2	0.524	0.460	*0.894*	0.632
BCA3	0.562	0.450	*0.780*	0.439
BCA4	0.559	0.507	*0.839*	0.580
BCE1	0.457	0.392	*0.756*	0.421
BCE3	0.435	0.291	*0.805*	0.512
BCE4	0.502	0.582	*0.768*	0.616
ID1	0.488	0.535	0.636	*0.876*
ID2	0.361	0.520	0.531	*0.839*
ID3	0.444	0.598	0.595	*0.891*
ID4	0.466	0.577	0.535	*0.826*
ID5	0.544	0.542	0.627	*0.866*
ID6	0.415	0.571	0.547	*0.861*
ID7	0.360	0.464	0.524	*0.742*

Table 4.
Item cross loadings

	Familiarity	Associations	Commitment	Brand equity
Familiarity	*0.810*			
Associations	0.667	*0.795*		
Commitment	0.629	0.552	*0.817*	
Brand Equity	0.525	0.646	0.678	*0.844*

Table 5.
Fornell and Larcker (1981) indicators

	Familiarity	Associations	Commitment	Brand equity
Familiarity				
Associations	0.745			
Commitment	0.693	0.574		
Brand Equity	0.573	0.676	0.720	

Table 6.
Heterotrait-Monotrait ratio criterion for discriminant assessment

weak by Chin (1998, p. 323). In our model, the R^2 value was 0.567, indicating an acceptable substantial level of exploratory power.

PLS estimates the path model for each bootstrap sample. Bootstrapping analysis with a resampling of 5,000 interactions was used to calculate the t values to assess the effects of the relationships among the hypotheses. Additionally, the PLS results for all bootstrap samples

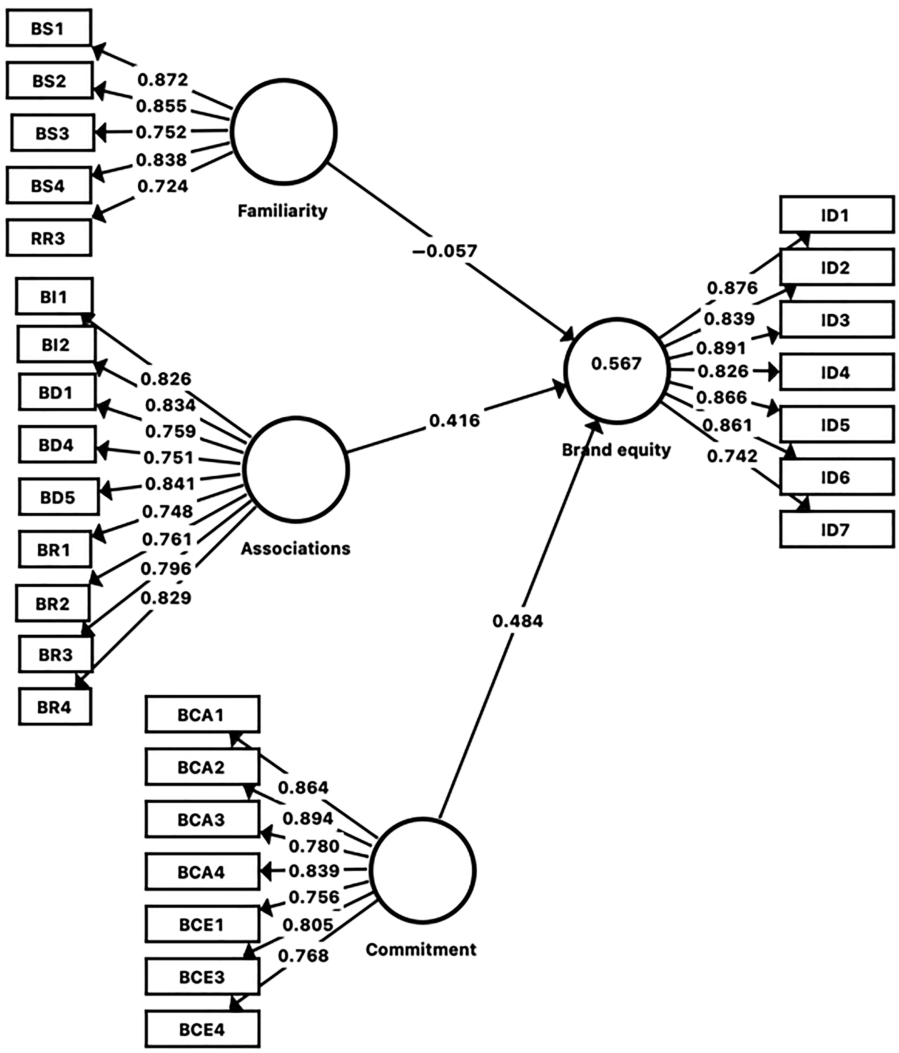

Figure 3.
The PLS structural model

provided the mean value and standard error for each path model coefficient. A t value > 1.96 and p value < 0.5 means that the relationship between these 2 variables is significant and has acceptable statistical significance (Chin, 1998). Table 7 presents these results.

Based on the results of our empirical study, our proposed donor-based brand equity construct is statistically valid. The path coefficients, t values and p values have allowed us to accept two of our three hypotheses. Table 8 exhibits a summary of our hypotheses testing.

According to our results, the brand association construct has a robust relationship with brand equity (path coefficient = 0.418, t value = 6.473, p value = 0.000); thus, H2 is confirmed. Similarly, a strong relationship between brand commitment and brand equity was observed (path coefficient = 0.484, t value = 6.374 and p value = 0.000), confirming H3. However, our brand familiarity results did not confirm its influence on brand equity; therefore, H1 is not supported.

5. Discussion

In this study, we have proposed and tested a novel donor-based brand equity model. Our proposal takes into consideration the special characteristics that donors confer to NGOs—specific examples of NPOs that demand higher moral capital. Our suggested framework includes a donor's perspective of NGO brand equity and identifies new dimensions, building on previously defined NPO and consumer-based brand equity dimensions.

Our results show the positive effects on donor-based brand equity of two dimensions—brand associations related to reputation, differentiation and identification and brand commitment—via the attitudinal and emotional dimensions.

For brand familiarity, the relationship we found was negative, although not significant; therefore, our hypothesis was not supported. This result, however, is similar to those of Faircloth (2005) and Paço *et al.* (2014). As in those studies, NGO familiarity apparently has no influence on donor intention. Faircloth (2005) has suggested that recall and recognition have no influence on a donor; rather, the (positive) degree of knowledge that the donor has of the organization is the main influence. Therefore, we suggest that brand familiarity might exert a necessary although insufficient condition to build brand equity and to activate donor intention.

The strong relationship among the differentiation, identification and reputation variables included under the association construct (path coefficient 0.418) suggests that for an NGO, the values and consistency of the NGO's activities as well as a donor's identification with the brand are the most important factors triggering donations, which extends the findings of Michaelidou *et al.* (2015) and Wymer *et al.* (2016) on the perception of NPOs' moral principles and individual values. Similarly, our results show that a donor's attitudinal and emotional commitment to an NGO—feeling part of the organization and identifying its values as his or her own—have an important influence on the intention to donate. Since Boenigk and Helming (2013) underline that self-identification has a dynamic character, we suggest that strong emotional and attitudinal commitment may protect an NGO's brand from the spillover effects of any scandals or any other brand image problems.

6. Conclusions, limitations and future lines of research

Despite some similarities between NPOs and NGOs, there are important differences, such as moral capital, that significantly affect how NGOs operate and how their brands are built. This is the first study to provide a holistic brand equity model for NGOs from the perspective

Table 7. Structural model results

	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	*T* statistics (|O/STDEV|)	*p* values
Familiarity > Brand equity	−0.060	−0.056	0.112	0.540	0.589
Associations > Brand equity	0.418	0.419	0.065	6.473	0.000
Commitment > Brand equity	0.484	0.483	0.076	6.374	0.000

Table 8. Summary of hypothesis testing

	Path value	*t*-value	*p* values	Decision
Familiarity > Brand equity	−0.060	0.540	0.589	Not supported
Associations > Brand equity	0.418	6.473	0.000	Supported
Commitment > Brand equity	0.484	6.374	0.000	Supported

of donors, building on previous NPO and commercial brand literature. The present research provides a number of theoretical contributions. First, our research has progressed the NGO literature by presenting a donor-based brand equity model comprising novel dimensions that reinforce the importance of considering a donor's evaluation of an NGO's reputation, differentiation and emotional and attitudinal commitment to its values, underscoring the relevance of an NGO's moral capital for attracting donors.

Regarding the dimensions included in the proposed model, we advance the literature on brand association, mostly via our analysis of brand personality and brand image, providing a general dimension that can be generalized to all types of NGOs. Thus, we avoid specific references to the image or personality of a brand and focus on the importance that the moral capital of an NGO has for donors. In this way, our construct assesses donor evaluation via the values and moral objectives of NGOs that are important. Additionally, we extend the conceptualization of the classical brand loyalty dimension in the context of NGOs, proposing a dimension of brand commitment by including not only a behavioral dimension but also an emotional dimension that suggests a deeper level of donor engagement with an NGO and thus true loyalty to it. In a highly competitive context where a donor has several donation options and could support different NGOs, the donor's commitment to an NGO's cause and values will strongly influence his or her present and future support.

The results of our study have relevant managerial and practical implications. Our novel donor-based brand equity model may help NGO managers better understand the sources of brand equity from a donor's perspective and more efficiently manage their resources and activities to strengthen the brand equity of their NGO. In addition, the results of our study have important practical implications that may inform NGO managers on several aspects of NGO brand management.

First, our results indicate that brand familiarity is not an objective to be achieved at any cost since familiarity alone is not a strong source of donor-based brand equity. Therefore, from a management perspective, NGOs should focus on disseminating their values and activities as opposed to relying only on word-of-mouth publicity since the latter will have no effect without the former. Consequently, NGOs should offer targeted communications explaining their values while building their reputation, as these are the pillars of brand equity. Accordingly, any advertising efforts of an NGO's brand should consider this.

Second, our results suggest the importance of an appropriate segmentation strategy since a donor's identification with the moral values of an organization is critical. Therefore, a practical implication is that a specific communication approach for each target group is likely to be more effective than a one-size-fits-all approach. Finally, the importance of emotional commitment in our model may suggest the opportunity to build stronger relationships with donors, i.e. engaging with them to ensure a more recurring flow of donations. NGO managers should also consider this in fundraising campaigns.

6.1 Limitations and future lines of research

As with any study, our research is not exempt from limitations, which open future avenues of research. We tested our proposed brand equity model on NGOs devoted to childhood in Spain. Thus, it would be interesting to replicate our study with NGOs that address different causes in different countries, as cultural factors may affect the results. Given the importance of values and moral perceptions in NGO assessment, future investigations may target cross-cultural representative samples to validate our model and reveal any possible cultural differences.

Regarding the data, we used a convenience sample to test the model. Future research should use a representative sample to generate new insights based on sociodemographic groups. In this model, we did not consider possible moderating effects such as NGO cause, NGO size or whether an NGO is local or international. Since these elements may impact

donor identification with an NGO brand and NGO brand equity, additional studies on those effects are recommended.

Further investigation of the role of brand familiarity in NGO brand equity is recommended as there has yet to be any conclusive results in the literature. We consider that additional research investigating the influence of NGO cause awareness on the formation of NGO brand familiarity is needed. Additionally, we observe a lack of studies on the impact of time and the various available marketing tools on NPO and NGO brand equity. Understanding how advertising, media, promotion and NGO availability affect the formation of brand equity over time is a very promising research avenue. Finally, considering the importance of reputation for NGO brand equity, new lines of research could deepen knowledge of its sources, such as NGO transparency and accountability.

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Impact of "mindfulness" or full awareness meditation on learning abilities

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Abstract

Purpose – This study experimentally aims to determine the degree of influence that mindfulness training exerts on learning capacity at the university level and contrasts it with previous observational or relational studies that have shown contradictory results.

Design/methodology/approach – A quasi-experiment was carried out to measure the variation of six academic learning abilities – a) self-efficacy, b) organization of and attention to studies, c) stress control due to time pressure and the environment, d) involvement with college activity, e) emotional satisfaction, and f) class communication – which together comprise the research questionnaire called the college learning effectiveness inventory (CLEI). The CLEI questionnaire was administered before and after the participants were trained in the mindfulness technique. The study was conducted in Ecuador, and the participants were selected from among the graduate students of a local university.

Findings – The learning ability measured by the CLEI was improved by a statistically significant margin in the two groups.

