Sustainable Technology and Entrepreneurship 3 (2024) 100082

Contents lists available at ScienceDirect

Sustainable Technology and Entrepreneurship

journal homepage: www.journals.elsevier.com/sustainable-technology-and-entrepreneurship

Full Length Article

Transforming sorted and performance of waste recovery companies: Circular Economy, Sustainability Technology and SDGs

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ARTICLE INFO

Classification Code JEL:
B54
B55
Q01
Q56

Keywords:
Sustainable technology
SDG
Gender
Circular economy
Financial performance
Recovery of sorted materials

ABSTRACT

Waste management is now a major global concern. Therefore, the circular economy (CE) and sustainable technology have become the necessary means of achieving sustainable business development. In this study, we conduct an analysis of the waste recovery sector in Spain to determine whether the most innovative and socially aware companies complied with sustainable development goal (SDG) 5 (gender equality) and SDG 8 (decent work and growth) during the period 2019–2021 (pre-Coronavirus Disease 2019, (pre-COVID-19), during COVID-19, and post-COVID-19). To this end, based on factors comprising economic and financial variables, the companies were grouped via a cluster analysis using the k-means method; they were linked to the SDGs (5 and 8) in order to determine the compliance of this sector. The results indicate that the technological transformations carried out by the waste valorization companies were reflected in their financial performance, with an increase in revenues of 61 % between 2019 and 2021; all clusters complied with SDG 8. However, despite promoting business transformation, social change, sustainable technology, and CE, these companies are far from compliant with SDG 5; indeed, a setback in social development was observed, with a significant decline in the number of women in positions of power after COVID-19. This therefore constitutes one of the greatest challenges for companies in this sector.

Introduction

Today, waste management and the overexploitation of resources have become major global challenges (Velenturf & Purnell, 2021). The linear economy (LE), which has been used up to now, does not take into account the long-term effects of consumption (Mastellone, 2022); it operates according to the system of 'extract, produce, buy, use and throw away', exerting a significant impact on resources and on the environment (Aliaga Gonzales, 2022). The circular economy (CE) has emerged as an innovative alternative (López Ruiz et al., 2020), a new economic model that aims to reduce the use of primary resources and minimize waste, taking into account social changes, environmental protection, and socio-economic benefits (Morseletto, 2020). It is a key factor in achieving the SDGs of the 2030 Agenda that, according to Rubio and Nuñez (2021, p. 165), are "the most significant universal call to action to change the current production and consumption model towards a sustainable one".

The circular economy through waste recovery companies

The CE has become a necessary means of achieving sustainable development, opening up new business opportunities (Prieto-Sandoval et al., 2017). The transition from the LE to the CE is slow (Grafstrom & Aasma, 2021) and, in order to be effective, companies must innovate their business models (Suchek et al., 2021). The main changes in this area are based on pollution controls, cleaner production, and waste management (Diaz Lopez et al., 2019), which are issues now prioritized by companies and institutions (García-Romeu, 2022). According to Pieroni et al. (2019), new innovative business models focused on circularity and sustainability are currently a competitive advantage that more and more companies want to exploit (Tequia González, 2022), however, although the CE is receiving more attention within the strategic management of enterprises (Centobelli et al., 2020), only 9 % of the economy is circular (Arnedo Lasheras et al., 2020).

Therefore, the transition of small and medium-sized enterprises (SMEs) towards a positive environmental impact, which takes into account both technological transformations and societal changes, has

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https://doi.org/10.1016/j.stae.2024.100082
Received 19 December 2023; Accepted 24 July 2024
Available online 4 August 2024

become a priority for the global agenda (Rodríguez-Espíndola et al., 2022). The incorporation of new technologies increases the positive impact on an entity's profit and loss accounts, maximizing the efficiency of the production process and reducing costs (Bartolacci et al., 2019); it also leads to the emergence of new business models that take sustainability into account (Guaita Martínez et al., 2022). It also allows the negative impact on the environment to be minimized by reducing the materials used in production or reducing energy consumption (Náñez Alonso et al., 2021), transferring these sustainable benefits to society via the circular economy (Laskurain-Iturbe et al., 2021).

The European Union has as its main objective for 2050 (Contreras Reyes, 2021) achieving a 'climate-neutral economy' (García, 2022). To this end, waste management is now a fundamental part of the CE (Zisopoulos et al., 2022); here, the collaborative economy is of vital importance to overcoming the financial challenges posed by this evolution (Austin & Rahman, 2022).

Europe has made the transition to the CE one of its most important projects (Cociña, 2018), and the use of this technology can increase its gross domestic product (GDP) by 0.5 % (European Comission, 2020). For this reason, in Spain, there has been an "explicit" commitment to the CE, focusing on improving the life cycle of products, since 2017 (Durán Romero, 2019). As a result, the government itself has implemented a series of programs and plans for 2030 (García-Romeu, 2022). The main objective is to increase by 10 % the reuse of municipal waste in a country in which "only 37.09% of waste was recycled" (Gobierno de España, 2020, p.18).

The recovery of aging resources reduces the use of non-renewable resources (Cheela et al., 2021), but, to this end, it is important to create effective circular connections between waste generators and potential waste receivers (Ciulli et al., 2020). This connection allows waste sector companies to become a new economic entity that enables socio-economic growth (Zhu et al., 2022) and is strongly linked to eco-efficiency. According to Puertas et al. (2022) eco-efficiency, which is achieved through recycling and proper waste management, results in an increase in GDP.

Therefore, more and more companies are developing value propositions by making significant changes to their waste management (Calle et al., 2020), identifying new business models that protect the environment and, at the same time, generate economic advantages for them (Oliveira Neto & Correia, 2019). Senge et al. (2001) proposed introducing eco-efficient technologies to the production process; these would allow the waste industry to convert waste into raw materials to be reused.

However, the difference in public policies at the global level may result in the uneven distribution of the environmental risks and benefits of the circular economy (Zeng et al., 2022), influencing government policy (Taghipour et al., 2022) regarding the success of its implementation. In Europe, inspections are carried out to check for contamination in production processes (Gutiérrez Alfayate, 2020) in order to achieve the 'climate-neutral economy'. Finland, Sweden, and Norway lead the way in waste management (Díaz Llamazares, 2020).

It is, therefore, the most modern societies that show the greatest concern for the future of the planet, exhibiting greater ecological awareness (Gutiérrez Alfayate, 2020). This has become a necessity because resources are finite, and it is necessary to reuse and recycle them (Grigoropoulos et al., 2020). According to Schmutz and Som (2022), if the Swiss textile industry—a generator of post-consumer waste—were to use an effective CE, it could manufacture 1.7 million t-shirts from one year's aged waste alone. A key example for sustainable economic, social, and environmental development (Knäble et al., 2022), this could be achieved with the involvement of the industry at a global level.

