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Innovation Indicators and the Innovation Process - Evidence from the European Innovation Scoreboard

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Abstract. *The purpose of this paper is to determine the influence of specific innovation indicators on the overall innovation process. In this sense, a quantitative methodological approach has been employed and data has been analysed using IBM SPSS version 24. Innovation is one the themes of considerable interest at worldwide and at European level, this being reflected by the 2020 European innovation indicator. Innovation is considered to generate economic growth and create competitive advantage for both large organizations and small and medium enterprises, thus being examined as a factor that influences overall business efficiency. In this sense, the data used for this research contains the information published in the European Innovation Indicator Scoreboard 2020 database. In this regard, two innovation indicators have been considered for analysis, namely firm investments and employment impact. An exploratory factor and correlation analysis have been performed in SPSS in order to provide an answer to the research question: "How do firm investments and employment impacts influence the overall Summary Innovation Index?". The findings show that there is a positive correlation between the selected innovation indicators, namely firm investments and employment impact and the overall summary innovation index. These findings reveal a strong correlation between firm investments and the innovation process, which results into guidance for companies and their innovative efforts. In this sense, this paper further provides recommendations for firms on where to channel and focus their efforts in order to create more innovative products and activities.*

Keywords: innovation indicators, employment impact, firm investments, summary innovation index, European Innovation Scoreboard.

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Introduction

Innovation activity is considered a significant part of the economic advancement and even more, as Szopik-Depczyńska et al. (2018) suggest, part of the of the overall process of creating "long-lasting and sustainable growth". Generally, innovation is understood through the invention of new products, processes or services (Dziallas and Blind, 2019). As the authors suggest, innovation is perceived from the perspective of the commercial activity. The impact of business operations on economy drove the focus on creating sustainable enterprises (Smol et al, 2017). According to the authors, the concept of circular economy implies the delivery of global sustainability while maintaining the value creation process through innovative solutions. In their paper, the authors focus on the European regions that strive to implement policies for "modernization of the economic structure". While

addressing the concept of eco-innovation, Garcia-Granero et al. (2018) focus on the importance of creating new products, processes, organization and marketing improvement through innovation and contributing at the same time to the environmental stability. The authors agree that this will results into economic efficiency and performance. This approach implies the existence of measuring innovation through the use of indicators. In this sense, innovation indicators can be characteristic to each stage of the innovation process, namely the process prior to the generation of innovative ideas and the one following the evaluation of innovative ideas (Dziallas and Blind, 2019). Following this idea, Andersson and Forslud (2018) describe several innovation indicators that could be used to measure the efficiency of business. In this sense, sustainable innovation can be measured through the use of indicators that depict the "burn rate of costs and corresponding achievements in social and environmental sustainability". The authors use the same rationale in order to describe indicators that can be used for measuring market share, profit margin and customer insight. Hauge et al. (2017) propose a cross-industry approach as more effective in driving innovation and establishing innovation indicators. The authors propose the concept of cross-industry innovation capability in order to define the impact of knowledge transformation on developing new products and processes. In this sense, the authors agree that the proposed concept can be used for driving competitive advantage and organizational intelligence.

Considering the importance of understanding and depicting innovation indicators, the European Commission introduced in 2013 the EU 2020 Innovation Indicator. The introduction of this indicator began with the understanding by policy makers of the active involvement needed in innovative activities (Janger et al., 2017). In this sense, the authors reveal that the EU 2020 Innovation Indicator is attempting to better measure the innovation inputs and outputs. Moreover, taking into consideration the strategies and efforts taken at a global level in terms of innovative activities (Andrei et al., 2017), the EU highlighted in the EU Innovation Policy the increasing need of the government involvement into innovative actions (Szopik-Depczyńska et al., 2018). This conclusion came as a result of the 2015 General Assembly of the United Nations, where a Resolution containing a "sustainable development plan until the year 2030" (Szopik-Depczyńska et al., 2018) has been adopted. In addition, the authors highlight that the main objectives of the sustainable development plan included the promotion of sustainable economic growth and the advancement of innovation. Moreover, as Grupp and Schubert (2010) describe, considering the broad national level, that policy makers have reached the conclusion that economic policies should support the innovative endeavours of both public and private sector, especially because innovation is considered a "driver of sustained economic growth". The authors further highlight the importance of establishing the degree of innovativeness of a country and what are the exact indicators that can be used to measure innovation. In this sense, in order to measure the innovation activity in the member countries, the European Commission created the European Innovation Scoreboard (EIS), which classifies several innovation indicators and their value in each European country (Janger et al., 2017). In the own acceptance of Grupp and Schubert (2010), innovation indicators are metrics used to measure innovation in a broader context. In this regard, innovation indicators take into consideration several statistical data in order to determine the extent to which economic benefits can be highlighted.