Research limitations/implications – The treatment groups consisted of graduate students who did not have opportunities for full-time activities on campus, as they were limited to attending regular classes at specific times, usually at night. The dropout rate was 14% due to inconveniences caused by the pandemic. These conditions could have affected the study results both positively and negatively. In addition, the pandemic limited academic interactions, which are required to evaluate the learning results after applying the research instrument. This limitation was especially critical for people who had experienced online classes only.

Practical implications – Offering graduate students the opportunity to learn about and adopt a mindfulness practice helps to improve their academic outcomes, as reflected through the statistical measurement of the CLEI indicator.

Social implications – This study is especially relevant within the context of sanitary conditions due to the pandemic and the intensive use of technology for managing academic interactions, both of which have replaced physical contact between participants.

Originality/value – The main contributions of this study are related to the determination of the practical effects of mindfulness training in postgraduate university settings and the identification of the mechanisms involving participants' reflecting upon, learning and understanding the importance of perfecting their soft skills to facilitate their learning processes and face today's uncertain environments.

Keywords Mindfulness, Teaching–learning, Soft skills, Quasi-experiment, CLEI

Paper type Research paper

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Introduction

The world is enduring economic, political, social and environmental issues as well as crises in the application of life principles and values. COVID-19 has highlighted social differences, marked by significant gaps in variables such as income; health; life expectancy; food and, particularly, education.

According to the World Health Organization (WHO), 12.5% of the world's population, approximately one billion people, suffer from a mental disorder; three million die each year from alcohol consumption; and one person commits suicide every 40 s. Mental illness increased in recent years because of the pandemic, caused by conditions derived from it, such as isolation; the treatment of infected persons; the unforeseen death of loved ones; and the use of technological means to carry out different activities, including education, replacing traditional physical contact (El Universo Newspaper, 2020).

El Universo Newspaper (2020) also noted that the United Nations Children's Fund (UNICEF) and the Ministry of Education of Ecuador conducted a survey in which parents were consulted about the effects of the pandemic on their children. The survey of 4,500 people in different parts of Ecuador concluded that 40% of students below 18 years felt affected by severe anguish or tension.

In another study carried out in 2020 by the American Council on Education (ACE), a survey was applied to 268 university presidents in the United States. Of those surveyed, 68% recognized that one of their most critical institutional problems was the deterioration of graduate student mental health. These students had dropout rates between 43 and 68%, becoming a conflict factor, altering academic effectiveness and varying the financial balance of these institutions. The study concluded that mental health is a serious problem that requires immediate reestablishing actions for both graduates and research personnel (Delgado, 2021).

Notwithstanding, educational efforts have focused on promoting and developing intellectual aspects such as reflection, logic and analysis. Meanwhile, very little has been done to stimulate the power of consciousness and the affective – emotional potential that both permit the implementation of new, scientific models of teaching – learning. Such models allow people to be instructed in a pleasant and motivating environment that facilitates learning and contributes to strengthening their human qualities and values.

Furthermore, university understanding has been under examined worldwide regarding the contribution of soft skills in preparing postgraduate students as a complement to professional training programs. This deficiency has been highlighted by company recruiters and firms specializing in hiring human capital (Succi and Wieandt, 2019). Given these conditions, the present study seeks to contribute by filling this gap while offering universities and students options, such as *mindfulness* practice, to reinforce regular education programs and face the current globally uncertain environments.

Therefore, this study assesses the influence level that the practice of the "*mindfulness*" method exerts on students' learning abilities. The following main research question was developed: How much can the mindfulness technique improve the learning ability of graduate students? To answer this question, the following central research hypothesis was proposed: The learning ability of graduate students increases after they are trained in the *"mindfulness"* technique. Figure 1 shows the conceptual research model that relates the study variables to the central hypothesis and five auxiliary hypotheses, presented later.

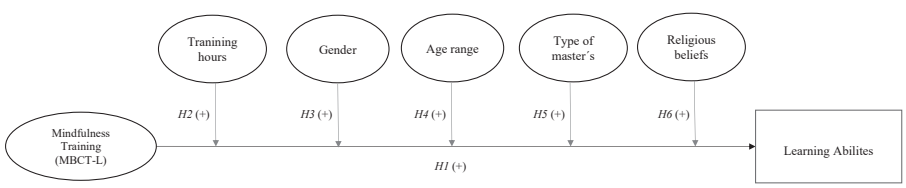


Figure 1.
Relationship between study variables and research hypotheses

In addition to the general objective, the following secondary objectives were developed for this study: (a) Help improve teaching–learning techniques by incorporating an emotional–affective approach that complements intellectual efforts. (b) Encourage a state of full awareness in all student activities, both autonomously and in collaboration with teachers and other participants in professional training courses. (c) Help to create mechanisms to control and reduce the levels of stress and anguish resulting from the intensive use of digital media that have replaced personal contact. (d) Develop a set of andragogic resources for professors and students to strengthen knowledge-sharing. (e) Provide specific recommendations to strengthen teaching–learning capabilities.

Specifically, our paper contributions are as follows. First, given that the previous research has been mostly observational or relational in nature; a quasi-experimental methodology was applied here to establish possible causal relationships between the mindfulness application and the studied effect. Second, various practical consequences were identified within postgraduate university environments that guided students, teachers and administrative staff to optimize their performance within training programs and academic interactions. Third, participant involvement is promoted in reflecting upon, learning and understanding the importance of perfecting soft skills to facilitate the teaching–learning processes and facing the uncertain conditions of life in the present century. Overall, the application of an unconventional mechanism such as mindfulness to improve learning will result in important benefits to society. This result is because students will be better prepared to assume and fully comply with their personal, family and professional responsibilities by consciously acquiring knowledge and actively using all their intellectual and emotional capacities. Finally, this study addresses the labor, economic and environmental crises that have been exacerbated over the last three years.

This article is organized as follows. First, the theoretical support and related previous research are presented. Second, the methodology is described. Third, the results are analyzed. Fourth, a brief discussion of the findings is included as well as their implications and recommendations for future studies.

Conceptual framework

Key concepts

Mindfulness. First, the word "*mindfulness*" is important to understand. The word describes a series of meditation techniques based on breath control and the practice of simple physical exercises inspired by the spiritual practices developed by Asian cultures of Buddhist, Taoist and Zen origin. These techniques were systematized, structured and adapted to Western needs and culture by Kabat-Zinn (1990), Professor Emeritus at the University of Massachusetts Medical School, who founded the *Stress Reduction Clinic* and the *Center for Mindfulness in Medicine, Health Care and Society.* He created the mindfulness-based stress reduction (MBSR) method, which integrates deep breathing exercises, yoga and meditation. The results have been scientifically proven beneficial for health and the body in general and particularly for counteracting the influence of stress factors in daily personal and work life. The *mindfulness* technique has been scientifically validated by researchers through 16,581 worldwide publications from 1966–2021 (Baminiwatta and Solangaarachchi, 2021).

Mindfulness is a secular, nonreligious technique whose purpose is to develop the ability to be fully aware of what is happening to us at all times. It is an invitation to approach with kindness our own bodies, minds, hearts and lives, leading to attention given systematically and kindly to discovering new facets of our lives that for various reasons have remained hidden or ignored by us. Kabat-Zinn and Kabat-Zinn (2021, p. 267) stated the following:

> The practice of mindfulness does not require us to be different from who we are. Quite the contrary. It invites us to be fully who we are in any and every moment, to be as large and authentic as we actually are in the only moment we ever have.

First applied in medicine, this practice has extended its influence to many disciplines, such as education, law, business, technology, sports and even politics and government (Kabat-Zinn, 2013).

Quasi-experiments. According to Reichardt (2019), the comparisons used to estimate the treatment effects can be classified into two types: randomized experiments and quasi-experiments. In randomized experiments, the study units are randomly assigned to treatment conditions, while in quasi-experiments, the assignment occurs nonrandomly, by applying administrative decisions, self-selection, legal mandates or any other similar nonrandom process.

Literature review

Several studies have been conducted worldwide to discover possible relationships between *mindfulness* and learning improvements. The research in *mindfulness* is emerging, and a vast body of ongoing research is generating promising results. However, many years will elapse before we have sufficient peer-reviewed material, including active controls and long timeframes, to establish firm evidence of the benefits (Mindful Staff, 2020). With this caveat, some outstanding studies are discussed below that relate *mindfulness* to the improvement of learning abilities published in the last decade.

Ching *et al.* (2015) conducted experimental work in Taiwan, a pioneer in the Asian continent, to evaluate the impact on the cognitive improvement of college students after *mindfulness implementations*. They used the Chinese version of the College Learning Effectiveness Inventory (CLEI) for this work. Likewise, they included software designed to evaluate the responses of various cognitive activities. No significant differences were found in the results obtained through the application of the CLEI measurement scale between the intervention and control groups. This work showed that after one semester of studying the *mindfulness* technique, college students learned more effectively in terms of the cognitive performance of attention and memory. This study is considered seminal for this research.

In 2016, Palomero and Valero conducted a study on *mindfulness* in which they highlighted its applicability in various fields, such as education. The methodology consisted of reviewing the concept and analyzing the transitional mechanisms between theory and practice in education, evaluating its advantages and disadvantages, and presenting some recommendations. They concluded that a broad knowledge base supports the capacity and potential for application in this area. However, further research is needed to facilitate its practical application.

Karunananda *et al.* (2016) highlighted the existence of various learning opportunities with a wide range of possibilities ranging from physical contact between participants to technology-based virtual learning systems. They identified several scientific pieces of evidence about the contributions that the development of *mindfulness* skills provides to students in terms of improving their cognitive abilities – such as retention, reflection, problem-solving – and their affective–emotional balance. The results reflected a very low relationship between the intention to apply this meditative technique and cognitive improvements. For this reason, they concluded that further research is needed and insisted on the importance of providing appropriate training to apply this technique before making any determination on its suitability.

Modrego *et al.* (2016) determined that significant scientific evidence is available about how *mindfulness* can expand its influence and advantages to other activities, including education. Students need to learn to manage their thoughts and regulate their feelings and emotions. Therefore, for this effort to succeed, training programs need to be developed for both groups.

Wang and Liu (2016) conducted a case study to understand how the application of *mindfulness* affects college students' learning of the English language. The study found that

the practice of *mindfulness* helps motivate students to take responsibility for their learning, generate new thoughts and be aware of them, which resulted in improvements in the students' skills, memory, creativity and positive mood. It also allowed them to awaken their awareness, learn from their own and others' experiences, and think critically.

Tobin (2018) reported various mechanisms on how understanding the advantages of meditation and *mindfulness* could be used to transform teaching and learning while strengthening democratic lifestyles for the benefit of those who practice it and the community as a whole.

In Ecuador, the country where this research was conducted, three published scientific papers by researchers from the Escuela Politécnica del Litoral (ESPOL) stand out. The first, conducted by Méndez and Rosado (2018), was related to the incorporation of *mindfulness* practice into the academic curriculum of the Faculty of Social and Humanistic Sciences at ESPOL. No significant relationships were found between the practice and the results. The evaluations were carried out using the Five Facet Mindfulness Questionnaire (FFMQ) and the Mindful Attention Awareness Scale (MAAS) instruments. The authors concluded that for their generalization, both instruments should be adapted for application within specific student groups in physical sciences or engineering.

In a second study, Méndez and Rosado (2019) explored the possible success of a *mindfulness* intervention in higher education using statistical techniques such as regression and a logarithmic analysis. The results indicated certain factors had significant effects on *mindfulness* practice: age, gender, school, school location, number of *mindfulness* training sessions, admission scores, type of courses passed, passing scores, family members with whom they live, birth order among siblings, type of education, musical instrument practice, sports practice and the use of corrective lenses. They concluded that this behavior could be unique to students who pursue majors in social sciences and humanities. Thus, they suggested that new studies should be conducted including students from other majors to identify whether the majors differ significantly.

The third study was carried out by Karl *et al.* (2020), jointly with researchers from 18 other institutions in several countries located in the regions of America, Europe, Asia and Oceania. The purpose was to evaluate the FFMQ and MAAS instruments and to analyze the strength of their variables and their intervention generalization related to the influence of *mindfulness* in educational activities. The main result of this globally shared study was that the FFMQ scale presented several conceptual and measurement problems in its cross-cultural application. Adjusting the FFMQ was more significant in the case of Western cultures, characterized by individualism, than it was in Asian cultures with a collective orientation. This adjustment would permit new validations of the instrument so it could be generalized and applied for educational purposes.

Austin and Loprinzi (2019) conducted an experimental study to evaluate the potential of the combined effects of high-intensity aerobic exercise and *mindfulness* meditation on episodic memory. The experiment provided evidence that *mindfulness* practice can encourage learning. Additionally, when combined with high-intensity exercise, long-term memory could be strengthened.