New business model based on SDGs

The 2030 Agenda (UN, 2015) developed by the United Nations includes responsible consumption, economic growth, and gender equity among its main Sustainable Development Goals (SDGs) (Velásquez Yepes, 2022). Integrating the SDGs into business models and incorporating sustainability into the CE (Awan & Sroufe, 2022) are vital for the survival of business and constitute major strategic challenges for companies (Bastida & Molas, 2022) and their economic development (Pratiwi et al., 2023).

SDG8 aims to promote inclusive and sustainable economic growth, full and productive employment, and decent work for all (Goiria & Herrera, 2021). However, although this goal would include gendered pay inequality, which amounts to 37 % globally (Crotti et al., 2021), as a priority issue, according to Rai et al. (2019), it leaves out any intervention related to unpaid reproductive work, of which women undertake a disproportionate amount(Oleaga et al., 2020; Susan Solomon et al., 2021). Reproductive work, which includes those activities or tasks that are essential or necessary for the maintenance of people, is not counted among productive activities; this approach serves to maintain inequality (OECD, 2017; Seedat & Rondon, 2021) and clashes with the goal of equality included in SDG 5, without which sustainable and equitable development proposed in the 2030 Agenda will not be possible (Tsalis et al., 2023). For these reasons,human needs such as wellbeing, equity, and inclusion are considered key requirements for the CE (Clube & Tennant, 2021).

However, the advances of the SDGs were slowed down by the arrival of COVID-19, which had a significant impact on the world economy (Nundy et al., 2021), compromising the scope of the 2030 Agenda (Echarte Fernández, 2023; Shulla et al., 2021). COVID-19 highlighted the interrelationship of economic sustainability with green development, health, and social inclusion (Van Zanten & Van Tulder, 2020), forcing many companies to transform their business practices (Dwivedi et al., 2020). One of the most strongly affected goals was SDG 8 (Oleaga et al., 2020), which focuses on the economy having a positive impact on the environment (Jiménez Barandalla et al., 2021), guaranteeing decent work for all people (men and women) (UN Women, n.d.). However, with the arrival of COVID-19, women and the informal economy, as well as the most vulnerable countries, were severely affected by the economic and labor-related consequences of the pandemic (OIT, 2021). As a result, SDG 5 has been impacted by increased inequality between men and women (Aleksanyan & Weinman, 2022). According to the United Nations (UN, 2020), the arrival of COVID-19 caused a setback in advances in gender equality and women's empowerment, as well as an increase in the feminization of poverty. In countries with a high infection rate, as was the case in Spain, women were 24 % more likely to lose their jobs and have their income reduced by 50 % (Dang & Viet Nguyen, 2021). Therefore, to achieve SDG 8 with decent, sustainable, and inclusive work, the gender perspective provided by SDG 5 must be taken into account (Rai et al., 2019).

Goals and importance of the study

The analyzed activity in the waste recovery sector is innovative and relatively new in the industry; it consists of adding value to sorted waste via a transformation process (INE, 2007). Thanks to the CE, this generates a multitude of benefits, not only for the company in the form of positive results in its profit and loss account, but also in terms of savings in the consumption of raw materials, which are replaced with secondary raw materials derived from the recycling of waste. This innovative economic activity makes it possible to develop a sustainable alternative by recovering, reusing, and transforming these inputs (waste) into outputs that are ready to be used again by other companies, closing the CE (Freitas et al., 2021) and following the line set by European authorities for the reduction of waste (European Parliament, 2017). The question remains, however, as to whether the companies that are more aware of social change comply with SDG 5 on gender equality, or whether they only focus on the economic and environmental challenges and neglect their social aspects, which are also highly important for the 2030 Agenda?

All of the issues noted above highlight the importance of conducting this research, the main objective of which is to determine the relationship between the financial performance of companies in a transforming sector that is essential for the development of the CE (i.e., the recovery of sorted materials) with SDG 5 and SDG 8, which were the SDGs most strongly affected by COVID-19 (Leal Filho et al., 2020). In this way, the social and economic development of SDG 8 -specifically, SDG 8.5.1.1., the average hourly earnings in EUR per employee- is linked to the universal values defended by SDG 5 (Fonseca et al., 2020): specifically, SDG 5.5.2.3 (the percentage of women in board member positions) and SDG 5.5.2.4. (the percentage of women business owners).

Materials and methods

Data and samples

The ORBIS database (version 334) was used for this study; it is suitable for researching companies where a global perspective prevails (Bajgar et al., 2020) and is universally accepted (Ukaegbu, 2014). Within this database, we selected the companies whose activity falls under heading 38.32—The revaluation of materials already classified, and whose registered offices are in Spain. Based on these criteria, the number of companies included in the database was 111, of which 28 were discarded because there is no public record of their financial statements in all, or any, of the years studied (2019 pre-COVID-19, 2020, COVID-19, and 2021, post-COVID-19).

Definition of variables

Seventeen variables were used, fifteen of which related to the economic–financial area of the companies under study; the remaining two related to the Sustainable Development Goals (SDGs 5 and 8) for the years 2019, 2020 and 2021, which were obtained from the same source. Of the economic variables, those most relevant to the following areas were selected:

1. Size of the company: total assets, total liabilities, net equity, average number of employees per year, net turnover.
2. Companies' results for the year: earnings before interest and taxes (EBIT), earnings before interest, taxes, depreciation, and amortization (EBITDA), profit after taxes, total personnel expenses per year.
3. Ratios related to the company's ability to meet its short- and long-term obligations: guarantee ratio, current solvency ratio, immediate liquidity ratio.
4. Ratios related to profitability: return on sales, return on assets, and return on equity (ROS, ROA, and ROE, respectively).

To analyze compliance with the SDGs, the variable of women/men on the Board of Directors and in the ownership of the analyzed companies was included in the analysis, enabling the discussion of SDG 5 (indicator 5.5.2); we also considered the variable average annual salary per employee, developing SDG 8 (indicator 8.5.1).

Statistical methods

Due to the large amount of data used, groupings were made in order to adequately process and analyze all the information.

First, a factor analysis of the 15 economic–financial variables was carried out using the principal components method and the Varimax rotation (Lin et al., 2011). Subsequently, a factor analysis of these 15 variables was performed, grouping them into factors or components with a high degree of similarity and correlation. This produced three factors, and the information contained in them was homogenized. Based on these three factors, a k-means cluster analysis was applied to the financial data; this is one of the most commonly used ways of summarizing and grouping the data related to these characteristics (Herman et al., 2022). This statistical analysis is intended to organize companies with similar characteristics in terms of their size and equity consistency, payment guarantee, and solvency, as well as the profitability of their main activity (EBIT). The groupings were configured into five clusters, and cross tables were drawn up based on these clusters, relating each one of them to the rest of the SDG measurement indicators. Specifically, we referred to SDG 5.5.2 'Proportion of women in managerial positions' and SDG 8.5.1 'Average hourly earnings of employees, by sex, age, occupation and persons with disabilities'. Once the groupings of the companies were described, the results obtained were presented in the contingency tables relating the five clusters to SDG 5 with Target 5.5 (INE, 2023b) and SDG 8 with Target 8.5 (INE, 2023c).

