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CONTENTS

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CONTENTS

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Editorial introduction

Economic theory is expected to simplify reality in order to identify and analyse the core mechanisms that drive it. In practice, this means that what constitutes a whole field of scientific inquiry for one person can be summarised in a single, simple sentence by an economist. For instance, an economist might say that a CEO is simply an economic agent who maximises income for the shareholders of the company.

The current issue of *Economics and Business Review* serves as a reminder that this is much easier said than done. This is because this issue focuses strongly on the challenges faced by many CEOs around the world (which turn out to be surprisingly common despite the diversity of countries covered by the six presented studies). Engagement in ESG practices or fair trade, obligations arising from diversity regulations, and managing employee voice and commitment are examples of the complex matters discussed in this issue, all of which must be dealt with by a CEO in order to generate income for shareholders. Moreover, as one of the studies included shows, a useful guide for navigating these challenges is not necessarily economic theory but rather the values that CEOs share and communicate. However, economic theory remains useful for understanding the broader context. For instance, as another article demonstrates, it helps to explain how corporate governance translates into economic growth.

Given its focus, this issue of *Economics and Business Review* can be recommended not only to economists and finance researchers, but also to management scholars and business practitioners. It has been prepared by 14 researchers working in Germany, Pakistan, Poland, Türkiye and the United Kingdom. A short description of their contributions is presented below.

The issue opens with a paper authored by Ashura Salim, Aleksandra Kowalska, and Louise Manning, titled **Fair trade and its role in sustainable development of agri-food system: A systematic literature review**. The study delineates key thematic areas and synthesises main conclusions from the body of literature examining the impact of fair trade certification. The review applies the PRISMA methodology in combination with SWOT analysis to examine Scopus-indexed publications from the years 2015 to 2024. The effectiveness of fair trade certification is shown to be shaped by the interplay of both demand-side and supply-side determinants. The findings offer valuable insights that may inform and support future research efforts aligned with Sustainable Development Goal 12: Responsible Consumption and Production.

The subsequent article, authored by Mustafa Kilinc and Talat Ulussever, and entitled **Corporate governance, financial markets, and economic growth: Does corporate governance moderate the finance-growth nexus?**, makes an empirical contribution to the extensive literature on the relationship between the financial sector and economic growth. The analysis encompasses a diverse sample of 39 economies over the period 2006–2020. The study provides an affirmative answer to the central research question, demonstrating that corporate governance moderates the finance-growth nexus. The findings underscore that both quantitative and qualitative dimensions should be considered in the design of the institutional framework for financial systems. In doing so, the paper offers valuable guidance for policymakers and contributes to the advancement of the Sustainable Development Goals, particularly SDG 16: Peace, Justice, and Strong Institutions.

The third article, **CEO values and corporate performance: A text mining and LLM-based approach**, written by Paweł Oleksy, Matthias Reccius and Marcin Czupryna, investigates whether the values of CEO's as captured using Schwartz's Theory of Basic Human Values translate into key performance indicators of the companies that they lead. These values are extracted from 4300 interviews, which are analyzed in two ways: via text-mining and a large language model (ChatGPT). The authors find that some CEO values do indeed seem to affect corporate performance, notably, Security is linked with the financial stability measures when using either of the method. A valuable contribution of this paper is that it makes excellent use of large language models to study economic phenomena, which are benchmarked against an older method (text mining).

The fourth article, **Clustering S&P 500 companies by machine learning for sustainable decision-making** by Cansu Ergenç and Rafet Aktaş, is yet another in this issue that makes use of various techniques to aggregate companies from the S&P 500 index into ESG-clusters. Three clustering techniques are used, namely *K*-Means, Gaussian Mixture Model, and Agglomerative Clustering: the first of these, as the authors have shown, offers the best performance. The article contributes to the still thriving literature focusing on environmental, social, and governance aspects of corporate activity. These remain important for many investors.

The fifth article, Sobia Shakeel and Mohsin Khawaja's **Gender diversity in corporate boards and firm risk-taking: Evidence from Pakistan**, makes a valuable contribution to the literature investigating the effects of having more women on corporate boards. In accordance with decades of research showing that women are on average less likely to take risks, the authors reveal that increasing the number of women on corporate boards of 49 companies from Pakistan leads to the companies having lower financial leverage and less volatile earnings. A strength of the paper is that it relies on a "shock"—a change in regulations in Pakistan—to establish causality.

Inferences are further strengthened through Difference-in-Differences and Markov Switching models.

The last article in this issue, **Speaking up in financial co-operatives: How values and job type shape employee commitment**, by Przemysław Piasecki and Maciej Ławrynowicz, draws on a unique dataset comprising 217 employees from eight UK building societies. The authors distinguish between supportive and challenging employee voice. The positive effect of both types of employee voice is more pronounced in co-operatives perceived as less oriented toward co-operative values and principles, while job type (front- or back-office) plays only a minor role in moderating the relationship under study. The guidance for managers of financial co-operatives derived from the findings aligns well with the priorities of Sustainable Development Goal 8: Decent Work and Economic Growth.

Monika Banaszewska
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Fair trade and its role in sustainable development of agri-food system: A systematic literature review

Ashura Salim[1] Aleksandra Kowalska[2] Louise Manning[3]

Abstract

The 'fair trade' movement aims to promote equitable trade relations between developed and developing countries. By guaranteeing producers a fair price, it seeks to improve the livelihoods of farmers and workers in marginalised regions. This review critically explores Fairtrade certification's impact on the economic, social and environmental sustainability of agri-food systems using PRISMA methodology and SWOT analysis. Key themes emerging from the reviewed papers include sustainable consumption, social equity and women empowerment, and governance in alternative food networks. Most sources focus on consumer behaviour and Fairtrade, concluding that consumer-driven strategies are crucial for systemic change and long-term success. Fairtrade still faces obstacles, including market competition with other certification schemes and the uneven distribution of

Keywords

- Fairtrade certification
- food trade
- sustainability
- agriculture
- minimum prices
- consumption
- food governance
- social equity
- global value chains
- PRISMA

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benefits between producers and supply chain actors. The final retail price is significantly affected by the value added by retailers, contrary to the Fairtrade mission, which can undermine confidence in the system.

JEL codes: D63, F13, O13, Q17

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Introduction

The World Fair Trade Organization (WFTO) is the global community and verifier of social enterprises that practise 'fair trade'. It has been promoting fair trading principles and practices within a global network of social enterprises since 1989. Fair trade initiatives have steadily grown since the 1990s. In 1997, Fairtrade Labelling Organizations International E.V. (FLO), or Fairtrade International, was founded to coordinate national fair trade certification initiatives (Naylor, 2014). This non-profit organisation has set private standards relating to labour, cooperative organisation, and the governance of the Fairtrade benefits, including financial advantages to farmers and workers from developing countries. In 2004, FLO was divided into two independent organisations, i.e. Fairtrade International and FLOCERT (Flocert GmbH). FLOCERT, which is an independent body, checks that producers and traders follow Fairtrade rules and use Fairtrade benefits for their own growth. Fairtrade International has shifted its focus from certifying Fairtrade organisations to directly certifying individual products through a recognizable certification mark (Naylor, 2014). This change broadened market access, allowing a wider range of actors, including non-Fairtrade organisations and transnational corporations, to sell fairly traded products, provided they were certified and displayed the now-common trademark. Simultaneously, FLO rebranded the term "fair trade" into the single word "Fairtrade" (with a capital "F"), establishing it as a distinct, proprietary label that exclusively designates products, brands, and organisations certified by the Fairtrade International system and identified by its blue and green mark. In contrast, "fair trade" or "fairly traded" (two words) remain broad, unregulated terms for ethical trade practices or related products. Unlike protected labels such as "organic", its use is unrestricted, meaning many products marketed this way often lack independent, third-party verification or affiliation with recognized networks like Fairtrade International or WFTO (Chow, 2017; Fairtrade International, n.d.).

In 2002, Fairtrade International introduced a global certification label. Recognised in over 50 countries, this label certifies farmers, traders, and businesses worldwide that meet their specific social, environmental, and economic requirements (FAO, 2017). It relates to products like bananas, coffee, sugar, cocoa, cotton, and tea produced in developing countries and mainly exported. Fairtrade certification aims to support exchange of goods in a way that ensures producers, particularly smallholders, receive a fair price and a stable living, guaranteeing a minimum price and a premium on product sales for producers (Dragusanu & Nunn, 2020; Sterie & Ion, 2022). One of the primary goals of the Fairtrade standard is to enhance the economic and social well-being of small-scale producers by ensuring a minimum price and providing an extra premium to support community development (Knößlsdorfer et al., 2021).

Fairtrade certification contributes to the creation of ethical standards and fairness in trade and value chains, and more sustainable agri-food system worldwide (Horodecka & Śliwińska, 2019; Nicholls, 2010; Nuseva et al., 2014; Raynolds, 2000). Fair trading in agri-food products is essential for ensuring fair farmer compensation, fair consumer pricing, economic equity, sustainable farming, responsible resource management, and the development of a resilient food system that provides affordable, nutritious and safe food for all (El Bilali et al., 2021; Onyeaka et al., 2024). Consumers choosing such products support fair wages, sustainable agricultural practices, and community development in developing countries (Lubowiecki-Vikuk et al., 2021).

In the 21st century, sustainable development has become a widely recognized objective for global society. The concept gained significant traction with the publication of *Our common future* in 1987, a landmark report that firmly integrated sustainable development into international development discourse (Hajian & Jangchi Kashani, 2021). The Brundtland Commission (or the World Commission on Environment and Development), which was established in 1983 by Gro Harlem Brundtland, Prime Minister of Norway, at the invitation of the then United Nations (UN) Secretary-General, defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations" (Heidrich, 2022; Mondini, 2019). The concept of sustainability encompasses economic, social, and environmental aspects (Purvis et al., 2019), protecting biodiversity and promoting long-term decisions that ensure the principles are upheld (Ozili, 2019; Rudevska et al., 2022). The UN General Assembly adopted the Agenda 2030 in 2015, which integrates the seventeen Sustainable Development Goals (SDGs) into the three pillars of sustainability to drive achievement of the goals (Dalampira & Nastis 2020; UN, 2018). SDG 12 focuses on promoting responsible production and consumption patterns, while developed countries are expected to lead the sustainable transformation, taking into consideration the development and capabilities of developing countries. To the best of the authors' knowledge, this is the first review based on a thorough analysis of the link between the

'fair trade' movement and the sustainability of global and local agri-food systems. The focus of our study is the Fairtrade certification scheme.

Food and Agricultural Organization (FAO) states that

> Agrifood systems have the power to sustain life on Earth. They tie together the people, activities, investments, and choices involved in producing and delivering food and agricultural goods. Agrifood systems include everything from how food is grown, harvested, processed, packaged, transported, distributed, traded, bought, prepared, eaten, and eventually disposed of. They also include non-food agricultural products such as forestry, feedstock, biomass for biofuels, and fibers. (…)
>
> Agrifood systems are full of untapped potential, where solutions already exist waiting to be scaled and connected. Transformation is about supporting and amplifying the possibilities that already lie within—to create a future of hope, collaboration, and lasting change. (FAO, 2025)

The global agri-food system is a complex network linking farmers, manufacturers, distributors, retailers, and consumers, with profound effects on economies, public health, and national security, yet it paradoxically results in food oversupply and waste in affluent nations, while poorer nations face scarcity and malnutrition (Bajzelj et al., 2020; Onyeaka et al., 2024). A number of factors are hindering the achievement of social justice, decent lives and sustainability in local agri-food systems. These include unequal power dynamics in global trade, unsustainable pricing, deforestation, land degradation, biodiversity loss, water stress and pandemics. Climate change, however, is one of the most significant factors (Development International e.V., 2022). Thus, increased attention to fairness in agri-food supply chains is driven by a combination of social, economic and environmental factors. As awareness grows and policy changes are implemented, it is likely that this issue will continue to be an important focus for researchers, policymakers and industry stakeholders in the years to come (Del Prete et al., 2024). The aim of this paper is to critically explore the impact of Fairtrade certification on economic, social and environmental sustainability of agri-food systems by applying the PRISMA methodology and Strengths, Weaknesses, Opportunities, Threats (SWOT) analysis.

The paper is structured as follows: the Introduction provides a rationale for further studies; Section 1 includes an initial literature review with an overview of how the 'fair trade' system operates. It also presents the research questions; Section 2 outlines the methodological approach. Section 3 contains research findings, Subsection 3.1 presents the results of the bibliometric analysis, Subsection 3.2 includes qualitative analysis of the evidence which has been synthesised and critiqued, Subsection 3.3 shows the results of a SWOT

analysis related to Fairtrade certification's role in the sustainable development of the agri-food system. Last Section is the Conclusions, where the authors present their final remarks and suggest several directions for future research.

1. Literature review

The broad 'fair trade' movement consists of two complementary approaches: one centered on mission-driven organisations and the other on certified products. WFTO promotes a holistic model grounded in its ten principles of fair trade (see Table 1), prioritising people and the planet through goals such as fair pricing, safe labour conditions, environmental sustainability, and community development (Sharma, 2024). The WFTO Guarantee System verifies entire organisations through independent audits and peer reviews, awarding the WFTO Mark to enterprises that embed the principles of fair trade across their operations. The Fairtrade certification label, governed by Fairtrade International and monitored by FLOCERT, is applied to specific products that meet established social, economic, and environmental standards. Both mechanisms enhance consumer choice by providing credible assurance and making such goods more visible and accessible in mainstream retail channels (Beardon, 2020). Since 1998, an informal association of the four main fair trade networks has been operating as FINE. These are: FLO, International Fair

Table 1. The ten principles of 'fair trade'

No	Principle
1	Creating opportunities for economically disadvantaged producers
2	Transparency and accountability
3	Fair trading practices
4	Payment of a fair price
5	Ensuring no child labour and forced labour
6	Commitment to non discrimination, gender equity and women's economic empowerment and freedom of association
7	Ensuring good working conditions
8	Providing capacity building
9	Promoting Fair Trade
10	Respect for the environment

Source: based on (WFTO Europe, 2016).

Trade Association (now WFTO), Network of European Worldshops (NEWS!) and European Fair Trade Association (EFTA) (Wielechowski & Roman, 2012).

Various stakeholders, including producers, importers, marketers, certifiers, and the Worldshops' network promote fair trading through retail stores and via education. The core objective of the movement is to ensure that producers from less economically developed countries receive a just and equitable price for their goods, e.g., via the implementation of the minimum prices and price premiums (Dammert & Mohan, 2015; Fiedoruk, 2021). In this way, producers are empowered to improve their livelihoods and protect the environment. This approach fosters long-term sustainability by reducing poverty, enhancing social equity, and safeguarding natural resources (Dangol & Chitrakar, 2021), but higher prices in certified markets are not always sufficient to raise household incomes and living standards (Knößlsdorfer et al., 2021).

In the late 1990s, several independent 'fair trade' certification organisations emerged to form the FLO, consolidating into one entity known as Fairtrade International. Its core mission is to foster sustainable development by upholding fair trading standards and safeguarding the rights of marginalised farmers and workers, especially in the Global South (Dammert & Mohan, 2015; Raynolds, 2017). Fairtrade certification for producers requires a comprehensive system that integrates respect for labour standards, sustainable farming practices, effective governance, and the empowerment of producers through democratic participation (Raynolds, 2018). This movement has significantly grown over the past three decades, evolving from its origins in the mid-20th century, focused on selling handicrafts to support marginalised artisans to now encompassing a broader range of products and more comprehensive approach (Ribeiro-Duthie et al., 2020). Fairtrade International certifies a diverse range of products (over 300), promoting fair trading principles across a multitude of agricultural and industrial sectors (Fairtrades International, 2022; Zysk, 2020). Fairtrade certifications are granted to farmer cooperatives and commercial plantations (Fiedoruk, 2021) operating along a supply chain that connects producers with consumers (see Figure 1). Producers sell their goods to exporters/importers, who then transport them to manufacturers. Manufacturers process the goods and sell them to brands and retailers, who ultimately sell them to consumers (Zhang et al., 2020). The Fairtrade programme decreases the intermediaries' market power and consequently, it increases farmers' added value in the agri-food chain (Podhorsky, 2015). Throughout the supply chain, FLOCERT ensures that Fairtrade standards are being met by verifying that producers receive fair prices, working conditions are safe, gender equality is ensured, accountability and transparency practices are operating, and environmental protection measures are implemented (Beardon, 2020; Fiedoruk, 2021; Liu, 2021).

Fairtrade International partners with 25 certified Fairtrade organisations, dedicated to improving the lives of farmers and workers across the globe

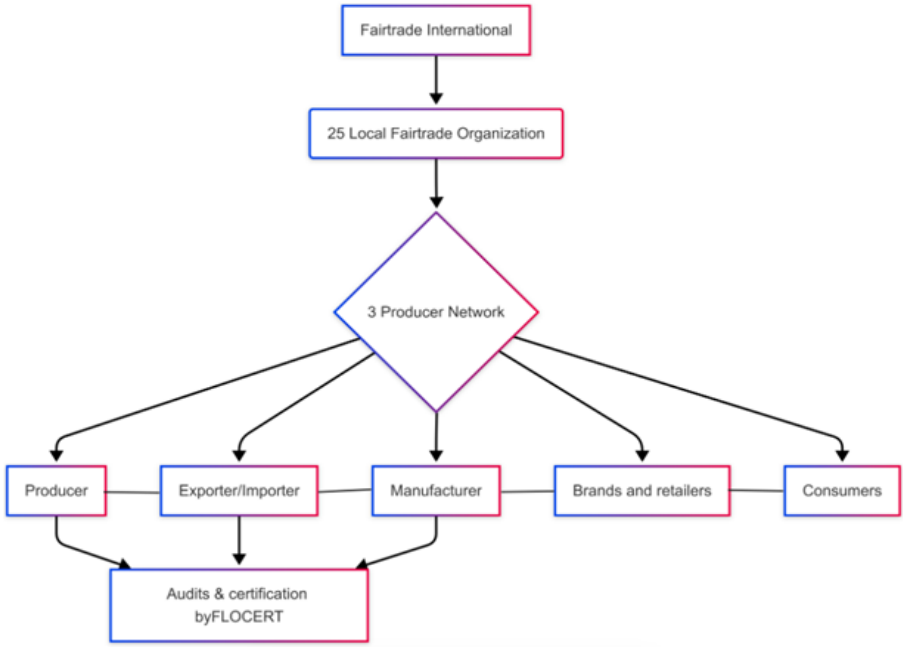

Figure 1. The structural framework of the Fairtrade system

Source: based on (Fairtrade International, 2023).

(Fairtrade International, 2023). As of 2023, the 'fair trade' movement empowered over 1900 producer organisations across 68 countries through its three regional producer networks (Fairtrade Africa, Network of Asia and Pacific Producers, and Network for Latin America and the Caribbean) (Figure 1). The movement delivers vital training to producers via its main networks on Fairtrade Standards, gender and child rights, sustainable agriculture, and teaching a variety of skills (Fairtrade International, 2023; Fiedoruk, 2021). In 2023, Fairtrade supported 2 million farmers and workers across the globe. This includes 1.4 million in Africa (71%), 340,000 in Latin America and the Caribbean (16%), and 260,000 in Asia and the Pacific (13%). As of 2022, a total of 1,910 producer organisations had been granted Fairtrade certification. This included 1,563 small-scale producer organisations, some of which were certified for contract production, and 347 larger farms known as hired labour organisations (Fairtrade International, 2023). Simultaneously, Fairtrade allows developed countries to source ethical products, expanding their product range and aligning with sustainable business models, particularly by supporting small-scale producers in developing economies (Aksoy & Ozsonmez, 2019; Simeoni et al., 2019). This demonstrates that ethical and sustainable practices can thrive alongside commercial success, proving that businesses can operate responsibly and contribute positively to sustainable development (Ribeiro-Duthie, 2019).

The Fairtrade system should support SDG 12 by fostering equitable economic development, promoting environmental sustainability, and ensuring social responsibility in global trade (Sharma, 2024). However, some studies have shown that the economic value generated is primarily realised by retailers, as in the case of fair trade cocoa value chains (Pieńkowski & Skýpalová, 2024). For instance, enterprises which are verified by the WFTO might be motivated to integrate sustainability information into their reporting cycle (in line with SDG 12), although this is not assured. With the above considerations in mind, our three research questions are as follows:

1. What are the key themes addressed in the screened papers regarding the relationship between fair trade and sustainability?
2. What are the strengths and weaknesses of the Fairtrade certification in the context of sustainable development of the agri-food system?
3. What are the opportunities and threats associated with the role of Fairtrade certification in sustainable development of the agri-food system?

2. Methodology

This paper employs a systematic literature review of Scopus-indexed academic articles, books, book chapters and conference proceedings published between 2015 and 2024. We chose Scopus since it is a comprehensive database of high-quality academic research. Our research adopted the PRISMA 2020 guidelines, a well-established framework for conducting systematic reviews and meta-analyses, which encompasses identification, screening, eligibility assessment, inclusion and data extraction. In the process for conducting and reporting systematic reviews, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses, see Page et al., 2021; Shaheen et al., 2023) framework enhances the quality and clarity of systematic review reporting with regard to transparency, completeness and accuracy of reporting (Blekking et al., 2024; Page et al., 2021; Poczta-Wajda & Sapa, 2021; Rethlefsen & Page, 2022). By adhering to the PRISMA method, we ensured a thorough and transparent approach to our literature review. This allowed us to conduct both quantitative and qualitative analysis of the selected studies.

We started our research by using Scopus to identify articles about “fair trade” and “sustainability”. This initial search helped identify keywords to refine the database search. We conducted 20 rounds of searches on Scopus, adjusting keywords and filters each time to narrow down the results. Keywords were combined into the following search string: “fair*trade” AND “sustainab*” AND “*food” to identify relevant literature published between 2015 and 2024. We searched within “Article title, Abstract, Keywords” category.

The search strategy produced 284 relevant records overall (see Figure 2). To ensure a focused and comprehensive review, we established inclusion and exclusion criteria. To improve consistency and accessibility, peer-reviewed articles, books, book chapters, and conference proceedings written in English representing specific subject areas (social sciences, business management and accounting, economics, econometrics and finance, agricultural and biological sciences, environmental sciences) and published between 2015 and 2024 were selected. We first established inclusion and exclusion criteria (date of publication, language, subject area) excluding 169 records. We then screened titles, abstracts and keywords to identify potentially relevant studies (Reason 1) excluding another 77 sources based of relevance.

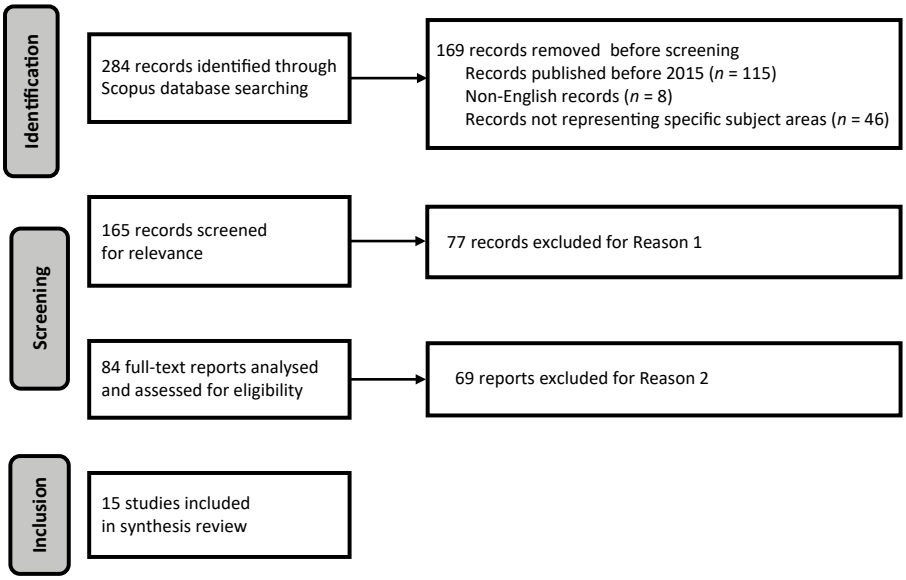

Figure 2. PRISMA flow diagram modified for authors' research

Source: based on (Page et al., 2021).

84 full-text reports were assessed with regard to the focus on 'fair trade' (Reason 2); 69 reports were then excluded. Subsequently, a full-text review was conducted on the remaining 15 studies. This stage involved extracting key information such as author, year, title, journal, findings, and conclusions. The selected studies were then subjected to an in-depth analysis using the SWOT (Strengths, Weaknesses, Opportunities, Threats) framework.

The strategy employed was slightly different to the approach suggested by the PRISMA 2020 Statement because it contained two parts: (1) bibliometric analysis and content analysis of publications related to sustainability and 'fair

trade', (2) qualitative analysis of studies focused on 'fair trade', and Fairtrade certification, in particular. This systematic approach helped us to identify the most relevant and high-quality evidence to address our research questions.

3. Research findings

This section of the paper presents quantitative and qualitative analysis of the evidence, which has been synthesised and critiqued.

3.1. Bibliometric analysis

The bibliometric analysis (n = 84 from 2015 to 2024) involved a diverse range of document types, including peer-reviewed articles (65%), book chapters (22%), and reviews (7%), among other sources. Subject areas included Social Sciences (n = 32), Business, Management, and Accounting (n = 28), and Environmental Science (n = 24). The timeframe reflected changing interest in sustainable and ethical production and consumption, with a decreased number of publications in 2023 and 2024 compared to the number of works published over the period 2018–2022 (Figure 3). Funding sources for this research included the European Commission and the British Academy of Management. Geographically, the contributions originated from institutions located in coun-

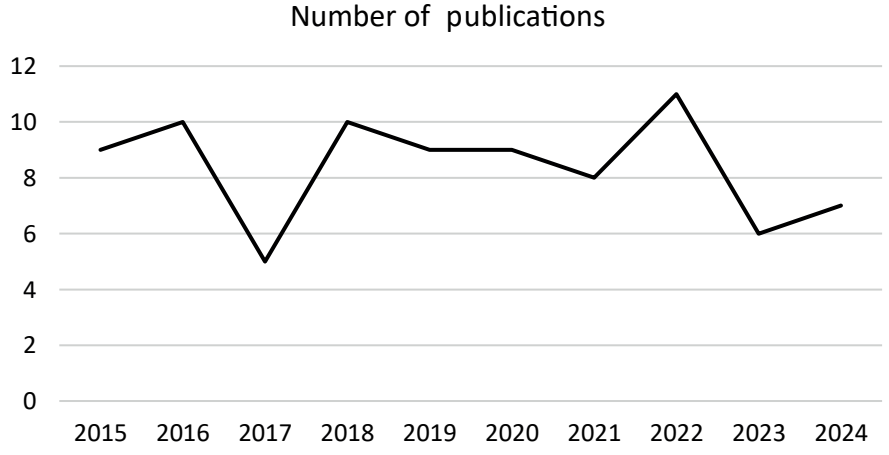

Figure 3. Publications regarding sustainability and fair trade over the period 2015–2024 (n = 84)

Source: own elaboration.

tries including Germany, Italy, the United States, and France, highlighting the international collaboration and global interest in these themes.

Key contributing journals include the British Food Journal (6 articles), where consumer studies were the primary focus, especially pricing strategies for Fairtrade products and an article regarding virtual water flows and water savings or losses deriving from fair trading of bananas, cocoa and coffee. Ecological Economics (7 articles) included work exploring consumer behaviour and articles examining sustainability performance of smallholder farms, competitiveness of Fairtrade products and relationship between soil quality and food security (Supplementary file 1). The top 10 most cited works are included in Table 3. Van Loo et al. (2015) explored the importance consumers attached to sustainability labels on coffee and investigated willingness-to-pay for such coffee. Timmermann and Félix (2015) investigated the specific capabilities and forms of social relationships that were consistently fostered and strengthened by agroecological agricultural practices. Tayleur et al. (2017) explored the potential contribution of voluntary sustainability standards to biodiversity conservation and other aspects of agricultural sustainability (see Table 2). Other highly cited works explored consumer preferences for sustainability certified food products, but also conditions and the results of the operation of small-scale entities, social and environmental benefits of 'fair trade' systems, governance mechanisms and value co-creation (Table 2).

To understand the relationships and evolving trends within this research area, we analysed how frequently keywords appeared together. This analysis, focusing on keywords used at least twice, reveals connections between terms, highlights emerging topics, and points to potential new avenues for research. The most frequently used keywords (Figure 4) are represented by larger nodes, and their closeness indicates the strength of their association. The most discussed terms were fair trade and sustainability (driven by our search terms), but also sustainable development, food, consumer behaviour, certification and sustainable agriculture. Three main clusters emerged. The first, in blue, covers *sustainable consumption* and consumer preferences for food produced in using sustainable practices (Sama et al., 2018; Sepúlveda et al., 2016; Van Loo et al., 2015), consumers' attitudes, motivation, purchase intention and willingness to pay for sustainable (including Fairtrade) products (Berki-Kiss & Menrad, 2022; Del Giudice et al., 2016; Dhaoui et al., 2020; Monier-Dilhan & Bergès, 2016). The second cluster, in green, is *sustainable performance* of coffee production (Miglietta et al., 2022; Ssebunya et al., 2019; Winter et al., 2020) and consumer preferences for cues representing *sustainable performance* (Sepúlveda, 2016; Van Loo et al., 2015), product certification (Borland & Bailey, 2019; Damasco et al., 2022; Duggan & Kochen, 2016; Mook & Overdevest, 2021; Omoto & Scott, 2016; Ssebunya et al., 2019; Winter et al., 2020), and food security (Anderson, 2015; Bacon, 2015; Cavanna, 2016; Sartori et al., 2024). Papers in the third cluster, in red, connect to *sustaina-*

Table 2. Top 10 most cited articles in Scopus

Title of the article	Authors list	Journal name	Headline themes	Number of citations
Sustainability labels on coffee: Consumer preferences, willingness-to-pay and visual attention to attributes	Van Loo et al. (2015)	*Ecological Economics*	sustainable consumption	260
Agroecology as a vehicle for contributive justice	Timmermann & Félix (2015)	*Agriculture and Human Values*	sustainable development	112
Global coverage of agricultural sustainability standards, and their role in conserving biodiversity	Tayleur et al. (2017)	*Conservation Letters*	sustainable performance	79
Small in scale but big in potential: opportunities and challenges for fisheries certification of Indonesian small-scale tuna fisheries	Duggan & Kochen (2016)	*Marine Policy*	sustainability performance	67
An integrated conceptual framework for the study of agricultural cooperatives: from repolitisation to cooperative sustainability	Ajates (2020)	*Journal of Rural Studies*	sustainable practices	67
Sustainability performance of certified and non-certified smallholder coffee farms in uganda	Ssebunya et al. (2019)	*Ecological Economics*	sustainability performance	55
Exploring local and organic food consumption in a holistic sustainability view	Scalvedi & Saba (2018)	*British Food Journal*	sustainable consumption	53
Consumers' preference for the origin and quality attributes associated with production of specialty coffees: results from a cross-cultural study	Sepúlveda et al. (2016)	*Food Research International*	sustainable consumption	51
Consumer preferences for foodstuffs produced in a socio-environmentally responsible manner: a threat to fair trade producers?	Sama et al. (2018)	*Ecological Economics*	sustainable consumption	46
Sustainability through food and conversation: the role of an entrepreneurial restaurateur in fostering engagement with sustainable development issues	Moskwa et al. (2015)	*Journal of Sustainable Tourism*	sustainable consumption	43

Source: own elaboration.

ble practices, e.g., sustainable agriculture (Ajates, 2020; Tayleur et al., 2017), organic production (Lee & Bateman, 2021; Mook & Overdevest, 2021) and sustainable development.

The application of overlay visualisation facilitated a longitudinal examination of keywords, thereby enabling the cartographic representation of the-

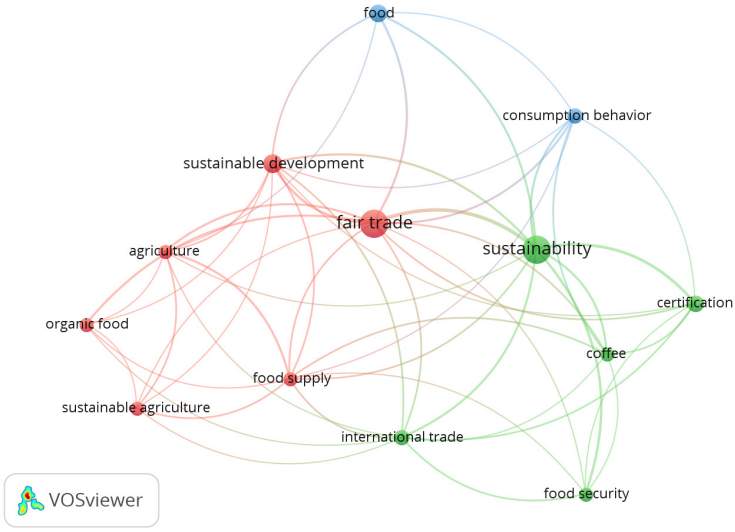

Figure 4. Keyword co-occurrence analysis

Source: own elaboration.