Dutta (2019) examined how *mindfulness* can help accomplish the fundamental purpose of education, which is comprehensive human development, based on a personal approach to *mindfulness* during the teaching–learning process. He emphasized that learners need opportunities to develop and internalize new knowledge. In this sense, producing only numerical evaluations of what has been learned is not enough, for either individuals or society. In his conclusions, he confirmed that *mindfulness* practice can generate notable physiological and psychological changes by reducing stress levels in both professors and students at different ages and with different training levels.

Hamman (2019) recognized that adult education and learning is a field of study aimed at individual and society-wide transformations. In practice, educational efforts have tended to prefer the rational cognitive approach, omitting the holistic approach. The research results suggest that this type of mindfulness-based learning should be considered in adult learning programs to complement cognitive and rational knowledge acquisition mechanisms.

Wamsler (2019) emphasized current ways of approaching the study of social science and education, which privilege the attention to and evaluation of external ecosystems, broader socioeconomic structures, technology, and management and governance dynamics. The study examines the connections between sustainability and inner transformation in education while sharing insights about contemplative and meditative interventions to provide the sustainability that education requires. The results showed that appealing to students' inner dimensions and transforming knowledge assimilation are critical to practically improving education in the long term.

Corti and Gelati (2020) conducted a case study in which they investigated the effects of a training program called mindful effective learning (MEL), which included *mindfulness*, coaching and study skills training, to improve college student learning skills. The study used two instruments: abilities and motivation to study (AMOS) and the Italian version of the MAAS. The results showed that after the intervention, students improved several cognitive skills and gained self-awareness and self-esteem.

Franco *et al.* (2020) worked on an experimental study in which they applied a psychoeducational mindfulness program to evaluate the achievement and learning motivations of Latin American students living in Spain. The study highlighted the benefits of implementing a mindfulness training program within the academic curriculum.

As a corollary to this literature review, Lytras *et al.* (2022) concluded that the COVID-19 pandemic has changed traditional educational models, creating the most disruptive innovations in educational systems in world history. The same authors suggested that it is the moment in which higher education should strive to design new strategies and alternative paths to respond to the rapid changes and unstable environments of the new century. In this way, the "new normal" should focus on seeking resilience, sustainability, change and the use of technology to ensure accessible and inclusive learning; as well as teaching for all, so that no one is left behind.

Method

Conceptual research model and hypotheses

Based on the literature review and the conclusions reported in previous investigations, a knowledge gap was detected between the intention to apply the *mindfulness* meditative technique and the cognitive improvements that could be achieved in educational environments at a higher level. In particular, there is a need to consider the effects of the pandemic and the limitations that exist in the educational environments of a developing country such as Ecuador.

This research was developed to deepen the understanding of this phenomenology. The previous studies have mainly been theoretical–conceptual, qualitative–explanatory and quantitative–relational. In particular, the research carried out in Ecuador by the ESPOL has been quantitative–relational.

At an international level, this study helps to close the current gap in understanding the importance of perfecting soft skills within postgraduate programs, such as the application of mindfulness for the personal self-management of thoughts and emotions. Chief Executive Officer (CEOs) and managers complain that job applicants who hold bachelor's and even master's degrees cannot write coherent paragraphs, clearly explain complex problems, or work effectively with people who differ from them. For this reason, professional human capital

recruiters are including these characteristics in their selection profiles as they have been in great demand among companies (Succi and Wieandt, 2019). In the new technological era of the 21st century, the competitive advantage of human beings over technological devices and artificial intelligence lies in skills such as empathy, resilience, critical thinking and assertive communication. Additionally, humans can adapt to changing contexts, take advantage of their creativity, and observe and reflect, among other abilities (Manes and Niro, 2021).

A quasi-experimental test was carried out to determine the extent to which the implementation and practice of a mindfulness program facilitate the teaching–learning process and improve academic skills measured through the CLEI instrument. According to Newton *et al.* (2008), the application of this instrument generates an individual profile of academic behavioral style, which can be positively modified through various specific interventions aimed at modeling said behavior.

The quasi-experiment was developed based on the conceptual research model shown in Figure 1, which includes mindfulness training as an independent variable, learning abilities as a dependent variable, and the following moderating variables: training hours, gender, age range, type of master's program and religious beliefs. These moderating variables were chosen to control the possible confirmation biases related to age, gender or religious beliefs as well as the different perceptions that the students of the different postgraduate programs could have of the impacts of mindfulness training. Regarding the training schedule, experienced meditators always recommend performing meditative activities in the early morning hours (Coulter, 2011). The possibility of including the health condition variable was ruled out because it is personal information of a sensitive nature that participants do not always want to reveal.

To evaluate the possible relationship between the application of the mindfulness technique and learning ability enhancement, the following six hypotheses were proposed:

Central hypothesis.

H1. The learning ability of graduate students increases after receiving training in the mindfulness technique.

Auxiliary hypotheses.

H2. Training hours positively influence learning abilities.

H3. Gender positively influences learning abilities.

H4. Age range positively influences learning abilities.

H5. Type of master's program positively influences learning abilities.

H6. Religious beliefs positively influence learning abilities.

Information sources

The review process included papers published in indexed academic journals mainly during the last five years worldwide. For this purpose, the multidisciplinary databases ProQuest, JSTOR, Scopus and EBSCO were used. Preference was given to original papers published by the mindfulness creator, Kabat-Zinn (1990, 2013) and for researchers who developed academic studies and experimental and quasi-experimental evidence on its application for educational purposes or for improving teaching–learning abilities and skills.

Research instrument

This research used the CLEI instrument, developed by Newton *et al.* (2008) at the University of Kansas. This tool includes the following variables: (a) self-efficacy, (b) organization of and attention to studies, (c) control of stress due to time pressure and the environment, (d) involvement with college activity, (e) emotional satisfaction, and (f) class communication.

Newton *et al.* successfully used it to measure college student academic performance and to support the efforts of institutional advising and mentoring departments. The variables that comprise this instrument have undergone several comparative and validation studies (Akbarov and Hadžimehmedagić, 2015; Ching *et al.*, 2015; Yeager, 2009).

Based on the CLEI, the authors of this study prepared a questionnaire in Spanish measured using a five-point Likert-type scale. The CLEI elements were subjected to the double translation method to verify the consistency of the questionnaire when compared to the English version. The questionnaire was distributed digitally over the internet. Before administering the questionnaires and the quasi-experimental tests, informed consent was obtained from all participants. A detailed description of this instrument is included in the Appendix.

Research design

The SEK International University (UISEK) Business School at Universidad Internacional SEK, located in Quito, Ecuador, acted as the basis for the study sample. In the study, 129 graduate students registered, 120 of whom were selected and conveniently assigned to the research groups, two for treatment and two for control, after checking the completed questionnaire responses. A quasi-experimental method was used to apply a nonrandom procedure to select study participants. Former students and second-level students in the postgraduate programs of UISEK Business School were invited to participate in this study. This condition is important since the participants were required to have previous social and academic interactions within the university facilities. Information was collected between May 16 and June 6, 2021. During this time, in-person participation was suspended due to sanitary conditions.

The study used the guide for quasi-experimental design and analysis proposed by Reichardt (2019), based on the original work developed by Campbell and Stanley (1963). Quasi-experimental design No. 13 was selected, "Separate-Sample Pretest-Posttest Control Group Design". In addition, Supino and Borer (2012) suggested working with two different control and treatment groups. Thus, the sources can be controlled of both internal (historical sources, maturity, test, instrumentation, regression, selection and mortality) and external invalidity (interaction of the test with the treatment, interaction of the selection with the treatment and reactive arrangements).

Two independent control groups were formed. The first (second) group of 30 (29) people acted as the pretreatment (post-treatment) control group. Two groups were formed for the treatment application, consisting of 23 and 21 people. Additionally, the instrument was calibrated with the remaining 17 people, following Newton *et al.* (2008), to recognize the sample particularities and to generate behavioral profiles in the learning process.

The quasi-experiment was organized into three stages: pretreatment, treatment and post-treatment. The pretreatment stage included the administration of the CLEI instrument to Control Group 1 and Treatment Groups 1 and 2. To implement the treatment stage, the selected groups were invited to a training workshop called mindfulness-based cognitive therapy for life (MBCT-L): How to feel good when everything seems to go wrong. For this purpose, a company was hired that was authorized and certified in the application of the methodology known as *MBCT-L*. The course was developed at Oxford University (Oxford Mindfulness Foundation, 2021). This research applied a four-week version oriented to facing life's challenges in a general way. The course was offered in four, two-hour sessions on Sundays. At the post-treatment stage, the CLEI was applied to Control Group 2, Treatment Groups 1 and 2 and to the calibration group to adjust the CLEI to local conditions. Table 1 shows the details of the tests performed.

Data analysis and results

The questions were answered on a five-point Likert-type scale. The scoring was (1) "strongly disagree", (2) "disagree", (3) "neither agree nor disagree", (4) "agree" and (5) "strongly agree".

Sequence	Stage	Group	*N*	Intervention	Objective
1	Pretest	Calibration	17	CLEI Administration	Standardize CLEI
1	Pretest	Treatment 1	23	CLEI Administration	Register CLEI baseline
1	Pretest	Treatment 2	21	CLEI Administration	Register CLEI baseline
1	Pretest	Control 1	30	CLEI Administration	Register CLEI baseline
2	Test	Treatment 1	23	Mindfulness Training (4 sessions of 8:00–10:00 h)	Run quasi-experiment
2	Test	Treatment 2	21	Mindfulness Training (4 sessions of 10:00–12:00 h)	Run quasi-experiment
3	Post-test	Treatment 1	13	CLEI Administration	Check CLEI changes
3	Post-test	Treatment 2	14	CLEI Administration	Check CLEI changes
3	Post-test	Control 2	29	CLEI Administration	Check CLEI changes

Source(s): Table by authors

Table 1. Quasi-experimental design of the study

Each variable element was processed using the statistical package for social sciences (SPSS) software, version 22 for Windows 10. A two-way analysis of variance (ANOVA) and a least squares regression analysis of the Microsoft (MS)-Excel 2019 program were also applied.

The next step included a descriptive analysis of each question of the questionnaire in which the main statistics were determined: (a) mean, (b) median, (c) mode, (d) standard deviation, (e) variance, (f) skewness, and (g) kurtosis. The responses presented a negative skewness, that is, the respondents tended to respond in high conformity with the scale. On the other hand, the responses presented a kurtosis greater than plus/minus 1.0. According to Lind *et al.* (2012), data following a perfectly normal distribution should reflect a kurtosis equal to zero.

To determine the normality of the data, Shapiro–Wilk and Kolmogorov–Smirnov goodness-of-fit tests were run. According to Razali and Wah (2011), the Shapiro-Wilk (SW) test is the best for determining normality in small samples. Furthermore, according to the same authors, the results of the Shapiro–Wilk goodness-of-fit test should vary between zero and one. Thus, low values indicate that the hypothesis of data normality should be rejected, while values close to one indicate that the data behaved normally. In this case, the average value of this indicator reached 0.708. However, the SW test also presented a *p value* lower than 0.05 for all elements. Therefore, the data were not normally distributed, so a normalization process was carried out.

Based on this result and as a step prior to data normalization, the negative scales to the inverted indicators were changed. Thus, in all cases, the answers reflected positive results that could be compared, so the scores were changed from 1 to 5, 2 to 4, 4 to 2 and 5 to 1. These changes were made to 22 questions on the questionnaire. The average values and standard deviations were then calculated for each of the CLEI scales. The results are shown in Table 2.

As recommended by Newton *et al.* (2008), t scores or normalized scores were calculated. The scores were expressed on a statistically comparable basis and allowed the study group results to be evaluated. The following formula was applied:

$$\text{t score} = 10 * [(\text{Xmi} - \text{Xn})/\text{SDn}] + 50$$

where t score is the normalized value for each scale of the CLEI reported, Xmi is the individual measurement value, Xn is the normative average value (from the calibration group), and SDn is the normative standard deviation (from the calibration group).

Table 2.
Average values and standard deviations of each CLEI scale

CLEI scale	Calibration ($N = 17$)			Control 1 ($N = 30$)		Control 2 ($N = 29$)		Treatment 1a ($N = 23$)		Treatment 1b ($N = 13$)		Treatment 2a ($N = 21$)		Treatment 2b ($N = 14$)	
	n	M	DE	M	DE	M	DE	M	DE	M	DE	M	DE	M	DE
Academic self-efficacy	14	3.53	1.79	4.69	0.64	4.40	0.93	4.39	0.86	4.60	0.47	4.52	0.69	4.61	0.61
Organization and attention to study	8	3.19	1.32	4.19	0.99	3.89	1.15	3.76	1.19	4.06	1.00	3.76	1.10	4.39	0.88
Control of stress due to time pressure	6	3.21	1.50	3.14	1.25	2.74	1.18	2.78	1.26	2.99	1.35	2.47	1.17	3.17	1.06
Involvement with college activity	9	3.07	1.58	3.20	1.23	3.23	1.21	3.63	1.08	3.85	1.01	3.66	1.14	3.90	1.09
Emotional satisfaction	7	2.86	1.06	4.46	0.89	4.12	1.05	4.25	0.99	4.13	0.65	4.43	0.86	4.73	0.56
Class communication	6	2.29	1.12	4.12	1.23	3.84	1.29	3.84	1.46	4.26	1.09	4.07	1.22	4.42	1.01

Note(s): Subscript "a" indicates before the treatment and subscript "b" indicates after the treatment
Source(s): Table by authors

This formula was applied to generate the average values of the t scores, and deltas were calculated for the analysis group. These results are presented in Table 3.

