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# The Sustainability of Romanian SMEs and Their Involvement in the Circular Economy

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**Abstract:** Sustainability involves extending the relational framework of SMEs outside the sphere of economic activity by justifying and legitimizing actions with a social impact on the environment. Links with the circular economy are achieved through the economic and environmental dimensions and through corporate social responsibility as a component of sustainable development. The main purpose of the paper was to determine the level of involvement of Romanian SMEs in activities related to the circular economy. The sample survey conducted among SME managers offered the advantage of collecting a large amount of direct information on the activities undertaken, the size of the investments and the nature of the funding sources used over the last five years. In this descriptive research, the process of setting up a representative sample of 384 enterprises was carried out by random sampling. The major contributions of the research project are to outline the contribution of Romanian SMEs to the development of a sustainable economy through their involvement in specific activities, the size of the investments made, and the level of participation of representatives of the enterprises in courses in order to identify new sources of financing and positive solutions in order to implement the principles of the circular economy.

**Keywords:** sustainability; circular economy; investments; sources of funding; SME; sustainable economy

## 1. Introduction

The circular economy and sustainability are two concepts that outline an extended framework for sustainable development, through which the implementation of strategies capable of providing the enterprise with healthy development is also achieved by addressing the problems of environmental degradation and resource shortages [1–4]. Besides, the circular economy is a sustainable development strategy that tackles the problems of environmental degradation and natural resource shortages through three principles: reduction, reuse and recycling of materials [5–7]. These principles define a circular system where all the materials are recycled, and all the energy comes from renewable sources that support activities and rebuild the ecosystem as well as support human health, society and healthy resources that generate value [8–11].

Since small firms are an important engine of growth in the economy and sustainability is an essential input in the production process, identifying how firms respond to the circular economy is crucial to understanding growth in developing economies [12–15].

Through this study, the authors intended to highlight the extent and the degree of involvement of Romanian SMEs in the activities specific to the circular economy. To achieve this, quantitative research was carried out among SMEs in Romania using a survey with a representative sample drawn using the random numbering method. The degree of involvement of enterprises in the circular economy was first assessed with regard to issues such as the activities carried out, the level of investments made, the sources of financing attracted and the level of managers' interest in attending courses in order to implement new circular business models. In light of an apparent logical fault, the diversity of views expressed in the literature specifically referring to the circular economy helped us to determine the best approach to position our scientific research with regard to the new challenges of SMEs in the Romanian economy.

The results of the present study suggest that successful sustainability plays an important role in the survival and success of any organization in today's environment, which is extremely competitive and continually evolving. Finally, our findings are relevant for the transformation of Romanian SMEs by identifying the specific actions they take as part of their involvement in the circular economy.

The remainder of this study is organized as follows. Section 2 provides a brief literature review. Section 3 presents a description of the research methodology. The empirical results are presented and discussed in Section 4. Finally, conclusions and suggestions are presented in Section 5.

## 2. Literature Review

The circular economy concept has been debated in several schools of thought and theory that have challenged linear economic systems that suppose that resources are infinite [16–18]. According to their studies, some specialists consider the circular economy as a space economy that works by reproducing the limited initial input stock and recycling the waste produced [19–21]. Other specialists consider the circular economy to be an industrial economy that relies on the ability to restore natural resources [22,23] and aims to minimize (or eliminate) waste, use renewable energy sources and phase out the use of harmful substances [24].

The specialists considered that there was also the need to accept an economic model in which the materials and energy of waste products are reintroduced into the economic system [25]. Thus, a clear distinction was made between two different types of materials in a closed-loop economy: materials of biological origin and materials of non-biological origin. Materials of biological origin (forest products) can return to the biosphere as raw materials, but materials of non-biological origin (plastics or metals) cannot return to the biosphere and are not biodegradable [26,27]. This type of economy transcends the linear economy [28], seeking new transformations across the value chain to keep both types of material in the circular economy, preserving their value for as long as possible [29].

Different studies based on the design, investigation and creation of a general framework on the ecological side of the circular economy have been carried out by specialists around the world, including circular design [30], design for circular behavior [31,32], the incorporation of ecosystem services [33], evaluating the environmental dimension based on material efficiency strategy [34], and the analysis of consumer behavior related to the circular economy [35].

Implementing the concept of the circular economy requires a detailed analysis of the opportunities and benefits it can bring to a country's economy. According to specialists' studies, large enterprises have greater facility in adopting and realizing beneficial circular business models, such as creating new jobs [36,37], reducing costs in different sectors of the economy (cars, electric machines, machinery and equipment) [38], supply-side price mitigation on commodity markets, or supply risks [39]. Once large enterprises have adopted circular business models, SMEs become aware of the benefits of the circular economy and of improving their efficiency in using natural resources.

The European Commission report states that more than two-thirds of interviewed SMEs are satisfied with the return on investments made to improve resource efficiency, and have seen production cost reductions over the past two years [40]. Romanian SMEs are extremely different, so every branch of the national economy can benefit from the implementation of the principles of the circular economy in an adapted manner [41]. In these conditions, the extent to which SMEs are willing to adopt ecological measures and their attitude to green policies depends on the sector in which they operate [42].

Most studies undertaken by specialists have indicated that SMEs do not adopt and implement the principles of the cyclical economy due to the initial costs, the reimbursement period for investments, or the high costs of achieving resource efficiency [43–45]; the high cost of organic business models [46,47]; the impossibility of supporting profitable economic activity due to hidden costs, a lack of highly qualified employees, and sudden changes in the economic environment [48]; the lack of financial resources to establish and manage a recycling system [49]; a lack of information, including information on deviations from the ex-ante cost estimates of ecological procedures, which may induce uncertainty and harm the competitiveness of SMEs [38]; the production of a small amount of waste, so that the circular economy represents an economically unfavorable option [50]; the lack of internal competencies leading to a dependence on recommendations made by external actors [44]; and the limited influence of SMEs on suppliers' involvement in sustainable activities [51,52].

In addition, in the SME sector, there is only modest initiative from the government to support new investment, with no coherent legislative measures to encourage the circular economy convictions and principles [42]. In support of this, we can offer the example of the Ecological Management and Audit Scheme (EMAS), which has no clear delimitation between large businesses and the SME sector [53,54]. In this case, only the managers' commitment to sustainability contributes to the adaptation and implementation of the principles of the circular economy to the needs of the SMEs [55,56]. The need for a better regulatory agenda to design and implement environmental policies is highlighted by the first assessment of the EU Environmental Assistance Program for SMEs [57].

Research undertaken by the European Commission highlights the fact that some concepts and terms in the EU legislation are not clearly defined, namely provider responsibility, separate collection quality and the definitions of recycling, re-use and recovery [58]. In Romania between 2002 and 2008, the SME sector developed steadily, with the growth of more than 69% in the number of enterprises [41]. The number of active entities increased from 326,443 in 2002 to 557,189 in 2008. The impact of the financial and economic crisis was felt strongly among SMEs, with the loss of about 11.73% of the enterprises, with a total of 491,805 active entities registered at the end of 2010 [43]. Over the last four years, the SME sector has seen a slow growth of only 10%, with a distribution by representative sectors of trade (38.98%), industry (11.84%), construction (9.60%), transport (6.10%), hotel and restaurants (4.52%), agriculture, forestry and fishing (2.18%) and other services (26.77%) [59].