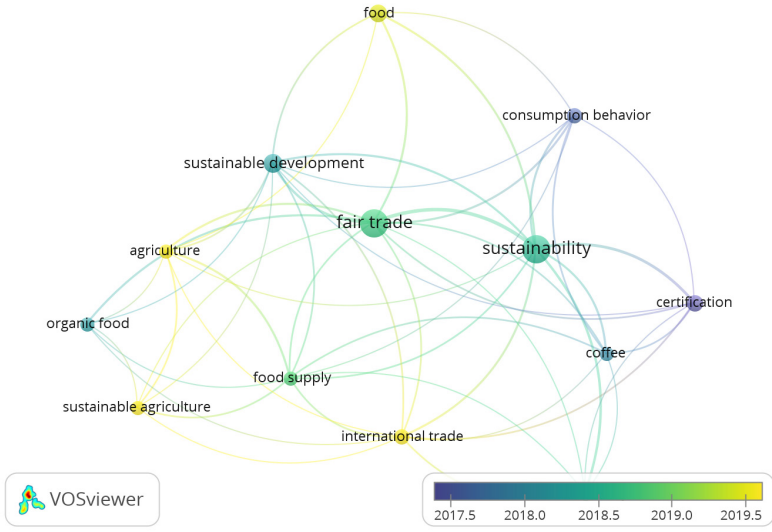

Figure 5. Keyword co-occurrence overlay visualisation

Source: own elaboration.

matic evolution within the scientific knowledge domain. This analytical approach allows for the identification of emerging trends and the forecast of new research trajectories. The topic "international trade", integrated with sustainable agriculture, fair trade, certification, coffee, food supply and food security, is interesting (Figure 5).

3.2. Content analysis

The literature derived from the systematic review was read and thematically analysed, which led to the emergence of nine major themes. These are:

1. **Sustainable consumption—consumer attitudes:** attitudes and behaviour towards sustainable agri-food products (including fairly traded products).
2. **Sustainable consumption—marketing strategies:** price strategies for fairly traded food products, the role of information and communication in food networks.
3. **Sustainable practices—social issues:** social movements and activism, social equity and women empowerment; responsibilising fair trade practices; reconceptualization of farm work.
4. **Sustainable practices—governance aspects:** public and/or private governance in alternative food networks that contribute to building sustainable agri-food systems.
5. **Sustainable practices—environmental sustainability:** sustainability certification and environmental sustainability; fair trade and land use, biodiversity, and water management; agricultural resilience; agroecology transition.
6. **Sustainable practices—new technologies and innovation:** digital technologies for sustainability; blockchain.
7. **Sustainability performance:** sustainability of certified agri-food production systems and alternative food networks; sustainable global food market.
8. **Sustainable development—adding value:** sustainable distribution of added value and value co-creation.
9. **Sustainable development—food security:** fair trade for food sovereignty and food security (see Table 2 and Appendix).

Among the key themes addressed in the screened papers, sustainable consumption is central, with studies investigating the drivers of sustainable purchasing decisions (Berki-Kiss & Menrad, 2022; Fernández-Ferrín et al., 2024) and exploring how demographic factors influence ethical consumer choices (Hrubá & Sadílek, 2021). Social issues related to fairly traded products and other sustainable food systems are examined in several works, such as social equity, gender equality and women empowerment (Doherty, 2018; Omoto & Scott, 2016; Thomas & Appasamy, 2021). The effectiveness of public and/or

private governance mechanisms in alternative food networks (Ajates, 2020; Anderson, 2015; Borland & Bailey, 2019; Constance et al., 2018; D'Amico, 2016; Mook & Overdevest, 2021; Partzsch et al., 2022; Shand, 2016; Silva et al., 2021; Sureau et al., 2019); agroecology and food sovereignty and justice in food systems (Timmermann & Félix, 2015). Emerging research areas include the application of digital innovations, such as blockchain technology, to enhance agricultural sustainability (Ordóñez et al., 2023).

The analysis reveals a strong academic focus on the intersection of fair trade, sustainability, and transitioning food systems particularly consumer behaviour and sustainability practices, reflecting the evolving priorities of consumers, businesses, and policymakers. These trends align with broader shifts towards transparency, ethical consumption, and systemic changes needed to support sustainable development of the global and local agri-food sectors (Jia et al., 2023; Kent et al., 2022).

This section has answered research question one, highlighting the key themes addressed in the sources examined regarding the relationship between fairly traded products and sustainability.

3.3. Strengths, weaknesses, opportunities of and threats associated with Fairtrade certification in the context of sustainable development: A synthesis review

3.3.1. Strengths of Fairtrade certification in the context of sustainable development

The literature analysed in this section focuses on the fifteen specific resources (Figure 2). Studies provide robust evidence of the positive impact of Fairtrade certification and consumer preferences, demonstrating its viability as a sustainable business model (Berki-Kiss & Menrad, 2022; Winter et al., 2020). Emotional and economic factors drive this preference (Fernández-Ferrín et al., 2024; van Loo et al., 2015), the latter demonstrating that consumers who dedicate more time to focusing on sustainability features tend to place a higher value on them. Fairtrade certification has the potential to empower marginalised groups and capacity for social reform (Bacon, 2015; Doherty, 2018) and environmental sustainability. Damasco et al. (2022) emphasise the environmental benefits, such as conserving Amazonian flora through agroforestry certification, which can help communities adapt to environmental challenges.

3.3.2. Weaknesses of Fairtrade certification with respect to sustainability

There are significant economic trade-offs associated with Fairtrade certification (Marconi et al., 2017). For example, the higher prices associated with Fairtrade-certified products can create challenges for both producers and consumers. Economic constraints, such as price sensitivity among consumers, can pose a significant barrier to the widespread adoption of Fairtrade products, limiting its overall impact and reach. Fairtrade certification plays a crucial role in ensuring compliance with standards, but it may have limitations (Mook & Overdevest, 2021). Over-reliance on quantifiable certification metrics can lead to an incomplete picture of the impact of Fairtrade standards if impacts are hard to quantify.

The analysed studies have some limitations. Much of the existing research on Fairtrade, such as the work of Ssebunya et al. (2019), focuses on a specific country. While these studies provide valuable insights into local contexts, they may not fully capture the diverse realities of Fairtrade certification across different countries and cultures. Nevertheless, Ssebunya et al. (2019) show that production systems of smallholder coffee farms in Uganda may have a greater impact on sustainability performance than certification alone.

3.3.3. Opportunities for Fairtrade certification in its role in sustainable development

Growing global awareness of ethical consumption presents a significant opportunity for expanding the market for Fairtrade-certified products. Consumers are increasingly concerned about the social and environmental impacts of their purchasing decisions (Van Loo et al., 2015). Likewise, Zecca and Rastorgueva (2019) underline the opportunity to integrate developing countries into global food markets through Fairtrade certification. However, potential consumers need to be better informed about ethical issues related to Fairtrade certification, and the availability of certified products must be improved.

The integration of digital technologies, particularly blockchain, holds immense potential for enhancing the transparency and traceability of Fairtrade supply chains (Lafargue et al., 2022), when ensuring that ethical and sustainable practices are upheld throughout the supply chain. This increased transparency can build trust between consumers and producers, further strengthening the market for Fairtrade goods.

Agroecology also offers a promising pathway towards sustainable and resilient food systems where agroecological practices such as agroforestry, crop

rotation and integrated pest management can enhance biodiversity, improve soil health, and increase the resilience of farming systems to climate change (Padró & Tello, 2022). Their study highlights the need for a balanced approach that considers both the benefits of trade and the importance of local self-sufficiency and ecological integrity, suggesting a need for Fairtrade practices that prioritize local and regional food systems while allowing for limited, carefully managed trade to address specific socio-economic needs.

3.3.4. Threats of Fairtrade certification in promoting sustainability

The proliferation of competing certification schemes poses a significant threat to the brand value of Fairtrade certification (Mook & Overdevest, 2021). A crowded market with numerous labels can confuse consumers and dilute the unique selling proposition of Fairtrade. This oversaturation can weaken the impact of individual certifications and make it harder for consumers to identify truly ethical and sustainable products.

Disparities can arise between certified and non-certified producers within Fairtrade communities, with uneven distribution of benefits leading to resentment and social tensions, undermining the very principles of fairness and equity that Fairtrade aims to uphold (Ssebunya et al., 2019). Addressing these inequalities is crucial for ensuring the long-term sustainability and social impact of Fairtrade certification initiatives. External shocks like pandemics, geopolitical conflict or climate change events can significantly disrupt Fairtrade-certified supply chains, as can ecological vulnerabilities (Damasco et al., 2022), because deforestation, habitat destruction, or changing climate conditions can alter the ecosystem, posing significant challenges to the resilience and sustainability of Fairtrade certification initiatives, if proactive adaptation and risk mitigation strategies are not embedded within the processes.

Conclusions

There is growing interest in exploring consumer purchase decisions regarding Fairtrade-certified products, as this underpins the long-term success of Fairtrade certification and systemic change in the agri-food sector (Kent et al., 2022; Shamma & Hassan, 2013). Willingness to pay (WTP) is driven by both societal and self-interest values (Quach et al., 2025; Yamoah et al., 2016). Both altruistic and egoistic values shape consumer self-identity, which positively influences WTP for Fairtrade products (Quach et al., 2025) and the way com-

panies operate (Kowalska et al., 2021; Spielmann, 2021). Providing consumers with extensive information on the production and distribution of Fairtrade food constitutes a precondition for the success of the system (Ssebunya et al., 2019), but multiple initiatives can cause confusion for consumers. The certification programmes such as Fairtrade need to be underpinned by effective mechanisms for assuring sustainable performance and sustainable development. However, there are both weaknesses within and threats to the dissemination of Fairtrade practices. While the review highlights significant achievements such as promoting ethical practices and improving the livelihoods of producers, it also brings to light the challenges that remain associated with the 'fair trade' movement. Issues like pricing and the uneven distribution of benefits within producer communities pose barriers to the building of a fair and sustainable global trading system. Yet the potential benefits are clear, including improving the quality of soil, biodiversity, and water management. Reinforcing both public and private governance mechanisms for fairly traded products could affect both supply and demand positively.

The focus of the literature explored is mainly consumer studies, in particular, raising awareness about Fairtrade certification and promoting it among potential buyers. However, this emphasis on consumer behaviour also reveals a gap in the research, namely, a lack of in-depth exploration of how 'fair trade' principles can be more effectively integrated into global food supply chains to create long-term, systemic change and how to create greater transparency in demonstrating sustainable performance. Four specific themes have emerged in this work when considering sustainable development and fair trade: sustainable development itself, sustainable practices, sustainable performance, and sustainable consumption. The interplay between these themes is important, worthy of more study, and product- and context-specific.

Looking ahead, future research could focus on innovative strategies for integrating 'fair trade' principles into global food supply chains. This includes exploring frameworks that balance ethical practices with market realities, ensuring that the benefits of certification are delivered to all stakeholders. Such efforts will be essential for building a more equitable and sustainable global trading system, ultimately contributing to both academic understanding and practical progress in this field. Other directions for future research which have arisen from the literature review include: (1) exploring the possible ways to develop frameworks that integrate ethical sourcing practices with commercial viability, thus enabling the adoption of 'fair trade' practices to scale up without compromising core values; (2) an empirical investigation into the long-term impacts of Fairtrade certification on producers, especially in underrepresented regions; (3) assessment of consumer values, attitudes and behaviour regarding Fairtrade certification initiatives; and (4) policy evaluation, focusing on how institutional support can enhance Fairtrade certification adoption and effectiveness.

Appendix

Distribution of papers by place of publication and major themes (*n* = 84)

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
Peer reviewed journals										
Ecological Economics	7	5				1		1		
British Food Journal	6	4				1			1	
Frontiers in Sustainable Food Systems	4	1			2			1		
Agriculture and Human Values	4	1	2	1						
Marine Policy	4		1	1	1		1			
Agribusiness	2	1							1	
Journal of Rural Studies	2		1	1						
Third World Quarterly	2		1							1
Annual Review of Food Science and Technology	1	1								
Anthropology in Action	1			1						
Asia Pacific Viewpoint	1		1							

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
Beverages	1						1			
Business Strategy and the Environment	1			1						
Cleaner and Circular Bioeconomy	1	1								
Conservation Letters	1					1				
Contemporary Issues in Entrepreneurship Research	1				1					
Data in Brief	1			1						
Discourse, Context and Media	1		1							
European Planning Studies	1							1		
Food Research International	1	1								
Food Science and Technology	1					1				
Agricultural and Resource Economics Review	1	1								
International Journal of Logistics Management	1			1						
International Journal of Sustainability in Higher Education	1	1								
International Journal of Wine Business Research	1	1								

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
International Review on Public and Nonprofit Marketing	1	1								
Journal of Agriculture, Food Systems, and Community Development	1				1					
Journal of Environmental Studies and Sciences	1			1						
Journal of Food Products Marketing	1	1								
Journal of International Food and Agribusiness Marketing	1	1								
Journal of Marketing Management	1							1		
Agroforestry Systems	1					1				
Journal of Sustainable Tourism	1						1			
Land	1					1				
Plants	1					1				
Resources	1			1						
Revista Brasileira de Zootecnia	1				1					
Revista de Gestão Social e Ambiental	1					1				

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
Rivista Internazionale di Scienze Sociali	1		1							
Supply Chain Management	1				1					
Tourism Planning and Development	1						1			
Books										
Asia's social entrepreneurs: Do well, do good... Do sustainably	1		1							
Innovation management and corporate social responsibility	1						1			
Contested sustainability discourses in the agri-food system	1			1						
Demand, complexity, and long-run economic evolution. Economic complexity and evolution	1	1								
East Asian ethical life and socio-economic transformation in the twenty-first century: The ethical sources of the entrepreneurial renewal of companies and communities	1		1							
Entrepreneurship and the sustainable development goals	1		1							

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
Environmental impacts of transnational corporations in the global south (Research in Political Economy, vol. 33)	1			1						
Generation Z marketing and management in tourism and hospitality: The future of the industry	1	1								
International encyclopedia of human geography (2nd ed.)	1		1							
International encyclopedia of the social & behavioral sciences (2nd ed.)	1		1							
Social innovation in Latin America: Maintaining and restoring social and natural capital	1		1							
Sustainable development and communication in global food networks: Lessons from India	1								1	
The governance of sustainable rural renewal: A comparative global perspective	1			1						
The Oxford handbook of political consumerism	1	1								
The sustainable marketing concept in European SMEs: Insights from the food and drink industry	1								1	

Source title	Number of publications	Sustainable consumption	Social issues	Governance aspects	Sustainability performance	Environmental sustainability	Adding value	New technologies and innovation	Marketing strategies	Food security
		Number of works in each theme								
The world guide to sustainable enterprise, vol. 4: The Americas	1				1					
Conference proceedings										
Developments in Marketing Science: Proceedings of the Academy of Marketing Science	3	2					1			
Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020	1				1					
Total	84	26	14	12	9	8	6	4	4	1

Source: own elaboration.

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Corporate governance, financial markets, and economic growth: Does corporate governance moderate the finance-growth nexus?

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Abstract

This paper examines whether corporate governance plays a moderating role in the impact of financial development on economic growth. The dataset consists of 39 advanced and developing countries for the 2006–2020 period. The empirical results show that the credit-to-GDP ratio is negatively associated with economic growth, and this finding is consistent with the literature, showing the relevance of "too much finance". The main findings indicate that the negative growth impact of credits is attenuated by corporate governance as measured by minority investor protection and disclosure extent. This moderating effect is economically significant and holds for different country groups and horizons. Hence, the paper argues that corporate governance measures the quality of financial markets, while the credit ratio measures its quantitative dimension. Therefore, it shows that both quality and quantity dimensions need to be taken into account to understand the finance-growth nexus properly.

Keywords

- corporate governance
- financial markets
- economic growth
- credits
- finance-growth nexus

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Introduction

The relationship between finance and economic growth is examined extensively in the literature, with mixed evidence on the impact of financial markets on economic growth (Arcand et al., 2015; Jayaratne & Strahan, 1989; Law & Singh, 2014; Levine, 2005; Mian et al., 2017; Rousseau & Wachtel, 2011). Given the evolution of the literature on this finance-growth nexus, or more narrowly, the credit-growth nexus, it can be argued that the relationship between financial markets and economic growth can be conditional on relevant developments and factors. For example, the strong growth in credit markets over a short period can be difficult for an economy to absorb, thereby leading to a higher likelihood of asset price booms and credit market crunches (Jordà et al., 2013). Similarly, strong capital inflows to open economies can result in the over-appreciation of the domestic currency and a worsening of the current account balance, along with the risks of an economic crisis in subsequent periods (Calderon & Kubota, 2012). Hence, it is important to control for the underlying dynamics and possible moderating factors in the finance-growth nexus.

The growth-finance literature mostly focuses on the quantitative dimensions of financial development, such as banking sector assets, credits to the private sector, and stock market capitalisation. However, this perspective neglects the qualitative dimensions of financial development, such as efficiency, investor protection, disclosure standards, and corporate governance. These qualitative factors can prove significant in terms of limiting information problems and decreasing risk premia associated with external financing (Akhtar, 2022). Regarding the possible effects of qualitative factors, Rajan and Zingales (1998, p. 562) state the following: "Financial development, in the form of better accounting and disclosure rules, and better corporate governance through institutions, will reduce the wedge between the cost of internal and external funds and enhance growth". Hence, the authors emphasize the role of corporate governance and disclosure standards in strengthening the positive growth effects of financial development. More recent literature looks at the quality dimension of financial development, whereas studies on the moderating role of corporate governance are relatively scarce. For example, Demetriades and Rewilak (2020) adjust the quality of financial development by incorporating information on non-performing loans, liquidity conditions, and z-scores. Then, the quality-adjusted financial development is shown to support economic growth, in contrast to the negative effects of the quantitative measure of banking credits.

De Nicolo et al. (2008) look at corporate governance quality in terms of accounting standards, earnings smoothing, and stock price synchronicity, and document the positive growth effects of this indicator for 41 advanced and developing countries over the 1994–2003 period. It is also documented that

this positive growth effect becomes stronger with higher financial development levels. Similarly, Fulghieri and Suominen (2012) note that better corporate governance standards can support growth, especially in sectors with more dependence on external finance. The authors consider the protection of investor rights to be an important indicator of corporate governance quality. Claessens and Yurtoglu (2012) provide a review of the relationship between corporate governance and economic development and argue that corporate governance can improve access to finance and decrease the likelihood of financial crises, thereby supporting economic development. Overall, these papers discuss the relationships between growth, financial development, and corporate governance, but they do not sufficiently examine the possible moderating role of corporate governance on the finance-growth nexus.

The present study contributes to the relevant literature by conducting a detailed examination of this moderating role for a large sample of advanced and developing countries in the 2006–2020 period. Specifically, it shows that the "too-much finance" hypothesis holds for the collected sample. However, a higher quality of corporate governance standards (as measured by the protection of minority rights and disclosure quality) alleviates this negative effect to some extent. Hence, the paper documents that the quality of financial development in terms of corporate governance standards matters for the finance-growth nexus.

The rest of the paper proceeds as follows: Section 1 provides an overview of prior studies on the topic. Then, Section 2 introduces the dataset, while Section 3 introduces the empirical methodology. Section 4 presents the empirical results, and Section 5 offers various robustness analyses. The last Section concludes the paper.

1. Literature review and hypotheses development

The quantitative dimension of the finance-growth nexus is widely examined in the literature both in terms of theoretical mechanisms and empirical evidence (Greenwood & Scharfstein, 2013; Levine, 2005). In contrast, the qualitative dimension or moderating factors are examined less extensively (Demetriades & Rewilak, 2020). This section provides an overview of prior studies and identifies research gaps that the current paper aims to contribute to. It also discusses possible mechanisms and offers a conceptual framework for the research hypothesis concerning the moderating role of corporate governance in the finance-growth nexus.

The research topic builds on the existing literature on the nexus between financial development (specifically banking credits) and economic growth. This

relationship, which is also called the finance-growth nexus, is widely examined in the literature (Breitenlechner et al., 2015; Jayaratne & Strahan, 1996; Yilmazkuday, 2011). The majority of these studies focus on the quantitative measures of financial development (generally measured by the size of banking credits or stock markets), whereas the quality of finance is not sufficiently explored in the literature (Demetriades & Rewilak, 2020). In the finance-growth literature, early studies generally find positive growth effects of financial development, including banking credits and stock market capitalisation (Levine, 2005; Levine & Zervos, 1998). However, more recent studies, conducted after the global financial crisis, started to document weak or negative effects of credits on economic growth (Arcand et al., 2015; Law & Singh, 2014). These studies generally find a threshold value of banking credits to GDP. The growth effects are negative until this value and turn negative after this threshold. This relationship is called the "too-much finance" hypothesis. In a related study, Claessens and Yurtoglu (2012) estimate that the average growth rates of countries decline after a 100% bank credit-to-GDP ratio. The relevant literature presents various mechanisms for these negative effects of credit growth. For example, strong credit growth can benefit less productive sectors due to collateral difficulties in more innovative sectors (Cecchetti & Kharroubi, 2019) or can increase demand beyond supply, thereby creating asset price bubbles or external imbalances (Mian et al., 2017). In a detailed sector-level empirical study of developing countries in Asia and Latin America, Aizenman et al. (2015, p.16) document the presence of a financial "Dutch disease", i.e. "booming financial service flows reduce the supply of long-term funding to manufacturing and other sectors that rely on stable external finance". This paper argues that controlling the quality of financial development is crucial to identifying the specific effects of different financing dimensions. These authors mention various factors (such as spreads, the ease of access to credit, and creditor rights) that can measure the quality of financial development.

The literature examining the finance-growth nexus and testing the "too--much finance" hypothesis is actively expanding. In a recent study, Demetriades and Rewilak (2020) show that the standard empirical models using banking credits obtain a negative coefficient for their growth effects. However, when the authors control the quality of banking credits using *z*-scores, liquidity conditions, and non-performing loans, they recover the positive growth effects of credits. In contrast to this positive effect, Haini et al. (2023) and Boďa (2024) utilise more comprehensive datasets and show that finance can be a growth-decreasing event after controlling for quality and institutional factors. Iwasaki and Kočenda (2024) conducted a detailed meta-analysis of more than one hundred papers and found a positive but declining effect of financial development on economic growth. Hence, it can be argued that the existing evidence of the "too-much finance" hypothesis is still mixed, and that there is a need for further studies to examine different dimensions of the fi-

nance-growth nexus in more detail. Our paper contributes to this extant literature by investigating the possible moderating roles of corporate governance in the finance-growth relationship.

Regarding how the quality of finance affects economic growth, Jayaratne and Strahan (1996) examine the impact of financial development by focusing on the effect of bank branch deregulation in the US. It is found that it is the quality of finance in terms of banking efficiency, not necessarily the level of bank credits, that affects per capita income growth. Specifically, deregulation leads to the exit of less-efficient banks and facilitates economies of scale in information and operations. In this way, the quality of banking improves, along with positive effects on economic growth. In another study, Rajan and Zingales (1998) show that the positive impacts of financial development are more relevant for the sectors dependent on external finance. Hence, these studies document how the impact of financial development can be mediated by different factors, and it might be necessary to control for these factors in order to develop a more reliable and comprehensive understanding of the finance-growth nexus.

The role of corporate governance in the aggregate financial markets and the global financial crisis is also examined extensively in the literature (Conyon et al., 2011). Failures and weaknesses in corporate governance, such as excessive risk-taking by financial institutions, limited safeguards on the boards against risky strategies, ill-incentivised remuneration systems, and disclosure problems, all played crucial roles in the credit boom-bust cycles around the global financial crisis (Kirkpatrick, 2009; Wiggins et al., 2019). Given these important effects of corporate governance on financial institutions and markets, it can be argued that the quality of corporate governance would also matter for the impact of financial markets on economic growth. Higher-quality corporate governance standards and practices in an economy would increase the efficiency of financial markets and decrease the risks of financial volatilities and crises. In return, corporate governance would strengthen the positive growth effects of financial markets.

De Nicolo et al. (2008) examine the real effects of corporate governance quality for a large sample of 41 advanced and developing countries over the 1994–2003 period. Given the lack of comparable cross-country indicators of corporate governance, these authors develop a new measure based on accounting standards, earnings-smoothing practices, and stock price synchronicity. They note that countries with better corporate governance quality would follow international accounting standards in terms of disclosing crucial information in standard ways, would have lower incidences of earnings management, and would experience lower levels of stock market synchronicity. Thus, De Nicolo et al. (2008) combine these three indicators to obtain a quality measure and use it in empirical analyses. Their results indicate that corporate governance quality has a positive impact on growth and productivity, while most

of this effect comes from the synchronicity dimension. The authors also show that the quality indicator positively interacts with the financial development measures (estimated as the sum of banking credits and stock market capitalisation as a ratio to GDP). Fulghieri and Suominen (2012) study a theoretical model and show that better corporate governance can increase competition and decrease inside ownership. In addition, it can lead to lower risks of excessive leverage. The model also implies that financial development driven by equity market liberalisation can interact positively with corporate governance to support growth and productivity. Hence, these two papers provide empirical evidence and theoretical models for the positive interaction between financial development and corporate governance. However, these papers fail to go into the details of this interaction using comprehensive empirical analyses.

Claessens and Yurtoglu (2012) provide a very detailed review of the possible relationships between corporate governance, finance, and economic growth. The authors document a non-linear relationship between banking credits and economic growth. Specifically, the average growth rates increase for the ratio of private credits to GDP up to 100%, whereas they start to decline after this threshold. This non-linear finding is consistent with the "too--much finance" hypothesis examined in the literature (Arcand et al., 2015; Law & Singh, 2014). Then, the literature also examines the legal foundations of financial markets and investigates the role of corporate governance in this context. In seminal papers, La Porta et al. (1997, 1998) show that legal development and contract enforcement are crucial for financial and economic development. Similarly, Djankov et al. (2008) document the relevance of the protection of minority rights in financial development. Based on these studies and the relevant literature, Claessens and Yurtoglu (2012) argue that there can be different mechanisms through which corporate governance interacts with finance and growth. In particular, good corporate governance can increase access to credit and lower the cost of external finance. In this way, it allows for better allocation of resources, thereby supporting growth. In addition, good governance can decrease the risks of inefficient credit cycles and financial crises. Hence, these papers document how good corporate governance can bolster the positive effects of finance on economic growth.

From a theoretical perspective, good corporate governance can alleviate information problems between borrowers and lenders, thereby improving the efficiency of financial development (including risk-sharing capacity) and supporting economic growth (Castro et al., 2004). It particularly reduces the extent and intensity of agency problems and decreases the costs of both equity and debt financing. In addition, it reduces the transaction costs in screening and monitoring borrowers. Given the improvements in information asymmetries and agency problems, good corporate governance can also limit excessive risk-taking and ensure that borrowers follow more sound financial risk management practices. In return, these factors lead to a more efficient

allocation of financial resources in the economy, thereby fostering financial stability and avoiding inefficient financial cycles (Claessens & Yurtoglu, 2012).

The above theoretical and empirical discussions provide a useful conceptual framework to understand the possible moderating roles of corporate governance in the finance-growth nexus. It can be argued that the finance-growth link can be weak in economies with poor corporate governance. In these economies, there can be a misallocation of credit and excessive risk-taking, which can create financial volatility and crises. In addition, limited protection of minority rights can restrict financial development and limit its growth effects. In contrast, economies with good corporate governance display a better allocation of credit and prudent risk-taking. Hence, corporate governance can support economic growth. Therefore, it can be argued that corporate governance can moderate the finance-growth relationship in significant ways. The review of the relevant literature reveals how the leading mechanisms in this moderation are the lower levels of information asymmetries and monitoring/transaction costs, prudent risk management, and financial stability.

Overall, the above discussions show that the moderating role of corporate governance in the finance-growth nexus has not received sufficient attention in the literature, and the present paper aims to investigate the relevant channel empirically using a large dataset of advanced and developing countries. Based on the above examination of the relevant literature, the paper postulates the following research hypothesis:

Hypothesis: The quality of corporate governance positively moderates the effects of bank credits on economic growth.

2. Data

The data are collected from two datasets from the World Bank (2022). The first source is the Doing Business dataset, which provides information on various business-enabling factors in different countries. The dataset also includes corporate governance indicators such as the protection of minority investors and the extent of disclosure. These indicators are available annually, starting from the mid–2000s. Two particular corporate governance variables are selected for the empirical analysis. The first is a broad indicator called “protecting minority investors” (PMI), which is a composite measure. It includes information on the ease of shareholder suits, conflict of interest regulation, corporate transparency, the extent of director liability, the scope of ownership and control, and the extent of shareholder governance. The Doing Business database scores countries relative to the best regulatory prac-

tice in these dimensions. The protection of investor rights is considered to be an important quality dimension of financial institutions and development in the literature (Aizenman et al., 2015; Djankov et al., 2008). These studies note that investor rights are crucial for addressing information asymmetries and agency problems. Hence, they can affect both access to financing and the costs of external funds, thereby becoming an important quality measure of financial development.

The second corporate governance measure is a more specific indicator called the "Extent of disclosure", which provides information on the approval and disclosure requirements of related-party transactions. Disclosure and report readability are also expected to alleviate information asymmetry and incomplete information issues in financial markets, thereby improving economic efficiency (Jiao, 2011; Leuz & Wysocki, 2016). Key studies, such as Djankov et al. (2008), also develop their measures of disclosure and show their importance in explaining financial market depth and access. The seminal paper by Rajan and Zingales (1998) also considers better disclosure standards to be one of the defining features of financial institution quality. Hence, these two corporate governance indicators (i.e. the protection of investor rights and disclosure standards) are expected to provide information about the quality of financial markets in different countries. Therefore, these two variables are utilized as the moderating factor for the relationship between credits and economic growth. Then, these dependent and independent variables, along with some control variables, are collected from the World Development Indicators database of the World Bank (2022). The sample is restricted to the period from 2006 to 2020, as the World Bank produces these variables only for this sample period. The dataset is not updated after 2020.

The qualitative dimension of financial development is more difficult to capture than the quantitative dimension. The size of different financial markets, such as the banking sector and stock markets, can be used as widely available and comparable indicators of financial development on the quantity dimension. However, developing comparable indicators concerning the quality of corporate governance across countries, such as disclosures and investor rights, can be more challenging due to different legal systems, distinct institutions, and differences between de jure standards and de facto implementations. Rogge and Archer (2021) criticize the World Bank's Ease of Doing Business (EDB) index for its equal weighting approach across different countries and for not sufficiently considering the heterogeneities across economies. The World Bank (2022) also acknowledged various issues in its collection and generation of this dataset and published a corrected version covering the 2006–2020 period. We use the final corrected dataset in our analysis. The literature also develops its own indicators, such as the corporate governance quality indicator of De Nicolo et al. (2008) and the investor protection indicator of Djankov et al. (2008), although these indicators are not updated regularly to provide

panel information on more recent years. It is therefore important to consider these limitations in appropriately measuring the quality of corporate governance when interpreting the empirical results.

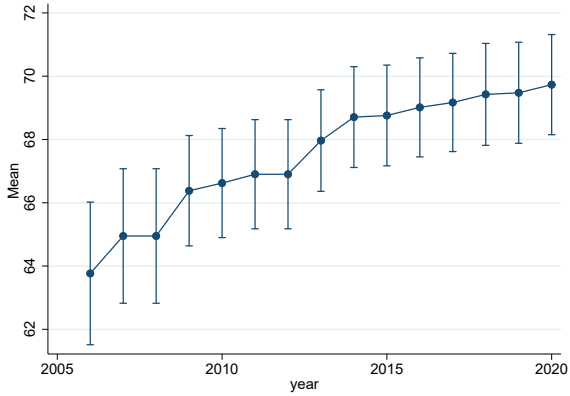

Figure 1. Protecting minority investor scores

Note: Bars show one standard deviation band around the mean values.

Source: World Bank (2022) and own elaboration.

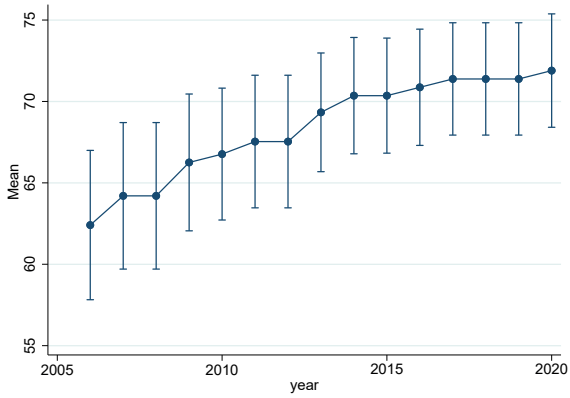

Figure 2. Extent of disclosure scores

Note: Bars show one standard deviation band around the mean values.

Source: World Bank (2022) and own elaboration.

The main independent variables "protecting minority investors (PMI)" and "extent of closure" are presented in Figure 1 and Figure 2, respectively. The graphs show the mean values and standard deviation bands over the sample period. It is visible that both indicators displayed upward trends between 2006 and 2020. The mean value of PMI increased from 64 in 2006 to close to 70 in 2020, while the mean value of EoD increased from around 63 in 2006 to 72 in 2020. In addition, the standard deviation bands around the mean values

also show that there are important cross-country variations in the relevant corporate governance scores.

The dependent variable is the GDP growth rate, while the independent variable is the bank credits to the non-financial private sector as a ratio to GDP. The selection of these variables is in line with relevant studies in the literature, such as Arcand et al. (2015) and Mian et al. (2017). The control variables are investments, savings, trade (the sum of export and import flows), and foreign direct investments (FDI), with all variables measured as ratios to GDP. Finally, based on the data availability issues from these two datasets, the sample of 39 advanced and developing countries is as follows: Albania, Australia, Austria, Belgium, Brazil, Bulgaria, Canada, Chile, Croatia, the Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, New Zealand, Norway, Poland, Portugal, Romania, Russia, Singapore, Slovakia, Slovenia, South Africa, Spain, Sweden, Thailand, Türkiye, the United Kingdom, and the United States. Table 1 presents the summary statistics of the dataset.

Table 1. Summary statistics (39 countries, 2006–2020 period)

Variable	Observations	Mean	Standard deviation	Min	Max
ΔGDP (%)	520	2.217	3.115	–10.149	25.176
Δ3GDP (%)	444	4.933	6.647	–23.683	33.166
Credit/GDP (%)	520	96.719	44.725	19.196	206.671
Δ3(Credit/GDP (%))	403	–0.24	13.376	–58.491	38.235
PMI	520	67.125	10.031	36.023	88
Extent of disclosure	520	67.646	24	10	100
Investments/GDP (%)	520	23.231	4.253	11.902	46.018
Savings/GDP (%)	520	23.834	7.152	4.66	50.592
Trade (Exports + Imports)/GDP (%)	520	96.973	62.057	22.106	437.327
FDI/GDP (%)	520	4.967	10.091	–40.33	86.589

Source: (World Bank, 2022).