To analyze these data, the following hypotheses were formulated:

H0-a: The deltas of the treatment means are equal.

H1-a: The deltas of the treatment means are not equal.

H0-b: The deltas of the means of the blocks are equal.

H1-b: The means of the blocks are not equal.

Subsequently, a two-factor ANOVA was applied to the control and treatment groups after verifying compliance with the conditions that, according to Lind *et al.* (2012), should be considered in these cases, using F (Fisher's distribution) as the test statistic. The results are shown in Table 4.

Table 4 shows that the F statistic of the CLEI blocks or scales reached a value of 0.859, which was less than its critical value of 3.326. Therefore, the null hypothesis was supported, and the alternative was rejected. That is, the deltas of the block means were very similar. On the other hand, the F statistic of the treatment or comparison groups was 15.94, which was greater than its critical value of 4.1. That is, the null hypothesis was rejected, and the alternative was supported. The deltas of the means of the treatments were not equal. To conclude, a complementary test was carried out by calculating the confidence intervals and confirming that the study groups exhibited significant differences. The results are shown in Table 5.

Groups 1 and 2, compared with the control group, had upper and lower confidence intervals with the same sign. Therefore, the means differed significantly between the treatment and control groups. In contrast, the upper and lower confidence intervals in the treatment groups did not have the same sign. Therefore, these treatment means did not differ. That is, the treatment effect generated similar effects in Treatment Groups 1 and 2.

Moreover, a least squares regression analysis was conducted to determine the possible correlations between the descriptive variables training schedule, age range, gender, master's program, religious beliefs and t scores. For this purpose, the databases of Treatment Groups 1 and 2 were integrated. The descriptive variables and each scale of the t score exhibited differentiated correlations. The most significant correlations, based on the multiple correlation coefficient and the F statistic, were emotional satisfaction and academic self-efficacy. On the other hand, the organization of and attention to studies, control of stress due to time pressure and involvement with college activities maintained an intermediate relationship. The least significant was class communication. The results are shown in Table 6.

Additionally, the possible correlations were studied between each descriptive variable and the average t score. The variables training hours, age range and master's program were correlated and exhibited statistical significance, while gender and religious beliefs were not relevant. These results are presented in Table 7.

Finally, the results obtained in each CLEI scale were used to prepare the individual behavior profiles of each participant in the treatment groups. Figures 2 and 3 show two examples of behavior profiles obtained from the study. They are associated with an excerpt from the comments obtained by each student at the end of the *mindfulness* training workshop.

Student A made the following comment at the end of the treatment:

> I consider that being carried away by routine is what does not motivate us to be conscious or have a focused state of attention because we are used to carrying out our activities in a conventional way,

Table 3.
Comparison of average values between original scores and T-scores

CLEI scale	Control 1	Control 2	Delta	%	Treat 1a	Treat 1b	Delta	%	Treat 2a	Treat 2b	Delta	%
						Original values						
Academic self-efficacy	4.69	4.40	−0.28	−6%	4.39	4.60	0.22	5%	4.52	4.61	0.09	2%
Organization and attention to study	4.19	3.89	−0.30	−7%	3.76	4.06	0.30	8%	3.76	4.39	0.63	17%
Control of stress due to time pressure	3.14	2.74	−0.40	−13%	2.78	2.99	0.20	7%	2.47	3.17	0.70	28%
Involvement with college activity	3.20	3.23	0.03	1%	3.63	3.85	0.21	6%	3.66	3.90	0.24	6%
Emotional satisfaction	4.46	4.12	−0.34	−8%	4.25	4.13	−0.12	−3%	4.43	4.73	0.31	7%
Class communication	4.12	3.84	−0.28	−7%	3.84	4.26	0.42	11%	4.07	4.42	0.35	8%
Average			−0.26	−7%			0.20	6%			0.38	11%
						T-scores						
Academic self-efficacy	56.46	54.89	−1.57	−3%	54.80	56.01	1.21	2%	55.56	56.05	0.49	1%
Organization and attention to study	57.60	55.32	−2.27	−4%	54.28	56.58	2.29	4%	54.33	59.12	4.79	9%
Control of stress due to time pressure	49.55	46.87	−2.68	−5%	47.19	48.55	1.36	3%	45.10	49.74	4.64	10%
Involvement with college activity	50.84	51.00	0.17	0%	53.56	54.91	1.35	3%	53.74	55.23	1.49	3%
Emotional satisfaction	65.14	61.94	−3.21	−5%	63.23	62.06	−1.16	−2%	64.87	67.77	2.90	4%
Class communication	66.26	63.79	−2.48	−4%	63.80	67.51	3.71	6%	65.86	68.94	3.08	5%
Average			−2.01	−3%			1.46	3%			2.90	5%

Source(s): Table by authors

Summary	Count	Sum	Average	Variance
Academic self-efficacy	3	0.127709438876899	0.042569812958966	2.08791290345781
Organization and attention to study	3	4.81152129421565	1.6038404314052 2	12.8300328650431
Control of stress due to time pressure	3	3.32224441299368	1.1074148043312 3	13.4582154093645
Involvement with college activity	3	3.01085384256822	1.0036179475227 4	0.53115951816947 9
Emotional satisfaction	3	−1.47252256406379	−0.490840854687929	9.65561407221752
Class communication	3	4.31460924473092	1.4382030815769 7	11.59692008153
Control	6	−12.0471648961322	−2.007860816022 03	1.41935333820742
Treatment 1	6	8.76351068913482	1.4605851148558	2.54479065368501
Treatment 2	6	17.398069876319	2.8996783127198 3	2.88251142252777

Analysis of variance Source of variation	Sum of squares	Degree of freedom	Mean squares	F	p-value	Critical value for F
Rows (blocks)	10.283661007258	5	2.05673220145159	0.858774594568 53	0.540078971344614	3.32583453041301
Columns (treatments)	76.3700934153879	2	38.185046707694	15.943907515930 5	0.000775463684668	4.1028210151304
Error	23.9496162841769	10	2.39496162841769			
Total	110.603370706823	17				

Source(s): Table by authors

Table 4.
Two-factor analysis of variance with a single sample per group (significance level = 0.05)

without realizing the reality or benefits that each of our activities brings to our personal and professional development.

Student B made the following comment at the end of the treatment: *"What motivates me the most is that you can easily suppress negative ideas or thoughts and 'clear' your mind. This undoubtedly allows us to take advantage of it in many aspects, including the learning process, of course"*.

Discussion

Graduate student learning abilities can be encouraged through the management of processes, strategies, pedagogical mechanisms and specific teaching models, which have been traditionally applied by professors over time. Parra (2003) carried out a study that

Table 5. Confidence intervals for differences between treatment deltas

	Treatment 1 vs. Control	Treatment 2 vs. Control	Treatment 1 vs. Treatment 2
Upper Confidence Intervals (UCI)	5.46	6.90	3.43
Lower Confidence Intervals (LCI)	1.48	2.92	−0.55

Source(s): Table by authors

Table 6. Regression statistics between descriptive variables and T-score scales

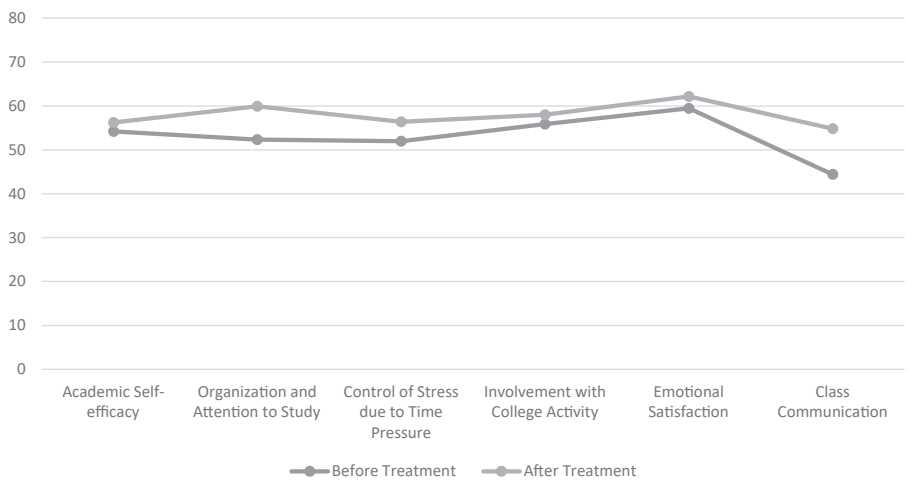
Regression statistics	Academic self-efficacy	Organization and attention to study	Control of stress due to time pressure	Involvement with college activity	Emotional satisfaction	Class communication
Multiple *R*	0.53	0.44	0.42	0.44	0.68	0.37
R Square	0.28	0.20	0.18	0.19	0.47	0.14
Adjusted *R* Square	0.11	0.01	−0.02	0.00	0.34	−0.07
Standard Error	1.33	3.53	4.09	3.49	2.27	4.38
Observations	27	27	27	27	27	27
F	1.65	1.03	0.92	0.98	3.68	0.66
Critical value for *F*	0.19	0.43	0.49	0.45	0.02	0.65

Source(s): Table by authors

Table 7. regression statistics between descriptive variables and T-score average

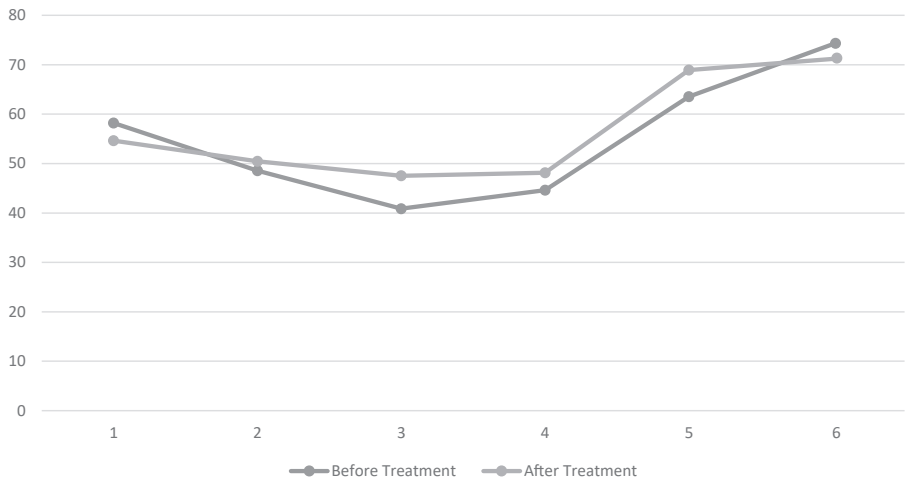
Regression statistics	Training hours	Age range	Gender	Master's program	Religious beliefs
Multiple *R*	0.30	0.28	0.06	0.15	0.07
R Square	0.09	0.08	0.00	0.02	0.00
Adjusted *R* Square	0.05	0.04	−0.04	−0.02	−0.04
Standard Error	2.06	2.07	2.15	2.13	2.15
Observations	27.00	27.00	27.00	27.00	27.00
F	2.46	2.13	0.08	0.58	0.11
Critical value for *F*	0.13	0.16	0.78	0.46	0.74

Source(s): Table by authors



Source(s): Based on Newton *et al*. (2008)

Figure 2.
T-scores changes for student A



Source(s): Based on Newton *et al*. (2008)

Figure 3.
T-scores changes for student B

integrates, describes and shows the characteristics and benefits of these processes. In his manual, he designs these approaches for flexible and adaptive use, but their approach and deployment in academic environments remain, fundamentally, exogenous.

This study demonstrated that applying an endogenous emotional–affective orientation mechanism based on the *mindfulness* technique can help to improve students' learning dispositions. For this purpose, a quasi-experiment was designed, following the guidelines of their predecessors Campbell and Stanley (1963) and the updates provided by Reichardt (2019)

regarding intervention groups with different numbers of participants and independent control groups as benchmarks to compare the results.