The analysis of SDG 5.5.2 was broken down into two indices showing the inclusion of women in the world of business management. The first index studied is 5.5.2.3, allowing us to determine the percentage of companies—grouped by cluster—with women on their Boards of Directors. In the second index studied, 5.5.2.4, we obtained the percentage of companies (grouped by cluster) with women included in the ownership of the company. With respect to the SDG 8.5.1.1 index, the resulting average salary of workers per cluster was analyzed, grouping the data into three intervals. To determine the intervals, data were taken from the average annual salary for women (EUR 22,467.48), the average annual salary for both sexes (EUR 25,165.51), and the average annual salary for men (EUR 27,642.71) for the year 2020 in Spain; these are the most recent published data (INE, 2022). This pay gap is studied with reference to compensation of the salary gap of women who are board members (Barrientos Báez et al., 2018) or top managers (Lucas-Pérez et al., 2015) and the wage gap between female and male incomes (Terjesen & Singh, 2008).

Due to the heterogeneity of the economic–financial data, a factor analysis was conducted, using the principal component analysis method for the extraction. For each of the years under consideration, the factors extracted were those with a large eigenvalue; all financial variables (15 variables) were considered because, for all of them, the absolute value of the initial factor loadings was greater than 0.5.

The software used for the statistical analysis, as well as for the graphs, diagrams and other visual components, was IBM SPSS Statistics (IBM software version 28.0.1).

Results

Factors

After conducting a Kaiser–Meyer–Olkin test (KMO), the three-year average was found to be greater than 0.7, and the Bartlett test of sphericity had a significance value of 0.000. Both results guarantee that the variables used are sufficiently correlated to carry out the extraction Figs. 1–10.

Based on orthogonal factor rotation (Varimax) and using this three-factor model, the explained variance was found to be greater than 80 %, resulting in values for each of the years as follows: 83.573 % in 2019, 84.017 % in 2020, and 89.117 % in 2021. Three factors were extracted, leaving the composition of each factor with its variables as follows Table 1:

In each of the analyzed years, there was variation in the saturation of the variables used to determine the factors, as well as their rotations. A different order was established for the variables within the factors, as well as for the last two factors, with the components of company size and balance sheet strength; this constituted Factor 1 in the three years, establishing the variables that carry the most weight in this study.

Economic and financial results by clusters in 2019–2021

Based on the economic and financial analysis for each cluster, the following characteristics and temporal evolutions in each cluster were identified:

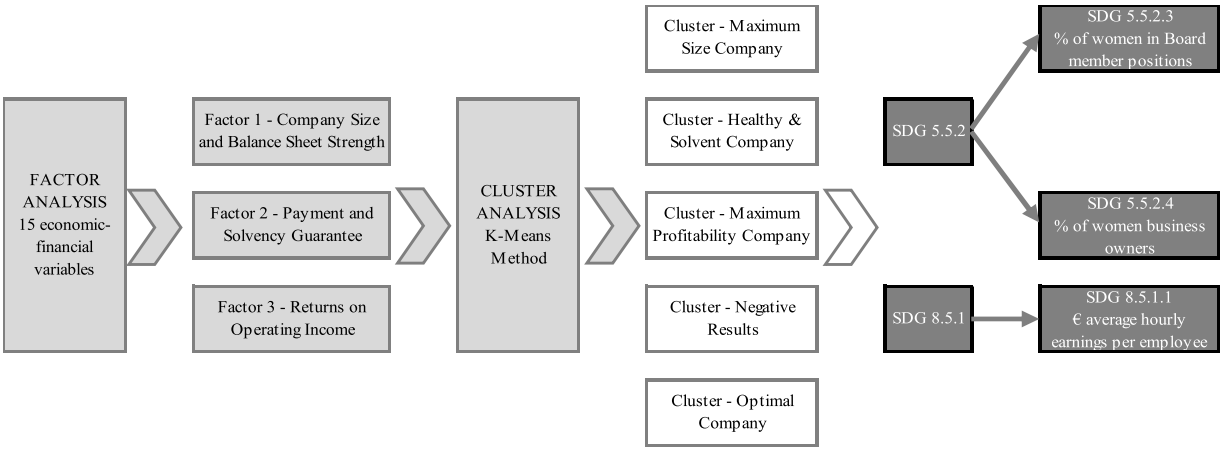


Fig. 1. Methodology applied.

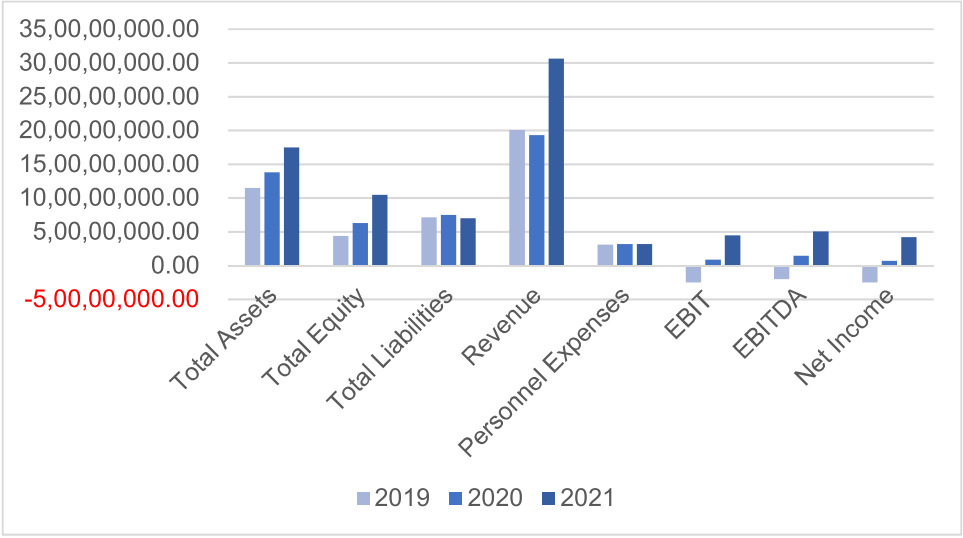


Fig. 2. Evolution of main variables 2019–2021 – Maximum Size Companies Cluster.

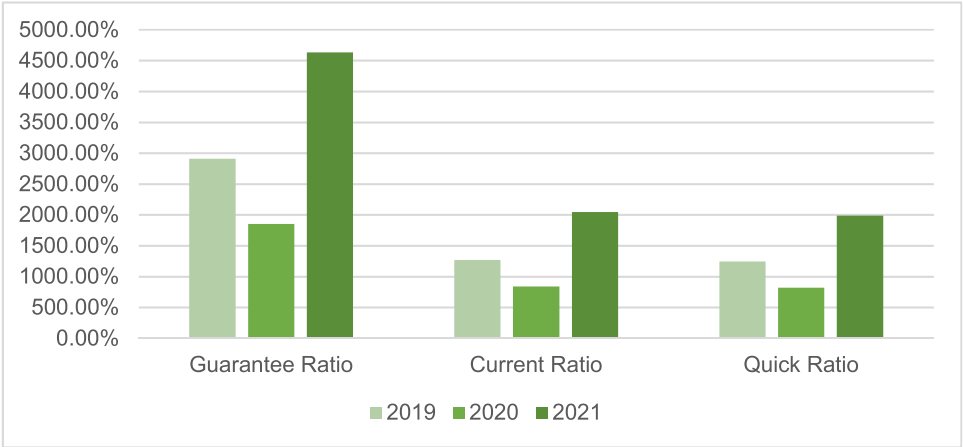


Fig. 3. Evolution of main variables 2019–2021 – Healthy & Solvent Companies Cluster.