The two corporate governance indicators of PMI and the extent of the disclosure are constructed as scores ranging from 0 to 100, with higher values showing better standards and practices. Table 1 shows that the PMI ranged between 36 and 88, with an average of 67 and a standard deviation of 10. For the disclosure variable, the mean is 68, with a standard deviation of 24. The variable had a larger range, with a minimum value of 10 and a maximum value of 100. Overall, these variables display variations that would be useful for documenting the role of corporate governance in the credit-growth nexus.

Figure 3 presents a histogram of PMI, while Figure 4 presents its scatter plot with the credit variable for the full sample. Figure 2 shows that the majority of observations for PMI are distributed between 50 and 80, while the distribution is heavily tailed on both sides. Then, it is seen from Figure 4 that corporate governance and financial development are closely related, as higher PMI levels are associated with higher credit ratios. As shown in Figures 3 and 4, the PMI observations below the value of 50 are relatively scarce. If this low segment of the variable is omitted, the positive association between PMI and credits becomes stronger.

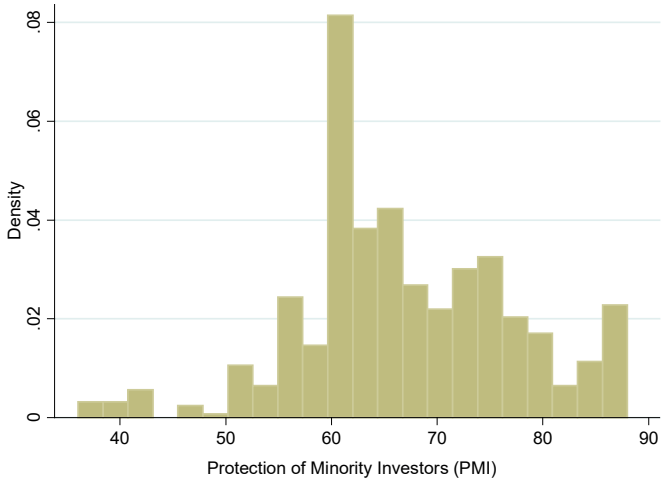

Figure 3. Histogram of PMI

Source: World Bank (2022) and own elaboration.

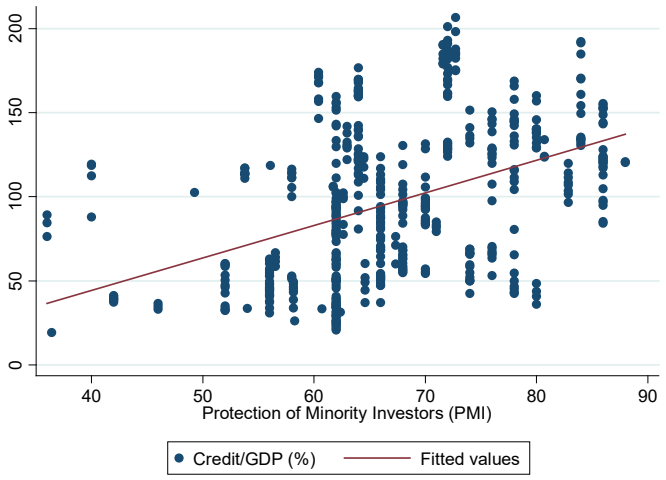

Figure 4. PMI and bank credits scatterplot

Source: World Bank (2022) and own elaboration.

3. Methodology

The longitudinal data nature of the dataset is utilised in the empirical analysis. The benchmark specification is as follows:

$$GDP\ Growth_{it} = \alpha_i + \beta_1 Credit/GDP_{it} + \beta_2\ Corporate\ Governance_{it} + \\ + \beta_3\ Credit/GDP_{it} \cdot Corporate\ Governance_{it} + \gamma\ Control\ Variables_{it} + \\ + \lambda_i + \mu_t + u_{it} \quad (1)$$

The dependent variable is the annual real GDP growth rate, while the main independent variable is the credit-to-GDP ratio. In order to measure the moderating role of corporate governance, an interaction term between the credit variable and the corporate governance indicators is also added. In line with Brambor et al. (2006), the regression model also includes the corporate governance indicator as a control variable. Studies such as Law and Singh (2014) and Mian et al. (2017) find the impact of credit to be negative, i.e. $\beta_1 < 0$. Then, the present paper argues that this negative effect would be attenuated by the quality of corporate governance. Thus, it is hypothesised that $\beta_3 > 0$. Equation (1) is estimated using the fixed-effects panel estimation in order to control for the invariant country characteristics in the sample. The equation includes country-fixed effects λ_i to control for time-invariant factors at the country level. The regression model also includes time-fixed effects μ_t in some specifications to control for global factors (such as the global financial crisis) that can affect all countries over time. Finally, u_{it} refers to the error term at the country-year level in the regression model. While this equation is expected to produce initial insights into the moderating role of corporate governance, the contemporaneous nature of the equation restricts the analysis. Given that the credit-growth nexus can be more dynamic and as a strategy to address endogeneity issues, to some extent, the present paper also follows the empirical specification of Mian et al. (2017):

$$\Delta_3 Y_{it+k} = \alpha_i + \beta_1 \Delta_3 (Credit/GDP_{it-1}) + \beta_2\ Corporate\ Governance_{it} + \\ + \beta_3 \Delta_3 (Credit/GDP_{it}) \cdot Corporate\ Governance_{it} + \gamma\ Control\ Variables_{it} + \\ + \lambda_i + \mu_t + u_{it+k} \quad (2)$$

Equation (2) presents a dynamic relationship between credits and economic growth. The dependent variable $\Delta_3 Y_{it+k}$ is the three-year logarithmic change in the real GDP level in period $t + k$, where k ranges from –1 to 5. Varying parameter k allows both short-run and medium-run relationships to be studied, as in Mian et al. (2017). The independent variables $\Delta_3 Credit/GDP_{it}$ and $\Delta_3 Credit/GDP_{it} \cdot PMI_{it}$ are the three-year changes in the private credit to GDP ratio in period t and its interaction with the corporate governance indicators, respectively. Consistent with Mian et al. (2017), this equation esti-

mates the short-run and medium-run relationship between credits and economic growth. When $k = 3$, the equation shows the impact of the credit ratio change in the last three years on the output change in the next three years. Hence, this equation looks at the credit-growth nexus over the short-term and medium-term business cycles. Both equations are also estimated using random-effects methods, and the results are compared using the Hausman test, which favours fixed-effect estimations.

4. Results

The fixed-effects regression results for equation (1) and the corporate governance indicator of PMI are presented in Table 2. The first column includes credit as the only independent variable of interest, while the second column adds PMI and its interaction with credits to see how the corporate governance variable affects the benchmark credit-growth regression. It is seen that the four control variables: investments, savings, trade, and FDI are positively associated with economic growth. The impact of credit on GDP growth is estimated to be negative. This finding is consistent with the literature on too much finance (Law and Singh, 2014; Arcand et al., 2015) or the negative effects of credits (Mian et al., 2017).

The main result is presented in column 2 of Table 2, which includes both credit variables for the full sample. It is seen that the control variables retain their positive and statistically significant effects on growth. In addition, the credit variable has a negative and statistically significant coefficient. This column shows that the interaction term between credits and the corporate governance indicator of PMI is positive and statistically significant at the 1% level. Hence, it implies that the negative effect of credits is attenuated, to some extent, by corporate governance. The last two columns show that the moderating effects hold for both advanced and developing countries. The comparison of these columns indicates that the negative growth impact of credits is stronger in developing countries. The attenuating impact of corporate governance is also enhanced in these countries.

The results presented in Table 2 can be interpreted as supporting the claim that corporate governance improves the efficiency and benefits of financial markets or limits their risks and volatilities. As another interpretation, it can be argued that the credit-to-GDP ratio measures the quantitative dimension or the size of financial development, while corporate governance provides information on the qualitative dimension or the quality of financial development. It therefore appears to be necessary to capture both dimensions in the empirical analysis.

Table 2. Fixed-effects regression results on the modifying effect of PMI

Dependent variable	Full sample	Full sample	Advanced countries	Developing countries
Investment	0.239***	0.274***	0.158***	0.470***
	(0.0392)	(0.0399)	(0.0527)	(0.0744)
Savings	0.243***	0.211***	0.365***	0.0287
	(0.0530)	(0.0523)	(0.0721)	(0.0900)
Trade	0.0238**	0.0368***	0.0343***	0.0689***
	(0.0111)	(0.0115)	(0.0129)	(0.0246)
FDI	0.0641***	0.0675***	0.0930***	–0.00925
	(0.0133)	(0.0131)	(0.0156)	(0.0236)
Credit	–0.0415***	–0.216***	–0.167***	–0.362***
	(0.00939)	(0.0430)	(0.0528)	(0.0822)
PMI		–0.140**	–0.130	–0.186*
		(0.0631)	(0.0851)	(0.0996)
Credit*PMI		0.00247***	0.00196***	0.00402***
		(0.000600)	(0.000735)	(0.00111)
Constant	–7.745***	0.798	–2.387	3.174
	(2.171)	(4.510)	(6.128)	(6.691)
Observations	520	520	345	175
R-squared	0.315	0.347	0.425	0.317
Number of id	39	39	26	13

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

In order to verify the credit-growth nexus and the moderating role of corporate governance, Figure 5 estimates the predictive margins of credit on economic growth for three PMI values. The mean values of the independent variables are used to predict the output growth level within the range of credit ratios between 20% and 206%. Since the growth impact of credit depends on the level of corporate governance, this analysis is repeated for three different values of PMI, for the mean and for the mean ± two standard deviations.

It can be seen from Figure 5 that for PMI values at and below the mean, there is a negative association between credits and economic growth, whereas this negative association disappears in the case of higher PMI values (i.e. mean + two standard deviations). In the case of the mean PMI value, when

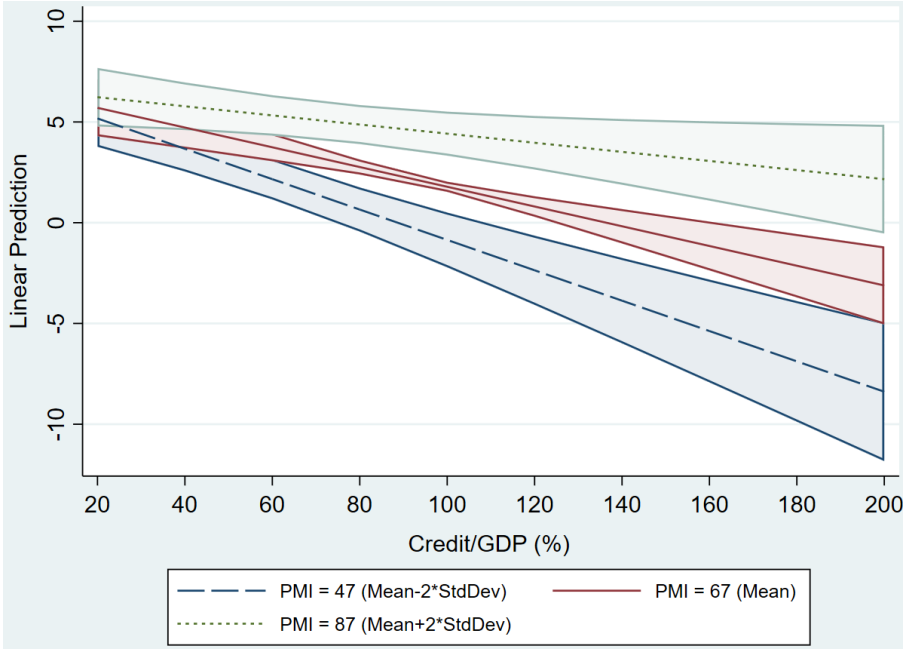

Figure 5. Predictive margins on the credit-growth nexus for different PMI values

Note: Shaded areas represent 95% confidence intervals.

Source: own elaboration.

the credit ratio moves from 20% to 200%, the average predicted growth declines from around +5% to around –5%. This negative association is stronger for a lower level of PMI. In this case, higher credit ratios are reflected in much lower predicted growth rates for the relevant countries. Specifically, when the credit ratio moves from 20% to 200%, the average predicted growth declines from above +5% to around –10%. However, when the corporate governance quality improves (i.e. PMI increases to 87, namely, mean + two standard deviations), the negative association between credits and economic growth disappears, as shown by the solid line in Figure 5. Hence, it is found that for countries with a higher quality of corporate governance, the "too-much finance" mechanism is not relevant. In general, the predictive margins document that the moderating impact of corporate governance is economically significant.

The analogous analysis is repeated for the second corporate governance indicator of the extent of disclosure in Table 3. The results are very similar in the sense that the credit variable has a negative influence on growth, whereas the modifying effect of corporate governance reduces this negative impact. Both advanced and developing countries have the same results, as shown in the last two columns of Table 3, while the relevant effects are again stronger in the case of developing countries. Overall, both Tables 2 and 3 provide sta-

Table 3. Fixed-effects regression results for the extent of disclosure

Dependent variable	Full sample	Advanced countries	Developing countries
Investment	0.287***	0.189***	0.433***
	(0.0404)	(0.0515)	(0.0782)
Savings	0.214***	0.347***	0.0455
	(0.0523)	(0.0706)	(0.0950)
Trade	0.0293**	0.0321**	0.0489**
	(0.0114)	(0.0126)	(0.0245)
FDI	0.0680***	0.0960***	–0.00432
	(0.0130)	(0.0155)	(0.0241)
Credit	–0.110***	–0.0953***	–0.223***
	(0.0250)	(0.0267)	(0.0709)
Disclosure	–0.0256	–0.0410	–0.0220
	(0.0360)	(0.0401)	(0.0753)
Credit*Disclosure	0.000895***	0.000883***	0.00196**
	(0.000310)	(0.000338)	(0.000842)
Constant	–6.470**	–8.343**	–6.122
	(3.256)	(3.558)	(6.965)
Observations	520	345	175
R-squared	0.350	0.437	0.283
Number of id	39	26	13

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

tistically significant evidence of the moderating impact of corporate governance on the credit-growth nexus.

In order to control for dynamic effects, Table 4 presents the results of Equation (2). The results indicate that the credit ratio change in the last three years has negative growth effects in the same period and the following two years. Hence, the negative association between credits and economic growth spans both the short and medium term. As the main result, the moderating impact of the corporate governance indicator PMI is statistically significant and positive in the same periods. Very similar results are obtained when the other corporate governance indicator of disclosure is used in the estimations.

Table 4. Dynamic impact of credits on economic growth

Dependent variable	$\Delta_3 Y_{t-1}$	$\Delta_3 Y_t$	$\Delta_3 Y_{t+1}$	$\Delta_3 Y_{t+2}$	$\Delta_3 Y_{t+3}$	$\Delta_3 Y_{t+4}$	$\Delta_3 Y_{t+5}$
Investment	0.864***	0.957***	0.471***	–0.305**	–0.658***	–0.579***	–0.553***
	(0.135)	(0.105)	(0.118)	(0.141)	(0.148)	(0.145)	(0.171)
Savings	0.475***	0.428***	0.482***	0.732***	0.280*	–0.155	–0.625***
	(0.140)	(0.116)	(0.130)	(0.144)	(0.164)	(0.170)	(0.183)
Trade	0.0753**	0.0788***	0.102***	0.0580*	0.0802**	0.177***	0.204***
	(0.0349)	(0.0256)	(0.0287)	(0.0312)	(0.0336)	(0.0338)	(0.0390)
FDI	0.0229	0.0730***	0.0666**	0.102***	0.0565	–0.0337	–0.0191
	(0.0285)	(0.0254)	(0.0284)	(0.0335)	(0.0443)	(0.0436)	(0.0503)
$\Delta_3 Credit/GDP_t$	0.249	–0.231*	–0.469***	–0.490***	–0.199	–0.132	–0.131
	(0.180)	(0.139)	(0.156)	(0.169)	(0.182)	(0.175)	(0.176)
PMI	0.438***	0.239***	0.0814	–0.00826	0.0513	–0.0636	–0.175
	(0.109)	(0.0861)	(0.0966)	(0.106)	(0.116)	(0.113)	(0.119)
$\Delta_3 Credit/GDP_t \cdot PMI$	–0.00325	0.00178	0.00456**	0.00528**	0.00161	0.000674	0.00138
	(0.00245)	(0.00187)	(0.00210)	(0.00228)	(0.00245)	(0.00235)	(0.00236)
Constant	–63.02***	–50.53***	–32.64***	–10.42	2.535	9.663	24.91**
	(8.049)	(6.338)	(7.111)	(7.964)	(8.759)	(8.876)	(10.28)
Observations	369	403	402	365	327	289	252
R-squared	0.389	0.498	0.409	0.333	0.220	0.259	0.226
Number of id	38	38	38	38	38	37	37

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

5. Robustness analyses

This part conducts various robustness checks. The first involves examining non-linear credit-growth dynamics as postulated by the "too-much finance" effects. A standard approach to check for non-linear effects is to include the

Table 5. Non-linear effects of credits

Dependent variable	Full sample	Full sample	Advanced countries	Developing countries
Investment	0.232***	0.274***	0.128**	0.471***
	(0.0395)	(0.0401)	(0.0548)	(0.0737)
Savings	0.233***	0.209***	0.404***	0.0318
	(0.0535)	(0.0525)	(0.0725)	(0.0893)
Trade	0.0241**	0.0385***	0.0446***	0.0696***
	(0.0111)	(0.0115)	(0.0131)	(0.0244)
FDI	0.0641***	0.0675***	0.0914***	–0.00923
	(0.0133)	(0.0130)	(0.0154)	(0.0234)
Credit	–0.0760***	–0.529***	–0.857***	–0.375
	(0.0282)	(0.132)	(0.240)	(0.290)
Credit^2	0.000152	0.00167**	0.00308***	0.00102
	(0.000117)	(0.000665)	(0.00104)	(0.00208)
PMI		–0.304***	–0.647***	–0.0712
		(0.0954)	(0.188)	(0.144)
Credit*PMI		0.00672***	0.0118***	0.00245
		(0.00189)	(0.00323)	(0.00418)
Credit^2*PMI		–2.26e–05**	–4.34e–05***	–3.36e–06
		(9.33e–06)	(1.39e–05)	(2.79e–05)
Constant	–5.778**	12.57*	32.27**	–0.808
	(2.645)	(6.497)	(13.69)	(9.383)
Observations	520	520	345	175
R-squared	0.317	0.356	0.444	0.337
Number of id	39	39	26	13

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

squared term of banking credits as an additional control variable. Table 5 presents the relevant results, which include both the level and square of banking credits, as well as their interactions with PMI.

The first column of Table 5 shows the results for the credit variables only, without corporate governance indicators. Then, the second column of Table 5 shows that the credits have a negative coefficient, whereas their squared term has a positive coefficient. Both coefficients are statistically significant at the 5% level. These coefficients imply a non-linear association between credits and economic growth in the full sample of countries. More importantly, the interaction variables of both the level and square terms of credits with the corporate governance indicators also have statistically significant regression coefficients. When country differences are examined in the last two columns of Table 5, it is found that the non-linear effects and interactions hold for the advanced countries, whereas they are statistically insignificant for the developing countries.

The robustness analysis in Table 5 shows that the credit-growth nexus and the moderating role of corporate governance in this nexus can be non-linear. In order to quantify this non-linear moderating effect, Figure 6 produces the predictive margins using the non-linear regression results in the second column of Table 5. Compared to Figure 5, which uses linear regression estimations, Figure 6 produces more nuanced results. In particular, the graph

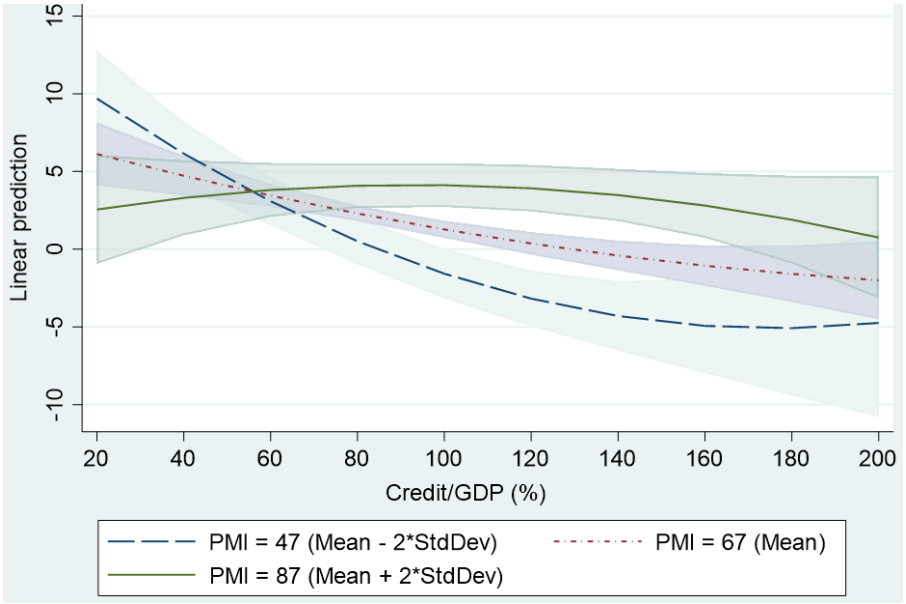

Figure 6. Predictive margins with non-linear effects of credits

Note: Shaded areas represent 95% confidence intervals.

Source: own elaboration.

shows that for countries with good corporate governance (i.e. a PMI level of 87, which corresponds to the mean plus two standard deviations), the credit-growth nexus has a hump shape. Specifically, banking credits produce positive growth effects up to a credit ratio of 100%, whereas the growth effects turn negative above this threshold. This finding is consistent with the result of Claessens and Yurtoglu (2012), who also find a threshold effect at around 100%. In the case of moderate or poor corporate governance, the positive growth effects of credits are no longer observed. Figure 6 shows that these countries (i.e. PMI = 67 or PMI = 47) experience negative growth effects of credit market development.

Another robustness check relates to the financial development indicator. The previous analysis focuses on banking credits to the private sector

Table 6. Regressions employing a broader financial development indicator

GDP Growth	Credits + Stocks	Credits + Stocks
Investment	0.329***	0.343***
	(0.0494)	(0.0495)
Savings	0.298***	0.291***
	(0.0563)	(0.0561)
Trade	0.0426***	0.0484***
	(0.0121)	(0.0122)
FDI	0.0688***	0.0708***
	(0.0158)	(0.0157)
PMI	0.0839**	–0.0488
	(0.0367)	(0.0687)
(Credits + Stocks)	0.00197	–0.0660**
	(0.00535)	(0.0303)
(Credits + Stocks)*PMI		0.000950**
		(0.000417)
Constant	–22.96***	–14.51***
	(3.305)	(4.955)
Observations	520	520
R-squared	0.317	0.356
Number of id	39	39

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

as a ratio of GDP. However, financial development also includes equity markets, which are generally very important in developed countries, especially in Anglo-Saxon economies. The literature also considers these dimensions of financial development. For example, De Nicolo et al. (2008, p. 220) consider a broader financial development indicator as "the sum of private credit and stock market capitalisation to GDP". We follow this approach for the sake of a robustness exercise. The relevant results are presented in Table 6. This shows that the sum of banking credits and stock markets also has a negative growth effect. However, this negative impact is attenuated to some extent by

Table 7. GMM estimation

GDP Growth	Pooled OLS	Fixed effects	Difference GMM
Lag. GDP Growth	0.332***	0.0618	0.177**
	(0.102)	(0.0796)	(0.0845)
Investment	0.102***	0.196***	0.204***
	(0.0298)	(0.0661)	(0.0716)
Savings	0.0320	0.123*	0.110
	(0.0207)	(0.0661)	(0.117)
Trade	–0.00275	0.0206*	0.0216
	(0.00264)	(0.0102)	(0.0189)
FDI	0.0404	0.0489	0.0475
	(0.0304)	(0.0430)	(0.0387)
Credit	–0.0325	–0.163**	–0.145***
	(0.0210)	(0.0663)	(0.0440)
PMI	0.0277	–0.0801	0.00345
	(0.0322)	(0.0852)	(0.0858)
Credit*PMI	0.000306	0.00171*	0.00153**
	(0.000303)	(0.000873)	(0.000668)
Constant	–1.215	3.581	
	(2.506)	(7.081)	
Observations	485	485	485
R-squared	0.598	0.606	
Number of id		39	39

Note: Fixed effects for countries. Standard errors in parentheses. Significance levels: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own elaboration.

good corporate governance. Hence, the results are robust to different measures of financial development.

The third robustness check employs another method for estimation. Endogeneity between the main variables of interest (growth, credits, and corporate governance in our case) can be an important issue to address in regression models. In addition, the dependent variable (the GDP growth rate) can display some persistence and ignoring the lagged term can lead to biased estimations of regression coefficients. In this case, Arellano and Bond (1991) propose a difference GMM (general method of moments) approach, where the lagged levels of the endogenous variables are used as instruments. Table 7 shows the regression results for this estimation approach. The table also includes the pooled OLS and the fixed-effects estimations as two benchmark cases.

Regarding the difference GMM method, Blundell and Bond (1998) show that if the lagged dependent variable is persistent (i.e. the autocorrelation coefficient is close to one) and the time dimension is short, this approach also suffers from some limitations. Then, these authors recommend a system GMM method to address these shortcomings. In order to verify the relevance of this method, we can check the coefficient of the lagged dependent variable in Table 6. It is seen that this coefficient varies between 0.06 and 0.33 and is not very persistent. In addition, the time dimension includes 15 years, which is not very short. Moreover, if the difference GMM produced biased results, the regression coefficient for the lagged dependent variable would be closer to the fixed-effects estimate than the pooled OLS estimate. This case is also not relevant in Table 6. Therefore, the difference GMM stands out as the appropriate estimation method. As another robustness check in the same context, the regression model estimates reported in Table 7 also include time-fixed effects. The table shows that the main results are robust to the use of a lagged dependent variable and employing GMM estimation.

Conclusions

The paper has investigated whether corporate governance (as measured by the two indicators of disclosure extent and PMI) mediates the relationship between credits and economic growth. Panel-data regression analyses on a sample of 39 advanced and developing countries show that the credit variable has a negative impact on economic growth, although this negative effect is attenuated by corporate governance. This moderating impact is economically sizeable, relevant for both advanced and developing country groups, and holds in both the short and medium term of the business cycle. We also

conduct detailed robustness analyses in terms of non-linear credit-growth patterns, broader financial development indicators encompassing stock markets, and GMM estimation. The non-linear analysis shows that for countries with high corporate governance standards, credits are associated with higher GDP growth rates up to the threshold level of 100% for the credit-to-GDP ratio, while the effect becomes negative after this threshold. However, in the case of countries with poor corporate governance standards, credits are associated with lower economic growth rates.

The findings have important policy implications for both credit policies and corporate governance measures. The paper implies that taking a one-dimensional approach to financial development can be misleading, as both quantity and quality dimensions of financial markets matter for the effects of financial development. The paper shows that financial development produces positive growth effects for countries with good corporate governance, whereas this effect turns negative for countries with poor corporate governance. Hence, improving the quality of corporate governance becomes a crucial policy area. Instead of merely focusing on credit developments (such as credit subsidies or liquidity measures to support credit growth rates), aiming to improve corporate governance practices (such as accounting standards, disclosure requirements, and the protection of investor rights) can become a more effective area of policymaking. In addition, these measures would improve the efficiency of the financial markets and the allocation of resources without needing to find additional credit or external funding. They can also support access to debt in financial markets. Future research can examine other measures of financial development, such as spreads and access to credit.

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CEO values and corporate performance: A text mining and LLM-based approach

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Abstract

This study explores the relationship between CEO values and corporate performance across five standard dimensions of companies' activity: liquidity, profitability, solvency, operating efficiency, and valuation. Utilising two complementary approaches—dictionary-based text mining and a ChatGPT-based approach to analyse over 4300 CEO interviews, we identified the CEO Schwartz value profiles and compared them with corporate outcomes. The findings indicate that that CEOs with a stronger emphasis on the Achievement value tend to be associated with higher corporate profitability. In turn, CEOs with a strong orientation toward Security are associated with higher corporate liquidity and long-term value creation. In addition, CEOs emphasising Self-direction or Stimulation are observed in firms with higher cash reserves and relatively lower operating efficiency. The results suggest that CEOs' values may lead to different strategies and, as a consequence, differences in companies' financial results. The findings contribute to a better understanding of the sources of these differences.

Keywords

- CEO
- personal values
- corporate performance
- text mining
- ChatGPT

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Introduction

Extensive academic research has examined the role of chief executive officers (CEOs), revealing their substantial impact on specific firm-level policies or outcomes (see Osei Bonsu et al., 2024 for a review). This influence concerns investments (Hu & Liu, 2015), companies' financial policies (Custódio and Metzger, 2014; Naeem & Khuram, 2020), corporate risk-taking (Bernile et al., 2017), leverage (Faccio et al., 2016), cash holdings (Chen et al., 2020), firm value (Wang & Fung, 2022) or ESG performance (Nguyen et al., 2024), among others. However, each CEO embodies a distinctive individuality represented by their personal traits, the combination of which may be important for company success and the benefits of the stakeholders. Bromiley and Rau (2016) classify these traits into three groups: observable attributes (e.g., age, gender, origin, education, work experience), personality and other underlying characteristics (e.g., charisma, values, hubris, intelligence), or interactions with others (e.g., social ties). Given that the executives' strategic choices may be inherently driven by internal stimulation and their intrinsic value systems (Carpenter et al., 2004; Hoffmann & Meusburger, 2018; Kotey & Meredith, 1997), this study addresses the specific thus far empirically underexplored nexus between CEO human values and corporate performance. It seeks to deepen understanding of how CEO value profiles may relate to companies' financial results across the following dimensions: liquidity, profitability, solvency, operating efficiency and valuation.

To analyse the impact of the CEO's personal values on corporate performance, we draw upon the Upper Echelons Theory (Hambrick & Mason, 1984) and, going beyond the related finance literature, embrace the widely acknowledged Schwartz's Theory of Basic Human Values from psychology (Schwartz, 1992, 2012). This interdisciplinary approach allows us to explore the fundamental, non-observable motivational drivers of executive decision-making,

while broadening the practical applicability of Schwartz's framework to strategic management and finance. The Schwartz value system conceptualises values as desirable, trans-situational goals that function as guiding principles in the lives of individuals, and exhibits a notable degree of robustness across various cultures (Bilsky et al., 2011; Schwartz, 1992, 2005). Specifically, it delineates ten fundamental and interrelated values: Benevolence, Universalism, Tradition, Conformity, Security, Power, Achievement, Hedonism, Stimulation, and Self-direction, converging to form a motivational circular continuum (see Appendix A), which can further be aggregated into broader bipolar dimensions (conservation vs. openness to change and self-transcendence vs. self-enhancement) or polar dimensions (personal vs. social focus). Unlike other personality characteristics, these values uniquely reflect what an individual truly believes to be appropriate behaviour. Therefore, they reveal personal motivations (Kraatz et al., 2020) and provide deeper insights into the fundamental drivers underlying CEO's observed behaviours and decisions. For example, CEOs prioritising openness to change have been found to exhibit a positive correlation with engaging in more risk-seeking activities (Roccas et al., 2002). Relatedly, Berson et al. (2008) demonstrate positive associations between CEO's Self-direction values (indicative of a culture of innovation) and sales growth, Security values (associated with a bureaucratic culture) and organizational efficiency, as well as between Benevolence (emblematic of a supportive culture) and employee satisfaction. Simultaneously, the relationship between Benevolence and sales growth exhibits negatively correlated patterns. Drawing from their study on small-business owners, Gorgievski et al. (2011) suggest that 'softer' success criteria, such as stakeholder satisfaction and a good work-life balance, are predominantly influenced by self-transcendent value orientations like Benevolence and Universalism. In contrast, owners oriented towards Power and Achievement tend to emphasise 'hard' success criteria, including business growth, innovation, profitability, and longevity. More broadly, Banning et al. (2023) demonstrate how employees' value-driven decisions influence others through their perception of social norms that shape corporate culture, highlighting the distribution of personal values as a key factor in determining corporate performance. The present study adds to this body of knowledge and provides further insights into the upper echelons' black box, revealing direct links between CEO value orientations and fundamental indicators of corporate performance. While adopting a perspective that foregrounds the role of individual-level factors, it does not claim that CEO values unilaterally determine company outcomes, but rather positions them as complementary to other potential (e.g., structural or regulatory) factors, thereby contributing to a more holistic understanding of corporate performance drivers.

Given the multidimensionality of Schwartz's value framework, we narrow our primary focus to the values of Achievement and Security. These values are particularly pertinent in corporate management, as they govern the dynam-

ics between two contrasting goals—greater performance or greater stability, respectively. This perspective aligns with the long-standing debate over the firm's objective function, a foundational question in corporate finance and governance (Berle, 1932; Jensen, 2001). While both Achievement and Security are the focal values of this study, other relevant values, including Conformity, Universalism, Self-direction, Stimulation and Power, were also included in the empirical models to shed light on broader patterns in the interplay between financial outcomes and CEO value orientations. However, given their more complex links to financial indicators compared to the clear performance–stability dichotomy represented by Achievement and Security, their expected effects prove less straightforward to hypothesise explicitly.