The design adopted for the execution of this quasi-experiment, integrating independent control groups with two treatment groups, generated positive and similar increases in the CLEI results. Thus, the design helped to strengthen the external validity of the study.

For Treatment Groups 1 and 2, on average, the different CLEI scales increased their original values by 6 and 11%, respectively. Similarly, the t scores corresponding to the normalization of the original CLEI values increased in each case by 3 and 5%. On the other hand, the comparative measure of the control groups decreased by 7% compared to the original values and 3% compared to the t scores. These changes were subjected to ANOVA testing and control interval testing. The results indicated that the treatment effect (training in the *mindfulness* technique) was not due to chance or to possible historical or circumstantial biases.

Although the changes in the 3 and 5% treatment groups could be considered low, they were consistent and based on the application of the CLEI instrument, which has been validated and refined for use by its developers, Newton *et al.* (2008).

The changes obtained supported the central hypothesis (H1) and auxiliary hypotheses H2, H4 and H5. Graduate student learning abilities increased after receiving training in mindfulness practice. Additionally, the CLEI scales were correlated with the descriptive variables training hours, age range and master's program. The results were better in Treatment Group 2, which received training between 10:00 a.m. and 12:00 p.m. Since this training was administered on Sundays, these people might have been more receptive and better rested than were those who received the training earlier, from 8:00 a.m. to 10:00 p.m. In addition, individuals at younger ages exhibited greater impacts on the CLEI. In other words, younger individuals reflected a greater openness to assimilating *mindfulness*, while older individuals were more skeptical. Regarding the master's program variable, the participants in the blended courses (face-to-face and online) were more receptive and reflected a greater adaptability than did those who were enrolled in only either the face-to-face or online programs.

Hypotheses H3 and H6 were rejected; that is, the influence of gender and religious beliefs on CLEI, and thus on learning abilities, was statistically insignificant.

These results are consistent with those found by Ching *et al.* (2015). However, they contradict the results obtained in Ecuador by Méndez and Rosado (2019). The fundamental difference between the two is the instrument type applied. In the first case, the instrument used was the CLEI created by Newton *et al.* (2008), while in the second case, the FFMQ and MAAS instruments were used. The negative result in the second case might have been caused by a lack of adaptation to the local environment, which was reported by the researchers.

The difference could also be related to the information sources used in each study. In the case of Méndez and Rosado (2019), the participants were undergraduate students between 18 and 24 years old. That is, they were postadolescent young people. Meanwhile, the participants in this study were more mature individuals whose age exceeded 30 years on average. In adolescents, the prefrontal cortex or neocortex is not fully developed. This is the place in the brain where logical thinking is generated along with the practice of the most developed characteristics of the intellect, such as reflection, critical thinking, and conscious decision-making based on facts and information. In adolescence, people act preferentially, guided by basic impulses derived from the amygdala. These young adults are very susceptible to external influences from friends and society. Their personalities are not fully formed; they are very impressionable (Manes and Niro, 2017). Therefore, for adolescents and postadolescents, mindfulness application is not recommended.

As a complement to the above, Montero-Marin *et al.* (2022) reported on the limited impact of mindfulness training in controlling depression and mental problems for adolescents. However, the authors concluded that even though this technique is not recommended in early adolescence, more studies are required to explore the impacts of mental health improvement programs adapted to the needs of specific groups of young people. Similar recommendations have been made by Palomero and Valero (2016), Karunananda *et al.* (2016), and Wimmer *et al.* (2020), who have reported that further research is needed to facilitate its practical application to the teaching–learning process.

Therefore, this article contributes additional elements to the research and knowledge. For example, the results suggest that a window of opportunity occurs between 25 and 35 years old, during which the application of the mindfulness technique would be the most appropriate to maximize its influence on the teaching–learning processes. Individuals below this range are unprepared because their cognitive abilities are only partially developed (Manes and Niro, 2017), while individuals above this range are more pragmatic about or skeptical toward the potential of meditative activities.

Conclusions

Below are the study conclusions based on the initial objectives.

First, the statistical evidence obtained by this study indicates that offering graduate students the opportunity to learn about and adopt mindfulness practice and helps to improve their academic outcomes, as reflected through the measurement of the CLEI indicator. Accordingly, *mindfulness* facilitates self-regulation or affective–emotional balance and awareness of learning experiences, but its impact is even more important in aspects related to the psychological and emotional well-being of its practitioners.

Second, the participants in the treatment groups, who completed mindfulness training, improved their cognitive and emotional abilities, as measured by the CLEI, which reflects a better disposition or attitude to assume and fulfill their academic responsibilities in the future. Through the comments, observations, and lessons learned by all the participants, a general conviction was evident that mindfulness training contributed to facilitating communication, interrelation, and fear elimination when facing the challenges that life presents. This new mental disposition must be taken advantage of so it can be extended to other learning areas. This program type is recommended not only for students but also for academic and administrative staff at universities.

Third, the results and the feedback showed an eagerness to acquire knowledge on complementary techniques—such as models, techniques, or processes—to facilitate business management and improve human behavior and interaction. This circumstance was intensified during this research due to limitations caused by sanitary conditions as well as by the new professional demands and technological challenges that accelerated during the sanitary crisis. To address this situation, the application of behavior profiles based on the determination of t scores is proposed to the student counseling departments of universities, which becomes an additional benefit of the present investigation, whose results could be used to provide individualized advice to students who are willing to take the CLEI independently.

Fourth, the way training is delivered is relevant. Therefore, not only for mindfulness training but also in the case of regular courses, it is important to consider a comfortable schedule that is free of interruptions to achieve better assimilation. It is better to concentrate on a single subject than to teach several subjects simultaneously. Also advisable is to enable outdoor spaces beyond the classroom, where users can enjoy greater freedom and fewer restrictions than those found in academic settings. In particular, spaces such as gardens and meditation rooms should be implemented that are specially designed to facilitate meditative practices.

Finally, the age range that best suits the application of mindfulness is between 25 and 35 years old. Additionally, students received it better who participated in blended master's programs (face-to-face and online), as people with these characteristics are more flexible and more open to assimilating alternative learning techniques. Consequently, elective courses including mindfulness should be integrated into this study modality to improve human skills. Mindfulness not only facilitates learning but also promotes resilience and motivates personal growth, mental health, and the will to achieve conscious development.

Implications for graduate educational institutions

This study highlights the importance of including courses to improve skills related to managing the emotional intelligence and human skills of students within academic programs. Academic institutions should consider the use of individual behavioral profiles that can be obtained from the CLEI application. These profiles constitute a valid mechanism for measuring the evolution of student responses to efforts to improve technical and soft skills. In addition, they must encourage students to take responsibility for managing their mental health and the impact it has on their peers and the university community.

Similarly, *mindfulness* should be considered a new discipline of behavior and personal interaction, whose benefits are applicable to any area of professional training. Additionally, faculty should be prepared to acquire the capacity and motivation to help apply mindfulness in the teaching–learning context.

On the other hand, a mindful collegiate body is capable of satisfying the needs and expectations of stakeholders and contributes to generating greater legitimacy for higher education institutions, together with easier and more sustained access to the resources necessary to survive. University legitimacy improves the identification and acceptance of the teaching staff and, therefore, also the sympathy and satisfaction of the students (Blanco-Gonzalez *et al.*, 2021).

Implications for students

The mindfulness technique contributes to improving not only the academic skills of the students included in the CLEI but also their levels of resilience, self-control, personal balance, empathy and perspective of their world. These skills can help them achieve their academic goals and career objectives as well as improve their quality of life.

In particular, through mindfulness practice, the development of a parallel personal development agenda could be encouraged. Such an agenda might include, among other things, daring to be different, living different roles, leaving the comfort zone, having the courage to achieve a full life, fighting for dreams, making good decisions and learning to learn and reflect on learning.

Implications for companies

Companies could benefit because complaints related to deficiencies detected in the academic training of job applicants are addressed and resolved (Pasamar *et al.*, 2019). Higher education has the opportunity, not only to train individuals with technical skills and abilities, but also with the wisdom to face global challenges and financial, economic, environmental, humanitarian, moral and health crises (Jakubik and Müürsepp, 2021). Employees who display balanced mental health and who have well-endowed cognitive and emotional skills can contribute optimally to business results and goals.

Limitations

The treatment groups consisted of graduate students who did not have opportunities for full-time activities on campus, as they were limited to attending regular classes at specific times, usually at night.

The participants were very interested in collaborating in the mindfulness workshop training, considering that it was free for them. However, not everyone was able to complete the workshop. The dropout rate was 14% due to inconveniences caused by the pandemic: some participants were infected, some had problems with their families and others lost their jobs or interest in continuing because of personal priorities. These conditions could have affected the study results both positively and negatively.

In addition, the pandemic limited academic interactions, which are required to evaluate the learning results after applying the research instrument. This limitation was especially critical for people who had experienced online classes only.

Recommendations for further research

To replicate and confirm the study results, the database should be expanded. Further studies can invite undergraduate students from several educational institutions because they interact more within their campuses, and they could take better advantage of the services that their universities offer to the academic community.

New studies on this topic should move forward by applying research designs that are more rigorous based on the development of randomized experiments and using larger samples to improve internal validity. In addition, the results could be monitored through longitudinal studies, which systematically collect actual behavioral data in various facets of academic and professional life.

Groups of professionals could also be integrated to detect the impacts of *mindfulness* in business management activities. Such impacts include their performance in the application of soft skills or competencies that contribute to effectiveness in the workplace.

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(The Appendix follows overleaf)

Appendix

CLEI scale	Item	Description
Academic self-efficacy	1	I believe I have the ability to complete the college studies
	2	I have goals that I want to achieve while I'm in college
	3	I have high academic expectations of myself
	4	I think it is possible for me to get good grades
	5	I hand in only partially completed assignments
	6	I don't think I can make the effort to finish the college studies
	7	I am determined to do whatever it takes to achieve my goals
	8	I do not hand in my assignments
	9	My family cares about my academic performance
	10	Family members criticize me because I am not a great student
	11	I am aware of the assignments due next week
	12	Acquiring knowledge is important to me
	13	I wonder why I need a degree for the career I want to pursue
	14	People in my community value a college education
Organization and attention to study	15	I organize my time so that I have enough time to study
	16	I set study goals and keep them up to date
	17	I only study the night before the exam
	18	I divide large assignments into manageable chunks
	19	I can't start studying even if there is nothing else to do
	20	I find myself daydreaming when I study
	21	I realize that my attention wanders in class
	22	I organize class information in a way that helps me retain and apply it later
Control of stress due to time pressure	23	I feel like there are so many things to do each week that I feel stressed out
	24	I have symptoms of stress for all the pressure I've had since I started college
	25	I think I don't have time to do everything I need to do
	26	I think I'm catching up
	27	My current situation distracts me from my studies
	28	I plan ahead to avoid getting overwhelmed with tasks at the last minute
Involvement with college activity	29	I participate in social activities on campus
	30	I belong to a club organized on campus
	31	I attend events such as concerts, plays, oratory events or sports contests as part of the college experience
	32	I know someone I can study with
	33	I have friends here at the college
	34	I belong to a study group
	35	I consider college is a great stage in my life
	36	My friends have good study habits
	37	I enjoy being a student here
Emotional satisfaction	38	I like my courses
	39	My professors show interest in me
	40	I hate college, but I know I have to study
	41	I see connections between my classes and my career goals
	42	I am discouraged by the way my professors treat me
	43	I can talk to people who encourage me about what I am learning
	44	I feel overwhelmed when I think about the requirements I have to meet in the classes

Table A1.
Information of the study instrument

(*continued*)

CLEI scale	Item	Description
Class communication	45	I avoid participating in class
	46	I ask questions in class
	47	I don't think I can express my ideas very well in writing
	48	I avoid classes where participation is required
	49	I dread the idea of getting test scores in certain classes
	50	I find it difficult to get the help I need for my academic success

Source(s): Newton *et al.* (2008)

Table A1.

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Efficient scale and scope of business models used in municipal solid waste management

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Abstract

Purpose – The paper aims to compare the efficiency of alternative municipal solid waste (MSW) management business models: a single provider against multiple providers.

Design/methodology/approach – In this paper the drivers of MSW management costs are analysed to test the impact of the scale and scope of MSW management services on the average cost. While the business-as-usual scenario foresees a single provider, the alternative scenario foresees multiple providers.

Findings – Based on the empirical data on municipal waste management costs, on average, the size and the average cost of the service are inversely related. This trend is supported using sub-sets defined by the quantity of waste managed. Multiple factors aid in explaining this result, and among others, due to scale and scope, factors such as transition costs increase with the number of players running different services.

Practical implications – The provision of public services of economic interest should favour the participation of more companies wherever possible to the extent that social surplus is produced. However, pursuing this principle to the detriment of efficient service delivery is not ideal. This paper demonstrated that a single-provider waste management business model is efficient under specific conditions, as in this article.