Maximum-Sized Companies: This cluster was represented by a single company over the studied period. Its turnover accounts for 25 % of the sector's total turnover, decreasing slightly over the three years. When the K-means method statistical calculation was performed to establish the different clusters, it did not group this company with any other company for any of the years considered (even though, in the first year, it exhibited losses like the rest of the companies in the Companies with Negative Results Cluster), since the strength of its balance sheet means

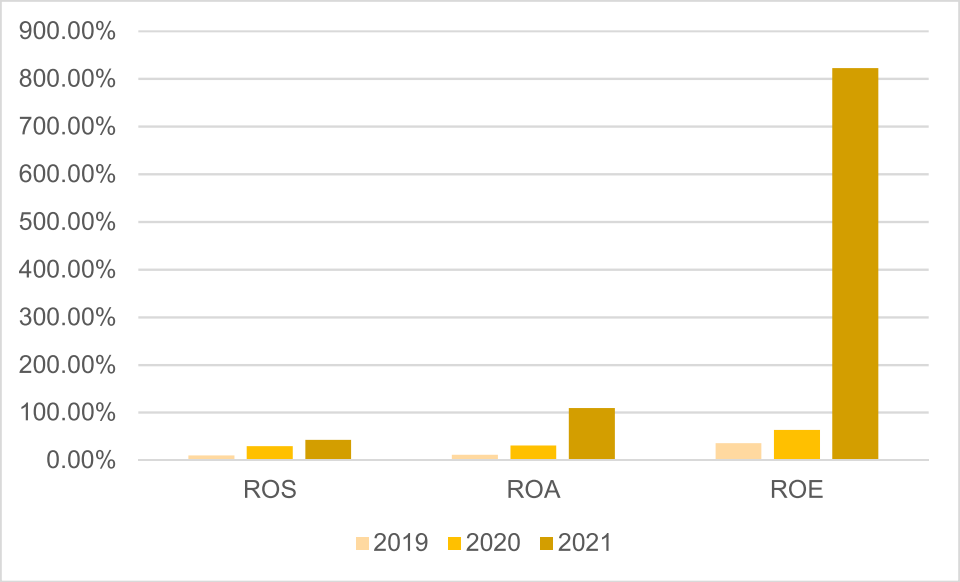


Fig. 4. Evolution of main variables 2019–2021 – Maximum Profitability Companies Cluster.

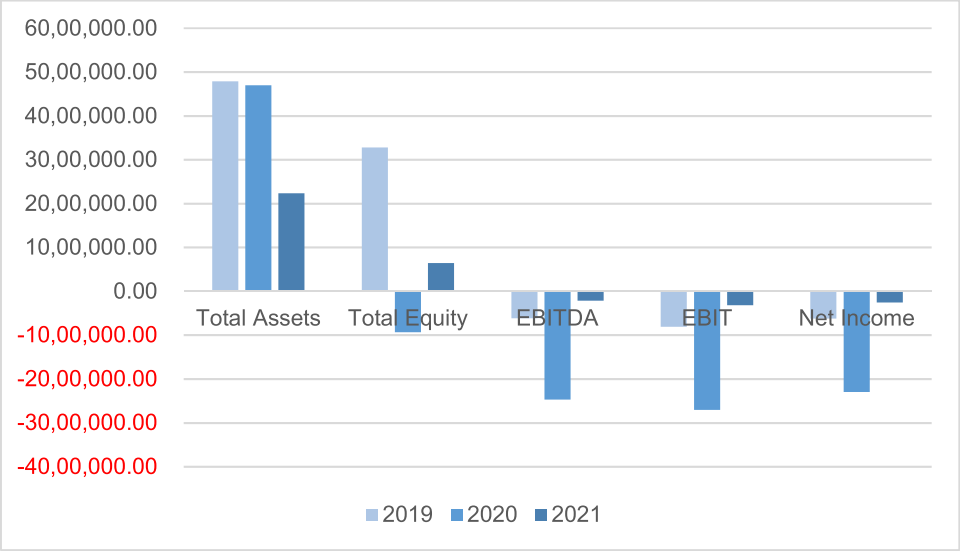


Fig. 5. Evolution of main variables 2019–2021 – Negative Results Companies Cluster.

that it forms a cluster of its own.

The number of employees remained fairly constant between the initial and final years, although the same is not true of the personnel costs borne by the company, which increased, especially between the first two years.

Its assets increased 1.5 times over the studied period, but, from the perspective of financing, the total equity gained more weight than external financing. This is mainly due to a capital increase of EUR 12,000,000 in 2020 and to the profits that it incorporated into its own financing (above all, the more than EUR 41 million in 2021).

Its guaranteed coefficient is recovering, but the company's payment capacity fell (between 12 and 14 percentage points) and has not yet recovered.

Its revenue increased by 150 % over these three years, but, in terms of the percentages of positive ROS, it is still a low-yield figure. The same is not true of the ROE, which went from −57.54 % (being the worst return on equity figure of all the clusters for all the years) to 42.73 %, being a profitable company for the shareholder. (In this case, it is a group of companies.)

Healthy and Solvent Companies: The companies in this cluster were reduced to a minimum, from four companies to one. They are characterized by having few employees and personnel costs quite close to the Spanish average per worker. However, these limited figures do not make us suspect the high figure of total assets that the companies in this cluster have (the average is close to EUR 5000,000). This finding also highlights the high degree of self-financing of these companies, which have a low level of dependence on external financing.

In view of the above findings, the solvency ratios (both quick and current) and the guarantee of payment of their liabilities reach exaggerated rates, which leads us to believe that these companies have almost no long-term investments, but almost all of them are invested in current assets.

For Factor 3 and due to the issues noted above, economic and financial profitability is positive, although it is very low with respect to the rest of the clusters.