By definition, Achievement involves a focus on personal success through demonstrating competence according to social standards (Schwartz, 2012). Hoffmann and Meusburger (2018) highlight that CEOs guided by Self-enhancement and Achievement values tend to feel a strong personal responsibility for their organisation's success. Similarly, Adams et al. (2011) found that CEOs who prioritise Achievement, along with the Power value, tend to promote shareholder wealth maximisation and pro-shareholder policies rather than the interests of other stakeholders. This is primarily evidenced by the maximisation of profits and share prices, both of which serve as prominent indicators of successful performance (Damodaran, 2014; Jensen, 2001). In corporate practice, performance measures encompass a broad array of financial and non-financial indicators (Kaplan & Norton, 1992; Koller et al., 2025; Parmenter, 2015; Wahlen et al., 2011). Among the finance-related domains, profitability remains a widely recognised fundamental driver of effective management (Damodaran, 2020; Robinson et al., 2012). Building on these insights, we hypothesise that:

H1: A stronger CEO emphasis on the Achievement value is positively associated with corporate profitability.

In turn, Security, as a prosocial value type, is typically associated with safety, harmony, and the stability of society, of relationships, and of the self (Schwartz 2012). Therefore, CEOs prioritising such value orientation are likely to favour firms' long-term financial stability, particularly in the liquidity dimension, but potentially at the expense of higher profitability. This conjecture corresponds to the findings of Chen et al. (2015), who revealed a negative relationship between individualism and corporate cash holdings. It is also supported by the evidence from Liu et al. (2013), who found positive links between individualism and corporate risk-taking that may translate into increased cash flow fluctuations. More broadly, companies that place greater emphasis on liquidity tend to experience stronger financial stability, lower bankruptcy risk, and enhanced investor confidence (Ndruru, 2025). Based on this reasoning, we additionally postulate that:

H2: A stronger CEO emphasis on the Security value is positively associated with corporate liquidity.

Although both hypotheses seem intuitive, their empirical verification poses challenges due to the difficulties in acquiring psychographic data from CEOs.[4] In practice, alternative approaches, including surveys (Gröber et al., 2023), experiments (Sagiv et al., 2011) or textual analysis (Fischer et al., 2022; Greiner et al., 2023; Ponizovskiy et al., 2020), are applied to identify the CEO value profiles. Notably, the ample corpus of publicly available CEO comments or speeches, coupled with recent advancements in text processing techniques and generative AI-powered tools creates new opportunities in this field. This study contributes to this emerging research trend by utilising the extensive content of CEO interviews to automatically identify CEO personal values, employing two complementary approaches to textual analysis: a dictionary-based method that emphasises rule-based, interpretable value categorisation (labelled as the TM-approach), and a content analysis method powered by the Large Language Model ChatGPT-4o mini (OpenAI, 2024a) to capture nuanced, context-aware insights (labelled as the LLM-approach). The combined use of both methods enables methodological triangulation, offering a more robust framework for assessing personal values from publicly available textual content. Their comparison provides complementary insights into different facets of CEO value expression.

The remainder of the paper is organised as follows: Section 1 provides a description of the dataset and methodology; Section 2 expounds upon the results and analysis; the final section sets out our conclusions.

1. Data and research methodology

1.1. Data collection and processing

To investigate the relation between CEOs' values and the diverse dimensions of corporate performance, we integrated two databases: (1) The Wall Street Transcripts, which provides CEO interviews, and (2) Capital IQ, which

[4] Recurrent and well-known: the World Values Survey (https://www.worldvaluessurvey.org) or European Social Survey (https://www.europeansocialsurvey.org) encompass relatively confined country-level subsamples of CEOs, typically concealed within occupation-related grouping classes, such as "Higher Administrative" (e.g., bankers, executives in large businesses, high government officials, union officials) in WVS (Haerpfer et al., 2022) or "Managing directors and chief executives" in ESS (ESS, 2024).

offers financial data. Combining these databases results in a sample of over 4300 observations spanning the years 1997 to 2022.

The text database used to infer CEO value profiles consists of CEO interviews published on The Wall Street Transcripts (TWST) website.[5] Unique CEOs and companies account for 21% and 48% of the total number of observations in the dataset, respectively. Despite the extensive time range of the data and the lack of a formal structure in the interviews, the style of these interviews has remained remarkably similar over the years. This allows for a consistent analysis of the value profiles reflected in CEOs' speeches.

The selected TM and LLM approaches required the textual data to be processed differently. For dictionary value extraction, the textual content underwent standard automated pre-processing steps using text mining tools, including punctuation removal, conversion to lowercase, and tokenization. In both methods, only the answers given by the CEOs were analysed. Subsequently, the value dictionary developed by Ponizovskiy et al. (2020) was applied to identify the value words present in each interview. Using these value words, we calculated the frequencies of terms related to each specific value type, thus establishing the CEOs' value profiles. Table 1 presents the value profile of the sample CEO, based on an interview containing 2142 words, of which 263 are value-related terms.

Although this dictionary method is validated and transparent, it cannot account for the particular setting of executive interviews. In contrast to most people, CEOs are media-trained and may communicate strategically, avoiding negatively coded words or emphasising certain buzzwords that signal positivity. A dictionary-based count will interpret repetitive buzzwords as high engagement with specific values, thus skewing the analysis.

To counteract the limitations of the dictionary-based approach, we used the generative LLM ChatGPT-4o mini (OpenAI, 2024b) with a tailored prompting strategy to also derive scores across all value dimensions. The model was guided to perform an analysis analogous to the Portrait Value Questionnaire (PVQ-21), but distilling human value-related insights from the interview data rather than responses to a formal questionnaire. We primed the model to consider in its answer that the input text is primarily concerned with the business environment and that the terminology used and the topics discussed may be biased accordingly. The exact prompt used is laid out in Appendix B. Beyond the codebook and some instructions regarding the desired output format, we did not provide the model with any labelled input-output exam-

[5] The Wall Street Transcript (TWST) provides access to CEO interviews upon registration at https://www.twst.com. In addition to CEOs, TWST also interviews financial analysts and company executives below the CEO level. To ensure comparability, all non-CEO interviews were excluded from the analysis. The interview database was accessed via subscription between October 9, 2023, and January 9, 2024.

Table 1. Value profile of the sample CEO

Value type	Unique value words in the sample interview	Total number of occurrences	Value frequency
Security	attention, dangerous, defence, defensive, guarantee, order, preserving, privacy, safer, safety, save, secure, security, threat, threatening, violence	25	0.0951
Conformity	certainty, code, integrity, law, orders, procedure, required, served, standards, system, trust	27	0.1027
Tradition	traditionally	1	0.0038
Benevolence	concern, dependable, feeling, friends, help, need, relationship, reliable	20	0.0760
Universalism	address, balance, communities, company, culture, meaning, protect, protecting, social, society, united	24	0.0913
Self-direction	ability, act, activity, controversy, create, creates, decision, freedom, goal, idea, intelligence, learn, resolve, science, special, think, thought	36	0.1369
Stimulation	attempted, challenges, dramatically, drive, exciting, interesting, newer, opportunities, opportunity, uncertainty, unique	29	0.1103
Hedonism	fulfilment, rest	3	0.0114
Achievement	advantage, approval, best, biggest, brains, business, capabilities, competing, competitive, effective, efficiency, growth, improvement, improving, job, progress, recognize, successfully, top, training, work	64	0.2433
Power	agency, aggressive, capital, cash, dealing, economics, enforcement, expensive, fight, force, management, might, profitable, revenue, strong	34	0.1293

Note: The following information is contained in the succeeding columns: (1) Value type: one of the ten Schwartz values; (2) Unique value words in the sample interview: a list of distinct words used by the CEO that correspond to each Schwartz value, based on the reference value dictionary; while these words may appear multiple times in the interview, each is listed only once; originally, all terms were in the American English form; (3) Total number of occurrences: the total number of value-related words (including repetitions) used by the CEO across the specific value types in the interview; (4) Value frequency: the proportion of words associated with a given value type (including repeated occurrences) relative to the total number of value-related words used in the interview.

Source: own elaboration.

ples. This strategy is known as zero-shot prompting (Kojima et al., 2022). It is a form of in-context learning, which does not require adapting model weights through fine-tuning nor supplying any examples of the task during

prompting. For each interview, the model was only supplied with the interview date, the CEO's name, and the company ticker in addition to the interview answers, providing context to the CEO's answers. This practice allowed the LLM to incorporate dynamic and contextual information acquired during pre-training that a static dictionary cannot capture. Such contextual information also includes potential changes in business-related language over a 25-year sampling period. It also enabled the model to rely on firm-, CEO- and industry-specific information it may have acquired through its training data. For our final inference, we set the temperature hyperparameter of the model to 0, which approximates a deterministic model output. For a subset of interviews, we also tested higher temperature settings informally, averaging the values attained through three model runs for each interview. For our task, the variation between runs proved negligible, making a deterministic setup optimal. Appendix C provides sample model outputs for selected input texts, illustrating how the LLM inferred value profiles from the interview responses.

As a result, each CEO was characterised by their own value system, comprising the values of Security, Conformity, Tradition, Benevolence, Universalism, Self-direction, Stimulation, Hedonism and Achievement, by two independent methodologies. To mitigate multicollinearity issues, three values, namely Hedonism, Tradition and Benevolence, were omitted from further analysis, which is a standard procedure in value-related studies.

Next, we integrated the interview data with financial metrics sourced from Capital IQ. These metrics are commonly used in financial analysis and cover the major dimensions of corporate finance: liquidity, profitability, solvency, operating efficiency, and valuation (Robinson et al., 2012). Specifically, we examined cash to total assets for liquidity, return on equity for profitability, total debt to total assets for solvency, sales to average total assets for operating efficiency, and the market value of equity plus the book value of debt relative to total assets as a proxy for the Q-ratio for the valuation dimension. These measures are succinctly labelled as Cash, ROE, Debt, Operating efficiency, and Q-ratio, respectively, throughout the text. Initially, potential outliers were identified using the Rosner test and replaced with values corresponding to the 1st or 99th percentile.

Descriptive statistics for the variables utilised in this study are presented in Appendix D. Among the TM- and LLM-based value dimensions, Achievement and Self-direction show the highest average intensities, which is consistent with the business-oriented context of the interviews. Notably, financial variables such as ROE, Debt, and the Q-ratio display substantial variability, indicating that the dataset captures both instances of severe financial distress and unusually high, though less extreme, cases of firm outperformance. This broad dispersion likely reflects the fact that the observation period of more than 25 years spans both episodes of economic turmoil and phases of prosperity.

1.2. Empirical specification

To examine the relationship between CEO values and corporate performance, we utilised Linear Mixed-Effects Regressions (Bates, 2015), treating each performance indicator as a dependent variable. While ideally, individual CEO fixed effects would be employed to perfectly control for unobserved time-invariant CEO characteristics and leadership changes, our dataset, due to the limited number of observations for an individual CEO or company, did not permit the inclusion of such granular CEO-specific fixed effects in a continuous panel data sense. Instead, we adopted a random-effects structure, grouping observations by the combination of the industry sector (initial digit of the SIC code) and year, which captures unobserved heterogeneity at the industry-year level. This approach was incorporated within the mixed-effects model framework, as there was no evidence of correlation between the random effects and other explanatory variables (Wooldridge, 2010).

Our primary model specification for a given firm observation *i* is as follows:

$$PM_i = \beta_0 + \sum_{k=1}^{7} \beta_k \cdot V_{ik} + u_{st} + \varepsilon_i \tag{1}$$

where: PM_i represents one of the five performance measures (ROE, Cash, Debt, Operating efficiency, Q-ratio) for observation i; β_0 is the fixed intercept; $\sum_{k=1}^{7} \beta_k \cdot V_{ik}$ represents the sum of the coefficients β_k for each of the CEO's personal value scores V_{ik}, derived from either the TM- or LLM-approach, where k indexes the seven Schwartz values included in the analysis: Security, Conformity, Universalism, Self-direction, Stimulation, Achievement, and Power; u_{st} represents the random intercept for the specific industry-year group defined by the combination of industry sector s (initial digit of the SIC code) and year t for observation i; ε_i is the idiosyncratic error term for observation i, assumed to be normally distributed with a mean of zero and a variance σ^2.

For a robustness check, we also estimated alternative simple linear regression models, in which the financial metrics were first normalised by their respective annual industry averages before being used as dependent variables. This additional step aimed to enhance the reliability of the analysis by ensuring that potential industry-specific variations were appropriately accounted for in the modelling process. The general specification for these robustness models is as follows:

$$NPM_i = \gamma_0 + \sum_{k=1}^{7} \gamma_k \cdot V_{ik} + \varepsilon_i \tag{2}$$

where: NPM_i refers to the five normalised performance measures (ROE, Cash, Debt, Operating efficiency, Q-ratio) for observation i; γ_0 is the intercept term in

the simple linear regression; $\sum_{k=1}^{7} \gamma_k \cdot V_{ik}$ represents the sum of the coefficients γ_k for each of the CEO's personal value scores V_{ik}, as defined above; ε_i is the error term for observation i.

2. Results and discussion

Table 2 presents the correlation coefficients between personal values derived from value profiles generated using the dictionary-based and LLM-based approaches. Overall, both methods demonstrate a general alignment in capturing CEO values, though discrepancies emerge for Universalism and Conformity. These inconsistencies are likely attributable to the specificity of business language in the interviews and inherent differences in data processing frameworks. While a dictionary-based approach detects explicit mentions of value-related words, LLM processing may better reflect implicit value priorities, particularly when CEOs communicate strategically. Importantly, the values of Achievement and Security, which are central to our hypotheses (H1 and H2), exhibit statistically positive correlations across both methods. Although modest in magnitude, these relationships are theoretically and empirically meaningful, providing valuable guidance for subsequent analysis of the link between CEO values and corporate performance.

Table 2. Pearson correlation coefficients: TM values vs. LLM values

Variables	Pearson	Variables	Pearson
Security	0.2***	Self-Direction	0.063***
Conformity	–0.02	Stimulation	0.16***
Tradition	0.13***	Hedonism	0.3***
Benevolence	0.33***	Achievement	0.14***
Universalism	–0.052***	Power	0.22***

Note: * $p < 0.1$ ** $p < 0.05$ *** $p < 0.01$.

Source: own elaboration.

We report the estimation results for the relationship between CEO values and corporate performance in Table 3 for the TM-approach and in Table 4 for the LLM-approach. Acknowledging the inherent complexity in assessing the role of CEO values and the critical influence of methodological choices in their extraction from business contexts, our focus is on uncovering previously

Table 3. Linear mixed-effects regression models I: TM values and corporate performance metrics

Predictors	ROE	Cash	Debt	Operating efficiency	*Q*–ratio
(Intercept)	–1.0607 (0.6188)	0.4764 *** (0.0711)	0.3545 (0.6385)	1.8840 *** (0.2096)	2.8820 (1.9690)
TM.Security	–0.6978 (1.0708)	0.2172 (0.1220)	2.9780 ** (1.0967)	–0.9650 ** (0.3578)	13.4938 *** (3.4008)
TM.Conformity	–0.8459 (1.1033)	–0.0766 (0.1243)	1.3881 (1.1458)	–1.7883 *** (0.3649)	9.4734 ** (3.4793)
TM.Universalism	–0.0566 (0.8530)	–0.3597 *** (0.0978)	0.9339 (0.8926)	–1.2160 *** (0.2871)	3.0603 (2.7192)
TM.Self-direction	–0.6950 (0.8401)	0.1768 (0.0961)	1.8535 * (0.8691)	–2.2276 *** (0.2822)	5.3248 * (2.6762)
TM.Stimulation	1.2020 (0.9396)	0.2808 ** (0.1080)	–0.2459 (0.9700)	–1.6453 *** (0.3171)	–1.2612 (2.9916)
TM.Achievement	1.6497 * (0.7610)	–0.7280 *** (0.0868)	–0.6538 (0.7870)	0.1994 (0.2550)	–5.6557 * (2.4186)
TM.Power	2.2422 ** (0.7668)	–0.3534 *** (0.0878)	–0.5701 (0.8038)	–1.5923 *** (0.2579)	–2.2943 (2.4390)

Predictors	ROE	Cash	Debt	Operating efficiency	*Q*–ratio
Random effects					
σ^2	3.90	0.05	3.75	0.44	40.48
τ_{00}	$0.11_{\text{Year:SIC}}$	$0.02_{\text{Year:SIC}}$	$0.15_{\text{Year:SIC}}$	$0.20_{\text{Year:SIC}}$	$3.56_{\text{Year:SIC}}$
ICC	0.03	0.25	0.04	0.31	0.08
N	27_{Year}	27_{Year}	27_{Year}	27_{Year}	27_{Year}
	10_{SIC}	10_{SIC}	10_{SIC}	10_{SIC}	10_{SIC}
Observations	4342	4559	3804	4526	4533
Marginal R^2 / Conditional R^2	0.009 / 0.037	0.054 / 0.290	0.010 / 0.048	0.032 / 0.334	0.021 / 0.100

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.
Description of dependent variables (in columns): ROE – return on equity, Cash – cash to total assets, Debt – total debt to total assets, Operating efficiency– sales to average total assets, Q-ratio (proxy) – market value of equity plus book value of debt relative to total assets. Variables prefixed with 'TM' refer to values extracted with dictionary-based text mining. Respective value variables represent the proportion of words describing a specific value type to the total number of value-related words in each CEO interview, identified using the value dictionary.

Source: own elaboration.

Table 4. Linear mixed-effects regression models II: LLM values and corporate performance metrics

Predictors	ROE	Cash	Debt	Operating efficiency	*Q*–ratio
(Intercept)	0.1572 (0.3543)	0.0540 (0.0412)	–0.1282 (0.4174)	0.8544 *** (0.1260)	0.6662 (1.1449)
LLM.Security	–0.0207 (0.0630)	0.0245 *** (0.0072)	0.0213 (0.0701)	–0.0532 * (0.0214)	0.4146 * (0.2024)
LLM.Conformity	0.2646 (0.1395)	0.0040 (0.0159)	0.0074 (0.1611)	–0.0638 (0.0477)	–0.2612 (0.4503)
LLM.Universalism	–0.2878 *** (0.0444)	0.0865 *** (0.0052)	0.1486 ** (0.0480)	–0.1268 *** (0.0156)	0.9665 *** (0.1452)
LLM.Self direction	–0.1445 (0.1228)	0.1034 *** (0.0140)	–0.1784 (0.1362)	0.0009 (0.0420)	0.9385 * (0.3952)
LLM.Stimulation	–0.0570 (0.0661)	0.0530 *** (0.0075)	–0.0046 (0.0672)	–0.0857 *** (0.0226)	0.6331 ** (0.2134)
LLM.Achievement	0.0558 (0.1883)	0.0479 * (0.0213)	0.5524 * (0.2158)	0.0330 (0.0641)	0.9433 (0.6033)
LLM.Power	–0.1536 (0.0880)	–0.0198 * (0.0100)	–0.2304 * (0.0949)	–0.0796 ** (0.0299)	–0.9151 ** (0.2825)

Predictors	ROE	Cash	Debt	Operating efficiency	*Q*–ratio
Random effects					
σ^2	3.90	0.05	3.76	0.45	41.24
τ_{00}	$0.06_{\text{Year:SIC}}$	$0.01_{\text{Year:SIC}}$	$0.14_{\text{Year:SIC}}$	$0.22_{\text{Year:SIC}}$	$2.78_{\text{Year:SIC}}$
ICC	0.01	0.20	0.04	0.33	0.06
N	27_{Year}	27_{Year}	27_{Year}	27_{Year}	27_{Year}
	10_{SIC}	10_{SIC}	10_{SIC}	10_{SIC}	10_{SIC}
Observations	4346	4564	3809	4530	4538
Marginal R^2 / Conditional R^2	0.017 / 0.032	0.087 / 0.270	0.006 / 0.041	0.013 / 0.337	0.021 / 0.083

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.
Description of dependent variables (in columns): ROE – return on equity, Cash – cash to total assets, Debt – total debt to total assets, Operating efficiency– sales to average total assets, Q-ratio (proxy) – market value of equity plus book value of debt relative to total assets. Variables prefixed with 'TM' refer to values extracted with dictionary-based text mining. Respective value variables represent the proportion of words describing a specific value type to the total number of value-related words in each CEO interview, identified using the value dictionary.

Source: own elaboration.

overlooked linkages between personal values and the key financial indicators. Although no formal causality tests were performed, the documented stability of personal values over a lifetime (Bardi & Goodwin, 2011) suggests that CEOs' values may influence the corporate financial results. The mechanisms of this influence are explored in light of the existing literature.

Consistent with our hypothesis H1, the TM-approach reveals a positive association between CEOs' Achievement motivation and corporate profitability. However, this association may not hold in the long term, as suggested by the negative coefficients for the firm value as proxied by the Q-ratio. Nevertheless, these relationships are not supported by the GPT-based method, which shows no significant associations in both cases. Instead, the LLM-approach identifies a significant positive relationship between Achievement and both liquidity and leverage, suggesting that Achievement-oriented CEOs may be more frequently observed in firms that maintain financial flexibility and rely on external funding.

In turn, in the case of the Security value, both methods indicate relatively strong alignment. CEOs who prioritise Security tend to be associated with firms maintaining higher levels of financial reserves, which supports our second hypothesis (H2). Interestingly, these reserves may potentially be accompanied by increased corporate debt. While a stronger emphasis on financial stability may come at the expense of operating efficiency and profitability, it could contribute to higher firm value in the long term.

Although CEO values explain only a small proportion of the variance (as indicated by low marginal R^2), the significance of the results underscores their relevance as part of the more complex system shaping corporate financial outcomes.

Table 5 and Table 6 present the estimation results of the linear regression models that examine the respective relationships between values and financial performance, where the financial metrics have been benchmarked against industry averages. The benchmarking was performed by subtracting the industry average from each particular ratio.

As previously, these results support both of our hypotheses. However, there are some differences when compared to the non-benchmarked variables and linear mixed model approach, particularly in the interplay between Security and Debt, as well as between Achievement and the Q-ratio. Both methods suggest no significant long-term association between Achievement or Security value orientations and corporate indebtedness or firm value.

Table 5. Linear regression models I: TM values and benchmarked corporate performance metrics

Predictors	Benchmarked ROE	Benchmarked cash	Benchmarked debt	Benchmarked operating efficiency	Benchmarked *Q*-ratio
(Intercept)	–1.0796 (0.6115)	0.2014 ** (0.0685)	–2.3936 (1.7204)	0.8314 *** (0.1994)	–19.9451 ** (6.4598)
LLM.Security	0.1531 (1.0607)	0.3550 ** (0.1189)	–2.6587 (2.9632)	–1.0563 ** (0.3454)	16.1808 (11.2105)
LLM.Conformity	–0.1888 (1.0979)	0.0217 (0.1223)	5.2297 (3.1117)	–1.5966 *** (0.3560)	20.6135 (11.5473)
LLM.Universalism	0.1998 (0.8404)	–0.2910 ** (0.0943)	2.9299 (2.3930)	–1.0687 *** (0.2739)	19.0099 * (8.8847)
LLM.Self direction	–0.2446 (0.8319)	0.2933 ** (0.0936)	2.5558 (2.3486)	–2.1456 *** (0.2722)	26.4697 ** (8.8185)
LLM.Stimulation	1.6945 (0.9259)	0.3680 *** (0.1037)	–4.7007 (2.6092)	–1.4100 *** (0.3015)	–0.2643 (9.7681)
LLM.Achievement	2.1597 ** (0.7525)	–0.6071 *** (0.0845)	2.1714 (2.1251)	0.1372 (0.2457)	14.8405 (7.9587)
LLM.Power	2.1950 ** (0.7592)	–0.3311 *** (0.0851)	1.5357 (2.1741)	–1.2247 *** (0.2475)	15.0678 (8.0167)
Observations	4342	4559	3804	4526	4533
R^2 / R^2 adjusted	0.008 / 0.007	0.070 / 0.068	0.005 / 0.003	0.037 / 0.035	0.003 / 0.001

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.
Description of industry-benchmarked dependent variables (in columns): ROE – return on equity, Cash – cash to total assets, Debt – total debt to total assets, Operating efficiency– sales to average total assets, Q-ratio (proxy) – market value of equity plus book value of debt relative to total assets. Variables prefixed with 'TM' refer to values extracted with dictionary-based text mining. Respective value variables represent the proportion of words describing specific value type to the total number of value-related words in each CEO interview, identified using the value dictionary.

Source: own elaboration.

Table 6. Linear regression models II: LLM values and benchmarked corporate performance metrics

Predictors	Benchmarked ROE	Benchmarked cash	Benchmarked debt	Benchmarked operating efficiency	Benchmarked *Q*-ratio
(Intercept)	0.0488 (0.3529)	–0.1300 *** (0.0393)	–0.4692 (1.1324)	–0.1002 (0.1165)	–4.1609 (3.7369)
LLM.Security	0.0092 (0.0630)	0.0211 ** (0.0070)	0.0051 (0.1904)	–0.0436 * (0.0208)	–0.9111 (0.6693)
LLM.Conformity	0.2038 (0.1395)	0.0046 (0.0156)	1.0159 * (0.4384)	–0.0502 (0.0462)	3.4336 * (1.4867)
LLM.Universalism	–0.1918 *** (0.0437)	0.0801 *** (0.0049)	–0.1085 (0.1290)	–0.1279 *** (0.0144)	–0.1595 (0.4638)
LLM.Self direction	–0.0615 (0.1223)	0.0941 *** (0.0137)	–0.1958 (0.3697)	–0.0073 (0.0405)	0.2892 (1.2983)
LLM.Stimulation	0.0589 (0.0652)	0.0398 *** (0.0072)	0.1290 (0.1804)	–0.0756 *** (0.0214)	–0.4621 (0.6894)
LLM.Achievement	0.2072 (0.1884)	0.0457 * (0.0210)	0.2233 (0.5879)	0.0416 (0.0622)	1.5881 (1.9950)
LLM.Power	–0.1656 (0.0879)	–0.0267 ** (0.0097)	0.3368 (0.2579)	–0.0611 * (0.0288)	–0.6031 (0.9300)
Observations	4346	4564	3809	4530	4538
R^2 / R^2 adjusted	0.009 / 0.007	0.088 / 0.087	0.006 / 0.004	0.019 / 0.017	0.002 / 0.001

Note: * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$.

Description of industry-benchmarked dependent variables (in columns): ROE – return on equity, Cash – cash to total assets, Debt – total debt to total assets, Operating efficiency – sales to average total assets, *Q*-ratio (proxy) – market value of equity plus book value of debt relative to total assets. Variables prefixed with 'LLM' refer to values extracted with ChatGPT-4o mini. Respective value variables represent the demeaned value scores, derived by the LLM model using the Portrait Value Questionnaire (PVQ-21) approach.

Source: own elaboration.

Conclusions

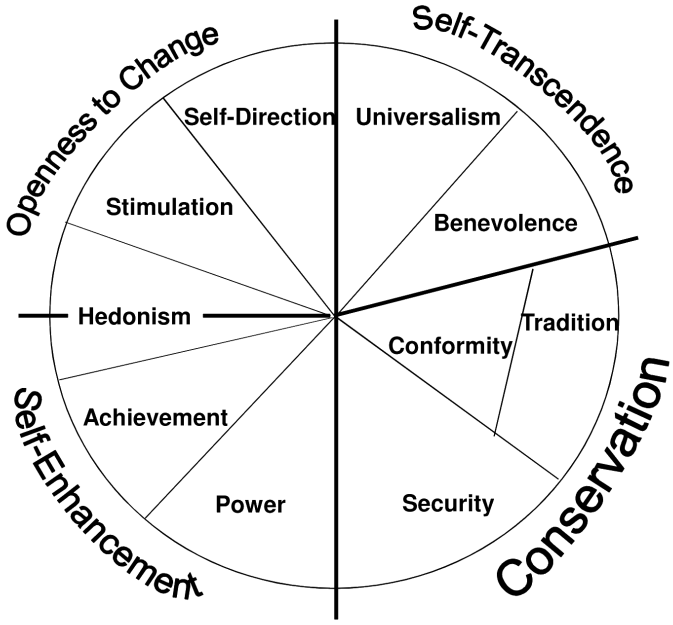
While the research interest on the role of CEOs' personality, particularly their values, in corporate decision-making has been steadily growing, there still exists a gap in understanding how these values link to corporate outcomes at the company level. This study contributes to the existing literature by providing novel empirical evidence on the relationships between CEO personal values and corporate financial performance across various dimensions, including liquidity, profitability, solvency, operating efficiency, and valuation. Utilising two complementary approaches – standard text mining and emerging LLM-based approach – our findings reveal that a stronger CEO emphasis on the Achievement value is positively associated with corporate profitability. In contrast, CEOs driven by the Security value are more likely to be found in firms prioritising financial stability, a factor that may contribute to greater firm value in the long term. While the results are consistent with both of our hypotheses, some mixed findings underline the complexity of assessing the role of CEO values in shaping corporate performance and highlight the importance of methodological choice in extracting CEO value profiles from the textual content.

Nevertheless, the findings may offer valuable insights for various stakeholders in the corporate world. They suggest that CEO values may, at least to some extent, help explain differences in companies' financial outcomes. This knowledge may assist boards of directors, shareholders or other stakeholders in shaping board composition, guiding executive selection or aligning strategic decision-making with long-term goals. Furthermore, recognising the connection between CEO values and corporate financial performance can help investors better anticipate a firm's financial performance or strategic trajectory, leading to more informed investment decisions. Finally, the application of advanced textual analysis techniques, particularly those powered by innovative LLM-based tools, demonstrates the potential for a scalable, data-driven executive profiling.

Our research has certain limitations. Firstly, the textual data set consists of business interviews that may not entirely capture the private opinions of CEOs. Despite the efforts to mitigate biases through the LLM-approach's contextual understanding, the inference of personal values from publicly delivered interviews, where strategic communication might play a role, remains a nuanced challenge inherent to such methodologies. Secondly, distinct methods for normalisation of value-related variables for both approaches, conditioned by the nature of the data, do not allow for direct comparison of the effect magnitude. Utilising alternative text resources and text processing frameworks could potentially enhance our results. Thirdly, due to the correlational nature of the approach, definitive causal claims about the relationships be-

tween CEO values and corporate financial outcomes cannot be made. Future research employing longitudinal data with lagged variables or experimental designs could better support causal inference. In our future research, we will strive to overcome these limitations and improve the robustness of the results.

Appendix A



The motivational continuum of 10 personal values (according to Schwartz's Theory of Basic Human Values)

Source: (Schwartz, 2012).

Appendix B

Prompt for deriving CEO personal values from interviews

Codebook: You are an expert psychologist. Your goal is to estimate the importance of basic human values for a company's CEO, according to Schwartz's theory of basic human values, through the answers given by the CEO in an interview for a business magazine. Provide an analysis similar to the PVQ21 questionnaire but based on the interview. The score for each value can be between 1 and 6 with 6 being the highest possible value. Keep in mind that the input text itself is not a value questionnaire but an interview primarily concerned with the business environment and that the terminology used and topics discussed are biased accordingly. Your output must be in JSON-format. Do not provide any tokens outside of the JSON! # Example output: { 'Self-Direction': 'Score', 'Stimulation': 'Score', 'Hedonism': 'Score', 'Achievement': 'Score', 'Power': 'Score', 'Security': 'Score', 'Conformity': 'Score', 'Tradition': 'Score', 'Benevolence': 'Score', 'Universalism': 'Score' } ## Input: # Interview date: <interview-date> # CEO: <ceo-name> # Company ticker: <company-ticker> # Interview answers: <interview-answers>

Source: own elaboration.

Appendix C

Example model outputs for input texts:

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4,\n \”Hedonism\”: 2,\n \”Achievement\”: 6,\n \”Power\”: 5,\n \”Security\”: 4,\n \”Conformity\”: 3,\n \”Tradition\”: 2,\n \”Benevolence\”: 4,\n \”Universalism\”: 5\n}”, “refusal”: null}, “logprobs”: null, “finish_reason”: “stop”}], “usage”: {“prompt_tokens”: 2256, “completion_tokens”: 85, “total_tokens”: 2341, “prompt_tokens_details”: {“cached_tokens”: 0, “audio_tokens”: 0}, “completion_tokens_details”: {“reasoning_tokens”: 0, “audio_tokens”: 0, “accepted_prediction_tokens”: 0, “rejected_prediction_tokens”: 0}}, “system_fingerprint”: “fp_bba3c8e70b”}}, “error”: null}
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22324,22324,1,5,4,2,6,5,4,3,2,4,5
22322,22322,1,4,3,2,5,4,5,3,2,4,3

Source: own elaboration.