## 3. Research Methodology

To conduct this research, we considered the hypothesis that SMEs are the engine for the development of a circular economy. SMEs can make a major contribution to the development of a sustainable economy by gradually integrating the principles of the circular economy into their own business model. The determining role of SMEs remains: (1) producing beneficial effects for a country's economy by recycling waste and using it as a raw material in production processes; (2) developing products and services in symbiosis with other industries by reducing resource consumption; (3) creating customized, high quality and value-customized products; (4) job creation and staff qualification in the field of environmental protection; and (5) increasing competition in sustainable product markets. Taking into account this hypothesis, the purpose of the research was to determine the level of involvement of Romanian SMEs in the activities specific to a circular economy.

The main objectives of the research were as follows:

- Highlighting the activities related to the circular economy conducted by SME managers in Romania in the last five years;
- Identifying the size of current and future investments by allocating percentages of turnover both to businesses that have carried out circular economy activities over the past five years and those willing to develop circular business models in the years to come;
- Description of the funding sources used by SMEs in the last five years to ensure good functioning and to carry out activities related to the circular economy;
- Identifying the level of participation of Romanian managers in courses to acquire the knowledge and skills regarding the performance of some activities that promote resource efficiency, eco-innovation and the circular economy.

Thus, in order to achieve the objectives, quantitative marketing research was carried out among SME managers in Romania. The main considerations were: (1) the development of governmental and European programs that provide access to important sources of funding and create premises for coherent, systematic and coordinated actions aimed at fostering entrepreneurship and increasing the number of SMEs; (2) the interconnected functioning of productive SME chains, with a high potential for adding value at the national, regional and global levels; and (3) the massive contribution of the SME sector to the formation of national GDP, to the economic and sustainable growth of a country, generating social progress and social prosperity.

At the end of February 2017, the statistical metadata database of the National Institute of Statistics of Romania was consulted in order to obtain the information necessary for the realization of the quantitative research. According to the data provided by National Institute of Statistics [59], on 28 February 2017, a list was established in which 552,483 active enterprises with a minimum of five years of age and a number of employees ranging from 1–249 were identified in Romania (www.statistici.insse.ro). Micro-enterprises represent 89.12% of all SMEs in Romania (Figure 1).

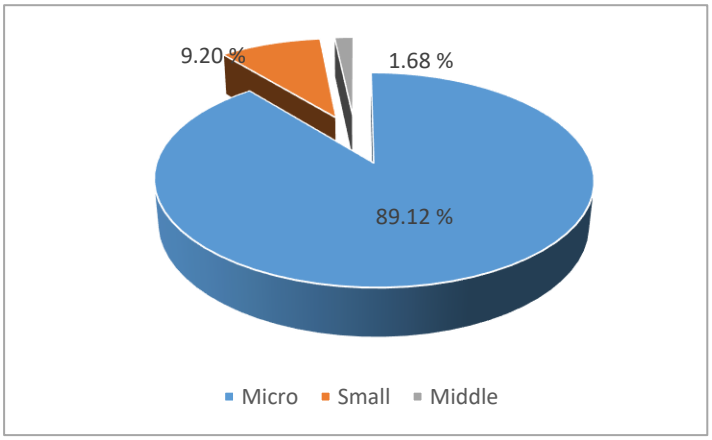


**Figure 1.** Distribution of economically active SMEs in Romania by their size on 31 January 2017 [59].

In Romania, micro-enterprises are defined as enterprises that have up to nine employees and achieve a net annual turnover of up to two million euro. Small enterprises are defined as enterprises that have up to 49 employees and achieve a net annual turnover of up to 10 million euro.

The research method used in the quantitative study was a survey by sampling, using a questionnaire as the data collection tool. The study was conducted between 12 March and 12 April 2017, with the support of eight interviewers with experience in the field who drafted the questionnaires for all eight development regions of Romania: North-East, South-East, South-Muntenia, South-West Oltenia, West, North-West, Center and Bucharest-Ilfov (Figure 2). Each interviewer held face-to-face interviews

with business managers in one of Romania's development regions. For example, one interviewer covered the West region, another the South-West region.

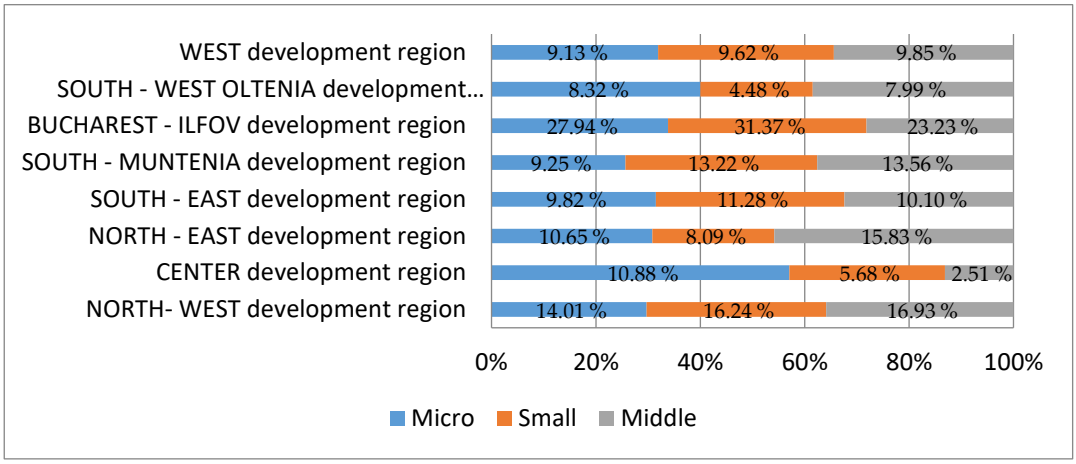


**Figure 2.** Distribution of economically active SMEs in the eight development regions of Romania on 31 January 2017 [59].

The sampling frame was made up of enterprises (SMEs), since these entities, both in terms of organization and functioning and through the activities carried out, were able to provide all the data and information necessary to achieve the intended purpose. The selection was based on simple random sampling, using a random number generator, from a list that included all Romanian SMEs with a minimum of five years of activity and a number of employees ranging from 1–249 people. The main criteria for structuring the enterprises were the number of employees, the development region; the field of activity and the year of establishment (minimum of five years) (Table 1 and Table A1).