Maximum-Profitability Companies: This cluster started with 30

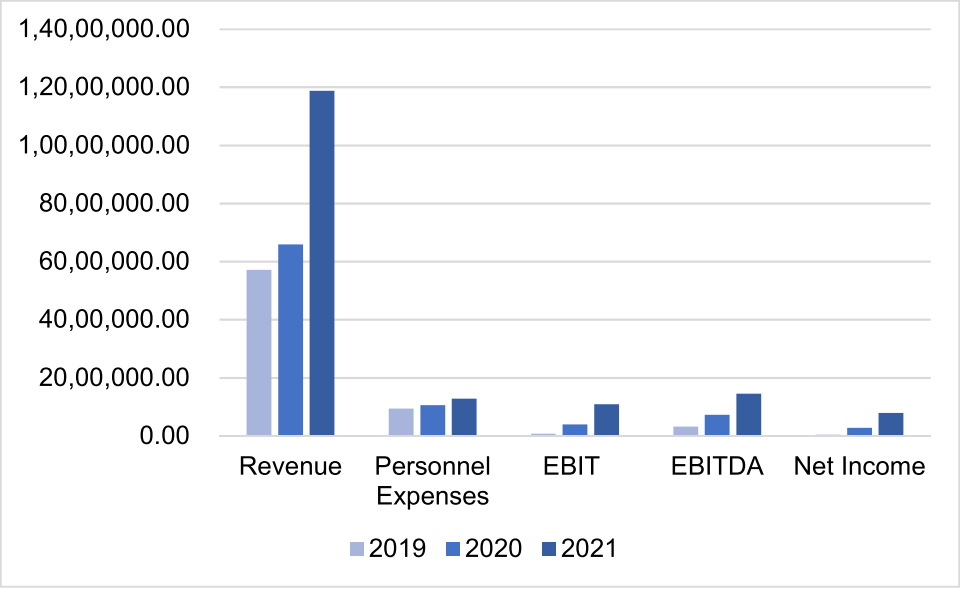
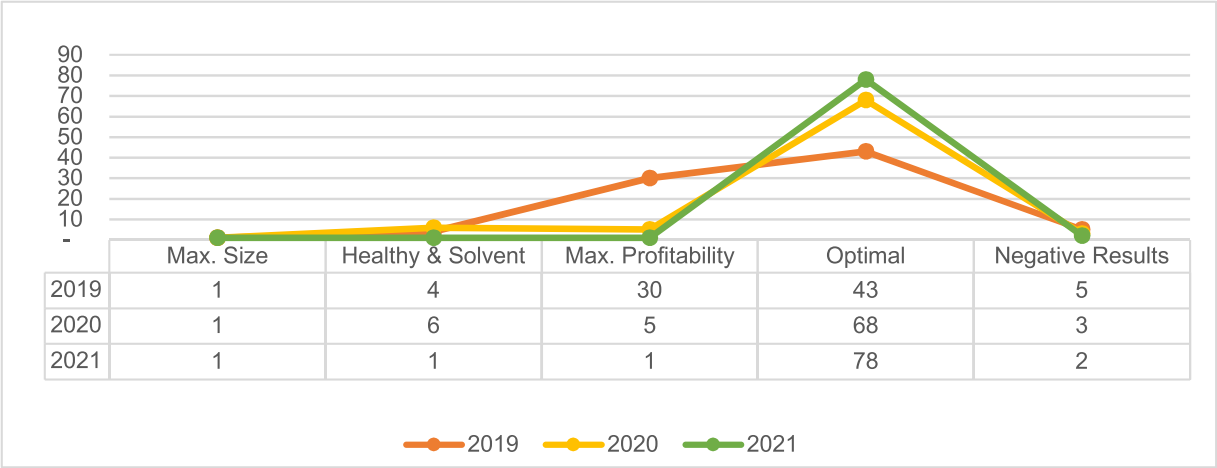


Fig. 6. Evolution of main variables 2019–2021 – Optimal Companies Cluster.



	Max. Size	Healthy & Solvent	Max. Profitability	Optimal	Negative Results
2019	1	4	30	43	5
2020	1	6	5	68	3
2021	1	1	1	78	2

Fig. 7. Evolution of number of companies per cluster 2019–2021.

companies and ended with only 1. In the final year, the only remaining company had fairly tight collateral and cash-flow ratios, which means that, in the event of a negative occurrence, the company does not have sufficient resources to be able to meet its current obligations.

The most noteworthy aspect in this group is profitability, where all companies exhibit figures well above the rest of the clusters; the ROE of the only company in the cluster in the year 2021 was 822.60 %.

Companies with Negative Results: This cluster includes companies with negative numbers in their income statements. Once again, there was a positive trend in the sector, which went from including five companies to only two. However, it is evident that, if these companies are not strengthened with contributions, their activities could cease and they may have to declare bankruptcy. The size of the total assets of the companies was reduced to less than half, although the figures related to liabilities remained the same. The total equity of the cluster in the year of the pandemic (2020) was negative, as one of the companies had a minimum figure of EUR −4536,286.

A company's ability to pay its debts may be affected by an evident decline in its cash flow, both current and immediate. Returns on operating income are dramatically low, with no sign of recovery in sight.

Optimal Companies: This cluster has the highest density of companies in the studied period, going from 43 to 78, with a growth in the figures for all variables.

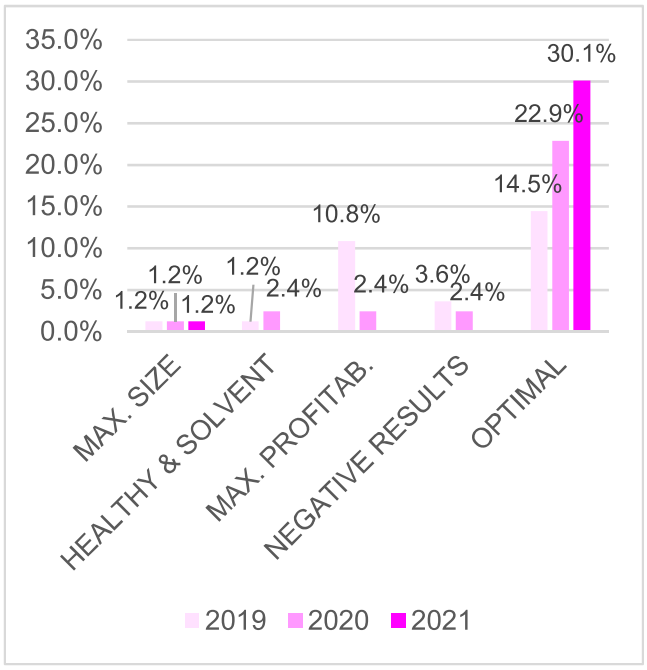
The number of workers hired progressively increased (29 to 36 employees), as did the related personnel expenses. It is striking that the growth of this last accounting item is less than proportional to the increase in revenue. The variables that increased the most are EBIT and net income, indicating a pronounced growth in the profits of the companies in the sector, which, together with the compactness of the companies studied around this cluster, indicates that the economic recovery materialized in just one accounting year.