Appendix D

Descriptive statistics

Variables	*n*	mean	sd	median	min	max	skew	kurtosis	se
TM.Security	4933	0.04	0.04	0.02	0.00	0.31	2.14	5.71	0.00
TM.Conformity	4933	0.06	0.04	0.05	0.00	0.48	2.07	11.57	0.00
TM.Tradition	4933	0.02	0.02	0.01	0.00	0.24	2.77	12.19	0.00
TM.Benevolence	4933	0.06	0.04	0.05	0.00	0.31	1.34	2.97	0.00
TM.Universalism	4933	0.14	0.05	0.13	0.00	0.39	0.62	0.69	0.00
TM.Self-direction	4933	0.15	0.06	0.14	0.02	0.43	0.69	0.78	0.00
TM.Stimulation	4933	0.09	0.04	0.08	0.00	0.31	0.85	1.15	0.00
TM.Hedonism	4933	0.02	0.02	0.01	0.00	0.29	4.02	34.07	0.00
TM.Achievement	4933	0.26	0.07	0.26	0.03	0.55	0.26	0.10	0.00
TM.Power	4933	0.18	0.06	0.17	0.03	0.45	0.58	0.54	0.00
LLM.Security	4943	0.35	0.66	0.10	–1.40	2.40	1.10	0.14	0.01
LLM.Conformity	4943	–0.98	0.29	–1.00	–2.20	0.50	0.66	1.25	0.00
LLM.Tradition	4943	–1.55	0.79	–1.90	–2.60	2.10	1.37	0.91	0.01
LLM.Benevolence	4943	–0.04	0.63	–0.10	–1.90	2.00	0.32	–0.14	0.01
LLM.Universalism	4943	0.26	0.79	0.20	–1.80	2.10	–0.04	–0.66	0.01
LLM.Self_direction	4943	0.80	0.32	0.90	–1.60	1.40	–1.20	1.98	0.00

Variables	n	mean	sd	median	min	max	skew	kurtosis	se
LLM.Stimulation	4943	–0.02	0.52	–0.10	–1.20	2.10	1.65	3.87	0.01
LLM.Hedonism	4943	–1.43	0.53	–1.30	–2.60	1.20	0.83	2.15	0.01
LLM.Achievement	4943	1.88	0.25	1.90	0.30	2.60	–0.71	1.19	0.00
LLM.Power	4943	0.73	0.49	0.90	–1.50	1.60	–1.52	2.02	0.01
ROE	4347	–0.29	2.01	0.06	–37.87	2.58	–12.76	201.99	0.03
Cash	4570	0.26	0.27	0.15	0.00	0.99	0.99	–0.19	0.00
Debt	3815	0.59	1.98	0.38	0.02	41.85	15.24	271.14	0.03
Operating efficiency	4535	0.83	0.80	0.65	0.00	6.99	2.10	8.14	0.01
Q-ratio	4543	3.03	6.69	1.60	0.34	120.75	11.55	172.45	0.10

Notes: The following information is contained in the succeeding columns: name of variable (vars), number of observations (n), mean, standard deviation (sd), median, minimum value (min), maximum value (max), skewness (skew), kurtosis. and standard error (se). Variables prefixed with 'TM' refer to values extracted with dictionary-based text mining, while those prefixed with 'LLM' to values extracted with ChatGPT-4o mini.

Source: own elaboration.

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Clustering S&P 500 companies by machine learning for sustainable decision-making

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Abstract

This study examines the Environmental, Social, and Governance (ESG) performance of S&P 500 companies using three clustering algorithms: K-Means, Gaussian Mixture Model, and Agglomerative Clustering. ESG scores from leading data providers are analysed to uncover sectoral patterns and performance trends. The findings indicate that technology and healthcare firms achieve the highest ESG scores, particularly in the governance and social dimensions, while the industrial and energy sectors face the greatest environmental challenges. Among the methods compared, K-Means demonstrates superior clustering performance by forming compact and well-separated ESG groups. These results offer a robust foundation for sector-specific ESG benchmarking, supporting investors and policymakers in identifying sustainability leaders, assessing risk, and targeting areas for improvement.

Keywords

- sustainability
- clustering algorithms
- machine learning

JEL codes: Q01, Q56, Q57

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Introduction

Environmental, Social, and Governance (ESG) criteria have become important indicators in the evaluation of corporate sustainability and ethical practices, influencing investment decisions and risk assessments globally (Elisabetta & Iannuzzi, 2017; Kocmanová & Dočekalová, 2012; Sultana et al., 2018). ESG metrics serve as non-financial performance measures, guiding risk and opportunity analyses for stakeholders, investors, and policymakers (Clementino & Perkins, 2021; Gebhardt et al., 2023). Their increasing relevance is reflected in the integration of ESG considerations into business models and investment frameworks (Atkins et al., 2023; MacNeil & Esser, 2022). Although many studies have explored the link between ESG performance and financial outcomes (Iamandi et al., 2019; Kotsantonis & Serafeim, 2019), limited research exists on systematically grouping companies based on their comprehensive ESG profiles (Chen et al., 2023; LaBella et al., 2019). Much of the literature focuses on individual ESG dimensions or the financial effects of ESG scores, which can obscure broader sustainability patterns across sectors (Nielsen & Villadsen, 2023; Papagiannidis et al., 2018). This narrow perspective challenges effective benchmarking and policy formulation, as it impedes the identification of meaningful peer groups and sectoral trends (Busch et al., 2024; Grougiou et al., 2024).

Advances in machine learning, and clustering algorithms in particular, offer data-driven approaches to analysing ESG data by identifying groups of firms with similar sustainability profiles (Borms et al., 2021; Sariyer et al., 2024). Such techniques have been applied successfully in risk analysis and corporate profiling, including personal bankruptcy prediction and financial forecasting (Brygała & Korol, 2024). As artificial intelligence becomes more prevalent in business governance and decision-making (Evans, 2017; Orchard & Tasiemski, 2023), the adoption of advanced analytics in ESG assessment is becoming increasingly common. Despite this progress, the use of these methods to examine ESG performance in large and diversified indices, such as the S&P 500, remains relatively limited (Costantiello & Leogrande, 2023; Wu et al., 2023).

The present study examines how S&P 500 companies can be grouped based on ESG scores and explores the sectoral patterns revealed by applying K-Means, Gaussian Mixture Model (GMM), and Agglomerative Clustering. Each clustering method provides a distinct analytical perspective: K-Means forms well-separated groups; GMM captures overlapping profiles; and Agglomerative Clustering facilitates multi-level sectoral analysis (Rusu et al., 2023; Vilas et al., 2022).

The analytical framework draws upon Resource-Based View (RBV), stakeholder theory, and signalling theory to interpret how ESG-driven clusters may

relate to firm value, stakeholder alignment, and disclosure effects (Barney, 1991; Freeman, 1984; Spence, 1973; Surroca et al., 2010).

The paper proceeds as follows. The literature review summarises previous research on ESG performance and clustering methods. The methodology section describes the data sources and analytical approach. The next section outlines the clustering algorithms applied in the study. The results section presents and interprets the main findings. The paper concludes with a summary of the key contributions and implications for sustainability research and practice.

1. Literature review

The expanding focus on Environmental, Social, and Governance (ESG) performance has led to a rapidly growing body of research examining the multidimensional nature of corporate sustainability (Kuo et al., 2022; Marie et al., 2024). ESG criteria, encompassing environmental impact, social responsibility, and governance practices, are increasingly recognised as key determinants of corporate resilience and value (Khalil et al., 2024; Lin et al., 2022). In parallel, recent studies have begun applying machine learning and clustering techniques to ESG data, offering new ways to identify patterns and groupings among firms (Saini et al., 2022; Van Holt & Whelan, 2021). Corporate sustainability inherently involves interrelated indicators. Radu and Smaïli (2021) highlight how analysing financial, social, and environmental dimensions collectively, rather than in isolation, reveals distinct corporate strategies and sustainability profiles. Similarly, González-Serrano et al. (2020) argue that the dynamic nature of sustainability research benefits from flexible analytical approaches capable of capturing nuanced relationships.

K-Means clustering is widely used for its simplicity and efficiency, effectively partitioning companies into clear groups when ESG profiles are distinct (Rusu et al., 2023; Saraswati et al., 2024). However, its reliance on rigid, non-overlapping clusters can oversimplify complex, overlapping ESG patterns (Cleuziou, 2007; Manduchi et al., 2021). To address this limitation, GMM clustering allows for probabilistic and overlapping group memberships, making it suitable for analysing companies with blended sustainability characteristics (Aerts, 2020; Vinayavekhin et al., 2023). GMM's flexibility is particularly valuable in sectors such as technology and financial services, where companies often excel in governance but vary across environmental or social dimensions (Ma et al., 2023; Xie et al., 2019). Agglomerative Clustering, a hierarchical technique, enables the identification of both macro and micro-level patterns by revealing nested clusters (Ah-Pine, 2018; Vichi et al., 2022). This approach is especially useful for sectoral analysis, as it can highlight industry leaders and

laggards within broad ESG dimensions (Jiménez et al., 2021; Sun et al., 2022). Clustering companies by ESG performance has significant practical implications. By revealing groups of firms with similar sustainability profiles, these methods support more informed investment, benchmarking, and regulatory decision-making (Paolone et al., 2022; Ronalter et al., 2023). Sector-specific clustering allows for targeted interventions, helping industries to identify areas for improvement and enabling policymakers to promote sustainable practices (Park & Jang, 2021).

Whilst prior studies have extensively examined the link between ESG scores and financial performance (Friede et al., 2015; Li et al., 2021), few have applied machine learning-based clustering to segment companies by their overall ESG performance. The application of unsupervised learning to ESG data is still emerging, particularly for comprehensive indices such as the S&P 500. By employing K-Means, GMM, and Agglomerative Clustering on S&P 500 ESG data, this study addresses an important gap in the literature. The findings provide a systematic approach to identifying sustainability leaders and laggards, thereby supporting strategic investment and policy decisions.

2. Methodology

2.1 Research design and objectives

This study employs a quantitative approach, utilising machine learning clustering algorithms to analyse ESG performance among S&P 500 companies. The primary aim is to identify groups of firms with similar ESG profiles, uncovering patterns that can guide sustainable decision-making. The process includes data collection, normalisation, outlier detection, and the application of K-Means, GMM, and Agglomerative Clustering. Clustering performance is evaluated using the Silhouette Score, Calinski-Harabasz Index, and Davies-Bouldin Index. These indices assess cluster cohesion and separation, providing robust validation of the identified groups.

The dataset comprises ESG scores for S&P 500 companies for the period 2023–2024, sourced from three major providers: Bloomberg, LSEG Data & Analytics (formerly Refinitiv), and MSCI. Each provider utilises distinct assessment frameworks and risk modelling techniques: Bloomberg relies on company-disclosed data and places strong emphasis on transparency; MSCI applies a rules-based, industry-relative rating system (AAA–CCC) to benchmark firms within their respective sectors; and LSEG Data & Analytics integrates financial disclosures, third-party sources, and proprietary risk assessments.

Given the diversity of data sources, min–max normalisation was applied to rescale ESG scores between 0 and 1, thereby ensuring comparability and minimising methodological bias. Sectoral validation was conducted to confirm that the identified clusters reflect meaningful sustainability patterns, rather than variations merely driven by differences in disclosure practices. A comparative summary of the ESG scoring methodologies adopted by Bloomberg, LSEG, and MSCI is provided in Table 1.

Table 1. Comparison of ESG scoring methodologies across data providers

Aspect	Bloomberg	LSEG Data & Analytics	MSCI
Data Sources	Company-disclosed, public data	Financial disclosures, third-party data	1,000+ indicators, industry risk
Scoring Range	0–100	Proprietary weighted score	AAA to CCC, sector-relative
Assessment Focus	ESG disclosure and transparency	Financial & ESG risk	Industry-adjusted ESG risk, governance
Methodology Transparency	Fully transparent	Limited public details	Rules-based, quality reviewed

Source: own summary based on Bloomberg ESG Report, LSEG and MSCI documentation.

As shown in Table 1, the ESG data providers employ notably different approaches in terms of data sources, scoring ranges, assessment priorities, and transparency. These differences necessitate robust data normalisation and validation steps to ensure the accuracy and comparability of ESG analyses across firms and sectors. The ESG assessment framework consists of three core dimensions: Environmental (E), Social (S), and Governance (G). The environmental dimension covers aspects such as carbon emissions, resource use, waste management, and environmental innovation, while the social dimension addresses employee well-being, diversity, community relations, and labour practices. The governance dimension focuses on board diversity, executive compensation, shareholder rights, and transparency. To ensure the reliability of ESG data, normalisation techniques and robustness checks were implemented, minimising biases that may arise from varying provider methodologies. Although relying solely on LSEG can increase consistency, it may also introduce transparency limitations; therefore, all three data sources were considered in the analysis. Although ESG data from Bloomberg, LSEG Data & Analytics, and MSCI were initially reviewed for comparison, all analyses, tables, and figures in this study are based exclusively on the LSEG dataset. ESG scores from Bloomberg and MSCI were used only for background review and data validation, not for the primary quantitative analysis.

2.2. Data preprocessing

All missing data imputation, normalisation, and clustering analyses were performed on the LSEG dataset. ESG data often contain missing values due to incomplete reporting. For companies with less than 25% missing ESG scores per dimension, missing values were imputed using the median value within each ESG dimension, thereby minimising the influence of outliers. Companies with more than 25% missing values in any ESG dimension were excluded from the analysis. Table 2 summarises the extent of missing and imputed values.

Table 2. Missing data summary

ESG Dimension	Total data points	Missing values (%)	Imputed values (%)	Threshold for removal (%)
Environmental (E)	500	8.5	8.5	25
Social (S)	500	12.3	12.3	25
Governance (G)	500	6.8	6.8	25

Source: own calculations based on LSEG data.

As shown in Table 2, the proportion of missing values was highest for the social dimension, necessitating careful imputation to preserve data integrity across the ESG dimensions. To ensure that each ESG dimension contributed equally to the clustering analysis, all scores were rescaled using min–max normalisation to the [0, 1] interval. This transformation preserves the relative differences between firms, whilst allowing for meaningful distance-based clustering. The entire ESG data preprocessing workflow is illustrated in Figure 1.

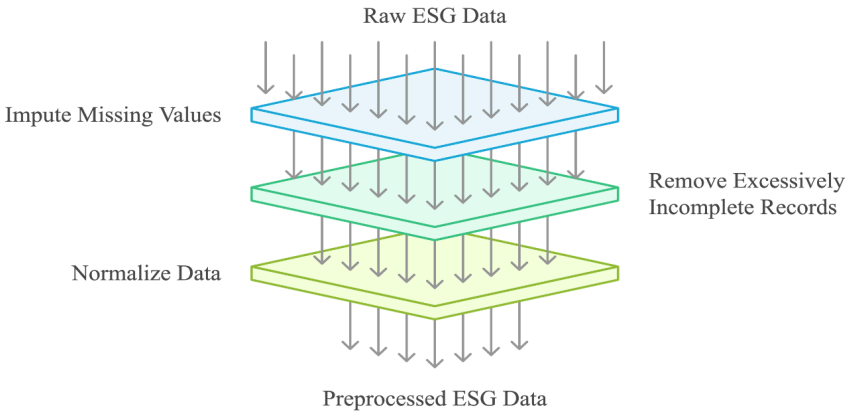

Figure 1. ESG data preparation process

Source: own elaboration.

Figure 1 visually summarises the data preparation steps, illustrating how raw ESG data were cleaned and standardised to support robust clustering analyses. As summarised above, the rigorous preprocessing of ESG data—through median imputation, exclusion of excessively incomplete records, and min–max normalisation—ensured that all subsequent clustering analyses were robust, comparable, and free from biases introduced by missing or inconsistent reporting. This standardised dataset provided a reliable basis for evaluating ESG-driven clusters and sectoral patterns in sustainability performance.

3. Clustering algorithms

Three clustering algorithms: K-Means, Gaussian Mixture Model (GMM), and Agglomerative Clustering were employed to group companies based on their ESG performance. These methods offer complementary perspectives on how firms align in terms of environmental, social, and governance practices.

K-Means is a widely used centroid-based algorithm that partitions data into k clusters by minimising intra-cluster variance (Jain, 2010; Kodinariya & Makwana, 2013). It effectively groups companies with similar sustainability profiles. The optimal number of clusters was determined using the Elbow Method, which identifies the point where adding further clusters yields diminishing returns in variance reduction. This ensures an optimal balance between granularity and interpretability.

The Gaussian Mixture Model (GMM) treats the data as a mixture of Gaussian distributions, allowing for soft clustering, where companies may belong to multiple clusters to varying degrees (Scrucca et al., 2016). Unlike K-Means, GMM does not assume that clusters are spherical or distinct, making it suitable for ESG datasets, where firms often exhibit blended sustainability characteristics across dimensions. The Bayesian Information Criterion (BIC) was used to select the optimal number of components, balancing model complexity and fit.

Agglomerative Clustering, a bottom-up hierarchical method, merges companies based on ESG similarity, gradually forming a tree-like structure of nested clusters (Vichi et al., 2022). This method is particularly effective for identifying both macro-level clusters and sub-groups within sectors. The choice of linkage criterion (e.g., Ward's method) influences how clusters are formed and determines the final hierarchy.

4. Results

The ESG performance of S&P 500 companies was analysed using K-Means, GMM, and Agglomerative Clustering. The objective was to group firms according to their ESG profiles, uncover sectoral trends, and identify outliers in sustainability performance.

4.1. *K*-Means clustering

K-Means clustering identified four distinct ESG clusters. The Elbow Method was used to determine the optimal number of clusters. Cluster 0 comprises companies with high overall ESG scores—predominantly from the technology and healthcare sectors—emerging as sustainability leaders. Clusters 1 and 2 represent firms with moderate and low ESG performance, often from diverse sectors, while Cluster 3 contains companies with the lowest ESG scores, especially in governance, highlighting transparency and stakeholder engagement challenges. The distribution of ESG scores across clusters reveals that Cluster 0 maintains consistently high scores in all dimensions, whereas Cluster 3 exhibits high variability and generally low performance. Figure 2 displays the distribution of total ESG, environmental, governance, and social scores by

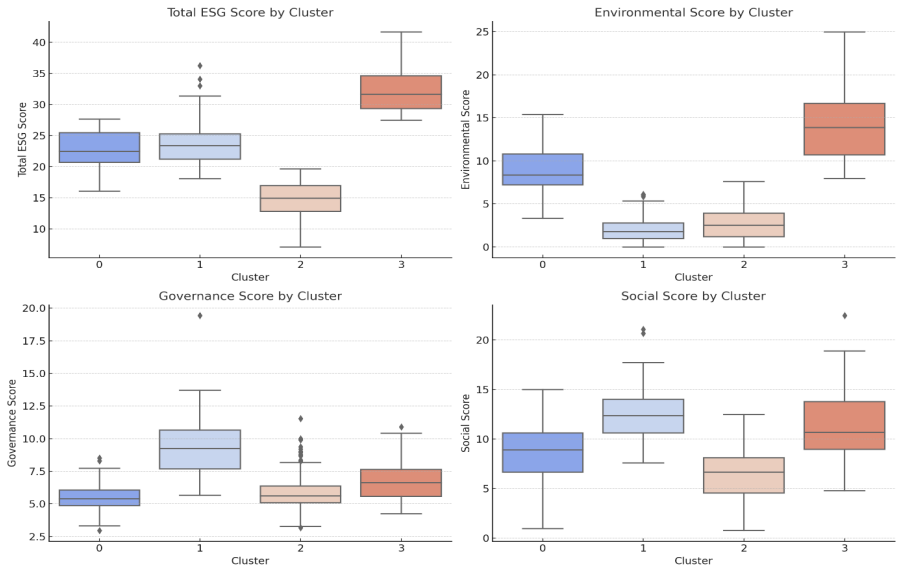

Figure 2. Distribution of ESG scores across clusters for *K*-Means clustering

Source: own calculations based on LSEG data.

K-Means cluster, highlighting clear differences in sustainability performance. Companies in Cluster 0 exhibit consistently higher scores across all ESG dimensions, identifying them as sustainability leaders. In contrast, Figure 3 shows the scatter plot of Total ESG Score versus Environmental Score, where the clear separation between clusters further demonstrates the effectiveness of K-Means clustering in distinguishing between leaders, average performers, and firms requiring improvement.

Figure 2 illustrates the distribution of total ESG, environmental, governance, and social scores for each K-Means cluster. The box plots clearly show that companies in Cluster 0 consistently outperform other groups across all ESG dimensions, whilst firms in Cluster 3 generally underperform, especially in governance.

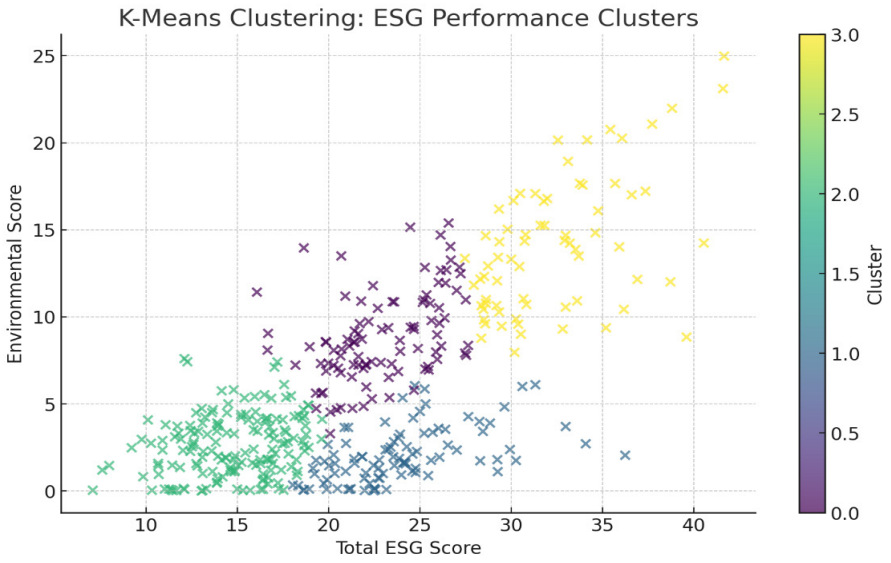

Figure 3. Scatter plot of total ESG score vs. environmental score by K-Means clustering

Source: own calculations based on LSEG data.

As depicted in Figure 3, there is a clear separation between clusters in the scatter plot of Total ESG Score versus Environmental Score. This separation further demonstrates the effectiveness of K-Means clustering in identifying sustainability leaders, average performers, and firms requiring improvement. Together, these visualisations form the foundation for subsequent sectoral and model-based comparisons. The clear separation of ESG performance across clusters demonstrates the ability of K-Means to identify sustainability leaders, average performers, and firms requiring improvement. These results form the foundation for subsequent sectoral and model-based comparisons.

4.2. Gaussian Mixture Model

GMM clustering, which allows overlapping memberships, also identified four clusters with more nuanced ESG profiles. Cluster 3 comprises top-performing firms, excelling in all ESG dimensions and frequently found in the technology and healthcare sectors. Cluster 1 includes firms with the lowest ESG scores, often facing transparency and compliance issues. Clusters 0 and 2 consist of firms with moderate or mixed ESG profiles, with some excelling in social responsibility but lagging environmentally. The probabilistic nature of GMM highlights the overlapping and blended ESG performance across sectors, capturing firms that do not fit neatly into a single cluster. Figure 4 presents the distribution of Total ESG, Environmental, Governance, and Social scores for each GMM cluster, demonstrating the central tendency and variability within clusters.

As shown in Figure 4, Cluster 3 comprises the highest-performing firms, particularly in total ESG and environmental scores, while Cluster 1 includes firms with the lowest ESG performance. Clusters 0 and 2 represent firms with moderate or mixed ESG profiles. These distributions reflect the nuanced and overlapping nature of ESG performance captured by the GMM approach, highlighting both leading and lagging firms within each ESG dimension. Figure 5

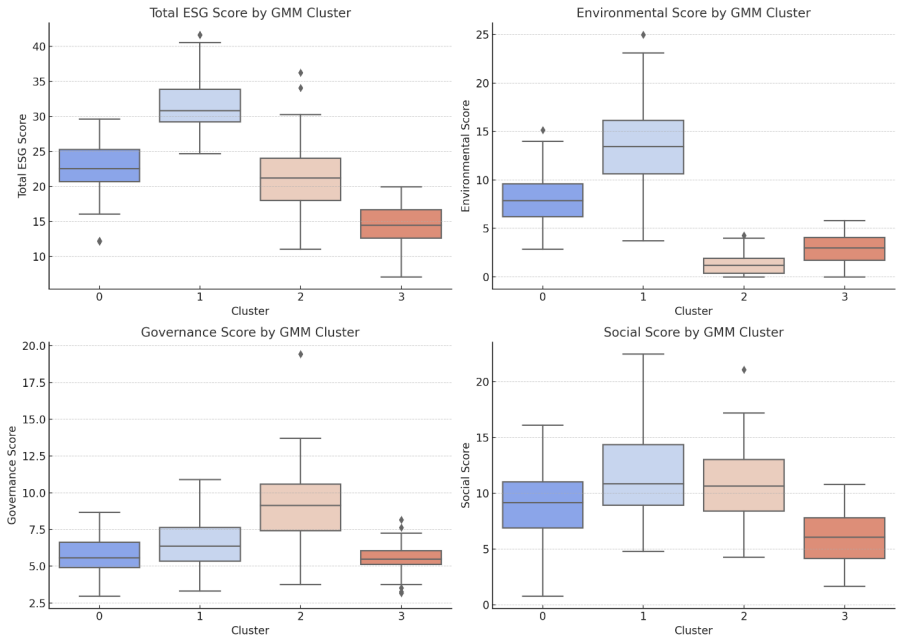

Figure 4. Distribution of ESG scores across GMM clusters

Source: own calculations based on LSEG data.

further illustrates the probabilistic assignment of firms, displaying a scatter plot of Total ESG Score versus Environmental Score, coloured according to GMM cluster membership.

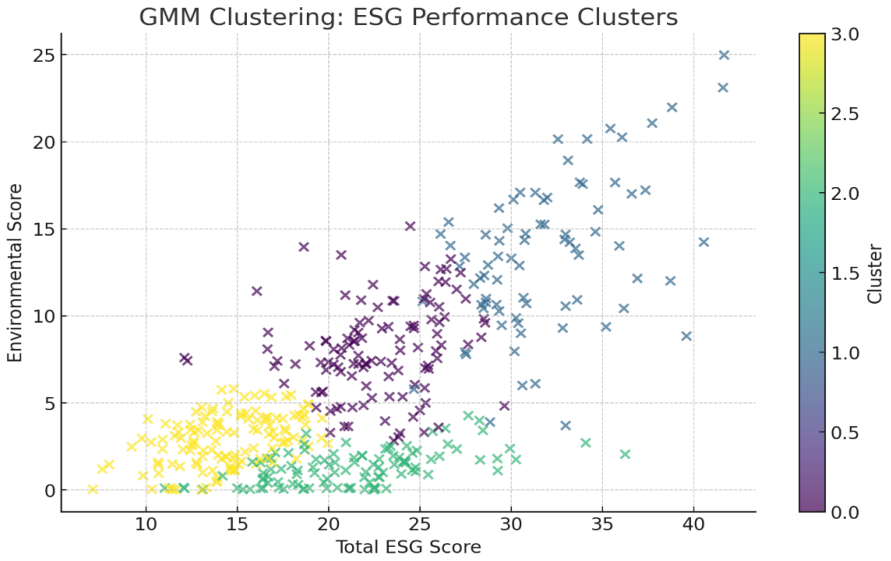

Figure 5. Scatter plot of total ESG score vs. environmental score by GMM clustering

Source: own calculations based on LSEG data.

Figure 5 visualises the relationship between Total ESG Score and Environmental Score for S&P 500 companies, coloured by GMM cluster membership. The plot reveals clear sectoral gradients and demonstrates the GMM's capacity to capture overlapping and transitional ESG performance patterns across firms. Together, these figures emphasise the nuanced and overlapping nature of ESG performance revealed by the GMM approach. The visualisations highlight how GMM captures companies with blended sustainability profiles that may not fit neatly into a single cluster, supporting a deeper understanding of ESG diversity within and across sectors.

4.3. Agglomerative Clustering

Agglomerative Clustering, a hierarchical approach, identified four clusters with clear distinctions in ESG performance. Cluster 3 comprises sustainability leaders with robust practices across all dimensions. Cluster 2 demonstrates strength in social and governance areas but only moderate environmental per-

formance. Clusters 0 and 1 include firms with lower ESG scores, particularly in energy and industrials, pointing to sector-specific sustainability challenges. The hierarchical structure reveals both high-level and sub-sector groupings (see Figure 6 and Figure 7).

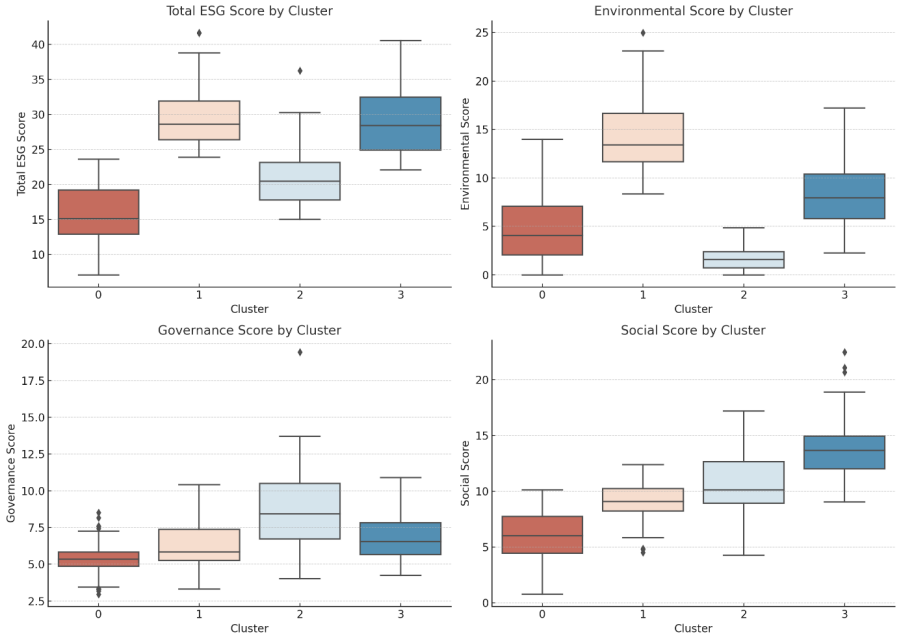

Figure 6. Distribution of ESG scores across clusters by Agglomerative Clustering

Source: own calculations based on LSEG data.

Figure 6 presents the distribution of Total ESG, Environmental, Governance, and Social scores for each cluster obtained through Agglomerative Clustering. The box plots show the central tendency and variability of ESG scores, allowing sustainability leaders and laggards to be identified. Clusters with higher medians and smaller interquartile ranges correspond to firms with more consistent ESG performance, while those with wider ranges indicate greater internal variability.

Figure 7 depicts the relationship between Total ESG Score and Environmental Score for all S&P 500 companies, with points coloured by Agglomerative Clustering membership. The plot reveals both distinct groupings and areas of overlap, reflecting the hierarchical and nested structure of clusters. This visualisation supports the interpretation of ESG performance differences across clusters and sectors, providing further context for the results shown in Figure 6. Across all methods, technology and healthcare firms consistently emerge as ESG leaders, whilst energy and industrial sectors face greater environmental

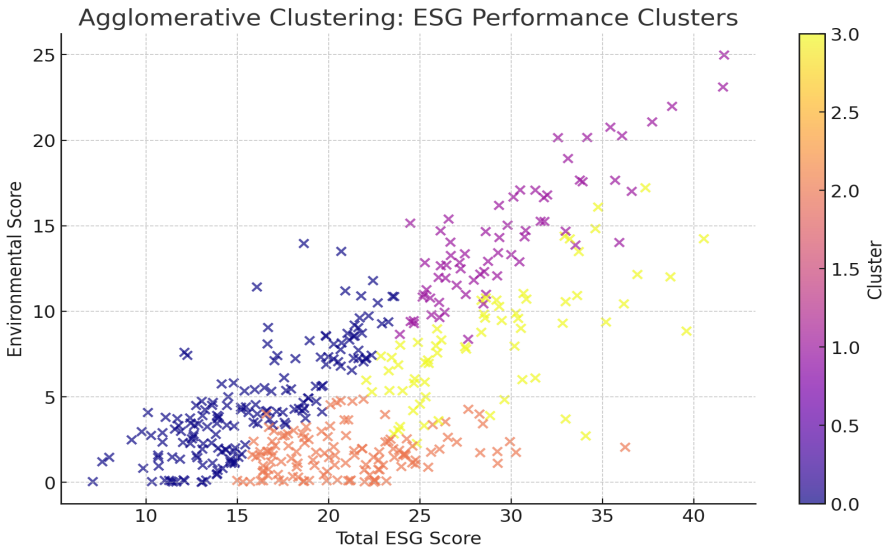

Figure 7. Scatter plot of total ESG score vs. environmental score by Agglomerative Clustering

Source: own calculations based on LSEG data.

and governance challenges. Each clustering approach highlights both commonalities and differences, supporting a nuanced understanding of sectoral sustainability performance.

4.4. Comparison of clustering models

To assess the effectiveness of the clustering algorithms, we used three standard evaluation metrics: the Silhouette Score, the Calinski-Harabasz Index, and the Davies-Bouldin Index. K-Means outperformed both GMM and Agglomerative Clustering across all metrics, forming more compact and well-separated clusters (see Table 3). The comparison of clustering models reveals that K-Means consistently outperformed GMM and Agglomerative Clustering across all three evaluation metrics, forming compact and well-separated clusters that effectively categorise companies based on their ESG performance. This suggests that S&P 500 companies exhibit distinct groupings in terms of their environmental, social, and governance practices, with K-Means emerging as the most effective tool for identifying these clusters. To evaluate clustering quality, we employed the following metrics:

Silhouette Score ($S(i)$): Measures the cohesion and separation of clusters, computed as:

$$S(i) = \frac{b(i) - a(i)}{\max\left(a(i), b(i)\right)} \tag{1}$$

where $a(i)$ is the average intra-cluster distance, and $b(i)$ is the minimum average inter-cluster distance.

Calinski-Harabasz Index (CH): Measures cluster separation and compactness:

$$CH = \frac{\text{Between-cluster dispersion}}{\text{Within-cluster dispersion}} \tag{2}$$

Davies-Bouldin Index (DB): Evaluates cluster distinctiveness:

$$DB = \frac{1}{N}\sum_{i=1}^{N}\max_{j\neq i}\left(\frac{\sigma_i + \sigma_j}{d_{ij}}\right) \tag{3}$$

where σ_i and σ_j represent within-cluster scatter and d_{ij} is the centroid distance between clusters. A higher Silhouette Score indicates that companies are more similar to their assigned cluster and distinct from other clusters, reflecting well-defined groupings. The Calinski-Harabasz Index evaluates the ratio of between-cluster dispersion to within-cluster dispersion, with higher values suggesting better-separated clusters. In contrast, the Davies-Bouldin Index measures the average similarity between each cluster and its most comparable cluster, where lower values indicate more distinct and well-separated clusters. These metrics provide a comparative assessment of clustering performance across different methods and reinforce K-Means' suitability for ESG analysis, particularly for investors and policymakers aiming to identify sustainability leaders and laggards. Table 3 presents the clustering performance comparison based on these evaluation metrics.