It is necessary to clarify that the list was based on the statistical metadata from the National Institute of Statistics of Romania, which removed active SMEs with a working life of less than five years, inactive SMEs and those with a number of employees over 249 people. In this way, the structure of the research sample was a faithful reproduction of the structure of the reference population. The fundamental principle that was taken into account when using the sampling method was that the layers chosen were related to the dependent variable that was the object of the research. The proportion of subjects (SMEs) in each layer of the sample was proportional to that of the subjects at that layer level in the total population. To ensure a probability of guaranteeing 95% of the research results and obtaining an error margin of $\pm 5\%$ for a value $p = 0.50$, the sample size should be 384 observation units, thus the survey included 384 enterprises (SMEs). In the first phase, sub-samples were extracted from each layer, resulting in a high level of representativeness of the total sample, compared to simple random sampling, which can generate overrepresentation of some population groups and underrepresentation of others.

After identifying the enterprises, contact was established with their representatives to determine who should be surveyed, to obtain the survey participation agreement and to establish details of the meeting. The survey was the basis of the research; the process used to interview the SME managers was face-to-face interviews. The questionnaire was structured around four distinct objectives: (1) the activities undertaken related to the circular economy; (2) the size of the investments made; (3) the funding sources used for these types of activities; (4) participation in the acquisition of skills related to resource efficiency, eco-innovation and the circular economy. The information processing was based on the responses received from the SME managers and the information centralization was performed in relation to the consistency and convergence of the purpose of the research.

**Table 1.** Sample structure.

| Number of Employees | Total SMEs Studied | | Sample of SMEs Investigated | |
|---|---|---|---|---|
| | No. | % | No. | % |
| 0–9 people (micro-enterprises) | 465,621 | 89.12 | 343 | 89.32 |
| 10–49 people (small enterprises) | 48,092 | 9.20 | 35 | 9.11 |
| 50–249 people (medium enterprises) | 8770 | 1.68 | 6 | 1.56 |
| Total | 522,483 | 100 | 384 | 100.00 |
| Development Region | | | | |
| North-West development region | 74,531 | 14.26 | 55 | 14.26 |
| Center development region | 53,596 | 10.26 | 39 | 10.26 |
| North-East development region | 54,846 | 10.50 | 40 | 10.50 |
| South-East development region | 52,057 | 9.96 | 38 | 9.96 |
| South-Muntenia development region | 50,624 | 9.69 | 37 | 9.69 |
| Bucharest-Ilfov development region | 147,210 | 28.18 | 108 | 28.18 |
| South-West Oltenia development region | 41,608 | 7.96 | 31 | 7.96 |
| West development region | 48,011 | 9.19 | 35 | 9.19 |
| Total | 522,483 | 100 | 384 | 100.00 |
| Areas of Activity | | | | |
| Agriculture, forestry and fishing | 11,395 | 2.18 | 8 | 2.01 |
| Industry | 61,880 | 11.84 | 45 | 11.85 |
| Construction | 50,175 | 9.60 | 37 | 9.61 |
| Trade | 203,665 | 38.98 | 150 | 38.99 |
| Hotels and restaurants | 23,621 | 4.52 | 17 | 4.52 |
| Transport | 31,886 | 6.10 | 24 | 6.25 |
| Other services | 139,861 | 26.77 | 103 | 26.78 |
| Total | 522,483 | 100 | 384 | 100.00 |
| Year of Establishment | | | | |
| 5–9 years | 382,458 | 73.20 | 281 | 73.18 |
| 9–14 years | 90,390 | 17.30 | 66 | 17.19 |
| >15 years | 49,636 | 9.50 | 37 | 9.64 |
| Total | 522,483 | 100 | 384 | 100 |

Source: Authors' calculation based on information extracted from the National Institute of Statistics of Romania [59].

## 4. Results and Discussion

The first objective was related to highlighting the main activities specific to the circular economy, carried out by SME managers in Romania (Figure 3).

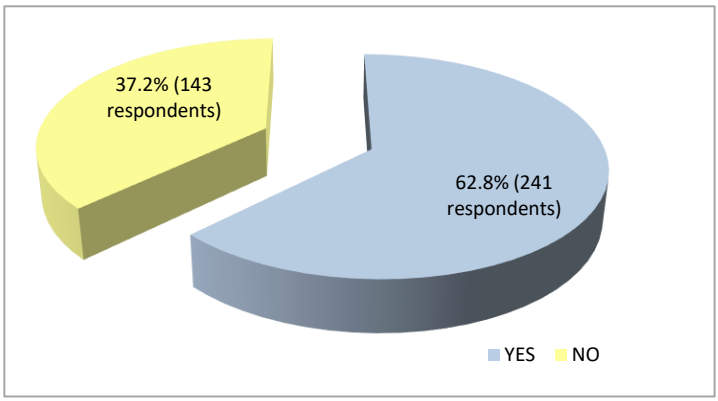


**Figure 3.** The share of SMEs that have carried out at least one activity related to the circular economy in the last five years.

In 241 (62.8%) of the 384 SMEs participating in the research, the managers said at least one activity related to the circular economy had taken place in the last five years. In total, 143 (37.2%) of 384 enterprises did not have at least one circular activity in the last five years. The management of the Romanian enterprises showed a positive attitude towards carrying out activities to support the circular economy at every stage of the value chain: production, consumption, repair and manufacture, waste management and secondary raw materials that are reintroduced into the economy.

In 62.8% of the SMEs surveyed in Romania, the managers said that they make real efforts to conduct activities related to the circular economy but face financial problems, with labor shortages and many legal barriers. However, the managers of these SMEs proposed the development of new strategies for the circular economy in the coming years and hoped to make a lot of progress in this regard.

The main activities related to the circular economy undertaken by Romanian SMEs in the last five years were (Figure 4) strengthening the guarantees offered to consumers who purchase goods online (14.10%), the use of renewable energy (12.78%), designing smart and green products and using energy labeling (12.33%), the use of advanced manufacturing facilities that generate cleaner production (10.13%), safe wastewater reuse (5.29%), the application of innovative techniques for the use of secondary raw materials/alternatives (3.08%) (2.64%), and the prevention of waste generation, the stimulation of recycling and the reduction of resource use (2.20%).