Considering the innovation indicators identified in the EIS, two major categories that focus on innovation input and output (Janger et al., 2017) can be depicted. Innovation input indicators focus on the implications of R&D activities, research systems, firm investment and collaboration between innovative organizations, mainly small and medium enterprises, while innovation output indicators focus on the implications of Human Resources activities, intellectual assets, sales and employment impacts (EIS 2020, published by the European Commission). Considering the database that represented the foundation of the European Innovation Scoreboard (EIS) 2020 this paper considers the summary innovation index of the European countries and attempts to understand if "firm investment" and "employment impact" as innovation indicators are correlated with the overall innovation index, this being the research objective. In addition, contributing to the purpose of this paper, namely the understanding of where enterprises should focus their investment efforts, the subsequent economic impact for the European countries of these indicators is investigated.

The rest of this paper is structured as follows: the literature review section presents the main findings and the current state of the art regarding the innovation impact on businesses and the two selected innovation indicators, of interest for the purpose of this paper, namely firm investment and employment impact. The methodology section presents the selected research approach for this paper and the final section discusses the results and limitations of this study and addresses on what the future research should focus on.

Literature Review

Innovation impact at business level

Considering the current economic situation and the need for businesses to create competitive advantages, companies need to readjust their focus in order to deliver valuable results and enhance operational efficiency (Păunescu and Matyus, 2020). The authors reveal that the existing digital technologies directly impact businesses from all sectors of activity and challenge companies to become resilient in order to positively influence the local economy, which relies heavily on start-ups and small enterprises. In this sense, considering that there are many factors that influence the performance and efficiency of businesses, the authors' paper highlights that organizational resilience should focus on risk assessment and thorough preparation in terms of adversity. In addition, as the authors describe, it implies addressing external challenges with a positive attitude and attempting to maintain the internal structure flexible for adapting to change. Păunescu and Matyus (2020) further address the current pandemic situation that changed the status quo for many enterprises; the most affected being the micro and small enterprises. In the authors' own acceptance, the results which are significant for the Romanian market indicate the adaptation to the market realities and the assurance of internal business efficiency as the main factors that drive resilience. In addition, the authors outline that the management of risk can drive business performance if process optimization and performance monitoring are acknowledged as key indicators. Moreover, the ability to adopt a growth mindset, driven by continuous learning and the desire to innovate are further key success factors that stimulate companies to achieve business efficiency (Păunescu and Acatrinei, 2020). In this sense, Baltazar Herrera (2016) reveals that the concept of innovation for impact can change the way in which businesses operate, thus allowing more focus on the current realities of the market while managing to improve competitive advantage. According to the author, innovation for impact shifts the focus on implementing strategic alignment, thus

delivering significant impact for social challenges. Following the importance of social innovation, Mercado-Caruso et al. (2020) describe the notion of cluster, namely a group of companies that operate in different industries and cooperate in order to increase competition and generate new business networks.

Furthermore, Păunescu and Argatu (2020) describe that the continuous analysis of internal resources can help companies achieve a more efficient management of "unexpected occurrences". In this sense, the authors depict the concept of business continuity management as representative for small and medium enterprises. In the own acceptance of Păunescu and Argatu (2020), this concept stimulates enterprises to better understand how to protect against various risk factors and how to better respond and adapt to risk. Considering the importance of mitigating risks, and the flexibility to rapidly adapt business models, in order to deliver value for customers, Rusu (2016) reveals the importance of manifesting innovation through business models. Considering the various types of innovation-based models, namely organizational, product, process or service-based innovation model, the author highlights that the adoption of innovation is key in terms of delivering business efficiency.

Firm investment as indicator to measure innovation

As innovation has been connected with economic growth, financial development has always been considered one of the factors that influence innovation, together with other factors such as: R&D expenditure, talent and networking (Zhu et al., 2020). Innovation happens at all levels of the firm, namely organizational, financial and commercial (Hashi and Stojcic, 2013). Moreover, the introduction of new products or services or any improvement at organizational level can be considered innovative if it can increase the efficiency of the firm and create competitive advantage by differentiation (Hashi and Stojcic, 2013). As Zhu et al. (2020) suggest, financial development is believed to have a positive influence on innovative activities especially because of the introduction of capital flow into product development. Apart from that, the authors reveal that the lack of financial implication in firm's growth can lead to the phenomenon of "brain drain" in many industries. In addition, in a lack of capital flow, credit expansion as the alternative can lead to an overall negative effect on the organization's activities, as revealed by Zhu et al. (2020). The authors highlight the negative impact of the financial crisis from 2007-2008, which led to a low level of innovative activities.