The results in Table 3 show that K-Means outperforms both GMM and Agglomerative Clustering across all evaluation metrics, producing more compact and well-separated clusters. These results indicate that S&P 500 compa-

Table 3. Clustering model performance metrics

Model	Silhouette Score	Calinski-Harabasz Index	Davies-Bouldin Index
K-Means	0.351	297.205	1.002
GMM	0.279	230.310	1.131
Agglomerative	0.270	226.378	1.210

Note: Higher values of Silhouette and Calinski-Harabasz Index indicate better-defined clusters. Lower Davies-Bouldin Index indicates better clustering quality.

Source: own calculations based on LSEG data.

nies exhibit distinct groupings in terms of ESG performance, with K-Means providing the clearest delineation of leaders and laggards. It is important to note that clustering metrics can be influenced by noise and outliers within the dataset. Variations in ESG scores, whether due to inconsistent reporting practices or external shocks, may impact clustering performance. To mitigate these effects, data preprocessing techniques such as normalisation and outlier removal were applied prior to clustering analysis. On the other hand, GMM's ability to form overlapping clusters may offer greater value in contexts where nuanced relationships between companies' ESG profiles are critical. By capturing companies that share characteristics across multiple ESG dimensions, GMM proves particularly beneficial for industries where environmental, social, and governance factors interact in complex ways. While Agglomerative Clustering is generally well-suited to hierarchical datasets, its effectiveness here was limited due to the absence of a clear hierarchical structure within the ESG metrics. Consequently, its clusters were less well-defined compared to those formed by K-Means and GMM.

4.5. Sector-specific analysis

A sector-specific analysis was conducted by mapping the ESG clusters against Global Industry Classification Standard (GICS) sectors. This comparison reveals pronounced differences in sustainability performance across industries. Technology and healthcare companies are predominantly represented in high-performing clusters, particularly with regard to governance and social responsibility. These sectors benefit from strong internal controls, transparent governance, and active employee and community engagement. The financial sector also demonstrates above-average ESG performance, particularly in governance.

In contrast, industrial and energy firms are more frequently grouped in lower-performing clusters, primarily due to environmental challenges such as high emissions and resource consumption. This underscores an urgent need for increased investment in clean technologies and more stringent sustainability measures in these sectors. Utilities display mixed results, with companies distributed across all ESG clusters, suggesting varying degrees of sustainability commitment within the sector. Figure 8 presents a combined visualisation of company distribution by sector and cluster assignments for K-Means, GMM, and Agglomerative Clustering. The consolidated figure enables clear cross-method comparison of sectoral ESG patterns and highlights both leading and lagging industries in sustainability performance.

Figure 8 presents the combined distribution of companies by sector and cluster assignment across the three clustering methods. The bar charts reveal

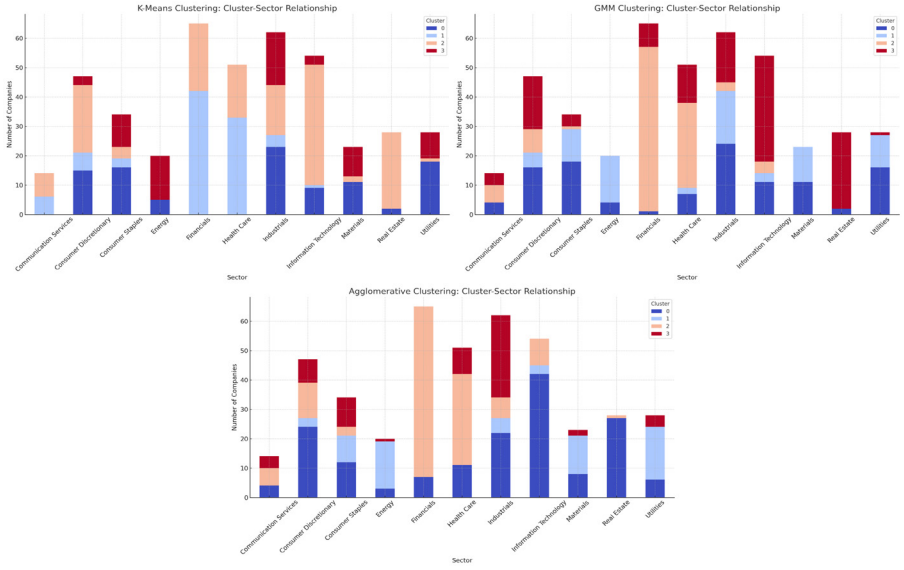

Figure 8. Combined distribution of companies across sectors and clusters for K-Means, GMM, and Agglomerative Clustering

Note: Each bar represents the percentage of companies from a sector falling into each ESG cluster.

Source: own calculations based on LSEG data.

clear sectoral patterns in ESG performance: technology and healthcare firms are concentrated in high-performing clusters, whilst industrials and energy are overrepresented in lower-performing groups. These results reinforce the importance of sector-specific ESG strategies and allow for direct comparison of sectoral cluster composition across methods. This sectoral comparison provides actionable insights for industry leaders, indicating where targeted sustainability improvements are most needed. The observed patterns reinforce the importance of tailored ESG strategies at the sector level, facilitating more effective resource allocation and regulatory focus.

Table 4 presents the sectoral distribution of ESG performance clusters as identified by K-Means, GMM, and Agglomerative Clustering.

The Table 4 results highlight clear trends: technology and healthcare firms are predominantly classified in high-performing ESG clusters, reflecting strong governance and social responsibility. In contrast, the industrial and energy sectors are overrepresented in low-performing clusters, emphasising ongoing challenges in environmental performance and the need for targeted investments in emissions reduction and sustainability practices. Notably, sectors such as real estate display high variability in cluster assignments across methods. The relatively homogeneous ESG scores within the real estate sector, confirmed by sector-level mean and median scores (Table 5), explain the inconsistent cluster classifications—particularly for clustering methods such

Table 4. Sector distribution of ESG performance clusters using K-Means, GMM, and Agglomerative clustering models

Sectors	*K*-Means Cluster 0	*K*-Means Cluster 1	*K*-Means Cluster 2	*K*-Means Cluster 3
Communication Services	0	6	8	0
Consumer Discretionary	15	6	23	3
Consumer Staples	16	3	4	11
Energy	5	0	0	15
Financials	0	42	23	0
Health Care	0	33	18	0
Industrials	23	4	17	18
Information Technology	9	1	41	3
Materials	11	0	2	10
Real Estate	2	0	26	0
Utilities	18	0	1	9
	GMM Cluster 0	**GMM Cluster 1**	**GMM Cluster 2**	**GMM Cluster 3**
Communication Services	4	0	6	4
Consumer Discretionary	16	5	8	18
Consumer Staples	18	11	1	4
Energy	4	16	0	0
Financials	1	0	56	8
Health Care	7	2	29	13
Industrials	24	18	3	17
Information Technology	11	3	4	36
Materials	11	12	0	0
Real Estate	2	0	0	26
Utilities	16	11	0	1
	Agg Cluster 0	**Agg Cluster 1**	**Agg Cluster 2**	**Agg Cluster 3**
Communication Services	4	0	6	4
Consumer Discretionary	24	3	12	8
Consumer Staples	12	9	3	10
Energy	3	16	0	1
Financials	7	0	58	0
Health Care	11	0	31	9
Industrials	22	5	7	28
Information Technology	42	3	9	0
Materials	8	13	0	2
Real Estate	27	0	1	0
Utilities	6	18	0	4

Note: The clustering results reveal distinct ESG patterns across sectors. Financials and Health Care are consistently grouped in separate clusters under all three models, indicating strong intra-sector homogeneity. In contrast, Industrials and Consumer Discretionary exhibit wider distribution across clusters, suggesting greater ESG performance variability within these sectors.

Source: own calculations based on LSEG data.

as K-Means that favour distinct group boundaries. Healthcare, by contrast, consistently demonstrates balanced ESG strength across all dimensions, whilst the financial and information technology sectors show pronounced strengths in governance.

Table 5 shows the mean and median ESG scores for each sector, confirming sectoral strengths and weaknesses identified through clustering. Technology, healthcare, and financials lead in overall ESG scores, whilst energy and industrials lag, particularly in the environmental dimension. These findings underscore the importance of sector-specific ESG strategies and targeted improvement efforts, especially for sectors facing regulatory and stakeholder pressure.

Table 5. Sectoral ESG performance: Mean and median scores

Sector	Mean ESG Score	Median ESG Score
Communication services	22.5	21.8
Consumer discretionary	25.3	24.7
Consumer staples	28.1	27.9
Energy	32.75	33.01
Financials	23.7	23.5
Health care	29.6	29.8
Industrials	26.8	26.5
Information technology	24.2	23.9
Materials	27.3	27.1
Real estate	20.9	20.7
Utilities	32.5	32.8

Note: Mean and median ESG scores are relatively aligned across most sectors, indicating consistent performance distributions. Energy and Utilities sectors display the highest ESG performance, while Real estate and Communication services rank lowest, highlighting sectoral disparities in sustainability practices.

Source: own calculations based on LSEG data.

Sectoral analysis based on Table 5 shows that Utilities and Energy have the highest mean ESG scores, reflecting both regulatory focus and significant investment in sustainability initiatives. The Financials and Information technology sectors also demonstrate strong ESG performance, particularly in governance and social aspects. In contrast, Communication services and Real estate report the lowest ESG scores, indicating areas where further sustainability measures and stakeholder engagement may be needed. Industrials and Materials present a more balanced or mixed ESG profile, which can be attributed to operational emissions and supply chain complexities. The close align-

ment between mean and median ESG scores within sectors suggests relatively normal distribution, although some internal variability remains, particularly among firms with lower compliance. These sectoral trends correspond with the clustering analysis in Table 6, where Utilities and Energy are predominantly classified in higher ESG clusters, while Communication services and Real estate appear more frequently in lower-performing clusters.

Table 6. Sector-wise ESG cluster distribution: percentage of companies in each cluster

Sector	Cluster 0 (%)	Cluster 1 (%)	Cluster 2 (%)	Cluster 3 (%)
Communication services	25	40	20	15
Consumer discretionary	30	35	25	10
Consumer staples	20	45	25	10
Energy	35	30	20	15
Financials	40	25	20	15
Health care	25	35	30	10
Industrials	30	30	25	15
Information technology	20	40	30	10
Materials	25	35	25	15
Real estate	30	30	25	15
Utilities	35	25	20	20

Note: Consumer staples and Information technology sectors show a strong presence in Cluster 1 (high ESG performance), whereas Real estate and Energy exhibit more even distribution across clusters, suggesting less ESG homogeneity.

Source: own calculations based on LSEG data.

The results presented in Table 6 indicate distinct ESG performance patterns across sectors. Utilities and Energy sectors are characterised by consistently high ESG scores, often appearing in clusters associated with lower risk and a stronger focus on sustainability. In contrast, Communication services and Real estate tend to exhibit lower ESG scores, indicating a need for further development in sustainability practices. The Consumer staples sector displays the highest membership in Cluster 1 (45%), which is associated with robust sustainability performance linked to ethical sourcing and governance. Information Technology is also strongly represented in high-performing clusters (40% in Cluster 1), reflecting sectoral strengths in innovation, transparency, and accountability. Health care maintains high ESG standards, supported by regulatory oversight and data security requirements. The Industrials and Materials sectors display more mixed ESG performance, with variability

reflecting differences in operational emissions and supply chain practices. ESG performance in Real estate is diverse, with some firms adopting green building standards, while others show lower efficiency. The Energy sector, despite investments in renewables, continues to face challenges related to fossil fuel dependency, as evidenced by a significant number of firms in lower-performing clusters. In the Financials sector, a high proportion of companies is found in the lowest-performing cluster (40% in Cluster 0), indicating ongoing issues with ESG disclosure and the alignment of financial practices with ESG principles. These patterns point to the importance of sector-specific reforms and regulatory initiatives to address persistent gaps in sustainability performance.

5. Discussion

Analysis of ESG performance across the S&P 500 using clustering algorithms highlighted distinct strengths and weaknesses within and across sectors. The results indicate that K-Means clustering most effectively distinguished between sustainability leaders and laggards, producing well-separated groups and enabling targeted assessment for investment and benchmarking purposes (Arnone et al., 2024; Yadav & Dhingra, 2016). The identified groupings correspond with the Resource-Based View (RBV), which associates unique resources—such as robust ESG capabilities—with sustained competitive advantage (Barney, 1991). The findings are also consistent with stakeholder theory, as high-performing firms exhibited responsiveness to stakeholder expectations regarding sustainability and governance (Freeman, 1984).

The Gaussian Mixture Model (GMM) identified nuanced and overlapping ESG profiles, capturing blended sustainability characteristics that are present in many companies (Aerts, 2020; Vinayavekhin et al., 2023). This approach was particularly relevant for analysing sectors or firms with less distinct ESG boundaries. The probabilistic nature of GMM, while providing flexibility, sometimes reduced the clarity of cluster assignments, making cross-company benchmarking more challenging (Choi & Yoon, 2023; Kinnunen et al., 2011). However, GMM remains valuable for identifying firms with hybrid ESG strategies or those undergoing organisational transition (Ma et al., 2023). Signalling theory may also be relevant in this context, as firms with evolving ESG practices may use disclosure to communicate intentions and attract investment (Spence, 1973).

Agglomerative Clustering was less effective in distinguishing well-defined groups within the S&P 500 ESG landscape. Although hierarchical clustering offers insight into nested structures and intra-sector relationships, its lower

performance in cluster distinctiveness (as indicated by the Davies-Bouldin Index) limited its utility for large, heterogeneous datasets (Bouguettaya et al., 2015; Wazarkar & Keshavamurthy, 2018). However, hierarchical methods may be more informative in sector-specific applications, where multi-level ESG relationships are more pronounced (Vichi et al., 2022).

Sectoral analysis contextualised these results further. Technology, healthcare, and consumer staples companies were typically classified as ESG leaders, with strong performance in governance and social responsibility, in line with previous findings on the benefits of transparent governance and active stakeholder engagement (Nakielski, 2023). The healthcare sector, in particular, demonstrated balanced ESG integration, including compliance, ethical practices, and employee well-being (Ratnam & Dominic, 2011). In contrast, industrial and energy sectors continued to face significant environmental challenges, such as high emissions and resource management issues, despite regulatory and stakeholder pressure (Janipour et al., 2022; Kanemoto et al., 2018). These persistent challenges underline the need for ongoing investment in clean technology and resource efficiency.

Considerable intra-sector variability was observed, especially within the financials and real estate sectors, where both ESG leaders and underperformers were present (Ko et al., 2022; Clément et al., 2022). This variation highlights the importance of company-level analysis to fully understand sector dynamics. The application of clustering models supports more nuanced investment and risk management strategies by distinguishing both sectoral and intra-sectoral differences (Zhong, 2023). Firms that improve ESG performance may benefit from reputational gains, better access to capital, and lower financing costs (Ma et al., 2023), while persistent underperformance can increase risk exposure and reputational challenges (Ehling et al., 2023).

Several limitations should be noted. The analysis focused exclusively on S&P 500 companies, potentially limiting the generalisability of the results to other markets. Applying these methods to international datasets could yield broader insights into ESG trends. The cross-sectional nature of the data also constrains assessment of temporal dynamics in ESG performance. Longitudinal studies may help identify trends and key drivers of ESG improvement or decline over time. Further research could also extend the clustering methodology to include additional ESG indicators such as carbon intensity, resource usage, or social impact. The choice of clustering method should align with the specific analytical goals and sectoral context to ensure meaningful and actionable ESG insights (Choi & Yoon, 2023; Ko et al., 2022; Vichi et al., 2022).

Conclusions

The ESG performance of S&P 500 companies was analysed using clustering algorithms, including K-Means, Gaussian Mixture Model, and Agglomerative Clustering. A systematic comparison of these methods and sectoral trends revealed key patterns in corporate sustainability and illustrated the utility of machine learning for ESG evaluation. Among the algorithms assessed, K-Means formed the most distinct clusters, supporting its use for segmenting companies by ESG metrics, while GMM identified nuanced and overlapping profiles. Agglomerative Clustering was less effective for broad ESG classification in large, diverse datasets.

Sectoral analysis indicated that technology and healthcare companies consistently lead in ESG performance, characterised by strong governance and social responsibility. In contrast, industrial and energy firms were frequently associated with environmental challenges, particularly in emissions and resource efficiency. These results point to the need for targeted sustainability measures and regulatory compliance in sectors with persistent challenges. The financial sector also contributes to shaping ESG outcomes, with responsible finance and transparency initiatives affecting sustainability standards across industries.

The application of machine learning-based clustering supports transparent, data-driven ESG assessment and can inform strategic decision-making for investment, governance, and sustainability. Future studies could apply these methods to international samples, examine temporal changes in ESG performance, or explore sectoral interactions.

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Gender diversity in corporate boards and firm risk-taking: Evidence from Pakistan

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Abstract

Using annual data from 49 publicly listed non-financial firms from January 2011 to December 2022, this study investigates how board gender diversity affects firm risk-taking behaviour in Pakistan. We use the exogenous shock introduced by the Securities and Exchange Commission of Pakistan (SECP) through the Companies Act in 2017, mandating the inclusion of at least one female director on corporate boards in Pakistan. To address endogeneity, we employ the Two-stage Least Squares (2SLS) and Two-stage Residual Inclusion (2SRI) estimations and validate the findings with the Difference-in-Differences (DiD) and Markov Switching (MS) models. The results indicate that greater female board representation correlates significantly with lower financial leverage and reduced earnings volatility. These results suggest that mandated gender diversity can shape strategic decisions that can help mitigate firm-level financial risk.

Keywords

- board diversity
- risk
- leverage
- capital allocation efficiency
- Difference-in-Differences
- Markov Switching

JEL codes: G32, G34, J16

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Introduction

Gender diversity in boardrooms has often concerned regulators, leading them to mandate quotas for women (Labelle et al., 2015). In 2017, the Securities Exchange Commission of Pakistan (SECP)[3] passed the Companies Act, mandating publicly listed firms in Pakistan to have at least one female director on their corporate boards within a three-year time frame.[4] However, there is limited research on the effect of board gender diversity in the Pakistani market on the risk-taking behaviour of businesses, particularly in the aftermath of this legislation. This study investigates how an increase in the proportion of female members on corporate boards affects firm risk-taking in Pakistan.

Why would a gender-diverse board take more or less risk compared to a board with no gender diversity? We attribute this to the Group Dynamics theory (Lewin, 1947; Murphy & McIntyre, 2007), which suggests that the interactions, behaviours, and decision-making processes taking place within a group are influenced by its composition, roles, and group norms. In the context of businesses, this theory helps explain how the inclusion of female directors in corporate boards can influence firm risk-taking. Gender-diverse boards may introduce different perspectives and decision-making styles, leading to more comprehensive discussions and potentially more cautious or balanced risk assessments. Therefore, it is likely that gender-balanced boards would display less extreme risk-taking behaviour, due to greater diversity in viewpoints.

We sample annual data from January 2011 to December 2022 of all public companies (excluding financial sector firms) listed on the Pakistan Stock Exchange (PSX). To evaluate the magnitude of the risk-taking behaviour of firms, we employ four key variables: (1) leverage, (2) earnings volatility, (3) capital allocation efficiency, and (4) idiosyncratic return volatility. Financial leverage is widely used in the literature as a proxy for risk[5]. This is because higher leverage may lead to the management taking additional risks to placate shareholders. Similarly, a smooth earnings pattern may reflect low firm risk-taking (Jayaraman, 2008). In addition, a firm's efficiency of capital allocation may reflect its risk-taking nature. This is because firms that are too risk-averse may fail to invest in positive net present value projects. As such, we follow the literature by taking the ratio of capital investments to total assets as a measure of firm risk (Faccio et al., 2016; Wurgler, 2000). Finally, we include a market-based measure, i.e. idiosyncratic volatility to measure firm risk (Huang & Kisgen, 2013; Lenard et al., 2014).

[3] The Securities and Exchange Commission of Pakistan (SECP) is the primary regulator of the corporate sector and capital markets in Pakistan.

[4] The Companies Act, 2017 governs the regulation of companies in Pakistan. See (Securities and Exchange Commission of Pakistan, 2017).

[5] See (Baxter, 1967; Leland, 1998; Matsa & Miller, 2013; Sila et al., 2016).

Results reveal that the enhanced female board membership in Pakistani firms after enforcement of the Companies Act 2017 led to a significant decline in leverage and earnings volatility. The findings are consistent with prior studies stating that board gender diversity is associated with lower firm risk. However, we do not find a significant impact of female board participation on capital allocation efficiency and idiosyncratic volatility. The outcomes could be attributed to two main factors. Firstly, capital allocation decisions typically unfold over several years. Secondly, while boards typically oversee major capital allocation policies, the detailed investment decisions and factors influencing stock return volatility are often managed by the firm's executive management and shaped by market dynamics, limiting the board's direct involvement.

To address endogenous omitted variable bias, we apply the Two-Stage Least Squares (2SLS) and Two-Stage Residual Inclusion (2SRI) models. Furthermore, we test our results for robustness by using the Difference-in-Differences (DiD) method, which compares firm risk from periods before and after enforcement of the Companies Act 2017. Additionally, we use the Markov Switching (MS) model to evaluate whether the introduction of the Act leads to separate regimes, each having significantly different levels of firm risk. The results remained consistent after applying each model, underscoring the importance of gender diversity in corporate boards in the context of firm risk.

This study contributes to the literature by extending Group Dynamics theory to a regulatory and emerging market context. We argue that mandated gender diversity not only changes board composition but also alters boardroom interaction and decision-making processes. By focusing on mandated diversity rather than voluntary adoption, our study offers a new theoretical perspective on how external regulatory shocks interact with internal board dynamics to influence firm behaviour. We further integrate board diversity into classical frameworks of capital structure and risk-taking, such as those introduced by Baxter (1967) and Leland (1998), which emphasise the role of leverage in firm risk. While studies like Faccio et al. (2016) and Bernile et al. (2018) have explored gender and risk, this is the first to examine how regulatory reforms that mandate board diversity shape capital structure decisions in Pakistan. Our study addresses this gap and opens new lines of inquiry into how diversity impacts boardroom risk management.

Building on this theoretical foundation, our study contributes empirically by analysing how a regulatory mandate for board gender diversity influences firm-level risk-taking, using a natural experiment in a developing market. Most prior studies have focused on firm performance in developed markets; we shift attention to firm risk outcomes, namely, leverage, earnings volatility, capital allocation efficiency, and idiosyncratic return volatility. This focus allows us to evaluate whether gender-diverse boards influence not just how firms perform, but also how they manage and absorb risk, thereby enriching the current understanding of board governance mechanisms.

Section 1 reviews the literature and develops hypotheses on the proportion of female directors on corporate boards and its impact on leverage and capital allocation efficiency. Section 2 presents the sample and summary statistics of the variables. Section 3 elaborates on the models and discusses the initial results. Next, Section 4 presents the results of the robustness tests. Finally, we conclude and summarise the implications of this study and discuss its limitations.

1. Literature and hypothesis development

Women are less likely than men to take risks (Byrnes et al., 1999; Hinz et al., 1997; Weber et al., 2002). According to Weber et al. (2002), women avoid risky behaviour and perceive higher risk in the "financial, ethical, safety, health, and recreational domains" than men. On the other hand, women believe that the social domain is less risky.

Recent psychological research affirms that women exhibit greater risk aversion than men across financial and strategic domains. For instance, Filippin and Crosetto (2016) conduct a meta-analysis confirming consistent gender differences in risk preferences, particularly in contexts involving ambiguity and loss. Buser et al. (2017) show that women are less likely to engage in competitive environments due to higher sensitivity to risk and uncertainty. Moreover, a recent neuroimaging study by Chen et al. (2025) highlights that emotional states may be more significant drivers for females in their reasoning tasks, which could partially explain divergent responses to risk-related stimuli across genders. These psychological insights support the premise that gender-diverse boards may adopt risk-averse financial strategies, a tendency that is shaped in part by board culture, which plays a critical role in firm performance (Evans, 2010).

In the context of Pakistan, few studies directly explore the relationship between board gender diversity and firm risk. For instance, Tabassum et al. (2023) examine the influence of CEO gender on corporate risk-taking and capital allocation efficiency in Pakistan, finding that female CEOs are associated with more conservative decision-making. Similarly, Nadeem et al. (2019) report that female board representation in Pakistani firms moderates the risk-return relationship, suggesting a risk-reducing effect of board diversity. Umer et al. (2020) find evidence of a negative relationship between board gender diversity and earnings management. In turn, Amin et al. (2022) show that female presence on board helps mitigate principal-agent conflict. Despite these contributions, most studies overlook the regulatory context introduced by the Companies Act 2017. This study addresses this gap by examining risk-taking behaviours considering mandated board diversity, thus offering a regulatory perspective.

Schopohl et al. (2021) assert that female CFOs can effectively reduce leverage in firms with diverse boards. Levi et al. (2014) suggest that male-only boards are more likely to engage in riskier activities, such as mergers and acquisitions. This is complemented by Sila et al. (2016) finding a negative impact of women directors on firm risk. According to Faccio et al. (2016), companies with female CEOs exhibit lower levels of debt and less volatile earnings, making them less risky. In contrast, Krystyniak & Staneva (2024) do not find evidence that female CFOs influence capital structure decisions. Consequently, we hypothesise the following:

H1: An increase in the proportion of female directors on corporate boards in Pakistan leads to a decline in firm leverage.

Another important measure of firm risk-taking is earnings volatility (Jayaraman, 2008). Peni & Vahamaa (2010) show evidence of decreased earnings management by firms with female CFOs. Earning management may be a key driver of earnings volatility, as it can disrupt the stability of a firm's earnings pattern. Krishnan and Parsons (2017) conclude that gender diversity in senior management helps improve earnings quality. In a similar study, Srinidhi et al. (2011) find that female participation in boards improves the quality of earnings. Attia et al. (2024) complement the findings by investigating the Egyptian market. Given the evidence in the literature on the impact of female board participation on earnings quality and stability, we expect a similar relationship to hold in the context of Pakistani firms. Accordingly, we propose the following hypothesis:

H2: An increase in the proportion of female directors on corporate boards in Pakistan leads to a decline in firm earnings volatility.

Several studies analyse the correlation between board gender diversity and capital allocation efficiency. Guizani & Abdalkrim (2022) examine firms in the Malaysian market and find that board gender diversity is positively associated with efficient cash flow allocation. Nadeem et al. (2017) show that the efficiency of intellectual capital in Chinese firms is not significantly affected by gender diversity in the boardroom. According to the study, stereotypes about gender are still prevalent in China, and the country's regulators would be advised to consider enforcing limited gender-related laws. Baik et al. (2024) use a global catalog of 83 board gender diversity interventions that were put into place in 59 countries between 1999 and 2021 to examine the impact of diversity on investment outcomes. Their findings suggest that interventions, like mandatory quotas, enhance investment outcomes by diminishing inefficient investment and augmenting the probability of above-median investment efficiency.

Hence, we investigate whether board gender diversity in Pakistani firms impacts capital allocation efficiency, which we take as the third measure of risk. Given the findings of prior studies, we hypothesise the following:

H3: An increase in the proportion of female directors on corporate boards in Pakistan leads to a decline in firm capital allocation efficiency.

While the preceding three hypotheses examine the impact of board gender diversity on internal firm outcomes—namely leverage, earnings volatility, and capital allocation efficiency—we also assess whether governance dynamics extend to how firms are perceived in financial markets. Idiosyncratic volatility, a market-based measure of firm-specific risk, captures how investors respond to firm-level information beyond broader market movements. Bekaert et al. (2025) discuss how the literature on expected idiosyncratic volatility should be helpful in risk management. Cho et al. (2024) find mixed results regarding board diversity and stock price crash risk. Studies by Huang and Kisgen (2013) and Lenard et al. (2014) suggest that female participation in boards is associated with lower variability of stock market return. Accordingly, we propose the following hypothesis:

H4: An increase in the proportion of female directors on corporate boards in Pakistan leads to a decline in firm's idiosyncratic return volatility.

2. Data and statistics

2.1. Sample

The sample for this study was constructed by initially selecting all non-financial firms listed on the Pakistan Stock Exchange (PSX) during the period from January 2011 to December 2022. We excluded firms in the financial, utilities and real estate sectors to maintain consistency in financial reporting structures and also because firms in these sectors operate under different regulatory environments. This initial screening focuses the scope of the study on non-financial firms only.

From this refined group, we further excluded firms with missing governance data, particularly those without available information on the percentage of female directors and governance pillar scores, which were obtained from Bloomberg Professional. Financial data such as leverage, return on assets, and capital expenditure were retrieved from Refinitiv Eikon. The records from both databases were matched using firm identifiers. After excluding firms with incomplete records across the key variables used in the analysis, our final sample comprised 49 firms, resulting in 221 firm-year observations used in the main multivariate analysis. The number of observations varies across different parts of the analysis depending on data availability for each risk measure.

2.2. Variables

To capture firm risk-taking, we use four proxies: leverage ratio (*LRATIO*), earnings volatility (*ROA_vol*), capital allocation efficiency (*CAPEX*), and idiosyncratic return volatility (*Ret_vol*). The leverage ratio is a widely employed financial risk indicator, as higher leverage may incentivise riskier strategies to satisfy equity holders (Faccio et al., 2016; Nadeem et al., 2019; Sila et al., 2016). Earnings volatility (*ROA_vol*), reflecting the 2-year standard deviation of the annual return-on-assets ratio, serves as an indicator of internal performance risk and is linked to the firm's earnings management behaviour. Greater earnings smoothness typically reflects lower risk-taking and more conservative financial policies (Jayaraman, 2008; Peni & Vähämaa, 2010; Srinidhi et al., 2011).

Capital allocation efficiency, measured as the ratio of capital expenditure to total assets (*CAPEX*), reflects the firm's willingness to invest in potentially high-return projects. Firms that are excessively risk-averse may underinvest, thus lower *CAPEX* may signal conservative risk-taking behaviour (Faccio et al., 2016; Wurgler, 2000). Finally, idiosyncratic return volatility (*Ret_vol*), based on residuals from a CAPM regression, captures market-perceived firm-specific risk. This measure has been used to proxy investor uncertainty and firm-level risk independent of market trends (Huang & Kisgen, 2013; Kim & Kim, 2016; Lenard et al., 2014). We follow Kim and Kim (2016) by using the equation below to calculate idiosyncratic volatility:

$$R_i - R_f = \beta_i (R_m - R_f) + \xi_i \quad (1)$$

Ret_vol is calculated by taking the 1-year rolling standard deviation of the error term, ξ_i. The reason for keeping a 1-year rolling window for *Ret_vol* (versus a 2-year window for *ROA_vol*) is twofold: (1) the *Ret_vol* is calculated using daily data from stock and market index returns, and (2) *ROA_vol* is based on accounting records that depend on management efficiency, which tends to change more gradually.

Our primary independent variable is WDIR, representing the number of female directors as a ratio of total board members. For robustness, we add a binary variable (*WoB*), indicating the presence of a female director. We control for firms' governance practices by taking the governance pillar score (*GS*) of their Environmental, Social, and Governance (*ESG*) rating. This is calculated by taking the weighted sum of the scores from board diversity, executive compensation, and risk management performance[6]. Variables definitions are presented in Table 1.

[6] Bloomberg Governance Scores' calculation methodology can be seen in Bloomberg (2021).

Table 1. Variable definitions

Variables	Descriptions
WDIR	percentage of women on boards of directors in sample firms
WoB	binary variable indicating the presence of female director(s) on board
LRATIO	measure of firm financial risk; calculated as follows: $LRATIO = \frac{total\ debt}{total\ assets}$
ROA_vol	earnings volatility calculated by taking the 2-year standard deviation of ROA
CAPEX	measure of firm capital efficiency; calculated as follows: $CAPEX = \frac{capital\ expenditure}{total\ assets}$
Ret_vol	idiosyncratic volatility calculated by taking the 1-year rolling standard deviation of residuals from the CAPM model shown in Equation 1
AIR	annual interest rate in percentage
PUR	annual political uncertainty level in Pakistan extracted from index by Choudhary et al. (2020)
ROA	annual return-on-assets ratio extracted from financial statements
MBV	annual market-to-book ratio extracted from financial statements
GS	governance pillar score generated from the cumulative ESG score
GROWTH	firm growth measured by change in total assets; calculated as follows: $GROWTH = \frac{total\ assets_{t+1}}{total\ assets_t} - 1$
TANG	asset tangibility measured by the ratio of plant, property, and equipment to total assets
TAX	annual tax rate applicable to the respective firm

Source: own work.

2.3. Summary statistics

Table 2 displays the variables' summary statistics. The variable WDIR has a mean of 11.17, suggesting that, on average, firms in Pakistan employed around 10.6% women on boards. There is also little variation in this trend, evident from standard deviation of 8.5. This is an indication of weak tendency of having female directors among businesses in the country.

The *LRATIO* variable has a mean of around 36% albeit with wider variation. This is an indication that the leverage ratio might have fluctuated during the sample period potentially after the enforcement of the Companies Act 2017. Similarly, the measure for earnings volatility (*ROA_vol*) displays a high

Table 2. Descriptive statistics

Variable	Observations	Mean	Standard deviation	Min	Max
Dependent variables					
LRATIO	395	35.805	64.462	0	354.7
ROA_vol	368	4.112	3.959	0.085	23.341
CAPEX	302	0.049	0.048	0	0.387
Ret_vol	450	0.019	0.005	0.008	0.035
Independent variables					
WDIR	489	10.583	8.496	0	50
WoB	489	0.755	0.431	0	1
AIR	477	9.063	3.295	5.5	16
PUR	477	96.198	40.713	52.128	198.529
ROA	408	10.837	9.489	–14.48	70.26
MBV	408	3.541	12.604	–61.54	133.3
GS	320	3.497	0.516	2.1	4.77
GROWTH	409	0.162	0.252	–0.33	1.275
TANG	393	0.343	0.2	0	0.856
TAX	384	32.153	50.842	0.01	924.05

Note: Summary statistics of dependent and independent variables used in the study with annual data starting January 2011 until December 2022 of sample firms from Pakistan. The statistics are based on the final set of 49 non-financial firms using all available firm-year observations. Variable definitions are given in Table 1.