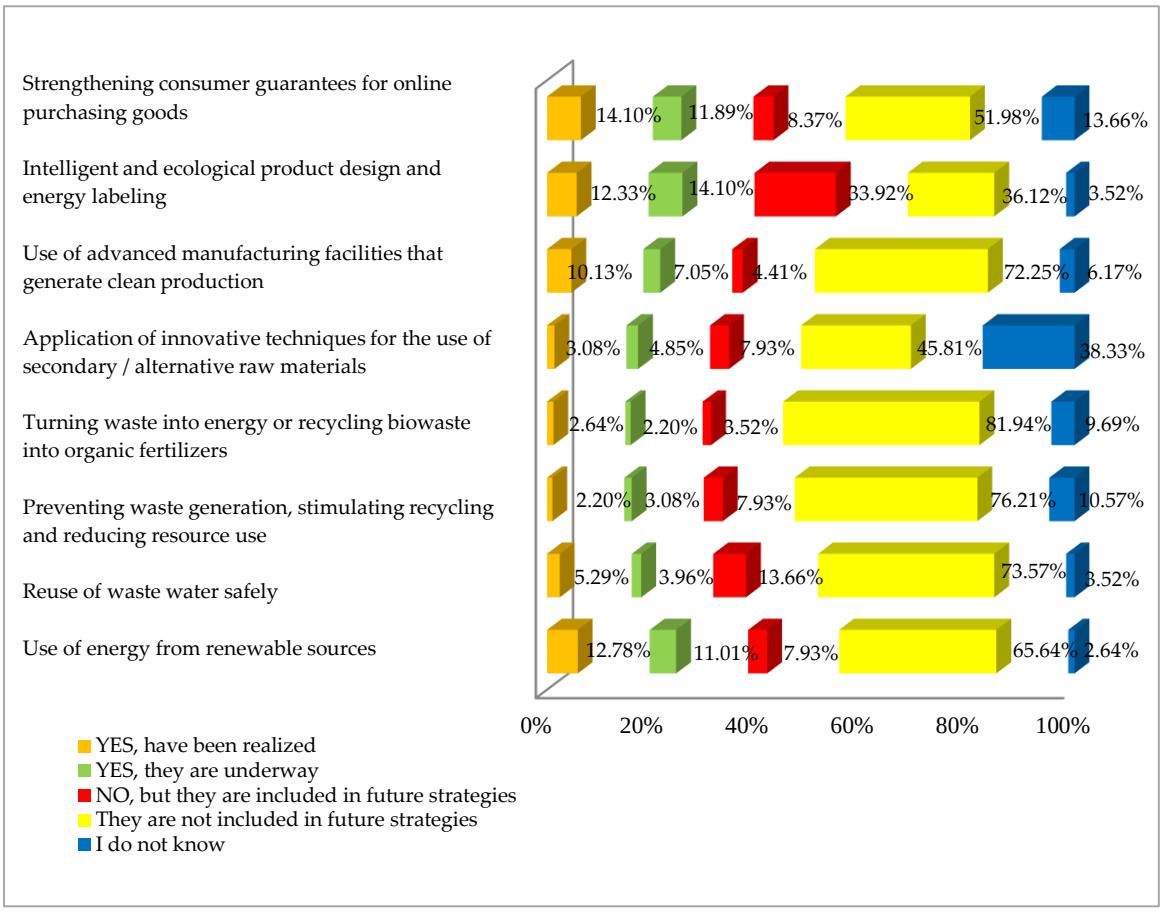


**Figure 4.** Description of activities related to the circular economy undertaken by Romanian SMEs in the last five years.

In order to identify the link between the three categories of enterprise and the activities related to the circular economy, a factorial analysis of correspondence (Figure 5) was used. The SMEs were

grouped into three categories: micro-enterprises (0–9 employees), small enterprises (10–49 employees) and medium-sized enterprises (50–249 employees). Figure 5 shows the existence of certain associations between the three categories of enterprises and the activities related to the circular economy undertaken in the last five years.

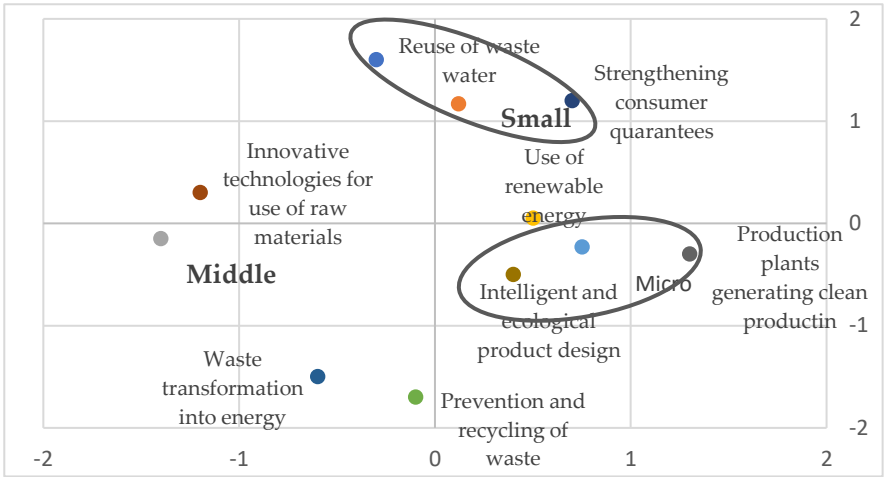


**Figure 5.** The correspondence between the three categories of enterprises and the activities related to the circular economy undertaken in the last five years.

A total of 219 of 343 micro-enterprise managers said that they already use advanced manufacturing facilities that generate clean production, carry out intelligent and environmentally-friendly product design, practice energy labeling, and use renewable energy constantly (see Table 1). In total, 5.29% of the 384 respondents claimed that they re-used waste water safely in the manufacturing process, the effects being reduced costs and reduced pressure on the resources used (see Figure 4). The two managers in the agricultural field claimed that water reuse contributes to the recycling of nutrients by replacing solid fertilizers. A further 22 small business managers claimed to have strengthened the guarantees offered to consumers who purchase goods online to provide better protection against defective products, thus contributing to sustainability and increased product repair potential. In this way, they claim they prevent the discarding of products and contribute significantly to the circular economy.

The managers of the SMEs surveyed said that they use innovative technologies that integrate into aspects relevant to the circular economy. At the level of their own businesses, the managers apply technologies to improve the use of secondary raw materials to increase energy efficiency and reduce wastewater generation, thereby helping to protect and reduce the use of available natural resources. Regarding waste reduction activities (recycling and reuse), most business managers have adopted sustainable and consistent waste management strategies. Some managers said they are trying to reduce the amount of waste by different methods: waste recycling, selling waste to certain specialized companies or re-using waste in the manufacturing process. Most respondents acknowledged that they do not carry out circular economy activities, but have planned future strategies based on concrete and measurable objectives. The second objective was to invest some percentage of the company's turnover in order to carry out activities related to the circular economy. Of the nearly 241 businesses that have developed circular economy activities over the past five years, most have invested an average of 1–5% of their turnover per year. Figure 6 shows that most of the investments were made by SMEs in the Bucharest-Ilfov and North-West regions. Almost 57.75% of the 241 enterprises that have carried out at least one activity related to the circular economy over the last five years have made investments of over 1%, while 31.69% of the SMEs have made no investments (Figure 6).