Originality/value – This paper presents an original research methodology for comparatively analysing waste management service efficiency in urban areas and provides adequate evidence using alternative measures of costs according to the phase of the waste management chain, the scale and ultimately the scope of MSW management services.

Keywords Waste management, Business model, Economies of scale, Public procurement, Waste management chain, Circular economy

Paper type Research paper

1. Introduction

Public services of general economic interest are fundamental to the nation's economic development and significantly impact social welfare (Boggio, 2016). The operational efficiency of the municipal solid waste (MSW) management industry has become increasingly significant for achieving sustainable development objectives (Zorpas, 2020). Business and governance models of MSW management need to evolve towards efficiency levels compatible with the achievement of economic and environmental objectives (Kaza *et al.*, 2018). Research has exposed the critical need for assessing different models of governance and organisation, and entrusting services for the governance and delivery of public services (Soukopová *et al.*, 2017). Trade-offs between the competitive dimensions in industrial structures characterised by imperfect competition must also be considered.

Typically, local authorities can choose between three models and procedures: entrusting the service to third parties through public procedures, the provision of the services through

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hybrid public-private firms and in-house provision. Free market and competition rules apply to actors entrusted with providing public services for economic interests as long as these rules do not prevent them from fulfilling their general mission (European Commission, 2022).

Additionally, the principle that underpins European competition and public procurement legislation since the introduction of Directive (2014)/24/EU is important, which is to encourage small- and medium-sized enterprises (SMEs) to participate in public procurement and, thereby, in the provision of public services. However, this principle can be abandoned by considering integrated utilities, which can provide more services at various stages of the chain, owing to the economies of scale and scope resulting from their production efficiency. Sub-dividing large municipalities can be assumed to lead to greater competition, fostering growth among service providers (Sarra *et al.*, 2020). However, on the contrary, a recent empirical study focused on Barcelona revealed that multiple firms can strategically interact to maximise producer surplus at the expense of social welfare (Bel and Sebő, 2021).

MSW management can be regarded as an industry with two or more intertwined phases. The market structure in the first phase is mainly labour-intensive, while the second phase is capital-intensive and supported by enabling infrastructure, such as waste treatment plants. Both phases are subject to the risk of market failure, and in certain circumstances, the market can effectively manage one or more services (Di Foggia and Beccarello, 2018).

The industrial organisation of the collection phase often involves local monopoly configurations justified by the economies of scale resulting from the size of the service and its economies of scope (AGCM - Italian Competition Authority, 2016). Much has been written regarding the existence of scale economies, an important issue with some consensus (Callan and Thomas, 2001), as confirmed in previous analyses that also found scale economies and some efficiency differences between public and private providers (Tickner and Mcdavid, 1986). Early research in the field of economies of scale focused on the inter-relationships of scale, market structure and costs, with scattered evidence in the beginning, based on the little evidence of the existence of certain scale economies (Stevens, 1978).

In this regard, the more recent findings on economies of scale have provided mixed results. For example, a recent study found that less than half (40.4% of the municipalities evaluated), presented negative economies of scale (Llanquileo-Melgarejo and Molinos-Senante, 2021). Another study underscores the drivers of costs under alternative cost definitions (Di Foggia and Beccarello, 2020). Similarly, a third article concluded that population and size are important factors for scale economies, and the implication is uncertain (Wowrzeczka, 2021). This uncertainty is partly due to information asymmetries that complicate comparative analyses. Another factor that concurs with mixed results is the unit of analysis.

Indeed, many studies aimed at understanding the economies of scope in MSW management by focussing on the input factors of firms and very different output variables, failing to differentiate among collection costs, total costs and treatment costs or using per capita cost against costs per unit of waste.

Scale economies in a public service of general interest such as waste management should be evaluated from the perspective of the contracting authority, paying more attention to exogenous factors affecting the organisation of the service that must be used at the same level as the input factors of firms. Indeed, failing to consider the above may result in formally correct results but be biased in practice if the sub-additivity of costs is not considered. Consequently, the contracting authorities may decide it inappropriate to divide the contract into lots to avoid the risk of rendering the execution of the contract excessively technically difficult or expensive and because co-ordinating the different contractors for the lots could risk undermining the proper execution of the contract.

Some scholars have empirically evaluated the impact of different regulated business models on MSW management and suggested that their efficiency can be increased by limiting the size of these service areas so that the system encourages large service providers

to compete for service allocation in a large number of small areas, thus intensifying the positive effects of market competition (Sarra *et al.*, 2020). However, it could be argued that reducing the size of the areas that can be allocated to a single firm may promote anti-competitive strategies aimed at creating divisions between several theoretically competing operators.

Strengthening market competition and realising economies of scale by integrating organisations (and thus reducing the number of individual economic actors) can be considered appropriate choices for achieving economic and environmental efficiency. First, this idea is supported based on an econometric model that identifies the main determinants of service costs. Then, the focus was on the analysis of multiple case studies, using a sample consisting of the ten most populous Italian cities. Third, a single case comparing a "business-as-usual" model involving a single economic actor with an alternative scenario consisting of four firms was analysed.

Evidence suggests that as the size of the service increases, the average cost tends to decrease. The case study confirms the presence of economies of scale, resulting from the specific factors employed in the production of the service.

The rest of the article is organised as follows. Section 2 presents a literature review and reports on the previously published studies that have explained some of the aspects analysed in this article. Section 3 describes the context and research design as well as the data collection process and the variables in this study. Section 4 presents the results of the econometric analysis and case studies. Section 5 discusses the main considerations and implications arising from the findings. The final section concludes.

2. Background and literature

The complexity of the waste management (WM) industry raises concerns about the technologies it relies upon and the sustainability of its business models (Björklund *et al.*, 1999), which also depend on how contracts between MSW management providers and institutions are structured (Walls, 2005). In light of the challenging environmental goals, the efficiency of MSW management business models has become an increasingly important concern (Kinnaman, 2009); thus, their sustainability as well as their emergent role in local communities is critical (Avilés-Palacios and Rodríguez-Olalla, 2021; Esmaeilian *et al.*, 2018). As such, the relationship between efficiency and economies of scale is attracting more attention at both the political and the organisational levels. Accordingly, the number of studies on the cost of MSW management has grown, such as the analysis of the cost functions (Bohm *et al.*, 2010) or the cost of recycling environmental policies (Da Cruz *et al.*, 2014).

Previous literature has focused on the determinants of demand for MSW management services (Diaz-Farina *et al.*, 2020), organisational forms and modes of supply (Zhang *et al.*, 2015), policy implications (Goddard, 1995), cost structures (Callan and Thomas, 2001; Pérez-López *et al.*, 2016) and the need to develop strategies to achieve sustainability goals. Regarding sustainability goals, geopolitical contingencies make it difficult to reach the binding agreements and credible commitments made by policymakers (Darus *et al.*, 2020).

Different approaches have been proposed to analyse the economic efficiency of MSW collection firms. For example, a recent study identified a relation between costs and environmental efficiency, although this relationship is non-linear, as a rise in the separated waste collection rate increases total costs by a less-than-proportional amount, which provides evidence of the existence of economies of scale (Bartolacci *et al.*, 2019).

Economic and technical efficiency have emerged as prominent factors in explaining costs (lo Storto, 2021). Given the increasing pressure governments face to increase cost efficiency, they may transfer waste disposal services to private firms (Jacobsen *et al.*, 2013). This possibility has raised the dilemma of whether for-profit enterprises are compatible with

outcomes that maximise social welfare (Kinnaman, 2009); the available findings are mixed (Bel and Fageda, 2010; Simões *et al.*, 2012).

Empirical evidence based on the existing MSW management business models is important, as it shows how economic and political factors exert different impacts on MSW management via both private and public firms (Plata-Díaz *et al.*, 2014). Other studies indicate that private MSW management operators are not necessarily better performers than public firms (Bel and Fageda, 2010).

Additionally, firm size, inter-firm relations and alternative technologies, as found in studies on green reverse logistics technology (Mugoni *et al.*, 2023), can be argued to significantly impact MSW management strategies (Lombrano, 2009). Considering that the size of firms that perform public services may correspond to a greater propensity to innovate, it is intuitive that advancing MSW business models can improve the net economic benefit they provide (Marashlian and El-Fadel, 2005). Broadly speaking, business models and MSW management methods, such as the organisation of collection services, have received limited attention (Guerrini *et al.*, 2017).

These methods are crucial because they significantly impact the organisation of work (Allesch and Brunner, 2014), and both controllable and non-controllable factors can significantly impact the costs of MSW management (De Jaeger and Rogge, 2013).

Furthermore, the way the service is provided, and the size and density of the population also affect the costs of MSW management due to economies of scale (De Jaeger *et al.*, 2011). The characteristics of the waste produced also play an important role (Chifari *et al.*, 2017; Greco *et al.*, 2015). Worth remembering is that morphological and geographical factors (Passarini *et al.*, 2011), socio-economic conditions (Mazzanti *et al.*, 2008), and policies and legal frameworks (Benito-López *et al.*, 2011) are also central to forming cost structures. Environmental objectives (Beccarello and Di Foggia, 2016), production technologies (Swart and Groot, 2015; Tisserant *et al.*, 2017), and the use of waste management facilities (Chu *et al.*, 2019) also play a role in this process.

With respect to how the competitive environment and business strategies influence agility, adaptability and alignment – which are linked, as reported by a recent study (Garrido-Vega *et al.*, 2021) – there is a paucity of articles focussing on the strategic behaviour of MSW management firms. Some studies have drawn conclusions concerning the degree and type of market competition (Bel and Sebő, 2020, 2021).

3. Methodology

3.1 Context

The waste management industry is a hybrid, regulated and market-driven sector as the main activities in the collection phase are often allocated to legal monopolies, whereas those in the treatment phase, for example of waste electrical and electronic equipment (Roy *et al.*, 2022), can mostly be fulfilled by the market.

Therefore, analysing economic and environmental efficiency based on identifying economies of scale and scope is particularly complicated. As evidence of this, the results in the previous literature do not necessarily reach the same conclusions. There are many reasons for this. Studies have been conducted in different disciplines; also, the type of cost analysed as a dependent variable (e.g. total costs, costs of separated collection, costs of non-segregated collection and sales prices) differs depending on the context. The unit of analysis may contribute to the variance in the results, and the analysed phase plays a large role in this phenomenon.

We refer to the combination of the transaction cost approach, economies of scale and the competitive aspects that are becoming increasingly important in defining how the MSW management industry should function.

The idea of transaction costs is applied in many contexts, from simple situations to more general ideas that consider various methods for allocating resources and coordinating economic activity (Klaes, 2016). Transaction costs are a necessary first step in separating the factor market from the product market. It may be impossible to distinguish between markets in service industries characterised by a supply chain with a significant number of suppliers. Therefore, distinguishing one organisation from another is often difficult when decisions are contractually binding. Furthermore, transaction costs are often difficult to measure and separate by type (Cheung, 2016).

Transaction costs, like production costs, are a wide-ranging designation for a heterogeneous assortment of inputs and transaction functions that may show diminishing, constant or increasing returns; in general, economies of scale are often pronounced. Compared to a theoretical state without transaction costs, transaction costs inevitably reduce social welfare due to the loss of allocative efficiency they incur. Efficiency problems also arise in a more general context. As complicated transactions may include multi-lateral contracts with many parties, transaction costs tend to increase (Niehans, 2016).

Figure 1 is a theoretical approximation of how transaction costs can be delineated within the two-stage waste chain. Figure 1a represents an integrated provider operating at both levels of the supply chain. Figure 1b represents a market structure characterised by several firms that, as in the case of an integrated system, operate in several stages of the supply chain. In this case, the concessionaire must manage contracts with some firms, which, as it is a public service, must be provided at the same level of quality for all citizens. Figure 1c

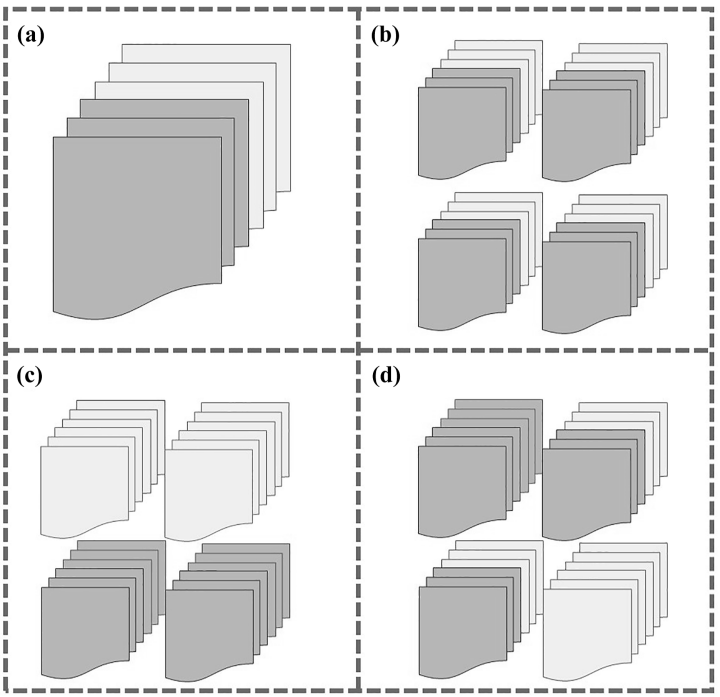


Figure 1.
Possible service configurations

Source(s): Author's creation

represents a market structure in which multiple firms specialise in services that take place in only one phase of the supply chain. In this case, a similar situation to that described in Figure 1b arises; however, not only is a coordination point necessary at a horizontal level in the same phase of the supply chain but also an additional element is added consisting of the provision of a service in only one phase of the supply chain. Figure 1d generalises different configurations. Please note that the cases presented in Figure 1 do not include all possible configurations.