Source: Refinitiv Datastream, Bloomberg Professional.

degree of variation. In contrast, the variables *CAPEX* and *Ret_vol* show little variation. This could imply that the inclusion of females on corporate boards may not have had a significant effect on factors determined by management, although this needs further analysis to validate. For the purposes of brevity, we do not discuss the other variables.

To examine how board gender diversity evolved over the sample period, we present the proportion of firms with no female directors, compared to those with at least one female director and those with multiple female directors in Table 3. The first column (no female directors) shows a declining trend, particularly from 2015 onward, when the ratio falls below 50%. This suggests that by 2015, more than half of the sample firms had appointed at least one female director. We conclude that the years leading up to 2017 witnessed a gradual increase in the female presence on corporate boards in Pakistan, a period during which the proposed law was likely under deliberation.

Table 3. Board gender diversity

Year	Board diversity		
	no women	1 woman	multiple women
2011	37 (75%)	8 (17%)	4 (8%)
2012	36 (73%)	9 (19%)	4 (8%)
2013	35 (71%)	9 (19%)	5 (10%)
2014	26 (54%)	20 (40%)	3 (6%)
2015	22 (44%)	23 (48%)	4 (8%)
2016	13 (27%)	32 (65%)	4 (8%)
2017	10 (21%)	35 (71%)	4 (8%)
2018	6 (13%)	39 (79%)	4 (8%)
2019	5 (10%)	38 (77%)	6 (13%)
2020	3 (6%)	39 (79%)	7 (15%)
2021	2 (4%)	39 (79%)	8 (17%)
2022	4 (8%)	34 (69%)	11 (23%)

Note: Table shows board composition in the sample by listing the number and proportion (in parentheses) of firms with either no female directors, only one female director, or multiple female directors on the respective boards.

Source: Bloomberg Professional.

3. Multivariate analysis

3.1. Empirical model

To investigate the effect of female directors on our measures for firm risk-taking, we employ the following regression model:

$$(Risk\text{-}taking)_{it} = \alpha + \beta_1 X + \gamma_t + \psi_{it} \quad (2)$$

The dependent variables in Equation 2 are the four risk-taking measures, namely leverage ratio ($LRATIO$), earnings volatility (ROA_vol), capital allocation efficiency ($CAPEX$), and idiosyncratic volatility (Ret_vol) for firm i at in year t. Matrix X includes the independent variable $WDIR$ along with control variables. Matrix γ_t represents year fixed effects and ψ_{it} represents the error term. The models employ robust standard errors, which are clustered across industry.

Our methodological choices are guided by the need to address endogeneity, regulatory shocks, and non-linear dynamics. The 2SLS approach accounts for omitted variable bias by instrumenting board diversity with governance scores (GS), which influence diversity but are plausibly exogenous to risk decisions. For binary diversity measures, we use 2SRI, following Terza et al. (2008).

3.2. Results

Table 4 reports 2SLS and 2SRI regression results using Equation 2, taking *LRATIO* as the proxy for risk-taking. We also estimated the model using the Generalised Method of Moments (*GMM*). Since *GMM* estimates were consistent with those of 2SLS, we do not present them here for brevity.[7] Column 1 lists the coefficients under 2SLS estimation, showing a negative and significant

Table 4. Regression analysis for H1

Variables	*LRATIO* (2SLS)	*LRATIO* (2SRI)
WDIR	–4.055**	
	(1.863)	
WoB		18.167
		(30.209)
AIR	–27.924	3.796
	(28.497)	(8.695)
PUR	1.743	–0.279
	(1.774)	(0.542)
MBV	2.987***	–1.114**
	(0.417)	(0.487)
ROA	–1.590**	3.027***
	(0.806)	(0.498)
GROWTH	11.991	10.350**
	(8.506)	(4.648)
TANG	139.933***	103.316***
	(25.844)	(29.453)
TAX	–0.031	0.019
	(0.138)	(0.038)
λ		–8.837
		(15.010)
Constant	154.459	–20.214
	(133.219)	(50.914)
Observations	221	221

Note: Results from 2SLS (Column 1) and 2SRI (Column 2) panel regressions using the model in Equation 2. Standard errors are clustered across industry. Year fixed effects are applied. *LRATIO* is the dependent variable. Variable *GS* is used as an instrument determining *WDIR* and *WoB*. Variable λ represents the control function (Mills ratio) from the 2SRI model. Probability of estimates greater than standard test statistics is provided in parentheses with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own calculations.

[7] The results are available upon request.

relationship between *WDIR* and *LRATIO*. The result suggests that a higher female proportion on corporate boards has coincided with a decline in firms' leverage. Specifically, a 1% increase in board gender diversity corresponds to a 0.04 unit (or 4%) reduction in the leverage ratio, on average. The results support H1 and the findings from Sila et al. (2016), Nadeem et al. (2019), and Faccio et al. (2016).

Column 2 in Table 4 reports 2SRI estimation results. The coefficient of *WoB* is not statistically significant. In conjunction with Column 1 results, we conclude that while the proportion of female directors on corporate boards has a significant effect on firm risk-taking behaviour, the presence of merely a single female director has no impact.

Table 5. Regression analysis for H2

Variables	*ROA_vol* (2SLS)	*ROA_vol* (2SRI)
WDIR	–0.765*	
	(0.430)	
WoB		–23.711**
		(10.628)
AIR	0.396*	–0.693
	(0.234)	(0.801)
PUR	–0.022	0.045
	(0.016)	(0.050)
MBV	–0.011	0.021
	(0.106)	(0.036)
L.ROA	0.049	–0.051
	(0.057)	(0.033)
L.GROWTH	0.625	0.538
	(2.027)	(1.091)
TANG	1.140	–1.104
	(3.253)	(2.402)
TAX	0.023	0.002
	(0.019)	(0.004)
λ		13.370**
		(6.185)
Constant	13.624**	26.153**
	(6.170)	(10.316)
Observations	197	197

Note: Results from 2SLS (Column 1) and 2SRI (Column 2) panel regressions using the model in Equation 2. Standard errors are clustered across industry. Year fixed effects are applied. *ROA_vol* is the dependent variable. Variable *GS* is used as an instrument determining *WDIR* and *WoB*. Variable λ represents the control function (Mills ratio) from the 2SRI model. Probability of estimates greater than standard test statistics is provided in parentheses with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own calculations.

Table 5 reports the results using earnings volatility as the measure for risk-taking. The two columns show negative and significant estimates for *WDIR* and *WoB*. Specifically, a 1% increase in the proportion of women directors is associated with a 0.765% decrease in the 2-year *ROA* volatility, on average; in addition, firms with at least one woman on board have, on average, a 23.7% lower *ROA* volatility than firms with no female directors. The results from both measures (*LRATIO* and *ROA_vol*) suggest that board gender diversity influences factors directly shaped by board decisions, such as firm leverage level and earning management.

Table 6 reports regression results using 2SLS and 2SRI estimations applied using Equation 2. Column 1 shows an insignificant estimate for *WDIR*, while

Table 6. Regression analysis for H3

Variables	*CAPEX* (2SLS)	*CAPEX* (2SRI)
WDIR	0.0194	
	(0.0313)	
WoB		0.1569*
		(0.0882)
AIR	0.0815	–0.0100
	(0.1859)	(0.0196)
PUR	–0.0050	0.0008
	(0.0116)	(0.0012)
MBV	0.0028	–0.0002
	(0.0070)	(0.0010)
L.ROA	–0.0024	0.0000
	(0.0042)	(0.0004)
L.GROWTH	0.0289	–0.0010
	(0.0509)	(0.0195)
TANG	–0.0429	0.1266**
	(0.2480)	(0.0645)
TAX	0.0001	0.0000
	(0.0003)	(0.0001)
λ		–0.0900*
		(0.0464)
Constant	–0.5085	–0.0994
	(1.0225)	(0.1010)
Observations	160	160

Note: Results from 2SLS (Column 1) and 2SRI (Column 2) panel regressions using the models in Equation 2. Standard errors are clustered across industry. Year fixed effects are applied. *CAPEX* is the dependent variable. Variable *GS* is used as an instrument determining *WDIR* and *WoB*. Variable λ represents the control function (Mills ratio) from the 2SRI model. Probability of estimates greater than standard test statistics is provided in parentheses with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own calculations.

Column 2 shows a positive *WoB* coefficient significant at the 10% level. This indicates that the proportion of female directors has no significant effect on capital allocation efficiency, with only weak evidence suggesting an increase. Most coefficients are not statistically significant, potentially owing to little variation in *CAPEX*. We conclude that the results do not support H3.

Next, we use the model in Equation 2 to estimate the effect of board gender diversity on idiosyncratic volatility of stock returns. Table 7 illustrates that the relationship is insignificant i.e., the proportion of female directors does not affect the stock return volatility. The results from Tables 6 and 7 suggest that board gender diversity is not a significant determinant of factors that are likely not directly influenced by board decision, such as capital allocation effi-

Table 7. Regression analysis for H4

Variables	*Ret_vol* (2SLS)	*Ret_vol* (2SRI)
WDIR	–0.018	
	(0.025)	
WoB		–0.006
		(0.006)
AIR	–0.096***	–0.011
	(0.016)	(0.037)
PUR	0.006***	0.001
	(0.001)	(0.002)
MBV	0.007	0.0001
	(0.006)	(0.000)
ROA	–0.018***	–0.0002***
	(0.005)	(0.0001)
GROWTH	0.162	0.001
	(0.145)	(0.001)
TANG	0.061	–0.002
	(0.574)	(0.005)
TAX	0.002	0.000
	(0.001)	(0.000)
λ		0.004
		(0.003)
Constant	2.317***	0.063
	(0.371)	(0.13)
Observations	201	201

Note: Results from 2SLS (Column 1) and 2SRI (Column 2) panel regressions using the models in Equation 2. Standard errors are clustered across industry. Year fixed effects are applied. *Ret_vol* is the dependent variable. Variable *GS* is used as an instrument determining *WDIR* and *WoB*. Variable λ represents the control function (Mills ratio) from the 2SRI model. Probability of estimates greater than standard test statistics is provided in parentheses with *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Source: own calculations.

ciency and idiosyncratic volatility. While capital efficiency may be considered in board meetings, it takes several years to evolve. Thus, further evidence is needed to better understand this relationship.

We note that the number of observations differs across results presented in regression estimations. In the case of the specification using the 2-year rolling standard deviation for ROA_vol as the dependent variable presented in Table 5, the sample size is reduced. In Table 6, we attribute this to missing data. Specifically, the $CAPEX$ variable has relatively more missing observations, leading to a smaller effective sample size in that regression. Similarly, some of the missing annual beta records led to reduced observations in Table 7. We ensure that each regression includes only complete cases for all variables involved.

There are two key takeaways from the multivariate regression results. Firstly, board gender diversity leads to lower firm risk when it is measured by financial leverage and earnings volatility. Secondly, both governance and macroeconomic factors make little impact on firms' capital allocation and their idiosyncratic returns, which is evident from the insignificant coefficients in Tables 6 and 7. Given the results, we infer that gender diversity is an effective determinant of factors directly affected by board decisions.

4. Robustness tests

To ensure the reliability of our results, we conduct additional robustness tests, including the Difference-in-Differences method and the Markov Switching model. The former helps isolate the causal impact of the Companies Act 2017 by comparing treated and control groups over time, while the Markov Switching model accounts for potential regime shifts in firm risk-taking behaviour.

4.1. Difference-in-Differences (DiD)

We employ the Difference-in-Differences (DiD) method as an additional empirical test. The DiD approach allows us to compare changes in firm risk before and after the Companies Act 2017 while controlling for time-invariant firm characteristics and macroeconomic environment. DiD helps mitigate concerns about endogeneity and omitted variable bias. This robustness check strengthens our causal interpretation by isolating the effect of the regulation from broader trends that could independently influence firm risk-taking. The

DiD method compares the variations in outcome means between the control and treatment groups over time to determine the average treatment effect on the treated group. This method accounts for variables such as group composition and unobservable time that may affect how the treatment affects the result.

We first apply the DiD model to LRATIO to assess whether there is a significant difference in the leverage ratio after the mandate of having at least one female director. The control group has no female directors on board, while the treatment group has at least one. The chosen period included the sample years prior to and following the year 2019.

While the Companies Act 2017 and SECP's Code of Corporate Governance mandated the inclusion of at least one woman on the board, firms were allowed until the end of their current board term to comply. Since board terms in Pakistan typically span three years, it is reasonable to treat 2019 as the first post-treatment year in our DiD analysis, given that the three-year term would be completed by the end of year 2019 or early 2020 (since the law was passed in May 2017). This timing reflects the period during which a significant number of firms would be transitioning to compliance, allowing us to capture meaningful changes in governance outcomes. Some firms would have complied early, some in 2019, and others just before the final compliance deadline in May 2020 (also evident from Table 3). Hence, the treatment year 2019 represents a reasonable point in the compliance window.[8]

We generate three variables for this test: *Time*, *Treated* and *did*. The binary variable *Time* indicates the period before and after treatment; here, it takes the value 0 for years before 2019 and 1 otherwise. The binary variable *Treated* identifies firms affected by the regulation. Hence, it equals 1 for firms with more than 1 female director and 0 for the remaining firms. The variable *did* is an interaction term between *Time* and *Treated*, capturing the differential change in firm risk-taking behaviour for treated firms relative to control firms after the enforcement of the Act starting in 2019.

$$(Risk\ taking)_{it} = \alpha + \beta_1\, Time_t + \beta_2\, Treated_i + \beta_3\, did_{it} + \beta_4 X_{it} + \gamma_t + \delta_{it}$$

The *did* coefficient represents the causal effect of the regulation on firm risk-taking measures. X_{it} is the vector of firm-level control variables. Year-fixed effects and industry-wise clustering are applied.

Table 8 reports the findings of the DiD regression. Column 1 shows the effect on leverage. The coefficient for variable *Time* is not significant. This suggests that external factors like macroeconomic trends or firm characteristics did not affect firm leverage significantly during the sampled period. However,

[8] We obtain broadly consistent results, albeit with minor variations, when estimating the DiD model using 2020 as the treatment year. The results are available upon request.

the variable *Treated* has a positive and significant coefficient. This implies that, on average, firms with female directors prior to the passing of the Companies Act 2017 had a significantly higher leverage compared to control firms. The *did* term is negative and significant at the 5%, suggesting that treated firms significantly lowered their leverage levels post the regulation.

Table 8. Difference-in-Differences (DiD) testing H1–H4

Variables	*LRATIO*	*ROA_vol*	*CAPEX*	*Ret_vol*
Time	2.960	1.7716	–0.0272	–0.0863
	(17.686)	(2.5980)	(0.0178)	(0.2458)
Treated	15.585**	–1.1058**	–0.0117	0.1781*
	(7.616)	(0.4762)	(0.0149)	(0.1012)
DiD	–16.389**	–1.6267	0.0368	–0.1159
	(7.812)	(1.1999)	(0.0224)	(0.2224)
Constant	74.896**	4.8949	–0.0543	2.2625***
	(30.207)	(3.3628)	(0.0885)	(0.3671)
Observations	221	210	160	214

Note: DiD results show the average difference in risk-taking measured by firm leverage (Column 1), earnings volatility (Column 2), capital efficiency (Column 3), and idiosyncratic volatility (Column 4) before and after the implementation of the Companies Act 2017 mandating women directors on corporate boards. Control variables are not shown for brevity. The difference is observed after 2019 given the flexibility by the SECP.

Source: own calculations.

In Column 2, the estimates show the effect on earnings volatility. The *Time* variable continues to have insignificant estimate, while the *Treated* variable has a positive and significant coefficient. Although the *did* coefficient is not statistically significant at the conventional 10% level, it attains significance at the 15% level, providing weak evidence of a decline in earnings volatility. Given the negative sign of the *did* variable, we find limited support for H2.

Columns 3 and 4 show the estimates after applying the DiD method to test for potential changes in variables *CAPEX* and *Ret_vol* after the mandate for diverse boards. The table shows mostly insignificant coefficients for each of the variables, namely *Time*, *Treated* and *did.* The insignificant estimator for *did* shows a lack of change in the variables *CAPEX* and *Ret_vol* in the treated group after the law's enactment.

To complement the regression results presented in the DiD table, we illustrate the findings graphically. Figure 1a shows the mean leverage ratio over the sampled periods, including pre-treatment and post-treatment years. The leverage ratio of firms without female directors (treated group, represented by a blue line) before the treatment is higher than the control group (dotted red line). After 2019, the treated group's leverage ratio declines sharply.

Figure 1a. Leverage

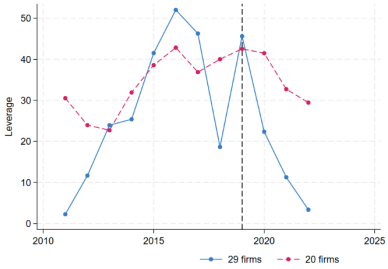

Figure 1b. Earnings volatility

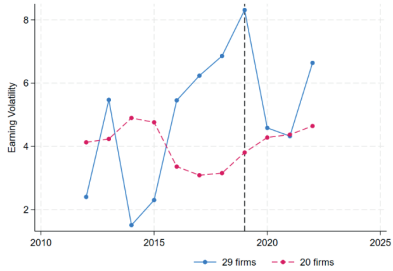

Figure 1c. Capital efficiency

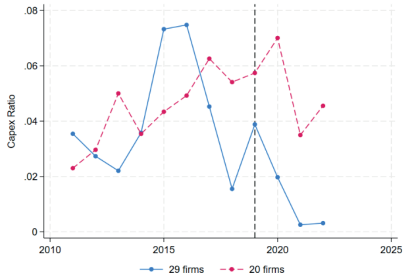

Figure 1d. Idiosyncratic volatility

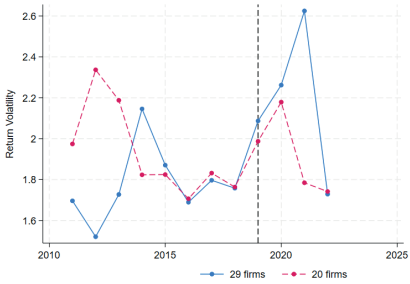

Figure 1. DiD testing H1–H4

Note: The figure shows the risk-taking behaviour measured by leverage (Figure 1a), earnings volatility (Figure 1b), capital efficiency (Figure 1c), and return volatility (Figure 1d) in firms with at least one woman as a director on their corporate boards (dotted red line) and those with none (blue line). The vertical line represents the year of enforcement of the Companies Act 2017, i.e. 2019.

Source: own work.

The interpretation for the treated group is straightforward: the enforcement of the Companies Act 2017 led to a decline in firm leverage for firms that previously lacked gender-diverse boards. Notably, the control group also witnessed a decline in leverage. This may be attributed to certain firms voluntarily increasing female board representation beyond the minimum requirement. Overall, the trends suggest that firms with more gender diverse boards exhibited lower leverage levels.

Figure 1b shows how the earnings volatility levels differed significantly across the treated and control groups prior to 2019, with the treated group exhibiting higher volatility. This disparity narrowed after the treatment period, before rising again in 2022 for the treated group. This potentially explains the weak *did* coefficient in Column 2 of Table 8.

Figure 1c shows the mean values for variable *CAPEX* over the sample period. Both the treated and control groups show a similar trend of drop in expenditures after the Companies Act 2017 took effect. Trends after the year

2019 indicate that both groups experience comparable patterns. This may be attributed to strategic changes and investment opportunities available to firms, particularly owing to COVID-19 effects on investment activity originating in the year 2020. Finally, Figure 1d shows that the difference in idiosyncratic volatility between the two groups remains largely unchanged after the treatment year. This is evident from the convergence of the two lines throughout most of the sample period.

Overall, the results from DiD analysis are robust and support H1 and H2. We note that the number of observations in Columns 2 and 4 are relatively higher than in the 2SLS and 2SRI estimations. The difference stems from the estimation approach: the two-staged regression models yielded smaller samples owing to missing GS records, which are required in the first stage regressions.

4.2. Markov Switching (MS)

We apply the Markov Switching (MS) model as a second robustness test. The model allows for regime shifts in firm risk dynamics. Unlike traditional linear models, MS can capture structural breaks and nonlinear patterns, distinguishing between different risk regimes (e.g., high vs. low leverage periods). By estimating the probability of transitioning between regimes before and after the implementation of the Companies Act 2017, this approach helps determine whether the policy induced a shift in firm risk-taking behaviour.

Column 1 in Table 9 reports the results of the MS model testing regimes of firm leverage. The model finds two states of the dependent variable: *State_1* and *State_2*, with leverage levels of 26.9 and 40.6, respectively. This is an indication that the leverage levels may have switched owing to the mandate for female directors.

The difference in states can be interpreted as the representation of a significant drop in average debt levels held in firms after the regulation. Furthermore, the volatility in *State_1* (represented by variable φ_1) is relatively higher. The variables p_{11} and p_{21} represent the transition probabilities between the two states. The probability of staying in *State_1* for firms already in this state is 86.5%, while the switching probability from *State_2* to *State_1* is 21.8%. We can infer that the leverage ratios of firms in *State_1* are lower and less likely to rise, while *State_2* firms have higher leverage ratios, which may fall. This adds evidence that leverage ratios declined after a certain event (i.e. the passing of the Companies Act 2017). The estimates for *ROA_vol* in Column 2 show a similar trend. *State_1* has a smaller earnings volatility as compared to *State_2*, indicating firms with diverse boards managed lower fluctuations in earnings.

Column 3 reports the results for capital allocation efficiency. Although the model identifies two states, *State_1* and *State_2* coefficients do not differ sig-

Table 9. Markov Switching testing H1–H4

Variables	*LRATIO*	*ROA_vol*	*CAPEX*	*Ret_vol*
State_1	26.883***	3.597***	0.0349***	0.0179***
	(1.919)	(0.096)	(0.0018)	(0.0003)
State_2	40.566***	4.391***	0.0569***	0.0202***
	(1.105)	(0.092)	(0.0022)	(0.0008)
p_{11}	0.865	0.582	0.863	0.715
	(0.141)	(0.265)	(0.143)	(0.203)
p_{21}	0.218	0.243	0.217	0.471
	(0.157)	(0.159)	(0.156)	(0.270)
φ_1	4.592	0.182	0.004	0.006
	(1.399)	(0.070)	(0.001)	(0.000)
φ_2	2.611	0.230	0.005	0.001
	(0.866)	(0.070)	(0.002)	(0.001)
Observations	12	11	12	12

Note: Results from Markov Switching model testing the variation of risk-taking measures during the sample period. Variables *State_1* and *State_2* represent two states for values of firm leverage (Column 1), earnings volatility (Column 2), capital efficiency (Column 3), and idiosyncratic volatility (Column 4).

Source: own calculations.

nificantly (0.04 vs. 0.06). This implies that the system has a higher likelihood of remaining in *State_1*. Likewise, estimates for *Ret_vol* in Column 4 show little variation in magnitude across the two states.

Conclusions

Weak and ineffective corporate governance practices have caused numerous corporate scandals and failures. Recent studies emphasise the role of boards of directors in firms' governance: Castellanos and George (2020) underscores their role in strategic leadership, while Alatassi and Pillai (2024) highlight their responsibilities in effective risk management. Literature identifies gender diversity on corporate boards as a significant governance mechanism. The SECP introduced the Companies Act in 2017 in Pakistan, requiring corporate boards to have at least one female director per board. Using a sample of Pakistani firms from January 2011 to December 2022, this study investigates whether board gender diversity in Pakistani firms (introduced by this legislation) led to significant changes in firm risk-taking behaviour.

We apply 2SLS and 2SRI estimations to account for endogeneity. In addition, we perform the DiD test to control for time-invariant unobserved heterogeneity by testing firm risk levels before and after the implementation of the Act. We also use the MS model to identify regime shifts in firm risk. We find evidence that an increase in the proportion of female board directors is associated with lower firm leverage and reduced earnings volatility in Pakistan. The findings complement existing literature asserting that gender-diverse boards are linked to lower firm risk. However, we do not find a significant relationship between gender diversity and capital allocation efficiency or idiosyncratic volatility. We conclude that while board composition may influence high-level financial policies (like leverage), other risk dimensions—such as investment efficiency or market-based volatility—depend on managerial discretion or evolve over longer horizons.

This study contributes to the theoretical discourse by showing that exogenously imposed board diversity can have measurable governance effects in an emerging market. Unlike studies from developed countries focusing on voluntary diversity, our experiment captures how a regulatory mandate alters boardroom dynamics. The results of this study are important for policymakers, particularly the SECP. The decline in firm leverage after the legislation implies potential for the regulator to indirectly influence firm debt levels. Hence, capital market regulators might consider using gender diversity for attaining financial stability objectives.

While this study provides evidence that board gender diversity is associated with reduced firm-level risk in Pakistani firms, we acknowledge several limitations. Firstly, the sample includes only 49 firms over 12 years, forming a relatively small and potentially unbalanced panel. Secondly, due to the limited number of firms in several sectors, we are unable to include industry fixed effects in our regression models without encountering multicollinearity and estimation issues.

Thirdly, although we use multiple econometric techniques to address endogeneity and validate our results, our evidence remains correlational rather than strictly causal. Lastly, data limitations—particularly with respect to governance variables—restricts the scope of our analysis in some robustness tests. Future research could explore these relationships using broader samples, alternative risk proxies, and longer post-regulation timeframes to assess the robustness of the observed effects.

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Speaking up in financial co-operatives: How values and job type shape employee commitment[1]

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Abstract

This article examines the relationship between employee voice and affective commitment in co-operative financial institutions. It focuses particularly on the moderating role that perceived employer orientation towards co-operative values and principles as well as job type (front- or back-office) has regarding the relationship between two types of voice (challenging and supportive) and affective commitment. The analysis was performed with a dataset of 217 employees from 8 UK building societies. The results indicate a clear positive relationship between supportive employee voice and affective commitment, while the effect of challenging voice is more complex. Moreover, both employee voice types correlate with higher affective commitment for employees who view their employer as little oriented towards co-operative values and principles, but not for those

Keywords

- employee voice
- affective commitment
- co-operative financial institutions
- values
- job type
- employee participation

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[1] The data used in this article was gathered during the project entitled "Organisational culture and human resource management in building societies" conducted by the Poznań University of Economics and Business, Poland and the Building Societies Association, the United Kingdom between 2021 and 2022 (number of the project in the Poznań University of Economics and Business internal project register: 15/01/2020). However, this research did not receive any specific grant from funding agencies.

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who rated their employer attached to these values. Finally, job type has little impact on the effects of employee voice, although a slightly more positive reaction from back-office staff is noticeable.

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Introduction

Co-operative financial institutions (CFIs) are a large and diverse group of organisations that include co-operative banks, credit unions and building societies (Akinsoyinu, 2017; Fiordelisi & Mare, 2014; McKillop et al., 2020). The specificity of this group lies primarily in their attempts to achieve co-operative goals stemming from co-operative values and principles (Groeneveld, 2017; Salas-Vallina et al., 2024), in addition to economic goals typical of financial entities (e.g., profit growth, compliance with financial regulations).

The dual nature of CFIs—driven by both social and economic goals—is the key to their strength, yet it also presents inherent challenges. Through various pro-social initiatives, CFIs foster community trust, securing a stable customer base (Bossler & Schild, 2016). Strong local ties enhance customer knowledge, which in turn contributes to financial stability (Fiordelisi & Mare, 2014) and bolsters resilience during economically turbulent times (Akinsoyinu, 2017). By aligning social and economic objectives, CFIs also advance sustainable development goals (Korzeb et al., 2024). However, balancing their democratic rule with the demands of operational expansion and structural development remains a challenge (Jones & Kalmi, 2012; Voigt & von der Oelsnitz, 2024).

These tensions are particularly evident in human resource management (HRM). CFIs have to navigate increasing competition in the financial sector, marked by the rise of profit-driven e-services and leading to branch closures that often conflict with the service needs of local communities. Additionally, they face mounting pressure from international regulatory bodies, impacting employment structures and work design (McKillop et al., 2020). Moreover, they strive to optimise employee performance, while safeguarding well-being to cultivate stronger attachment to the organisation. However, this dual focus can inadvertently cause stress and strain (Piasecki, 2024; Salas-Vallina et al., 2024). Employees are also often members of the financial co-operative (Jones et al., 2012), which leads to dilemmas in balancing individual benefits

and organisation's welfare. Employees may seek benefits for themselves by influencing the decisions of other members in the general assembly. On the other hand, CFIs care that employee-members are actively involved in how the co-operative functions, as they possess a unique knowledge of its activities.

One way to handle these tensions is to promote employee voice (EV), understood as "all of the ways and means through which employees attempt to have a say about, and influence, their work and the functioning of their organization" (Wilkinson et al., 2020). EV provides an opportunity to use employee knowledge to increase efficiency (Bashshur & Oc, 2015), which, in the case of CFIs, is related to understanding the needs of customers by making use of relationships in the local community (Voigt & von der Oelsnitz, 2024). However, aside from efficiency, employers must strive to create long-term relationships with employees (Jones et al., 2012) to avoid costly turnover (Piasecki, 2024), and by increasing employee belief that they have a real impact on decision--making (Bashshur & Oc, 2015), EV also facilitates that goal.

Research on EV in CFIs is very limited. The three key studies (Detert et al., 2013; Howell et al., 2015; Jalette & Bergeon, 2002) explore its connection to HRM practices, supervisory recognition, and collective outcomes. However, none of them address the unique challenges posed by the co-operative structure and dual social-economic goals of CFIs, leaving a critical gap in contextual understanding.

To fill this gap, in this article we aim to explore the relationship between EV and organisational affective commitment, defined as employees' emotional attachment and identification with their organisation (van Rossenberg et al., 2022), taking into account the characteristics of CFIs as moderators. We focus on affective commitment, due to its link to lower stress and turnover, and higher productivity (Kaźmierczyk et al., 2022; Meyer et al., 2002). To better understand this relationship in the dual context of CFIs, we investigate two moderators: perceived employer orientation towards co-operative values and principles (CVP), and job type (front- vs back-office). Perceived CVP orientation signals how co-operative employees view their employer (Marcoux et al., 2021), which shapes their attitudes more strongly than formal policies (Makhecha et al., 2018). The division into front- (e.g., counter personnel) and back-office staff (e.g., liquidation centre), a core feature of financial institutions, affects employee skills, training, and customer contact (Värlander & Julien, 2010). Front-office staff face more pressure and embody co-operative values in client interactions (International Co-operative Alliance, 2015), whereas the expanding back-office workforce plays an increasingly strategic role (Funcas, 2021).

In order to understand the relationships between the above-mentioned variables, we conducted analyses on a dataset of 217 employees from eight UK building societies using two-level linear regression models with two-way interactions. The results indicate that supportive EV is positively correlated with affective attachment, whereas the impact of challenging EV is not un-

ambiguous. Moreover, for both types of EV, the relationship with affective commitment is only significant when the employer is perceived as low in CVP orientation. Finally, job type is not highly relevant for EV effects, although we identify slightly more positive reactions for back-office employees.

The contribution of our study is twofold. Firstly, it deepens understanding of the dual nature of CFIs in employment relations, thus contributing to the ongoing discussion on the reconciliation of social and economic goals in CFIs and, more broadly, in co-operatives (Jones & Kalmi, 2012; Novkovic et al., 2022; Rabong & Radakovics, 2020; Voigt & von der Oelsnitz, 2024). Insight into the role played by the specific characteristics of CFIs is crucial if they are to continue to be a driving force in the development of local communities (Fiordelisi & Mare, 2014; Korzeb et al., 2024) during times of increasing competition and technological change (Kornelakis et al., 2022). Secondly, by examining the relationship between EV and affective commitment (Bashshur & Oc, 2015) in CFIs, the study responds to the call for a broader integration of context into the studying HRM (e.g., Farndale & Paauwe, 2018; Mayrhofer et al., 2019). This is particularly relevant in the case of EV research, which is often criticised for being psychologised and detached from wider organisational and market settings (Barry & Wilkinson, 2021).

The remainder of this article begins by presenting the relationship between EV and affective commitment in light of a selected theory about human behaviour. It then discusses the influence of moderators on this relationship. After describing the research methodology and results, the article concludes with a discussion of the theoretical and practical implications.

1. Literature review

1.1. Employee voice and affective commitment in light of social exchange theory

Employee voice plays a vital role in promoting participative decision-making and contributing to the overall success of co-operatives (Mori & Cavaliere, 2024). Despite its significant impact on organisational outcomes, including creativity and innovation (Guzman & Espejo, 2019), we noted a severe lack of literature on EV in CFIs. We looked through the literature following the advice of Collins et al. (2015)[4] and identified only three articles devoted to EV

[4] We conducted a brief literature review on 23.02.2023 using Web of Science Core Collection. In the analysis, we included all the combinations of various words covering different

in CFIs. Jalette and Bergeon (2002) used the data from 241 Desjardins' credit unions to analyse how HRM practices, clustered into three groups (one including voice, associated with the problem / grievance resolution) are linked to organisational performance. Howell et al. (2015) investigated 693 credit union employees to determine how supervisors' voice recognition was affected by ascribed or assigned employee status and how it affected performance evaluations. Detert et al. (2013) theorised upon when and why voice flows contribute to important collective organizational outcomes in 93 units across 9 US credit unions. The studies focused on general aspects of EV and performance, but did not delve into the specific challenges and tensions arising from the co-operative structure and dual nature of CFIs. This is a serious omission, since the effects of employee suggestions can be significantly influenced by various moderators (Bashshur & Oc, 2015) and context is crucial for understanding the overall process of EV (Barry & Wilkinson, 2021).