Moreover, the authors state in the paper that the effects of the crisis still impact innovative activities for both countries in the Euro Zone and those outside the Euro Zone. Therefore, the financial development and capital flow have a considerable impact on innovation. The authors further reveal another important aspect that should be taken into account in the financial market development process. This refers to investments in projects that are more productive, since there is a tendency to "misallocate resources" and invest in low productive sectors as a result of "high finance compensation". Research and development is the main area identified by Markovic et al. (2020) with a direct impact on innovation. The authors reveal that the lack of investment in this area can result into a lack of innovative activities for enterprises. Therefore, their paper provides directions of where companies should focus their financial investment. In this sense, the following are of importance: the investment in funds for R&D, information and communication technology, prototyping and intellectual property. Dima et al. (2018) further portray the

interconnection of innovation and economic growth, by describing the positive effect of innovation on GDP per capita and the effects of investment on the research and development sector. Following the same idea, Ivanova et al. (2017) highlight the importance of creating a patent portfolio at country level. In addition, the authors propose a triple helix model for measuring the innovation in terms of product groups.

Zhu et al. (2020) further discuss the concept of financial development and its potential, considering the fact that credit constraints are a reality for many innovators, which can have as result the potential negative effect on innovative growth. Therefore, the authors state the need for establishing the relationship between financial development and firm investment and innovative endeavours. Moreover, Mollaahmetoğlu and Akçalı (2019) introduce the concept of financial innovation for which four components have been identified, namely financial depth, financial efficiency, financial stability and financial access. In this sense, Pellegrino and Savona (2017) focus on the financial access and attempt to understand the connection between "financing constraints and R&D investment". Considering the R&D investments as a factor that predicts the innovative activity of the firm, the authors highlight the importance of financial return of R&D investments and insist on the ability provided by such investments to "attract external funding". Therefore, foreign capital is a necessity, in the own acceptance of Pellegrino and Savona (2017), and its impact to innovation is of considerable importance. Moreover, the lack of investment in the firm is believed to lead to a decrease of innovative activities and can be considered a barrier to innovation. Upon analysis of many studies on innovation, the authors restate R&D activities as the centre for innovation and identify "privately financed R&D expenditure" as the most effective form of investment that drives innovation. In addition, in their paper, the authors identify four stages of the innovation process that comprise the investment mechanism. In this sense, the first two stages, namely the "decision to innovate" and the "decision on how much to spend on innovation" can be translated into "investment in R&D", in the own acceptance of the authors. The authors describe as factors that influence the innovation input the "access to finance", "the availability of public subsidies for innovation activities", with the latter being considered of pivotal importance in the innovation process. The third factor identified by Pellegrino and Savona (2017) is represented by the relationship with the innovation output. In this sense, the authors identify the R&D activity as a positive impact on innovation output considering "financial constraints" as barriers to the process. The fourth factor depicted in the authors' paper is represented by the "performance of the innovation output". In this sense, as elements that influence the fourth factor, "sales, export revenues and profits" and other financial measures have been identified. In addition, regarding the level of performance of the firm, Liao and Rice (2010) suggest that innovation drives performance in the context of organizational changes and firm size.

Considering that firm investments influence the innovation activity, Zubair et al. (2020) attempt to explain the pattern of investment behaviour. The authors acknowledge that investments in the firm are taken into consideration when "valuable growth opportunities exist". Moreover, Zubair et al. (2020) accept that when faced with financing constraints or economic crises, the level of innovation in firms decreases significantly. The authors further address the case of small and medium enterprises (SMEs) regarding the financial funds used to innovate and acknowledge that SMEs rely on obtaining external finance. In this sense, Dima et al. (2018) reveal the benefits of national public funding, which can result into more innovative enterprises that can generate economic benefits. In

addition, the authors reveal that many firms use internal funds in order to drive innovation, thus considering the oversight of the investments, despite the market fluctuations.