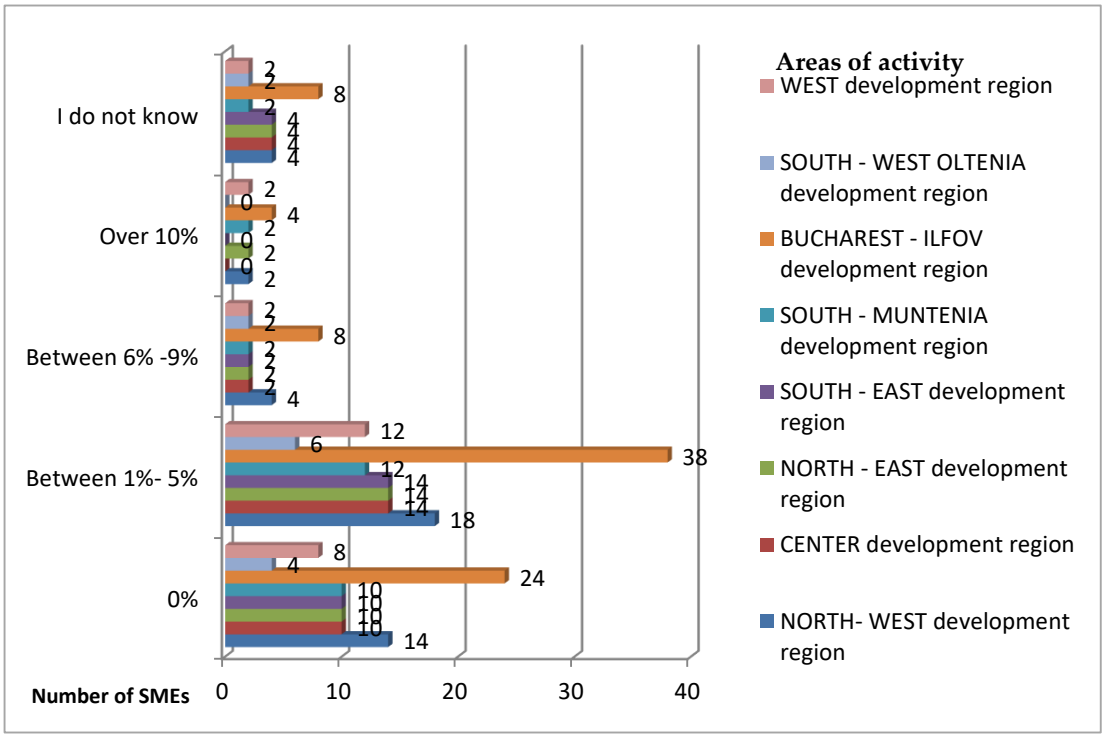


**Figure 6.** The distribution of SMEs that have carried out activities related to the circular economy in the eight development regions of the country, according to the share of investments made during the last five years.

In 10.56% (30 enterprises) of the SMEs participating in the research, managers did not keep a clear record of what percentage of their turnover they invested in circular economy activities over the past five years. Of the 158 enterprises that had not developed circular economy activities over the past five years, 30.38% would be willing to invest more than 1% of the turnover on average per year, 58.23% do not want to invest, and 11.39% did not know. Almost 34 enterprises invested between 1% and 5% of their turnover per year (21.52%), while 10 enterprises (6.33%) invested between 6% and 10% and 2.53% invested, on average, over 10% or more (Figure 6).

Figure 7 shows that 16 business managers in the Bucharest-Ilfov region who have not developed circular economy activities over the past five years, would be willing to invest more than 1% of their own turnover, on average, per year. Another 20 SME managers (North-West, Center, North-East, South-West Oltenia and West) said that they would be willing to invest part of the enterprise's turnover into circular economy activities over the next few years. Most activities undertaken by microenterprises that are related to the circular economy will be included in their future strategy; microenterprises represent 84.58% of all SMEs in Romania (Figure 7).

The third objective was related to the funding sources used by SMEs over the last five years to finance the activities related to the circular economy. Most of the SMEs surveyed funded their activities related to the circular economy from their own funds, i.e., turnover. Approximately 42.75% of the enterprises that have carried out at least one activity related to the circular economy over the last five years financed these types of activities from their own funds or from loans from close persons. Only 13.04% of enterprises used bank loans, while 10.51% benefited from government grants. Another 9.42% of the SMEs used various non-reimbursable funds from the EU, the EBRD, and the IMF, or had access to alternative sources of funding. Of the SMEs included in the survey, no enterprise had used a certain type of green technology investment (0%) for the circular economy activities undertaken over the last five years (Figure 8). Figure 8 shows that 125 enterprises of the 196 that used finances from their own funds come from two important sectors of the national economy: trade and services.

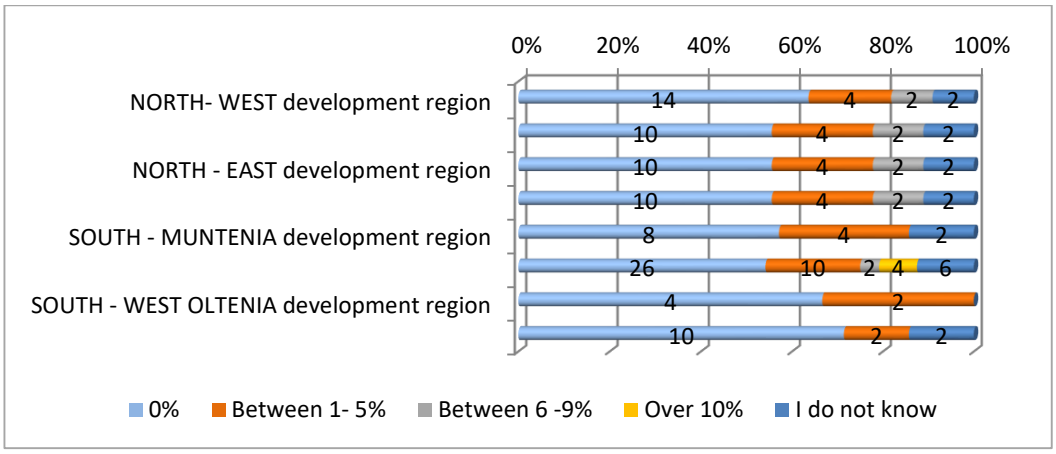


**Figure 7.** Distribution of SMEs not involved in circular economy activities in the eight development regions of the country, according to the share of future investments achievable.

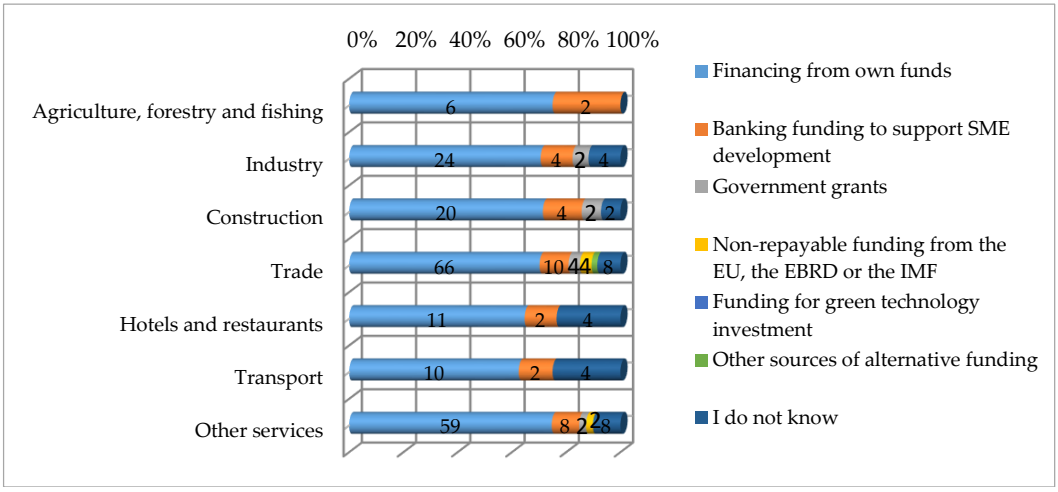


**Figure 8.** Distribution of SMEs according to the main fields of activity of the economy and by the way in which they finance activities related to the circular economy.