We also consulted the wider literature on EV in co-operatives and found that Mori and Cavaliere (2024) enhance our understanding of EV within worker co-operatives by placing it within the larger framework of loyalty, leadership (specifically leader-member exchange), and coordination mechanisms. Another work, Mori et al. (2024), examines EV, integrating motivational synergy theory and social exchange theory. They explore the motivational factors related to job satisfaction and the different types of EV (destructive and constructive), focusing on transformational and transactional leadership styles as well as performance-based rewards.

Based on our examination of the existing literature, we chose social exchange theory as the basis for further analysis. This theory has been used repeatedly in research explaining the impact of EV (Bashshur & Oc, 2015) and is well suited to understanding HRM in CFIs as it takes into account both the economic and social dimensions of exchanges (Jussila et al., 2012). Finally, earlier studies carried out in CFIs proved the usefulness of using social exchange perspective in explaining staff attitudes (Marcoux et al., 2021; Salas-Vallina et al., 2024).

According to social exchange theory, people engage in exchanges involving various resources, with the norm of reciprocity being the most frequently analysed rule of exchange (Cropanzano & Mitchell, 2005). In workplaces, employees reciprocate the organisation's care expressed through specific HRM practices by being involved at work and committed to the organisation (Wei,

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CFIs (based on McKillop et al., 2020) and those related to EV (based on Litwin & Eaton, 2018), searching titles, abstracts and keywords. Although we are aware that some authors perceive significant differences between constructs describing the involvement of employees in submitting ideas and improving the workplace (Barry & Wilkinson, 2021), we used broad keywords, as recommended by Xiao and Watson (2019), given the novelty of our topic. We obtained 77 articles, but after removing duplicates and publications not dealing with both CFIs and EV, we had only 3 articles. See Table S1 (Supplementary Material) for the full results of our analysis.

2015). However, how employees perceive these HRM practices is key to explaining their attitudes (Makhecha et al., 2018). The opportunity to voice will influence employees' attitudes only if the suggestions are endorsed and implemented by supervisors (Kim et al., 2023). At the same time, the approach of managers towards EV may depend on its type (Burris, 2012).

In this study, we divide EV into challenging and supporting types, as proposed by Burris (2012). Challenging EV refers to an employee activity aimed at changing generally accepted practices and policies, whereas supportive EV aims to stabilise and maintain the status quo, for example, by supporting planned organisational actions (Burris, 2012). We assumed that, in general, employees in CFIs would welcome opportunities to express themselves in both types, as doing so aligns with the democratic nature of co-operatives (International Co-operative Alliance, 2015). Their expression should thus strengthen social exchange between employee and employer and lead to higher affective commitment (Bashshur & Oc, 2015). Naturally, challenging EV may be less well received by managers than supportive EV due to financial institutions' desire for stability (e.g., Fiordelisi & Mare, 2014), the perception that challenging the status quo is an expression of disloyalty (Bashshur & Oc, 2015) and the potential threat to managerial authority (Burris, 2012). However, the strong reliance on relationships in CFIs (Jussila et al., 2012; Salas-Vallina et al., 2024) should lead to a certain proportion of ground-breaking suggestions being accepted and implemented. Thus, we formulated two similar hypotheses:

H1a: Challenging employee voice is positively correlated with affective commitment in co-operative financial institutions.

H1b: Supportive employee voice is positively correlated with affective commitment in co-operative financial institutions.

1.2. The moderating role of perceived employer orientation towards co-operative values and principles

The co-operative orientation of CFIs and their managers may significantly influence the way ground-breaking suggestions are handled. First of all, since employer dedication to CVP makes values such as honesty or openness particularly welcome in the workplace (International Co-operative Alliance, 2015), a strong orientation towards CVP should lead to a greater openness among managers to receive challenging suggestions, which will in turn elicit a positive response from employees (Kim et al., 2023). However, when the employer is less oriented towards CVP, managers operate in settings that resemble commercial institutions, where the dual nature of CFIs is less discernible. Their predominant motivation for listening to employees may be to

improve branch or organisational performance (Salas-Vallina et al., 2024) in order to maintain their own managerial position. Consequently, this motivation will influence the type of exchange between superiors and subordinates (Jussila et al., 2012), making it more economic (than social) in nature. Since the implementation of ground-breaking suggestions can be risky in terms of both performance and managerial position, and employees who challenge the status quo may be seen as hindering the accomplishment of tasks (Burris, 2012), challenging EV may be little appreciated by managers.

Things look different in the case of supportive EV, as it is less problematic for managers. Regardless of the employer's orientation, it should usually be received well, at least because it aligns with the status quo. Furthermore, supportive EV can give employees small benefits from the implemented improvements and is not associated with too much risk. According to social exchange theory, employees try to reduce risk and increase benefits from the exchange with their employer (Kim et al., 2023). For this reason, supportive EV might be practised even among employees who do not perceive their employer as having a strong CVP orientation. Thus, we did not expect a significant change in a supportive EV-affective commitment relationship resulting from different levels of employer's CVP commitment. Our second hypotheses are therefore:

H2a: The positive correlation between challenging employee voice and affective commitment in co-operative financial institutions is stronger for high than for low perceived employer orientation towards co-operative values and principles.

H2b: The positive correlation between supportive employee voice and affective commitment in co-operative financial institutions is similar for both high and low perceived employer orientation towards co-operative values and principles.

1.3. The moderating role of job type

Managers' reactions to EV depend not only on the values in the workplace, but also on the group of employees who generate new ideas. As mentioned in the introduction, the back-office staff in financial companies is currently gaining importance, which may lead to greater managerial care about social exchange with these employees and eventually workforce differentiation (Piasecki, 2020). Moreover, due to their lower likelihood of termination, back-office employees tend to furnish management with a more reliable stream of information, thereby increasing the probability of managerial support for their suggestions (Lam et al., 2022). This disparity should

be particularly pronounced in the context of challenging EV, where managers, limited by available resources, may be more willing to introduce radical proposals put forward by critical employees. Regarding the managerial divide, front-office staff managers may have limited capacity to implement broad initiatives, due to the centralisation of decisions (Ayadi et al., 2010) and regulatory requirements to separate sales and risk management (Lim et al., 2017). Thus, front-office employees may be more disappointed and manifest less positive feelings following engagement in challenging EV compared to their back-office colleagues.

Supportive EV is easier to adopt both in front- and back-office positions since it entails small improvements; hence, we do not expect any noticeable differences in accepting it. Front-office staff may have several valuable ideas for small improvements to the CFI's workflow, due to their proximity to customers (Alexiadou et al., 2017) and back-office employees can give input to incremental service development (Li & Huang, 2012). One can thus predict that the supportive EV of both groups will be appreciated by their superiors and the significant difference postulated between front- and back--office staff will only obtain in the case of challenging EV. Therefore, our final hypotheses state:

H3a: The positive correlation between challenging employee voice and affective commitment in co-operative financial institutions is stronger for back-office employees than for front-office employees.

H3b: The positive correlation between supportive employee voice and affective commitment in co-operative financial institutions is similar for both back-office and front-office employees.

All our hypotheses are presented in Figure 1.

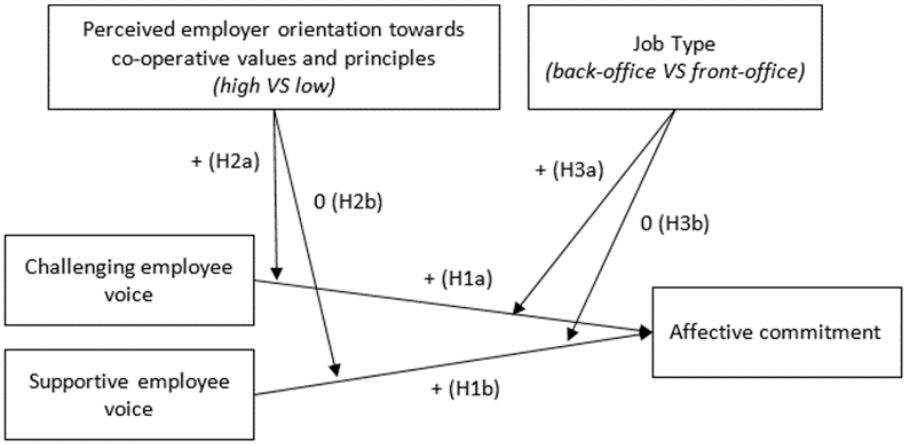

Figure 1. Research model and hypotheses

Source: own elaboration.

2. Methodology

2.1. Sample

Research hypotheses were verified using a sample of UK building societies. These companies are a good example of CFIs and their dual nature dilemmas, as their practices and stated purposes align closely with CVP, although in the past few decades they have experienced significant demutualization (Akinsoyinu, 2017; Ayadi et al., 2010). The challenges faced by building societies are similar to those faced by other CFIs, such as co-operative banks, including fierce competition and the associated pressure to cut costs (Akinsoyinu, 2017; Piasecki, 2024). Moreover, as with other CFIs, building societies are oriented towards their members (Akinsoyinu, 2017; Fiordelisi & Mare, 2014).

As part of the research project, the Building Societies Association, which is the trade body for all UK's building societies, sent all members an invitation to participate in the project. Of all the functioning organisations (43 entities), 8 agreed to participate in the survey. The smallest building society employed 38 people, while the largest employed 159 at the end of 2021 (mean = 88.6). Thus, the sample contains entities of a typical size for CFIs, as this group is primarily composed of small organisations (Akinsoyinu, 2017). The response rate across organisations ranged from 15% (24 answers) to 62% (42 answers).

The Building Societies Association provided us with basic statistics of 8 participating entities, and additional primary data was obtained through an online survey for employees. The survey was shared among employees via the internal communication channels of each building society. Data was collected from March to May 2022. We received 311 employee responses; however, on checking for completeness, 217 observations remained.

2.2. Measures

To measure affective commitment, we used a shortened 4-item scale from Allen and Meyer (1990) similarly as other authors (e.g., Kundu & Gahlawat, 2018) (1 = strongly disagree, 5 = strongly agree; Cronbach's $\alpha = 0.714$). EV was measured against six items adapted from Burris (2012), three for challenging EV (sample item: 'I challenge my manager to deal with problems around here'), and three for supportive EV (sample item: 'I keep well-informed about issues where my opinion might be useful'). Both measures used an adapted 5-point scale (1 = almost never, 5 = almost always; Cronbach's $\alpha = 0.848$ and 0.849, respectively).

To capture perceived employer orientation towards the CVP, we first provided respondents with a short and simplified description of co-operative values and principles adapted from 'Guidance Notes to the Co-operative Principles' (International Co-operative Alliance, 2015). A full description is provided in Table S2 (see Supplementary Material). Next, following Quenneville et al. (2010), we asked the respondents to what extent they agreed (1 = strongly disagree, 5 = strongly agree) that their organisation maintained these values and principles. Two statements were posed ('These values are very important in our organisation' and 'Our organisation works according to these principles'; Cronbach's $\alpha = 0.893$), and we calculated the mean values from the responses. Adopting the difference between front-and back-office from the literature (see Li & Huang, 2012), we identified job type by asking respondents: 'Would you say your role is predominately customer facing?' (1 = yes, 0 = no). A positive answer indicated a front-office employee.

We controlled for organisational tenure (1 = a year or less, 2 = more than 1 year – 3 years, 3 = more than 3 years – 5 years, 4 = more than 5 years – 10 years, 5 = more than 10 years); education (0 = GCSE, NVQ, A-levels or equivalent, 1 = degree level or equivalent, post-graduate qualification or higher, professional qualifications); and managerial position (1 = yes, 0 = no). These variables can influence employees' expectations of their employer and their consequent attachment as a result of the social exchange (Jun & Eckardt, 2023; Wei, 2015). We also added a control variable specific to CFIs, namely, ownership of the organisation's shares (1 = yes, 0 = no), since shareholders have more opportunity to engage in decision-making, which may in turn influence their relationship with the employer (Groeneveld, 2017). Finally, we included the size of the company (measured by the number of employees), since it could have an impact on employees' relationships and their social exchange (Piasecki, 2024).

To minimise the risk of common method bias, we introduced control variables relating to individual characteristics associated with cognitive ability and familiarity with the survey topic (i.e. education and organisational tenure), since these might influence the way an employee answers (Kock et al., 2021). Following the recommendations made by Kock et al. (2021) and Podsakoff et al. (2003), we also separated the measurements of the independent, moderator and dependent variables from one another in the questionnaire, used different descriptions for the EV and affective commitment scales, and discussed survey items with a representative of the Building Societies Association.

2.3. Analysis

First, we assessed our measures using confirmatory factor analysis with Swain correction for a small sample size (Antonakis & Bastardoz, 2013; Langer, 2017) on our multi-item measures (affective commitment; perceived employer orientation towards CVP; and EV—analysed as one variable or divided into two types) (see Table S3, and Figures S1 and S2 in the Supplementary Material). The three-variable model had a worse fit to the data than the four--variable model (RMSEA: 0.089 VS 0.072; CFI: 0.919 VS 0.951, SRMR: 0.080 VS 0.073), confirming that we should conduct separate analyses for challenging and supportive EV.

Next, we checked the two-level structure of our data (employees nested in organisations). Although the results for our dependent variable indicated that the differences among organisations were relatively small (likelihood ratio test statistic = 0.98, p = 0.162, ICC = 0.02), we followed Bliese et al. (2018) and used multilevel modelling (MLM) to obtain unbiased estimates. Bliese et al. (2018) show that even such a small ICC value as 0.013 has an impact on standard error estimates providing convincing evidence that MLM is the right choice with clustered data. Since in our case the ICC is higher than the level adopted in their simulation, we used MLM in the main analyses, while we additionally performed one-level regressions (see the description of the robustness test at the end of the results section).

Before proceeding with the analysis, we performed an initial transformation of our complex construct measures (affective commitment, challenging and supportive EV, and perceived employer orientation towards co-operative values and principles). First, we calculated the mean for each of these constructs from all items included in the scale, as recommended by Robinson (2018). Next, we conducted grand-mean centring of independent and moderator variables, leaving dummy variables and control variables not centred (Aguinis et al., 2013; Shen, 2016). Centring allows easier interpretation of results and helps avoid collinearity (Bliese et al., 2018; Shen, 2016). Bliese et al. (2018) indicate that researchers have different approaches as to which type of first-level variable centring to use: group-mean centring (i.e. subtracting the group mean from each observation in that group), or grand-mean centring (i.e. subtracting the overall mean for the variable from each observation). We chose grand-mean centring because it reflects the actual intensity of the phenomenon (e.g., the frequency of employee comments), not its strength in relation to the mean in a given organisation (e.g., the mean frequency of employee comments in a given building society). However, we tested our assumption by conducting an analysis with group-mean centring as part of a robustness test.

We then performed our analyses using two-level linear regressions with the restricted maximum likelihood estimation method and the Kenward-

-Roger correction employed due to the small Level-2 sample size (8 building societies) (McNeish, 2017; McNeish & Stapleton, 2016). In all calculations, we used Stata 17.0.

3. Results

Means, standard deviations and correlations are listed in Table S4 in Supplementary Material. The data shows that the employees studied were relatively committed to their employers (M = 3.88) and perceived them as strongly oriented towards CVP (M = 4.57). Both EV measures were highly correlated with each other (r = 0.714) and not with the two moderators.

The results of the MLM are presented in Tables 1 and 2. Each estimated parameter is accompanied by an exact p-value, as recommended by Aguinis et al. (2010). Moreover, for each analysis we compared the random slope with the random intercept model, using likelihood-ratio test statistics, and concluded that for challenging EV, the random slope model should be preferred, while for supportive EV, the random slope model did not fit the data better than the random intercept model (Leckie, 2010). In other words, the effect of challenging EV on affective commitment varied across the analysed organisations, while the effect of supportive EV was similar for all organisations. Therefore, here we present the results for the random slope models for challenging EV and random intercept models for supportive EV, while complementary models (random intercept models for challenging EV and random slope models for supportive EV) are presented in the Supplementary material (Tables S5 and S6). Finally, for each interaction term, we analysed adjusted predictions (Figure 2) and the average marginal effects (Figure 3), following the recommendations made by Kingsley et al. (2017).

The results indicate that the relationship between challenging EV and affective commitment is insignificant (with positive sign), while supportive EV has a significantly positive correlation with affective commitment. This means that H1a was not supported, whileH1b was supported. The result for challenging EV is related to its varying impact within individual organisations. Correlation analysis across building societies indicated that sometimes the relationship between challenging EV and affective commitment was positive and sometimes negative.

As expected, the relationship between challenging EV and affective commitment is influenced by the perceived co-operative orientation of the employer, but the moderating effect was different from what we assumed (Table 1, Model 2A; Figure 2A). For those who perceived their employer as not particularly focused on implementing CVP, the opportunity to speak out in a way

Table 1. Multilevel modelling results: Challenging employee voice

Variable	Model 1A		Model 2A		Model 3A	
	Coefficient	*p*	Coefficient	*p*	Coefficient	*p*
Organisational tenure	0.041	(0.374)	0.043	(0.350)	0.033	(0.472)
Education	–0.086	(0.498)	–0.093	(0.459)	–0.053	(0.680)
Managerial position	0.365	(0.006)	0.396	(0.003)	0.324	(0.015)
Shares ownership	–0.070	(0.601)	–0.062	(0.643)	–0.087	(0.517)
Company size	–0.001	(0.757)	–0.001	(0.706)	–0.001	(0.700)
Challenging EV (grand-mean centred)	0.132	(0.389)	0.097	(0.489)	0.234	(0.139)
Perceived employer CVP orientation (grand-mean centred)	0.362	(0.000)	0.425	(0.000)	0.357	(0.000)
Customer-facing job	–0.345	(0.009)	–0.351	(0.008)	–0.321	(0.015)
Perceived employer CVP orientation (grand-mean centred)*Challenging EV (grand-mean centred)			–0.164	(0.034)		
Customer-facing job*Challenging EV (grand-mean centred)					–0.228	(0.116)
Intercept	3.883	(0.000)	3.882	(0.000)	3.916	(0.000)
Log-restricted likelihood	–201.295		–200.601		–201.115	
Slope variance	0.115		0.090		0.088	
Intercept variance	0.037		0.029		0.033	
Covariance between random intercepts and slopes	–0.055		–0.045		–0.038	
Residual variance	0.484		0.478		0.481	
Likelihood-ratio test statistic (comparison of random intercept and random slope model)	8.51	(0.014)	5.20	(0.074)	6.42	(0.041)

Note: Number of organisations in each model: 8. Number of employees in each model: 172. The results of the corresponding random intercept model can be found in Table S5 in the Supplementary material.
Variables:
Dummy coded: Education (0 = GCSE, NVQ, A-levels or equivalent, 1 = Degree level or equivalent, post-graduate qualification or higher, professional qualifications); managerial position (0 = no, 1 = yes); shares ownership (0 = no, 1 = yes); Job type (0 = back-office, 1 = front-office).
Category coded: Organisational tenure (1 = a year or less, 2 = more than 1 year - 3 years, 3 = more than 3 years - 5 years, 4 = more than 5 years - 10 years, 5 = more than 10 years).
Continuous variables: Affective Commitment (min. 1, max. 5); Company size (min. 38, max. 159); Challenging Voice (min. 1, max. 5); Supportive Voice (min. 1, max. 5); Perceived employer CVP orientation (min. 1, max. 5).

Source: own elaboration.

Table 2. Multilevel modelling results: Supportive employee voice

Variable	Model 1B		Model 2B		Model 3B	
	Coefficient	*p*	Coefficient	*p*	Coefficient	*p*
Organisational tenure	0.042	(0.371)	0.045	(0.326)	0.038	(0.418)
Education	–0.075	(0.560)	–0.085	(0.502)	–0.055	(0.672)
Managerial position	0.220	(0.109)	0.255	(0.063)	0.204	(0.139)
Shares ownership	–0.085	(0.528)	–0.054	(0.685)	–0.100	(0.460)
Company size	–0.001	(0.529)	–0.001	(0.538)	–0.002	(0.512)
Supportive EV (grand-mean centred)	0.226	(0.001)	0.214	(0.002)	0.280	(0.001)
Perceived employer CVP orientation (grand-mean centred)	0.413	(0.000)	0.476	(0.000)	0.398	(0.000)
Customer-facing job	–0.294	(0.025)	–0.339	(0.010)	–0.281	(0.032)
Perceived employer CVP orientation (grand-mean centred)*Supportive EV (grand-mean centred)			–0.195	(0.021)		
Customer-facing job*Supportive EV (grand-mean centred)					–0.146	(0.284)
Intercept	3.977	(0.000)	3.947	(0.000)	3.991	(0.000)
Log-restricted likelihood	–203.010		–201.880		–203.509	
Between-company variance (level 2)	0.020		0.014		0.020	
Within-company between-employee variance (level 1)	0.514		0.503		0.513	
Likelihood-ratio test statistic (comparison of random intercept and random slope model)	2.07	(0.355)	0.92	(0.630)	1.53	(0.465)

Note: Number of organisations in each model: 8. Number of employees in each model: 173. Description of the variables provided with Table 1. The results of the corresponding random intercept model can be found in Table S6 in the Supplementary material.

Source: own elaboration.

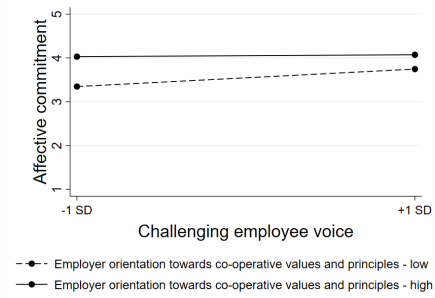

Figure 2A (Ref. Model 2A in Table 1)

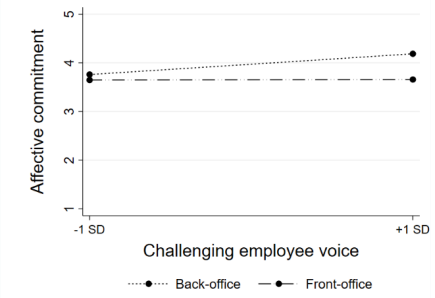

Figure 2B (Ref. Model 3A in Table 1)

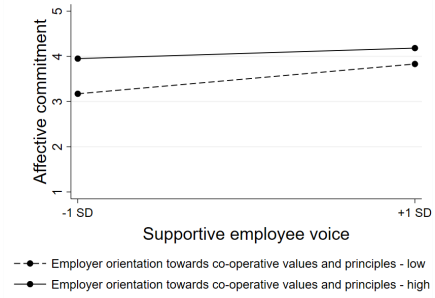

Figure 2C (Ref. Model 2B in Table 2)

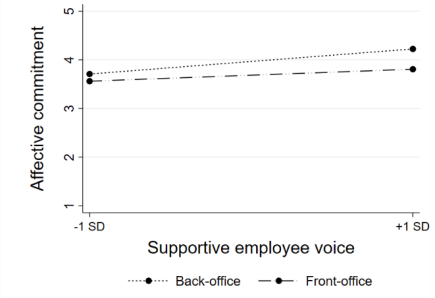

Figure 2D (Ref. Model 3B in Table 2)

Figure 2. Adjusted predictions for the interaction between employee voice and perceived employer orientation towards co-operative values and principles (left) and job type (right)

Note: –1 SD/+1 SD – one standard deviation below/above the mean. Reference to the models used to create graphs given below each figure.

Source: own elaboration.

that challenged the status quo was related to higher affective commitment. In contrast, the marginal effect for those who believed their employer was committed to CVP was statistically insignificant (Figure 3A). Thus, hypothesis 2a was not supported. The results for the job type were also not in line with our predictions. The interaction was statistically insignificant, and the analysis of the marginal effect indicated that it was not significant for any of job types considered (Figure 3B). However, it is possible that the result obtained is due to a rather small sample size in the case of 2-level regressions, making it difficult to detect interactions that are not very strong. Note that the figure of adjusted predictions suggests that there is some difference between front- and back-office staff (in favour of the latter, see Figure 2B). Moreover, the interaction for the random intercept model was found to be statistically significant (Table S5, Model 3-S5 in Supplementary material). These results support our hypothesis 3a to some extent.

Although we assumed that the relationship between supportive EV and affective commitment would remain unaffected by our moderators, we iden-

tified some non-negligible effects for each. The interaction with employer orientation to CVP was statistically significant (Table 2, Model 2B), and the marginal effects analysis confirmed some kind of moderation. For high CVP--orientation, the association of supportive EV with affective commitment was statistically insignificant, but for other moderator values it was positive (Figure 3C). The character of the interaction in this case is similar for both types of EV. Furthermore, the interaction with job type was statistically insignificant (Table 2, Model 3B). However, the analysis of marginal effects indicated that there is a positive marginal change for the back-office positions, while it is not the case for front-office jobs, suggesting the presence of some kind of interaction (Figure 3D). This indicates that hypothesis 2b was not supported, while hypothesis 3b was only partially supported.

To test the robustness of our results, we first performed MLM with group--mean centring for both EV measures and perceived employer CVP orienta-

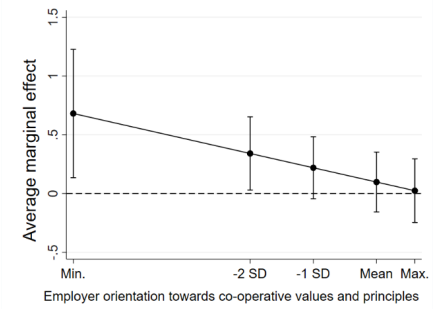

Figure 3A (Ref. Model 2A in Table 1)

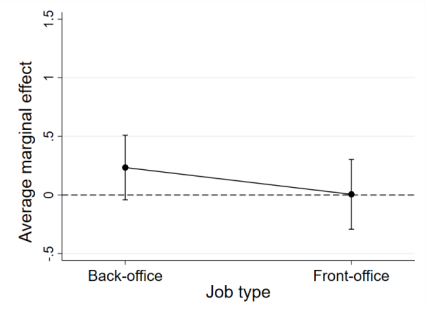

Figure 3B (Ref. Model 3A in Table 1)

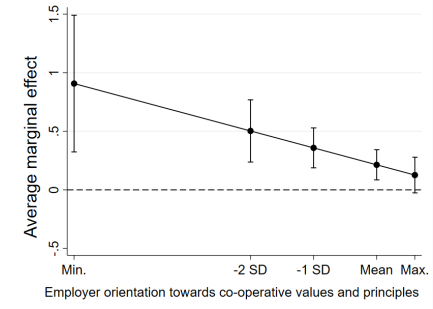

Figure 3C (Ref. Model 2B in Table 2)

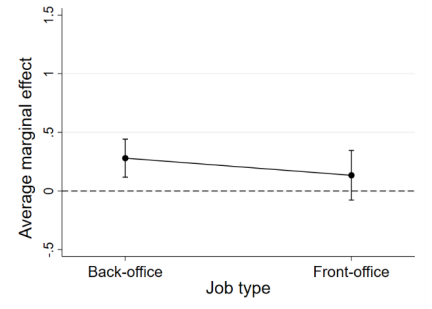

Figure 3D (Ref. Model 3B in Table 2)

Figure 3. Average marginal effect for the interaction between employee voice and perceived employer orientation towards co-operative values and principles (left) and job type (right)

Note: The bars next to each value indicate the 95% confidence intervals. Min. – minimum value, SD – standard deviation, Max. – maximum value. The dashed line shows a value of 0. (When the confidence interval for marginal effect include 0 the marginal effect is statistically insignificant for the particular value of the moderator.) Reference to the models used to create graphs given below each figure.

Source: own elaboration.

tion. Next, we calculated several single-level linear regressions. We then conducted the MLM with an additional control variable describing the significance of the organisation's values and principles at the time of the employee's hiring (exact statement: 'When I chose to work for this organisation, I was very much guided by its principles and values'; 1 = strongly disagree, 5 = strongly agree). Since, according to social exchange theory, relationships and mutual exchange evolve over time (Cropanzano & Mitchell, 2005), we presumed that an employee's attitude at the time of hiring would influence their formation of a social exchange relationship with the employer and its attitudinal outcomes. The results of these analyses (see Tables S7-S12 in Supplementary Material) are consistent with those presented here.

4. Discussion

Our study represents one of the initial contributions to a deeper understanding of EV and affective commitment within CFIs. It reveals that both challenging and supportive EV are tied to the affective commitment of CFIs staff. Moreover, the dual nature of financial co-operatives is crucial in elucidating these relationships. Previous research has explored the connection between co-operative members as employees and their capacity for voice (Mori et al., 2024). In our study, we aimed to contextualise the relationship between EV and affective commitment by including two moderators: the impact of job type and perceived employer orientation towards CVP in the relationship between EV and affective commitment. This study thus contributes to the ongoing debate about maintaining co-operative identity (e.g., Novkovic et al., 2022), in which HRM seems to play a crucial role (Voigt & von der Oelsnitz, 2024).

Our results indicate that supportive EV is positively correlated with affective commitment. In light of social exchange theory, we conclude that employees who support managers with their voice gain favour, which strengthens their attachment to the organisation (Bashshur & Oc, 2015). For challenging EV, the positive relationship with affective commitment is less clear. This type of EV is more difficult for managers to accept and implement and hence may require additional moderators (Mori et al., 2024) to increase the affective commitment of subordinates. This supposition is consistent with Burris (2012), who argues that employees who put forward revelatory ideas may encounter more resistance from their superiors than those who engage in supportive EV.

Both moderators in this study played some sort of role in the relationship between EV and affective commitment, but their actual influence differed from what we expected. We found that both EV types correlated with higher affective commitment for employees who viewed their employer as little

CVP-oriented, but not for those who rated their employer as CVP-attached, although the latter group generally had higher affective commitment. Therefore, our analysis suggests that a strong employer orientation towards CVP may (to some extent) substitute for certain HRM practices. This conclusion introduces novel insight to the work of Marcoux et al. (2021), who assumed that employees' perceived 'co-operative difference' (of which CVP is the essence, e.g., Rabong & Radakovics, 2020) arises from HRM practices. We presume that, since the CVP-oriented activities of CFIs contribute to the organisation's democratisation (International Co-operative Alliance, 2015), employees in CFIs oriented towards CVP do not feel a significant change resulting from EV. In other words, the implementation of the CVP probably contributes to the development of forms of employee participation other than making direct suggestions (both supportive and challenging) to superiors. This may involve providing employees with detailed information or giving them wide autonomy within the limits of their duties (Mowbray et al., 2015). However, it is also possible that the implementation of CVP by the employer influences other HRM practices, such as intensive training (which is one of the co-operative principles (International Co-operative Alliance, 2015)). If the employer cares for employees by appropriately shaping many HRM practices unrelated to EV, then, in the light of social exchange theory, employees 'do not need' more opportunities to express themselves in order to establish a positive relationship with the employer and reciprocate with high commitment.

Regarding job tasks, although the interaction was insignificant for both EV types, the values predicted from our models suggested a slightly stronger relationship for back-office than front-office tasks. Interestingly, the relationship was more pronounced for supportive rather than challenging EV. As McNeish and Stapleton (2016) suggest, it is possible that the effect for both EV is so weak that it might not be detected in a sample containing only eight organisations, despite using one of the preferred methods for this type of data. However, this result can be explained by Barry and Wilkinson's (2021) argument that EV needs to be considered in a broad context, which includes employee-employer relations and the labour market. It is possible that back-office employees (and their suggestions) are more valuable, but co-operative factors, such as the desire to achieve social goals (Voigt & von der Oelsnitz, 2024), undermine the employee differentiation taking place in CFIs (Piasecki, 2020).

In this way, our analysis contributes to the EV literature by demonstrating how two CFI-specific variables moderate the EV–affective commitment relationship. Many authors have identified the need to consider the role of organisational context in explaining the impact of EV on employee attitudes (Barry & Wilkinson, 2021; Bashshur & Oc, 2015). The results of our study suggest that under certain conditions, like the high level of perceived CVP implementation, the expected relations (e.g., positive impact of EV on affective commitment) may not occur.

Conclusions

Our study highlights the role of specific characteristics of CFIs in explaining HRM in these institutions. The conclusions drawn from the study offer a number of suggestions for CFIs managers. Firstly, they should invest in building a positive climate for EV, as it positively affects employees' affective commitment. In this way, EV will support both the economic and social aims of CFIs, helping to reconcile tensions stemming from their dual nature. Secondly, employees' perceptions of CVP matter. In CVP-oriented organisations, employees already report higher affective commitment, and EV has limited additional impact. Thus, when CFIs cannot fully implement CVP practices, involving staff in decision-making may still enhance commitment. Thirdly, the employee's position does not change much. The differences between front- and back-office are small, hence it is beneficial to involve all employees in the decision-making process.

A major limitation of our study is the simultaneous measurement of all variables included in the analysis. Although we took steps to limit the risk of common method bias, we are aware that the relationship between EV and affective commitment is a loop: initial attitudes towards the supervisor and employer influence the employee's willingness to submit ideas, while endorsement and implementation of ideas by supervisors creates positive feelings towards the organisation and also encourages further ideas (Kim et al., 2023). We therefore suggest an analysis using at least two measurements with a time gap. A larger sample is also recommended. One must bear in mind that, despite the similarities outlined in the article, CFIs in each country may vary considerably due to different legal conditions, size or internal integration of financial groups (Groeneveld, 2017). For this reason, caution should be exercised in applying the results of this study to other organisations within the broad family of CFIs.

Further research should also focus on enhancing our understanding of how the dual nature of CFIs influences the relationship between EV and employee attitudes. This will involve analysing the impact of variables specific to co-operatives, such as local embeddedness and membership (Voigt & von der Oelsnitz, 2024). Another avenue of research could explore how digital transformation affects co-operative structures, governance, member engagement, and identity (Camargo Benavides & Ehrenhard, 2021; Osejo-Bucheli, 2024).

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