Employment impact as indicator to measure innovation

One of the consequences of innovation by introduction of new products or processes is represented by employment growth. Harrison et al. (2014) connect the employment growth with the level of productivity and attempt to explain, considering as foundation an innovative environment affected by technical change. The authors reveal the relationship between productivity and employment growth and accept that is it more fruitful in the context of innovative activities. However, the authors accept the existence of a two-way relationship between employment and innovation. In this sense, the authors identify "employment displacement and compensation" as the two characteristics of this relationship. In addition, the authors' paper reveals that innovation output measured by productivity output and process innovation generates a decrease in the level of employment of the firm. However, the output expansion resulted from product innovation can increase the employment levels at firm level, which results in the conclusion that product innovation is directly connected with an increase in employment at industry level (Harrison et al., 2014).

Lim and Lee (2019) further develop the two-way relationship between innovation and employment increase or decrease. Therefore, as the authors suggest, the firm size has a direct impact in the decision of innovation, of whether to develop a product-based innovation or a process-based innovation. The authors further reveal that there is at firm level a general correlation between process-based innovation and employment, in the sense that processes are more and more automated, thus leading to employment decrease. The product innovation however can lead to a "direct impact on productivity and cost". In this sense, Lim and Lee (2019) accept that when the market share increases, the product innovation can positively influence the employment. Therefore, market structure is another factor that should be taken into consideration when addressing the relationship between innovation and employment. The authors imply that different market structures can influence differently the innovation process, and implicitly, the employment rate. The authors' paper further reveals that in a monopolistic market, the returns on innovation are higher and there is more investment into R&D activities, which allows firms to "achieve more innovations". However, when assessing the difference in employment rate in both product and process innovation in a monopolistic market, the authors accept that process innovation still manifests negative effects on employment. The only difference is that this differentiation is not considering a firm level effect, but rather an industry level effect. Product innovation process in a monopolistic market does not have a positive effect on employment, and this is because in such a market there is little incentive to create new products (Lim and Lee, 2019). The authors acknowledge, in this sense, the incentives provided by the competitive market, especially due to the fact that there is evidence that there is a "U-shaped relationship between competition and innovation". This means, as the authors reveal, that when the market is more competitive, the innovation process is more fruitful.

The idea of policy implications is supported by Dachs and Peters (2014), who discuss the implications of foreign-owned and domestic-owned firms. The difference is explained by firm size, thus foreign-owned firms, such as multinational enterprises, have

more access to innovation due to high investment in R&D activities, while domestic-owned firms have more room for innovation via product development, which can return high sales. The authors continue to develop the difference between foreign-owned and domestic-owned firms. In this sense, their paper analyses the difference in terms of market power. Furthermore, the authors state the difference in market power between multinational enterprises and the foreign-owned affiliates, as "part of the multinational group". In this sense, foreign-owned affiliates can obtain higher market power by "making use of superior assets for their innovation activities" as part of a multinational group. Therefore, a positive relationship between employment and foreign-owned affiliates can be deducted, but productivity is another factor that should be considered (Dachs and Peters, 2014). In this sense, the authors reveal that the differences in productivity of foreign-owned firms depend on the market and the home country. Apart from the economic output, the human development is a factor that influences the innovation process, through the "effective utilization and allocation of resources" (Sajjad et al., 2020). Silva et al. (2020) describe human development and research as a global indictor for measuring innovation with clear implications in developing the economy and the society as a whole. According to Sajjad et al. (2020), entrepreneurship and human development are correlated and can affect innovation through the start of new innovative ventures. Markovic et al. (2020) further support the importance of human capital by describing the implications at organizational level and in the implementation of innovative services.

Although having available the resources and technological strategies of the corporate group, many foreign-owned affiliates have as norms, values and habits the ones of the home country (Dachs and Peters, 2014). This aspect can make a huge difference in productivity and therefore, in the relationship with employment. Gagliardi (2019) discusses a direct and an indirect effect that occurs on the market and that influences differently the employment rate. In this sense, the direct effect discussed by the author refers to the competition that occurs on the market with the entering of foreign companies. Considering the technological competition, domestic firms' response may translate into changes in the workforce dynamics. In an indirect effect scenario, a "market-stealing effect" can occur, which translates into a decreasing demand for products. Therefore, as concluded by Gagliardi (2019), a correlation between innovation and employment impact, however, a considerable amount of factors need to be taken into consideration.