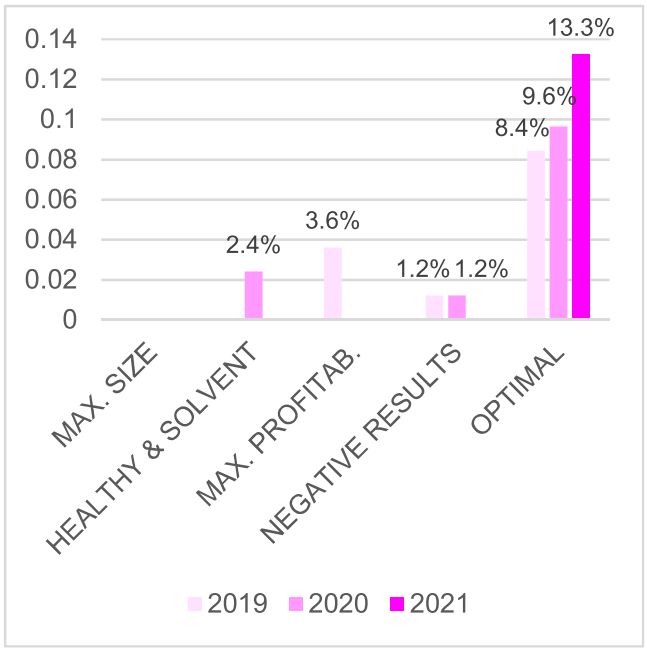
The growth in the rest of the variables was sustained and generalized, with none of them standing out for their slowdown or explosive growth.

Finally, it is worth noting the trend that seems to be marking the formation of clusters. At the beginning of this study, variables with very different figures are grouped under the Optimal Companies cluster, accounting for almost 94 % of the companies studied.

Comparative results of SDG 5.5.2 and SDG 8.5.1 by clusters

Having described the groupings of the companies, we present the





Figs. 8 and 9. SDG 5.5.2.% Companies with women in Board member positions and Business owners per Cluster 2019–2021.

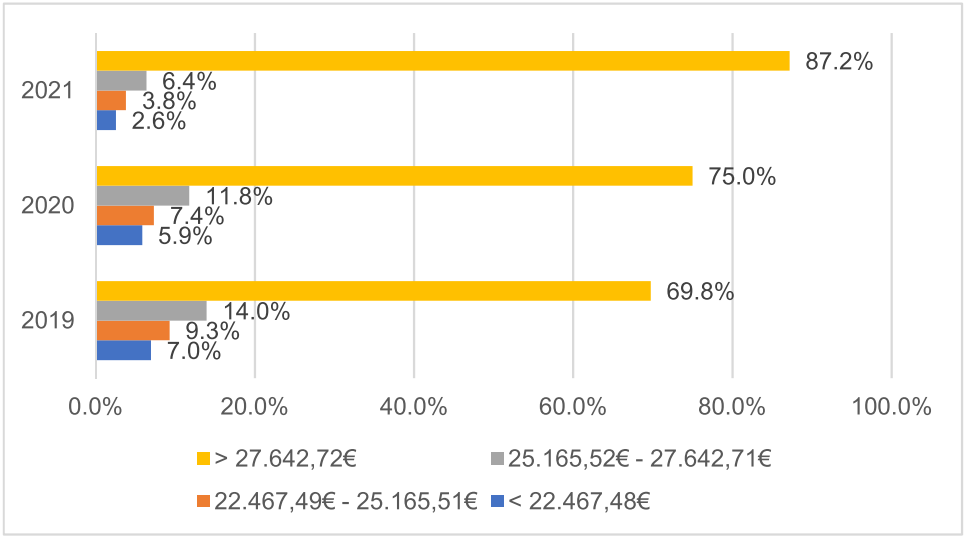


Fig. 10. SDG 8.5.1. Evolution% Companies with average annual earnings per employee in Optimal Companies Cluster 2019–2021.

Table 1
Variables comprising the factors.

Factor - Company Size and Balance Sheet Strength	Factor - Payment and Solvency Guarantee
Total Assets (€)	Guarantee Ratio (%)
Revenue (€)	Current Ratio (%)
Number of employees	Quick Ratio (%)
Total Equity (€)	
Total Liabilities (€)	**Factor - Returns on Operating Income**
EBITDA - Earnings Before Interest, Taxes, Depreciation and Amortization (€)	
EBIT - Earnings Before Interest and Taxes or Operating Income (€)	ROS - Return On Sales (%)
Net Income (€)	ROA - Return On Assets (%)
Personnel Expenses (€)	ROE - Return On Equity (%)

results obtained in the contingency tables relating the five clusters to SDG 5 (Gender Equality) with Target 5.5 and SDG 8 (Decent work) and economic growth with Target 8.5.

SDG 5.5.2 and SDG 8.5.1 and the cluster of maximum-sized companies

In the studied period, only one company was placed in this cluster; for all three years, this company had female representation on its board. However, 100 % of its capital belongs to corporate groups. In terms of compliance with indicator 8.5.1, the average salary of the company exceeds the average salary of men.

SDG 5.5.2 and SDG 8.5.1 and the healthy and solvent companies cluster

In 2019, 25 % of the companies that make up this cluster included women in board member positions; this percentage increased to 33.3 % in 2020. Ultimately, female representation disappeared in 2021 because some of the companies in this cluster are, by this time, grouped within

the Optimal Companies cluster. As for female representation among company ownership, in 2019, it was nonexistent, growing to 33.3 % in 2020, and returning to zero in 2021.

In terms of compliance with indicator 8.5.1, in 2019 and 2020, half of the companies in this cluster exceeded the average salary of men. In 2021, average salaries decreased, with 100 % of the companies staying the interval between the average salary of both sexes and the average salary of men, thus reducing the average salaries of the companies.

SDG 5.5.2 and SDG 8.5.1 and maximum-profitability companies

For the Maximum-Profitability Companies, 30 % had women in board member positions in 2019; in 2020, this figure increased to 40 %, and it was reduced to 0 % in 2021. As for female participation in ownership, in 2019, the figure was 10 %, and, in 2020 and 2021, there was no female representation in ownership.

On the other hand, the average salaries mostly exceed the average salaries of men during the three-year period, increasing by 36 % from 2019 to reach 100 % of the companies that exceed this amount in 2021.

SDG 5.5.2 and SDG 8.5.1 and companies with negative results

In this cluster, companies with women in board member positions in 2019 and 2020 moved to the Optimal Companies cluster in 2021. The same is true for companies with ownership composed of women. Only two companies remain in this cluster in 2021 that are 100 % owned by business clusters.

As for the salaries of the companies, they mostly exceeded the average salary of men, with the number of companies meeting this target increasing from 40 % in 2019 to 100 % in 2021.

SDG 5.5.2 and SDG 8.5.1 and the optimal companies cluster

In the cluster with the highest density, every year, the number of companies with women in board member positions decreased, although there was a 15 % increase in 2021, with 32.1 % of women. In terms of company ownership, the same pattern of lower female representation is repeated. In 2019, there were 16.3 % female owners. In 2020, this number decreased to 11.8 %. In 2021, it rebounded slightly to 14.1 %, but without reaching pre-pandemic levels.

In this cluster, more than half of the companies had salaries above the average salary of men. In addition, this figure increased throughout the period, rising by 17.77 % to reach, in 2021, 87.2 % of the total number of companies that make up this cluster.