The phases that make up this network industry as well as the main functions – and consequently the different services within the two resulting phases – can be seen in Figure 2.

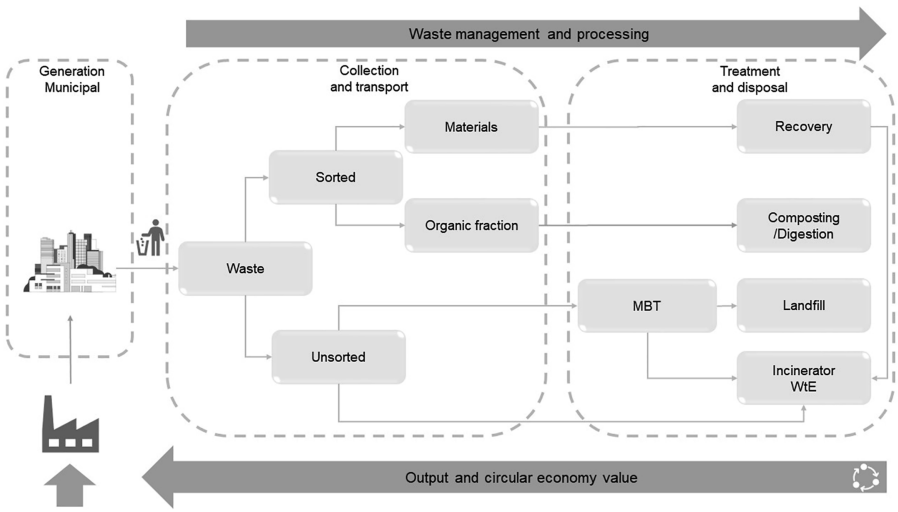
Figure 2 shows operations in one or more phases. Figure 2 also includes an additional phase (the generation of urban waste), as it is increasingly important in organising citizen activities that extend beyond mere communication and awareness campaigns. The two arrows are significant. The arrow in the upper part of Figure 2 shows the path of waste; that in the lower part reflects the circular economic process.

Therefore, the relationship between efficiency and economies of scale is more important at both policy and market organisation levels, and thus, the number of relevant studies on the cost of MSW management has increased (Pérez-López *et al.*, 2016; Sarra *et al.*, 2017). The economic literature has often focused on the determinants of demand for MSW management services (Diaz-Farina *et al.*, 2020), organisational forms and mode of supply (Zhang *et al.*, 2015), and cost structures of MSW management (Callan and Thomas, 2001; Pérez-López *et al.*, 2016) as well as the need to develop MSW management strategies to achieve sustainability goals.

3.2 Research design

The analyses were developed at two levels to increase the robustness of the results; two research questions were developed to investigate this topic.

RQ1. What is the relation between the size of the service and the cost? An econometric analysis based on 54% of Italian municipalities was developed to identify the



Source(s): Author's creation

Figure 2.
Waste management chain

impact of the determinants of MSW management costs. Then, a sensitivity analysis of different samples was performed by dividing the sample into 3, 5, 10, 15 and 20 sub-samples. The hypothesis is an inverse relationship between scale and cost.

RQ2. Which factors impact the optimisation of MSW management services? A case study was used to test the best option between assigning MSW management to a single firm or dividing the city into four lots and assigning the service to four firms. The observed cost was reclassified, based on the 56 sub-services (see Annex 1 for additional details) that constitute the service. An alternative scenario in which four firms provide MSW management services was simulated for comparative purposes.

This scenario first considered the organisational structure of the incumbent, which is divided into four branches referring to four sub-areas of the city of Milan. Then, a hypothetical total cost was calculated, based on the four existing operating divisions. The case study analysis aimed to shed light on the operating and organisational factors that have received little attention thus far in MSW research on scale and scope. The hypothesis is that a single contractor is expected to provide MSW management services more efficiently due to organisational issues and transaction costs.

3.3 Data collection and variables

The official data from the municipal waste cadastre published by the Italian national environmental protection institute (ISPRA) and openly accessible from the ISPRA web portal were used to run the analyses. The cadastre database contains data referring to the cost of MSW management, treatment options and waste production at the municipality level. Similarly, the data available in the public balance sheets of the city of Milan were used. Only municipalities with available data were included in the sample. The morphological and geographical data were retrieved from the Italian Statistics Institute portal, which contains the data on all Italian municipalities, which are publicly available for download. We aimed to increase the robustness of the analysis at the sub-sample level by rerunning the econometric analysis using comparable municipalities by size, as reported in the sensitivity analysis.

Table 1 contains the key statistics for the variables used in this analysis. The data refer to 2019, as it was the last available certified period at the time of data collection (see Figure 3).

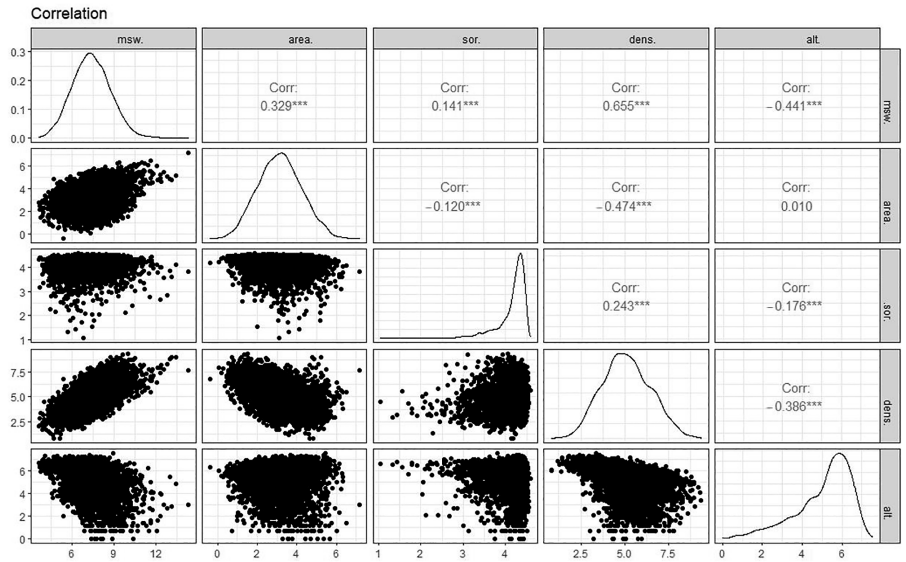
4. Empirical evidence

Figure 4 shows the relationship between costs and the scale of services. As this relationship is influenced by organisational dynamics, the scale of services and costs appear inversely related.

Variable	Label	N	Mean	SD	Min	Max
TC	Cost of waste management per kg	4,169	33.28	11.36	11.99	65.36
DC	Cost of sorted waste management per kg	3,438	20.65	12.08	7.80	107.80
UC	Cost of unsorted waste management per kg	4,047	38.33	24.19	11.24	258.75
msw	Municipal waste generated (th)	4,158	5.43	33.20	0.04	1691.89
sor	Percentage of sorted waste	4,163	66.59	17.47	2.87	97.48
area	Municipality km2	4,169	41.24	57.26	0.67	1287.39
dens	Population density	4,169	419.41	788.21	2.29	11675.83
alt	Altitude	4,169	300.05	272.26	1.00	1816.00
coast	Coastal municipality	4,169	0.17	0.37	0.00	1.00

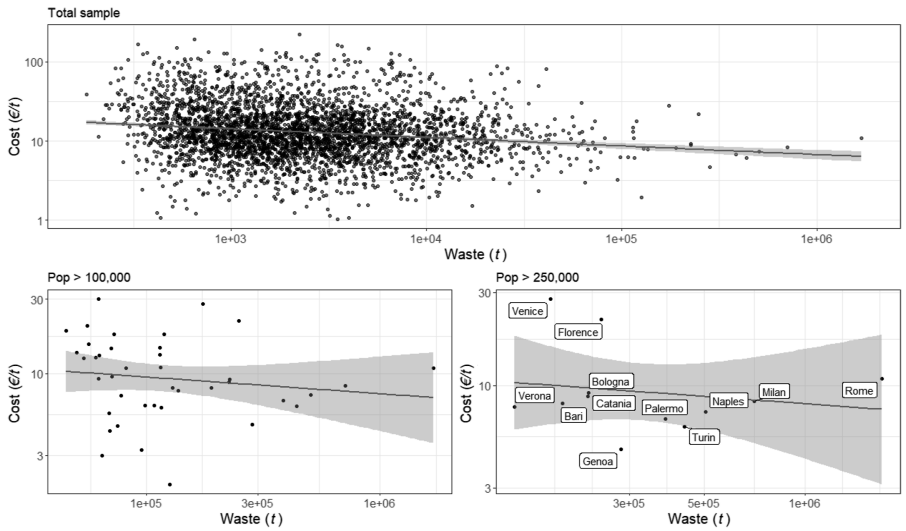
Source(s): Author's creation

Table 1. Variables



Note(s): Correlation matrix, scatter plot, and density of the main variables used in this analysis
Source(s): Author's creation

Figure 3.
Correlation between the main variables and their relative distribution



Source(s): Author's creation

Figure 4.
Scale and costs of MSW management

4.1 Econometric analysis

Applying the model in Equation (1) and shown in Table 2, the determinants of the variations in MSW management costs with respect to organisational size were examined. Other conditions, such as the specific demographic and morphological characteristics of the territory (which, together with the industrial structure of the waste treatment phase, influence

	Model 1 TC	Model 2 SC	Model 3 UC
(Intercept)	5.664***	3.868***	1.789***
	(0.067)	(0.112)	(0.110)
Municipal waste generated	−0.430***	−0.618***	−0.448***
	(0.016)	(0.026)	(0.025)
Municipality km2	0.477***	0.663***	0.426***
	(0.017)	(0.027)	(0.027)
Percentage of sorted waste	−0.114***	−0.414***	0.439***
	(0.013)	(0.022)	(0.021)
Population density	0.407***	0.606***	0.367***
	(0.016)	(0.027)	(0.027)
Altitude	0.024***	0.025***	−0.005
	(0.004)	(0.006)	(0.006)
Coastal municipality	0.314***	0.245***	0.271***
	(0.013)	(0.021)	(0.021)
N	4,152	3,430	4,031
R2	0.322	0.295	0.198

Table 2. Econometric analysis

Note(s): ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. Logarithms (except coastal municipality being a dummy)
Source(s): Author's creation

MSW management costs), were considered. Furthermore, whether the average cost of MSW management tends to decrease as the population increases was checked. In Equation (1), the dependent variable is the average cost of management (Eurocents per kg), while the independent variables are the population, size of the area in which the service is provided, percentage of separated collection, population density and altitude, as well as being a coastal municipality or otherwise.

Equation (1): Econometric analysis

$$\log(cost) = \alpha + \beta_1 \log\,(msw) + \beta_2 \log\,(area) + \beta_3 \log\,(sor) + \beta_4 \log\,(dens) + \beta_5 \log\,(alt) + \beta_6 cost + \varepsilon \tag{1}$$

The equation is reiterated in three variants, as shown in Table 2, which contains three columns corresponding to the three models, specifically.

(1) Model 1 refers to the total cost of the MSW management service;

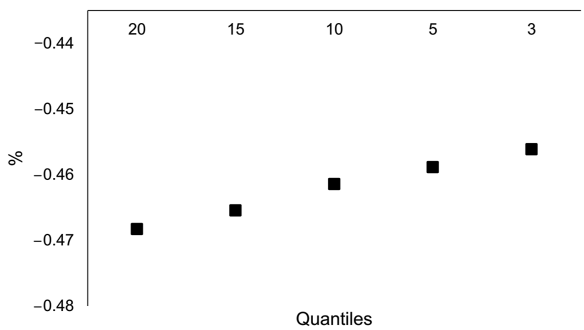
(2) Model 2 refers to the management costs of sorted waste;

(3) Model 3 refers to the management costs of residual waste.