Of the 32 enterprises financed by bank loans, only eight come from industry and construction and six from agriculture, hotels and restaurants and transport. Non-reimbursable government funding benefited 10 enterprises from industry, construction, commerce and other services. Only six of the businesses analyzed, from trade and other services, used non-reimbursable grants from the EU, the EBRD or the IMF. Managers from 276 enterprises of the 384 surveyed who have been involved in the circular economy over the last five years specified the funding sources for these types of activity. For 42 of the 276 enterprises analyzed, managers did not want to indicate the sources of finance for the activities related to the circular economy undertaken over the last five years.

The last objective of the research was to identify the level of participation of SME representatives in courses to acquire new knowledge and skills regarding the implementation of resource efficiency, eco-innovation and circular economy activities and the determination of subjects of high interest for them (for example, the following courses are organized by the Chamber of Commerce and Industry, the National Center for Production and Sustainable Consumption Denkstatt Romania, the Ministry of Regional Development and Public Administration, the Ministry of European Funds and other public institutions and approved NGOs: Creative START, EU Ecolabel, START-UP Nation, GO Circular, capital markets and derivative financial instruments, etc.). Of the 384 SMEs surveyed, only 24.7% attended courses such as Geometric, 4th CSA, WaterWorks 2015, Synamera, Innovoucher, Columbus,

CoBioTech and others. Almost 64.8% of the SME managers did not attend courses, despite being aware of the running of governmental and European programs where free lectures are organized with the support of major institutions such as KPMG, Ecofys, CSR Netherlands and Circle Economy. Figure 9 shows that the managers who attended courses show an increased interest in topics such as EU-funded financial instruments to finance circular solutions (26.79%), participation in green public procurement (21.43%) and government programs to support SMEs related to circular actions (17.86%) (Figure 9).

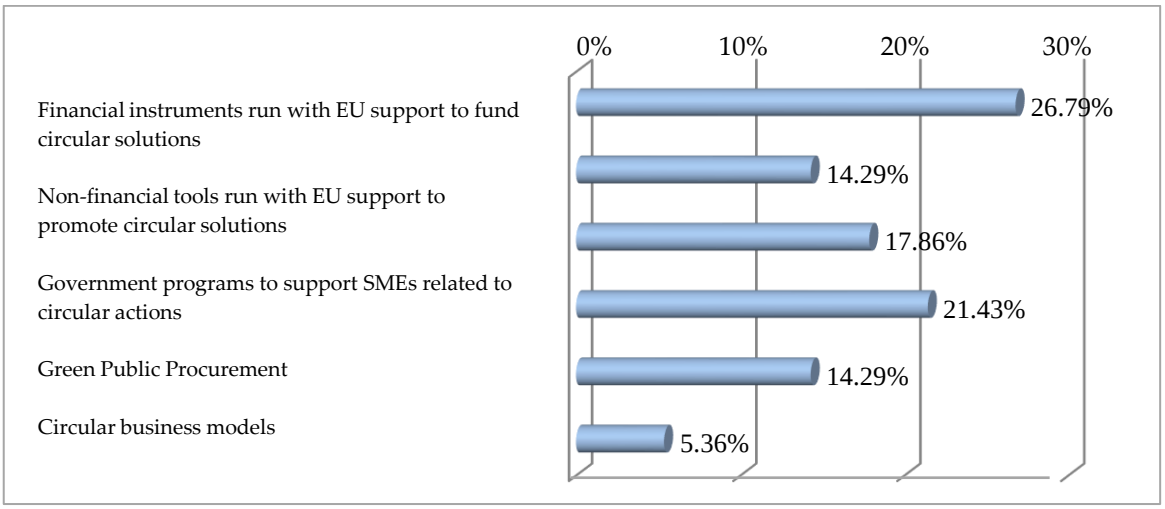


**Figure 9.** Assessing the interest of managers in the subjects treated in the specialization courses and in actions specific to the circular economy.

## 5. Conclusions

The results of this research highlighted the major contribution of SMEs to the development of a sustainable economy through their engagement in specific activities and through increasing the size of their investments. In the last five years, almost six out of ten Romanian enterprises (62.8%) engaged in activities specific to the circular economy [41]. The most frequent activities were the consolidation of guarantees for consumers who purchase goods online (14.10%), use of renewable energy (12.78%), smart and environmentally friendly product design and energy labeling (12.33%) and the use of advanced manufacturing facilities to achieve clean production (10.13%).

The research revealed that although more than half of the Romanian SMEs have undertaken at least one activity specific to the circular economy over the last five years, their level of involvement will remain moderate in the future. The main barriers to the development of a sustainable economy remain: (1) the low volume of future investments made by small- and medium-sized enterprises and micro-enterprises due to their small turnover; (2) the reduced rate of participation of business managers in non-reimbursable grant programs for circular actions and distinct SME programs that include courses necessary for the specialization and development of new circular business models.

Based on the review of the literature on the strategies, advantages and difficulties encountered in adopting the circular economy, a quantitative research study was carried out, including a wide range of areas of activity captured by SMEs, providing knowledge that can support successful actions for the implementation of the circular economy [60–62]. In Romania, according to the answers provided by the managers of the interviewed SMEs, the circular economy is seen as a significant strategic issue. As noted, circular economy activities in Romania's SMEs are still modest, and we believe that creating a fiscal, legal or organizational framework coupled with additional governmental actions to promote the principles of the circular economy would contribute to the successful implementation of the circular economy. Enhancing collaboration between micro, small- and medium-sized enterprises

and providing support from large enterprises can also help to successfully implement the circular economy in Romania.

The size of the sample and the nature of the data used in this study did not allow for detailed research into the public or private sector, but this information is nonetheless very important and useful to policy-makers, professionals and economic agents in the business environment and academia. Research into the circular economy should be deepened at the national level.

Our suggestions for future research can be summarized as follows: (1) analyze how SMEs can access the human resources and technology needed to successfully adopt the circular economy; (2) determine the potential for internal and external optimization of the consumption of raw materials, water and energy; (3) analyze how SMEs can meet the needs of consumers, taking into account the principles of the circular economy; (4) analyze the effectiveness of the strategies aligned with the policies of the circular economy at the level of SMEs; (5) carry out a comparative analysis of the efficiency and the degree of successful implementation of the circular economy between different countries of the European Union.