Discussion and conclusions

The idea of using scarce resources has been present throughout history, but, in the last century, CEs and sustainable development have become a global necessity (Sinha et al., 2020). This study focuses on analyzing the economic data of companies in the 'Recovery of Sorted Materials' sector in Spain during the period 2019–2021 (pre-COVID-19, during COVID-19, and post-COVID-19), considering whether or not they comply with SDG 5 and SDG 8.

First, the analysis of SDG 5.5.2 in the five clusters shows a worsening of the data between 2019 and 2021, in line with the figures provided by EUSTAT (2023). The presence of women in the post-COVID-19 era is much lower than it was before the pandemic. This has led to the addition, in Spain, of article 529 to the 'Anteproyecto de Ley Orgánica de representación paritaria de mujeres y hombres en órganos de decisión' (Draft Organic Law on equal representation of women and men in decision-making bodies) (Ministerio de la Presidencia, 2023) to demand that "Boards of Directors have a composition that guarantees the presence of at least 40 % of members of the less represented sex". This is because, although, for the first time, more than 30 % of the directors of IBEX-35 companies are female, 91.43 % of chairmanships are still held by men (ATREVIA & IESE, 2023). As pointed out by UN Women (2023) although women are still underrepresented in positions of power, (Lawson et al., 2022) this is becoming a major strategic challenge for companies, as shown in this study, which is in line with the data provided by Ramadani et al. (2022). According to the contributions of Chai (2020), governments must launch public policies to improve the representation of women in business in line with ongoing social transformations and changes and as required by the 2030 Agenda. When there is gender diversity within a board of directors, with three or more women, the positive results become highly significant (Brahma et al., 2021), reducing risks and creating long-term strategies (Yarram & Adapa, 2022). Women are more likely to occupy positions of power within companies in countries with smaller gender gaps (Griffin et al., 2021), as is the case in Spain -a pioneering country in terms of equality- (Alvarez, 2010). However, this study shows how SDG 5.2.2.3 (women in board member positions) is only met in two of the five clusters analyzed in this country; meanwhile, SDG 5.2.2.4 (women business owners) is only met in one of the five clusters, with the presence of women on the boards and in ownership positions in the companies analyzed diminishing between 2019 and 2021. Thus, at times of social change such as the present, in which issues related to SDG 5 are deepened, the business world still makes it difficult for women to access positions of power; first, the issue of equality between men and women must be addressed.

In relation to the SDG 8.5.1, all the companies analyzed in the five clusters have average annual salaries above the average, making the recovery of sorted materials a highly competitive sector. It is worth noting that, in Spain, during the last year, 2021, salaries increased by an average of 3 % (OECD, 2023), taking into account Spanish inflation (INE, 2023a); however according to UN (2020), men continue to earn 12.5 % more than women, resulting in a gender gap of 23 %, with a labor force participation rate of 94 % for men and 63 % for women. In terms of salaries, in the Negative Results cluster, in 2021, 100 % of the companies that make up this cluster pay above the average annual salary and, therefore, offer the maximum remuneration in this study. The economic and company-related changes in the five clusters indicate the strong economic momentum of this sector, which makes it an attractive sector for new companies to enter (Puertas et al., 2022).

In terms of the period analyzed (pre-COVID-19, COVID-19, and post-COVID-19), our data show that the turnover in the analyzed sector ('Recovery of Sorted Materials') grew considerably, with an increase in revenue of 61 %. It grew from being a sector with losses of EUR −9036,269 in 2019 to having profits of EUR 103,304,148 in 2021, contributing to an increase in the GDP of Spain. It is important to note that, in 2020, severe limitations were placed on the mobility of citizens to control the global health crisis (Duque-Calvache et al., 2020). However, while this led to a slowdown and even a paralysis of the main activity of other sectors, this study shows that, in the analyzed sector, it led to a recovery of companies' financial statements. The recovery of urban waste and its revaluation, converting it into raw materials, allows companies to be less heavily dependent on third-party companies. In addition, companies with a green value chain see a positive impact on business performance (Li et al., 2019).

These findings respond, negatively and forcefully, to the research question. Despite their significant growth during the period analyzed, companies in the waste recovery sector, which are more aware of social changes due to the activity they carry out, only focused on the economic and environmental aspects of the Agenda, forgetting the social aspect defended by SDG 5, which is highly important for the 2030 Agenda.

Of all the companies analyzed, only one of them (Saica Natur SL, belonging to the Saica Group) has its own management strategy that is related to the objectives set out in this article; this is the 'Sustainable Development and People Management', according to which women are its best representatives and precursors of sustainability, development, and equality policies. In this regard, it is clearly the leading company in the sector analyzed. It is also the only company with a sustainability report (Saica Group, 2021), in which the company reports on the corporate group's contribution to the achievement of the SDGs. According to Valls Martinez et al. (2019), studies show that gender diversity on boards of directors has a positive influence on corporate social

responsibility (CSR) performance, as shown in this study; the only company with a woman at the helm is the leading company in the sector and the only one that complies with 'Sustainable Development and People Management'. Therefore, the social economy contributes significantly to the achievement of SDG 5 and SDG 8, with the greater participation of women, stable jobs, and less of a glass-ceiling phenomenon (Núñez et al., 2020). In addition, other studies have found that there is a negative relationship between board gender diversity and carbon emissions, amplified by environmental innovation (Konadu et al., 2022).

In summary, COVID-19 brought about changes in recycling habits, leading to significant improvements in the economic capacity of companies in the "Sorted Materials Recovery" sector. However, this study shows that these companies, which promote business transformation, social change, sustainable development, and CE, only meet SDG 8.5.1, having salaries above average or at the national average. They remain far from achieving SDG 5, with only two of the analyzed clusters meeting SDG 5.2.2.2.3 (women in board member positions) and only one meeting SDG 5.2.2.4 (women business owners). This goal therefore constitutes a significant strategic challenge for the analyzed companies. In this specialized and innovative sector, the presence of women dropped considerably between 2019 and 2021. This exemplifies the fact that setbacks in social change were experienced after the arrival of COVID-19; this means that the sector fails to comply not only with SDG 5 but also with the obligations set by the EU and Spain—the country under consideration in this study. In short, although COVID-19 led to economic improvements in the analyzed sector, with an increase in income of 61 %, it affected women to a greater extent than men. One of the most innovative business sectors thus fails to comply with the SDGs of the 2030 Agenda.

Finally, it should be noted that future research could go beyond the approach proposed in this article and relate the financial results of these companies to the types of final products manufactured by the companies, analyzing the margins that each product allows; after all, certain products may be more profitable than others. Researchers could also carry out a more in-depth analysis, with a gender perspective, on the presence, role, and progress of women in this sector. This will help to make visible the realities that contribute to the social and economic improvements laid out in the 2030 Agenda.

CRediT authorship contribution statement

Alicia Ferradás-González: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Cristina Pérez-Rico:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Alba Adá-Lameiras:** Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

Research Support: This research received no external financial o non-financial support.