Regarding Model 1, Figure 5 shows the results of the sensitivity analysis performed to test the robustness of the results.

Considering the results shown in Table 3, it appears that an inverse relation between the scale of the service and the cost exists in the types of costs considered when developing the three models.

Figure 5 presents a sensitivity analysis of the elasticity of the average cost of production in terms of the amount of waste handled, which seems to confirm the general hypothesis that asserts that the MSW sector tends to be characterised by economies of scale. The coefficient for the full population was − 0.46. As the number of intervals increases, the coefficient, although based on limited data, tends to increase. At this point, we conduct a comparative evaluation of the cost of collection and transport of the main Italian cities, which represents



Note(s): See Annex 2 for additional details
Source(s): Author's creation

Figure 5.
Average cost reduction due to scale

One firm. Figure 1 (a)	More firms. Figure 1 (b, c, d)
• Economies of scope • Coordination among the grantor and the concessionaire • Reduction of transaction costs resulting from fewer contracts • Equity and same quality of the service provided to citizens • Technological innovation given that positive linkages between size and innovation can occur in presence of high sunk costs • Quality standardisation that derives from the same organisation of inputs • Economies of scale especially in the collection phase	• Competitive environment • Lower bargaining power of the concessionaire • More symmetric information and performance comparison among competitors • Low market concentration that if not properly regulated may lead to inefficiency in the medium-term due to the loss of market attractivity for potential efficient firms • Reduced risks of market foreclosure • level playing field

Source(s): Author's creation

Table 3.
Opportunities of alternative scenarios

the segment of urban MSW management most affected by the dynamics of company organisation and the consequent optimisation of services. Such an analysis allows a comparative assessment based on a scenario defined by sub-dividing the city of Milan into four sub-areas to simulate the organisation of MSW management services and examine the impact of transaction costs.

Given that the analysis is limited to the main Italian cities and a small number of observations, we proceed with a bottom-up approach that reconstructs the costs using information published on the website of the Municipality of Milan, including the 2019 financial statements of the incumbent, explanatory notes, and the service contract between the Municipality and the incumbent. The scenario in which four firms provide MSW management services would imply a 6% increase in production costs compared to that of the incumbent.

5. Discussion

Economies of scale can play a significant role in defining business models (Di Foggia and Beccarello, 2021) even though they may seemingly conflict with the common knowledge that policymakers should favour SMEs in the provision of public services to create new opportunities and support the growth of SMEs, which in turn can make a significant economic contribution. It is worth emphasising that the involvement of SMEs in public procurement

allows contracting authorities to broaden their base of potential suppliers and to benefit from the increased competition for public contracts. However, such positive externalities in terms of efficiency and market development gains vanish in certain circumstances. Indeed, the arguments regarding the presence of economies shall be contextualised to fit with the cases. Considering that a few studies have stated that the existence of scale economies, to a certain level, does not indicate that it can be generalised to all cities. In fact, most studies have analysed samples only with no or just a few large municipalities. In contrast, this article deeply analyses the MSW cost structure in a 1.38-million inhabited city, suggesting that the MSW service is large and complex enough to require specific analyses.

In cities where public or private incumbent monopolies have long-run MSW management services, policymakers should not allow for excessive exemptions, such as splitting a city's area into several sub-areas to allow more firms to participate in MSW management. Nevertheless, it is possible to argue that splitting the municipal area into several sub-areas or the MSW management service into sub-services each, or some of them corresponding to many, may encourage anti-competitive strategies. This action limits the number of lots in which a single economic operator can run the service and may even lead to covert agreements between competitors, which would in turn worsen social welfare, for example, due to transaction costs (Cheung, 2016; DaSilva and Trkman, 2014) that have received little attention in MSW management studies.

Analysing the city of Milan enabled the determination of the efficiency of the business model by including costs sourced from public information regarding the incumbent, and the results conveyed that a single firm was more efficient than four firms. The main reasons highlighted include the differences, especially regarding the separated collection of materials (e.g. street-sweeping activities and bin-emptying activities), given that the production factors, employees, means of production and containers required are proportional in the two scenarios analysed in this article. However, this study found several issues related to transaction costs. Furthermore, the results indicate that the incumbent is more efficient from an economic standpoint.

The services causing the greatest cost burden are those related to collection, which include the sorting of bulky waste, durables, batteries, pharmaceuticals and spent toner cartridges, the collection of residual and differentiated waste with dedicated containers, the collection of residual and differentiated waste in cemeteries, the cleaning of markets, the collection and disposal of small items containing asbestos, the separated collection of used clothing, the separated collection of used oil and some sweeping activities such as cleaning the banks of watercourses, collecting leaves, cleaning tree rows and their areas, mowing and weeding pavements, and washing tunnels, arcades and sub-ways. Similarly, other activities, including on-demand services, have been shown to experience a significant increase in costs. Some production factors are not divisible or shareable between firms, which would entail the duplication of that production factor and therefore its cost.

Evidence suggests that entrusting MSW management services to a single firm may positively affect the community given the potential cost savings (−6%) and, thereby, the waste tax that citizens pay to finance them. The main drivers increasing production costs are the need for personnel and means of production – namely, vehicles – to provide the same level of service if they were to be provided by several firms. The above results are correlated with strategic management and uncertainty-coping strategies, given that uncertainty plays a substantial role in strategic decision-making processes and increases the risk and ambiguity of innovation (Beraha *et al.*, 2018), which is needed to improve the performance of the MSW management industry.

Interestingly, a recent study focussing on the city of Barcelona showed that dividing the region into four lots discriminated in terms of quality and, furthermore, differentiated service quality. The study analysed the effects of competition by focussing on the strategic behaviour of firms and illustrated the incentive to strategically determine the quality, based on the operating distance from competitors, which is an approximation of competitive pressure. This is, therefore, a risk if the principle of universality of service quality is to be

respected. It is important to avoid triggering strategic behaviours that increase service quality only in the most relevant and directly comparable areas (Bel and Sebő, 2021).

However, both positive and negative aspects should be noted to exist even when a single firm provides the service, as shown in Table 3.

The results also provide information on the compatibility of such strategic behaviour of firms with the principle of universality of service. This is an essential element and a principle that cannot be derogated from and a risk that may emerge. A further risk lies in the information asymmetries between local authorities and contractors, which could reduce the efforts of the latter in neighbourhoods farthest from those where there is more competition.

The main contribution of this paper is threefold. From a theoretical perspective, it summarises the previous literature on economies of scale and scope in MSW management and provides thought-provoking results that further the discussion on competitive policy and the regulation of public services. From a managerial perspective, the results offer new insights into critical organisational and operating factors that may emerge in running such services, which, due to transaction and other costs, may lead to sub-optimal levels of output and economic inefficiency. This paper also has policy implications given that the abovementioned considerations can serve as a reference for public decision-makers in designing municipal strategies that consider economic and social welfare outcomes. Managerial and practical perspectives are also straightforward for both bit utilities and SMEs, which shall analyse in detail the organisational and transaction costs they may experience in running this service in complex circumstances.

Our results also suggest that additional research is needed to evaluate the relation between scale and MSW management costs, which is a public service of general interest. Its effectiveness should be evaluated from a contracting authority – often municipality – perspective, not only from the firm perspective, paying more attention to the exogenous factors affecting the organisation of the service. Indeed, failing to consider the above may result in formally correct results but bias in practice if the sub-additivity of costs is not considered. In fact, a paradox may emerge. When analysing samples of firms the results of relatively small-scale economies may suggest the optimal size that, if put into practice in relatively large cities, resulted in multiple firms operating conjunctively, paving the way to transition costs and organisational failures that lead to negative externalities: one pitfall relates to costs, and the other downside refers to different quality levels that may occur in different parts of the cities because the service is run by different companies, and other hypothetical problems emerge in the potential strategic behaviour of firms and difficulties in regulating more firm issues.

6. Conclusion

This paper investigates the scale and scope of MSW management business models in terms of their economic efficiency to provide empirical evidence to support both the debate and the design of competitive waste management policy strategies. On one hand, it is generally recognised that the broad participation of SMEs in the provision of public services is a public policy goal. On the other hand, monopolistic competition outperforms other models in certain circumstances – for example, in that of integrated utilities, which can provide more services at more stages of the supply chain, owing to economies of scale and scope resulting from their optimised and streamlined production models.

A novel contribution of this paper is in its effort to analyse and test the same hypothesis across different conditions. From a national perspective, based on an econometric analysis of a significant sample of Italian municipalities, the results confirm the presence of an inverse relation between the scale and the average cost of the service. This finding is important considering that as the size of the service increases by 1%, the average cost of MSW management services decreases by 0.46% nationwide. From the results, the inverse relation

between service scale and costs can also be inferred to persist even under different hypotheses, as confirmed by our scenario analysis.

To fine-tune the analysis and provide useful insights that benefit managers and local administrators, a simulation has been carried out for the city of Milan by testing whether the service costs were lower when run by a single firm compared to when run by four different firms. The evidence suggests that MSW management is more efficient when carried out by a single firm given the industry structure, resource and labour force optimisation, and lower transaction costs, which, in certain circumstances, overcome the efficiency gains of the market, envisaged by economic theory.

The simulation revealed that dividing the city into sub-areas may lead to diseconomies, thus undermining economic efficiency and general service quality and creating undesirable consequences for social welfare and the equal treatment of citizens. Therefore, there are cases where contracting authorities shall decide that it is not appropriate to divide the contract into lots due to the risk of rendering the execution of the contract excessively technically difficult or expensive and because coordinating the different contractors could risk undermining the proper execution of the contract to the detriment of equity and quality.

This study has certain limitations. The results are extendable and relevant to other cities only when the spatial and socio-economic characteristics are comparable given that the factors used to identify whether a single firm is more efficient can lead to varied results in cities characterised by non-homogeneous conditions or in larger multi-centric cities. In fact, the land of the city of Milan is flat, with an altitude of approximately 130 metres, on an administrative area of approximately 181.7 square kilometres, with a population of slightly less than 1.4 million inhabitants: 7,315 inhabitants per square kilometre. Consequently, a very different situation with respect, for example, to Rome: approximately 2,860,889 residents in 1,285 km^2, 2.226 inhabitants per square kilometre and varied land characteristics. In such urban conditions, the results in terms of optimal business organisation may significantly change, preventing our results from being extended to geographically significantly different cities.

In the context of large cities, both the advantages of dividing the municipal area into smaller sub-areas – or the service into more lots – to facilitate the potential entry of smaller operators and the *a priori* advantages related to the existence of economies of scale need to be further studied and contextualised to avoid a strategic drift in municipal waste service planning.

The future research should focus on two topics. First, the activities that comprise waste management services should be broken down to investigate the opportunities presented by and costs of alternative forms of management for each sub-service according to scale and other exogenous factors. Second, provided that cross-sectional studies struggle due to sampling reasons, an analysis of the impact of economies of scale and scope in large cities is needed using case study approaches.

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Annex 1

Figure A1.
Taxonomy of sub-services classified by scope that make up the municipal waste management service examined in this article

Annex 2

Sub-data	20	15	10	5	3	Sample
[1]	−0.31372	−0.33094	−0.31634	−0.37158	−0.37862	−0.42978
[2]	−0.32611	−0.37511	−0.43249	−0.40171	−0.44498	
[3]	−0.48359	−0.41878	−0.43975	−0.48186	−0.54488	
[4]	−0.38682	−0.37266	−0.35493	−0.47869		
[5]	−0.37478	−0.40508	−0.48093	−0.56061		
[6]	−0.52579	−0.4231	−0.4811			
[7]	−0.30548	−0.52618	−0.41572			
[8]	−0.40513	−0.43573	−0.54459			
[9]	−0.4777	−0.48171	−0.52883			
[10]	−0.45353	−0.38149	−0.61994			
[11]	−0.45757	−0.57469				
[12]	−0.5055	−0.52394				
[13]	−0.35008	−0.46211				
[14]	−0.55512	−0.58765				
[15]	−0.58066	−0.68303				
[16]	−0.55199					
[17]	−0.46168					
[18]	−0.57222					
[19]	−0.54199					
[20]	−0.73681					
Mean	−0.46831	−0.46548	−0.46146	−0.45889	−0.45616	−0.42978
Mean 3	−0.37448	−0.37494	−0.39619	−0.41838		
Mean 5	−0.377	−0.38051	−0.40489			
Mean 10	−0.43344					
N	208	278	417	834	1,390	

Table A1.
Reiteration of model