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## Appendix A

**Table A1.** Sample structure.

| Development Region | Number of Companies | Areas of Activity | Number of Companies | Number of Employees | Number of Companies | Weight in Total (%) | Sample Size |
|---|---|---|---|---|---|---|---|
| North-West development region | 74,531 | Agriculture, forestry and fishing | 1625 | 0–9 people | 1449 | 0.28 | 1 |
| | | | | 10–49 people | 150 | 0.03 | 0 |
| | | | | 50–249 people | 27 | 0.01 | 0 |
| | | Industry | 8827 | 0–9 people | 7866 | 1.51 | 6 |
| | | | | 10–49 people | 812 | 0.16 | 1 |
| | | | | 50–249 people | 148 | 0.03 | 0 |
| | | Construction | 7157 | 0–9 people | 6378 | 1.22 | 5 |
| | | | | 10–49 people | 659 | 0.13 | 0 |
| | | | | 50–249 people | 120 | 0.02 | 0 |
| | | Trade | 29,052 | 0–9 people | 25,891 | 4.96 | 19 |
| | | | | 10–49 people | 2674 | 0.51 | 2 |
| | | | | 50–249 people | 488 | 0.09 | 0 |
| | | Hotels and restaurants | 3369 | 0–9 people | 3003 | 0.57 | 2 |
| | | | | 10–49 people | 310 | 0.06 | 0 |
| | | | | 50–249 people | 57 | 0.01 | 0 |
| | | Transport | 4548 | 0–9 people | 4053 | 0.78 | 3 |
| | | | | 10–49 people | 419 | 0.08 | 0 |
| | | | | 50–249 people | 76 | 0.01 | 0 |
| | | Other services | 19,951 | 0–9 people | 17,780 | 3.40 | 13 |
| | | | | 10–49 people | 1836 | 0.35 | 1 |
| | | | | 50–249 people | 335 | 0.06 | 0 |

**Table A1.** *Cont.*

| Development Region | Number of Companies | Areas of Activity | Number of Companies | Number of Employees | Number of Companies | Weight in Total (%) | Sample Size |
|---|---|---|---|---|---|---|---|
| Center development region | 53,596 | Agriculture, forestry and fishing | 1169 | 0–9 people | 1042 | 0.20 | 1 |
| | | | | 10–49 people | 108 | 0.02 | 0 |
| | | | | 50–249 people | 20 | 0.00 | 0 |
| | | Industry | 6348 | 0–9 people | 5657 | 1.08 | 4 |
| | | | | 10–49 people | 584 | 0.11 | 0 |
| | | | | 50–249 people | 107 | 0.02 | 0 |
| | | Construction | 5147 | 0–9 people | 4587 | 0.88 | 3 |
| | | | | 10–49 people | 474 | 0.09 | 0 |
| | | | | 50–249 people | 86 | 0.02 | 0 |
| | | Trade | 20,892 | 0–9 people | 18,618 | 3.56 | 14 |
| | | | | 10–49 people | 1923 | 0.37 | 1 |
| | | | | 50–249 people | 351 | 0.07 | 0 |
| | | Hotels and restaurants | 2423 | 0–9 people | 2159 | 0.41 | 2 |
| | | | | 10–49 people | 223 | 0.04 | 0 |
| | | | | 50–249 people | 41 | 0.01 | 0 |
| | | Transport | 3271 | 0–9 people | 2915 | 0.56 | 2 |
| | | | | 10–49 people | 301 | 0.06 | 0 |
| | | | | 50–249 people | 55 | 0.01 | 0 |
| | | Other services | 14,347 | 0–9 people | 12,785 | 2.45 | 9 |
| | | | | 10–49 people | 1321 | 0.25 | 1 |
| | | | | 50–249 people | 241 | 0.05 | 0 |
| North-East development region | 54,846 | Agriculture, forestry and fishing | 1196 | 0–9 people | 1066 | 0.20 | 1 |
| | | | | 10–49 people | 110 | 0.02 | 0 |
| | | | | 50–249 people | 20 | 0.00 | 0 |
| | | Industry | 6496 | 0–9 people | 5789 | 1.11 | 4 |
| | | | | 10–49 people | 598 | 0.11 | 0 |
| | | | | 50–249 people | 109 | 0.02 | 0 |
| | | Construction | 5267 | 0–9 people | 4694 | 0.90 | 3 |
| | | | | 10–49 people | 485 | 0.09 | 0 |
| | | | | 50–249 people | 88 | 0.02 | 0 |
| | | Trade | 21,379 | 0–9 people | 19,052 | 3.65 | 14 |
| | | | | 10–49 people | 1968 | 0.38 | 1 |
| | | | | 50–249 people | 359 | 0.07 | 0 |
| | | Hotels and restaurants | 2480 | 0–9 people | 2210 | 0.42 | 2 |
| | | | | 10–49 people | 228 | 0.04 | 0 |
| | | | | 50–249 people | 42 | 0.01 | 0 |
| | | Transport | 3347 | 0–9 people | 2983 | 0.57 | 2 |
| | | | | 10–49 people | 308 | 0.06 | 0 |
| | | | | 50–249 people | 56 | 0.01 | 0 |
| | | Other services | 14,681 | 0–9 people | 13,084 | 2.50 | 10 |
| | | | | 10–49 people | 1351 | 0.26 | 1 |
| | | | | 50–249 people | 246 | 0.05 | 0 |

**Table A1.** *Cont.*

| Development Region | Number of Companies | Areas of Activity | Number of Companies | Number of Employees | Number of Companies | Weight in Total (%) | Sample Size |
|---|---|---|---|---|---|---|---|
| South-East development region | 52,057 | Agriculture, forestry and fishing | 1135 | 0–9 people | 1012 | 0.19 | 1 |
| | | | | 10–49 people | 105 | 0.02 | 0 |
| | | | | 50–249 people | 19 | 0.00 | 0 |
| | | Industry | 6165 | 0–9 people | 5494 | 1.05 | 4 |
| | | | | 10–49 people | 567 | 0.11 | 0 |
| | | | | 50–249 people | 103 | 0.02 | 0 |
| | | Construction | 4999 | 0–9 people | 4455 | 0.85 | 3 |
| | | | | 10–49 people | 460 | 0.09 | 0 |
| | | | | 50–249 people | 84 | 0.02 | 0 |
| | | Trade | 20,292 | 0–9 people | 18,084 | 3.46 | 13 |
| | | | | 10–49 people | 1868 | 0.36 | 1 |
| | | | | 50–249 people | 341 | 0.07 | 0 |
| | | Hotels and restaurants | 2353 | 0–9 people | 2097 | 0.40 | 2 |
| | | | | 10–49 people | 217 | 0.04 | 0 |
| | | | | 50–249 people | 40 | 0.01 | 0 |
| | | Transport | 3177 | 0–9 people | 2831 | 0.54 | 2 |
| | | | | 10–49 people | 292 | 0.06 | 0 |
| | | | | 50–249 people | 53 | 0.01 | 0 |
| | | Other services | 13,935 | 0–9 people | 12,418 | 2.38 | 9 |
| | | | | 10–49 people | 1283 | 0.25 | 1 |
| | | | | 50–249 people | 234 | 0.04 | 0 |
| South-Muntenia development region | 50,624 | Agriculture, forestry and fishing | 1104 | 0–9 people | 984 | 0.19 | 1 |
| | | | | 10–49 people | 102 | 0.02 | 0 |
| | | | | 50–249 people | 19 | 0.00 | 0 |
| | | Industry | 5996 | 0–9 people | 5343 | 1.02 | 4 |
| | | | | 10–49 people | 552 | 0.11 | 0 |
| | | | | 50–249 people | 101 | 0.02 | 0 |
| | | Construction | 4862 | 0–9 people | 4332 | 0.83 | 3 |
| | | | | 10–49 people | 447 | 0.09 | 0 |
| | | | | 50–249 people | 82 | 0.02 | 0 |
| | | Trade | 19,733 | 0–9 people | 17,586 | 3.37 | 13 |
| | | | | 10–49 people | 1816 | 0.35 | 1 |
| | | | | 50–249 people | 331 | 0.06 | 0 |
| | | Hotels and restaurants | 2289 | 0–9 people | 2040 | 0.39 | 1 |
| | | | | 10–49 people | 211 | 0.04 | 0 |
| | | | | 50–249 people | 38 | 0.01 | 0 |
| | | Transport | 3089 | 0–9 people | 2753 | 0.53 | 2 |
| | | | | 10–49 people | 284 | 0.05 | 0 |
| | | | | 50–249 people | 52 | 0.01 | 0 |
| | | Other services | 13,551 | 0–9 people | 12,077 | 2.31 | 9 |
| | | | | 10–49 people | 1247 | 0.24 | 1 |
| | | | | 50–249 people | 227 | 0.04 | 0 |