Relationships:

There are no additional relationships to disclose.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.stae.2024.100082.

APPENDIX

Tables 2-5.

Table 2

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Company Size and Balance Sheet Strength	
Total Assets (€)	
Revenue (€)	
Number of employees	
Total Equity (€)	
Total Liabilities (€)	
EBITDA - Earnings Before Interest, Taxes, Depreciation and Amortization (€)	
EBIT - Earnings Before Interest and Taxes or Operating Income (€)	
Net Income (€)	
Personnel Expenses (€)	
Payment and Solvency Guarantee	Formulas
Guarantee Ratio (%)	Real Total Assets / Total Liabilities
Current Ratio (%)	Current Assets / Current Liabilities
Quick Ratio (%)	Cash + Short-term marketable investments + Receivables / Current Liabilities
Returns on Operating Income	Formulas
ROS - Return On Sales (%)	Operating Income / Revenue
ROA - Return On Assets (%)	Operating Income / Total Assets
ROE - Return On Equity (%)	Operating Income / Total Equity

Table 3
Means of the variables comprising each of the Clusters 2019.

CLUSTER ANALYSIS 2019 CLUSTER NAME	CLUSTER 1 MAX. SIZE COMP.	CLUSTER 2 OPTIMAL COMP.	CLUSTER 3 NEGATIVE RESULTS COMP.	CLUSTER 4 HEALTHY & SOLVENT COMP.	CLUSTER 5 MAX. PROFITABILITY COMP.
Company Size and Balance Sheet Strength					
Personnel Expenses (€)	30,878,132.76	935,079.45	913,503.67	232,324.43	1418,110.47
Revenue (€)	200,758,568.12	5708,127.68	3598,657.03	1484,678.12	9935,471.72
Number of employees	880	29	31	7	43
Total Assets (€)	114,908,357.52	5115,483.08	4787,786.58	4991,066.04	10,456,965.11
Total Liabilities (€)	71,106,008.70	3114,471.59	1508,306.62	232,288.35	5602,026.42
Net Income (€)	−24,923,639.48	41,561.25	−625,416.01	194,497.82	551,711.21
EBIT (€)	−25,205,076.31	74,064.85	−811,311.84	247,396.49	746,822.57
Total Equity (€)	43,802,348.82	1951,945.90	3279,479.96	4758,777.69	4854,938.70
EBITDA (€)	−20,130,447.62	317,898.51	−617,472.61	320,555.51	1134,533.53
Payment and Solvency Guarantee					
Current Ratio (%)	139.42 %	151.14 %	170.01 %	1268.90 %	194.68 %
Quick Ratio (%)	130.40 %	120.91 %	109.28 %	1242.60 %	174.59 %
Guarantee Ratio (%)	161.60 %	227.94 %	263.78 %	2907.14 %	249.97 %
Returns on Operating Income					
ROA	−21.93 %	2.87 %	−15.09 %	−0.28 %	11.65 %
ROS	−12.55 %	2.40 %	−15.58 %	6.91 %	10.16 %
ROE	−57.54 %	6.55 %	−32.59 %	−0.45 %	35.82 %

Table 4
Means of the variables comprising each of the Clusters 2020.

CLUSTER NAME	MAX. SIZE COMP.	HEALTHY & SOLVENT COMP.	MAX. PROFITABILITY COMP.	OPTIMAL COMP.	NEGATIVE RESULTS COMP.
Company Size and Balance Sheet Strength					
Revenue (€)	193,026,919.98	1595,833.19	18,252,609.19	6583,945.89	6263,943.16
Total Assets (€)	137,934,624.18	4129,854.28	15,740,578.91	7423,772.02	4699,519.08
Number of employees	883	16	55	32	54
Personnel Expenses (€)	31,530,423.14	429,717.43	1891,775.62	1055,266.28	1738,019.75
Total Equity (€)	62,888,882.90	3839,506.04	9611,361.79	3349,157.44	−934,754.87
Total Liabilities (€)	75,045,741.28	290,348.24	6129,217.12	4089,917.04	5634,273.95
EBITDA (€)	14,254,620.67	254,253.53	4020,121.84	725,140.22	−2468,955.36
EBIT (€)	8794,421.54	182,749.05	3392,944.32	395,135.71	−2706,252.31
Net Income (€)	7082,622.90	160,785.84	2594,005.11	280,472.61	−2298,389.60
Returns on Operating Income					
ROA (%)	6.38 %	6.74 %	31.12 %	6.97 %	−39.30 %
ROS (%)	4.56 %	12.42 %	29.12 %	6.33 %	−54.10 %
ROE (%)	13.98 %	7.93 %	63.34 %	18.24 %	16.52 %
Payment and Solvency Guarantee					
Current Ratio (%)	125.13 %	838.44 %	199.86 %	183.48 %	79.01 %
Quick Ratio (%)	118.40 %	820.72 %	193.32 %	147.68 %	54.80 %
Guarantee Ratio (%)	183.80 %	1849.67 %	235.15 %	250.29 %	129.60 %

Table 5
Means of the variables comprising each of the Clusters 2021.

CLUSTER ANALYSIS 2021 CLUSTER NAME	CLUSTER 1 MAX. SIZE COMP.	CLUSTER 2 HEALTHY & SOLVENT COMP.	CLUSTER 3 MAX. PROFITABILITY COMP.	CLUSTER 4 OPTIMAL COMP.	CLUSTER 5 NEGATIVE RESULTS COMP.
Company Size and Balance Sheet Strength					
EBITDA (€)	50,410,583.62	232,880.49	597,655.81	1449,785.82	−214,584.89
Personnel Expenses (€)	31,567,664.58	129,425.49	354,907.99	1285,628.29	317,291.97
Number of employees	879	5	5	36	10
EBIT (€)	44,728,312.67	195,946.24	597,006.84	1092,809.71	−318,808.26
Total Assets (€)	174,670,836.68	5143,711.63	544,985.32	9506,515.33	2234,951.47
Revenue (€)	306,400,871.14	722,485.77	1400,724.56	11,879,105.80	717,746.37
Net Income (€)	41,836,653.01	149,233.22	444,563.04	786,941.98	−253,887.76
Total Equity (€)	104,678,923.58	5032,633.69	72,575.20	4510,429.01	642,290.27
Total Liabilities (€)	69,991,913.10	111,077.94	472,410.12	5010,094.84	1592,661.20
Payment and Solvency Guarantee					
Current Ratio (%)	125.26 %	2045.14 %	115.36 %	200.65 %	46.34 %
Quick Ratio (%)	119.90 %	1986.20 %	111.10 %	175.86 %	45.50 %
Guarantee Ratio (%)	249.56 %	4630.72 %	115.36 %	258.77 %	141.53 %
Returns on Operating Income					
ROA (%)	25.61 %	3.81 %	109.55 %	12.74 %	−14.29 %
ROE (%)	42.73 %	3.89 %	822.60 %	29.70 %	−55.24 %
ROS (%)	14.60 %	27.12 %	42.62 %	10.67 %	−180.13 %

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