**Table A1.** *Cont.*

| Development Region | Number of Companies | Areas of Activity | Number of Companies | Number of Employees | Number of Companies | Weight in Total (%) | Sample Size |
|---|---|---|---|---|---|---|---|
| Bucharest-Ilfov development region | 147,210 | Agriculture, forestry and fishing | 3211 | 0–9 people | 2861 | 0.55 | 2 |
| | | | | 10–49 people | 296 | 0.06 | 0 |
| | | | | 50–249 people | 54 | 0.01 | 0 |
| | | Industry | 17,435 | 0–9 people | 15,537 | 2.97 | 11 |
| | | | | 10–49 people | 1605 | 0.31 | 1 |
| | | | | 50–249 people | 293 | 0.06 | 0 |
| | | Construction | 14,137 | 0–9 people | 12,598 | 2.41 | 9 |
| | | | | 10–49 people | 1301 | 0.25 | 1 |
| | | | | 50–249 people | 237 | 0.05 | 0 |
| | | Trade | 57,383 | 0–9 people | 51,138 | 9.79 | 38 |
| | | | | 10–49 people | 5282 | 1.01 | 4 |
| | | | | 50–249 people | 963 | 0.18 | 1 |
| | | Hotels and restaurants | 6655 | 0–9 people | 5931 | 1.14 | 4 |
| | | | | 10–49 people | 613 | 0.12 | 0 |
| | | | | 50–249 people | 112 | 0.02 | 0 |
| | | Transport | 8984 | 0–9 people | 8006 | 1.53 | 6 |
| | | | | 10–49 people | 827 | 0.16 | 1 |
| | | | | 50–249 people | 151 | 0.03 | 0 |
| | | Other services | 39,406 | 0–9 people | 35,117 | 6.72 | 26 |
| | | | | 10–49 people | 3627 | 0.69 | 3 |
| | | | | 50–249 people | 661 | 0.13 | 0 |
| South-West Oltenia development region | 41,608 | Agriculture, forestry and fishing | 907 | 0–9 people | 809 | 0.15 | 1 |
| | | | | 10–49 people | 84 | 0.02 | 0 |
| | | | | 50–249 people | 15 | 0.00 | 0 |
| | | Industry | 4928 | 0–9 people | 4392 | 0.84 | 3 |
| | | | | 10–49 people | 454 | 0.09 | 0 |
| | | | | 50–249 people | 83 | 0.02 | 0 |
| | | Construction | 3996 | 0–9 people | 3561 | 0.68 | 3 |
| | | | | 10–49 people | 368 | 0.07 | 0 |
| | | | | 50–249 people | 67 | 0.01 | 0 |
| | | Trade | 16,219 | 0–9 people | 14,454 | 2.77 | 11 |
| | | | | 10–49 people | 1493 | 0.29 | 1 |
| | | | | 50–249 people | 272 | 0.05 | 0 |
| | | Hotels and restaurants | 1881 | 0–9 people | 1676 | 0.32 | 1 |
| | | | | 10–49 people | 173 | 0.03 | 0 |
| | | | | 50–249 people | 32 | 0.01 | 0 |
| | | Transport | 2539 | 0-9 people | 2263 | 0.43 | 2 |
| | | | | 10–49 people | 234 | 0.04 | 0 |
| | | | | 50–249 people | 43 | 0.01 | 0 |
| | | Other services | 11,138 | 0–9 people | 9926 | 1.90 | 7 |
| | | | | 10–49 people | 1025 | 0.20 | 1 |
| | | | | 50–249 people | 187 | 0.04 | 0 |

**Table A1.** *Cont.*

| Development Region | Number of Companies | Areas of Activity | Number of Companies | Number of Employees | Number of Companies | Weight in Total (%) | Sample Size |
|---|---|---|---|---|---|---|---|
| West development region | 48,011 | Agriculture, forestry and fishing | 1047 | 0–9 people | 933 | 0.18 | 1 |
| | | | | 10–49 people | 96 | 0.02 | 0 |
| | | | | 50–249 people | 18 | 0.00 | 0 |
| | | Industry | 5686 | 0–9 people | 5067 | 0.97 | 4 |
| | | | | 10–49 people | 523 | 0.10 | 0 |
| | | | | 50–249 people | 95 | 0.02 | 0 |
| | | Construction | 4611 | 0–9 people | 4109 | 0.79 | 3 |
| | | | | 10–49 people | 424 | 0.08 | 0 |
| | | | | 50–249 people | 77 | 0.01 | 0 |
| | | Trade | 18,715 | 0–9 people | 16,678 | 3.19 | 12 |
| | | | | 10–49 people | 1723 | 0.33 | 1 |
| | | | | 50–249 people | 314 | 0.06 | 0 |
| | | Hotels and restaurants | 2171 | 0–9 people | 1934 | 0.37 | 1 |
| | | | | 10–49 people | 200 | 0.04 | 0 |
| | | | | 50–249 people | 36 | 0.01 | 0 |
| | | Transport | 2930 | 0–9 people | 2611 | 0.50 | 2 |
| | | | | 10–49 people | 270 | 0.05 | 0 |
| | | | | 50–249 people | 49 | 0.01 | 0 |
| | | Other services | 12,852 | 0–9 people | 11,453 | 2.19 | 8 |
| | | | | 10–49 people | 1183 | 0.23 | 1 |
| | | | | 50–249 people | 216 | 0.04 | 0 |
| Total | 522,483 | | 522,483 | | 522,483 | 100.00 | 384 |

Source: Authors' calculation based on information extracted from the National Institute of Statistics of Romania [59].

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