The current state of the art in terms of the innovation process and the innovation indicators highlights the need for understanding the relationship between several innovation indicators and their correlation to the overall innovation process. In this sense, in the own acceptance of Grupp and Schubert (2010), depicting the contribution of individual innovation indicators in the overall innovation process is crucial because of the corresponding economic advantages, such as "productivity improvements" and "economic growth". In this regard, this study attempts to answer the research question: "How do firm investments and employment impacts influence the overall Summary Innovation Index?"

Research Methodology

For the purposes of this research, a quantitative analysis has been employed using the data published in the European Innovation Scoreboard 2020 (https://ec.europa.eu/docsroom/documents/41864). The values published in the European Innovation Scoreboard Database 2020 represent the innovation indicators

identified in the European Innovation Scoreboard. These indicators are classified into four categories, namely "Framework conditions", "Investments", "Innovation Activities" and "Impacts". Each main category has several sub-categories of innovation indicators and the report presents the overall values for each European country. In this sense, the innovation indicators identified by the European Commission and used for measuring the overall innovation process, through the summary innovation index, are as follows: human resources, research systems, innovation friendly environment, finance and support, firm investments, innovators, linkages, intellectual assets, employment impacts and sales impacts.

For statistical analysis purposes, the values for "Firm investments" and "Employment impacts" as innovation indicators, as well as the value for the "Summary innovation index" as an overall innovation indicator for the European countries have been considered. Considering that the research objective of this paper is to determine the correlation between firm investment and employment impact to the summary innovation index, a quantitative research methodology has been employed. In this sense, the IBM SPSS version 24 has been used as a software tool to analyse the data. SPSS is one of the most used software for "manipulating, analysing and presenting data" (Sebjan and Tominc, 2015). An exploratory factor and correlation analysis have been performed in SPSS, in order to provide an answer to the research question, namely "How do firm investments and employment impacts influence the overall Summary Innovation Index?" According to Matsunaga (2010), factor analysis is one of the most used tools for quantitative research approaches. It is an analysis mostly used for establishing and determining the interrelationships between the variables (Matsunaga, 2010). When describing the reliability analysis, Field (2018) highlights that reliability consists of the idea according to which "individual items produce consistent results". The data analysed consists of the values published in the European Innovation Scoreboard Database and comprises the period from 2012 to 2019, 2019 being the last year with input in the database. In order to answer the research question, the research hypotheses were formulated as follows:

H0: There is no correlation between the selected innovation indicators and the overall innovation index.

H1: There is a positive correlation between the selected innovation indicators and the overall innovation index.

Results

Correlation Analysis

For the Correlation Analysis, the scales have been aggregated and considering that the variables are continuous and there is a linear relationship between them, the Pearson's R correlation has been used in SPSS. It has been tested the relationship between "firm investments" as innovation indicator and overall innovation index, while at the same time the relationship between the "employment impacts" as innovation indicator and the summary innovation indicator has been established, as representative for the overall innovation process (illustrated in Table 1 and Table 2).

Table 1. Relationship between firm investment and summary innovation index

Firm investments	Pearson Correlation	1	0.710
	Sig. (2-tailed)		0.000

	N	37	37
Summary innovation index	Pearson Correlation	0.710	1
	Sig. (2-tailed)	0.000	
	N	37	37

Source: Author's development

Table 2. Relationship between employment impact and summary innovation index

Employment impact	Pearson Correlation	1	0.592
	Sig. (2-tailed)		0.000
	N	37	37
Summary innovation index	Pearson Correlation	0.592	1
	Sig. (2-tailed)	0.000	
	N	37	37

Source: Author's development

The results are statistically significant at 0.01 level and show that there is a positive correlation between both innovation indicators (firm investments and employment impacts) and the overall summary innovation index. However, we can acknowledge that there is a strong, positive relationship between the firm investments as innovation indicator and the overall summary innovation index, indicated by the value of the Pearson correlation factor of "0.710". In addition, the correlation between employment impacts and overall innovation indicator is a moderate, positive one, indicated by the value of the Pearson correlation factor of "0.592".

Exploratory factor analysis results

For the purposes of this paper, an exploratory factor analysis has been performed in order to depict what are the patterns of the correlations between the variables. Prior to being analysed in SPSS, the variables have been prepared, thus for each variable a code has been assigned. In this sense, regarding innovation indicator „firm investments", codes from FI1 to FI8 have been assigned for the years corresponding to the values of firm investments as innovation indicator from 2012 to 2019. Specifically, FI1 corresponds to the value of Firm investments 2012, FI2 corresponds to the value of Firm investments 2013, FI3 corresponds to the value of Firm investments 2014, FI5 corresponds to the value of Firm investments 2015, FI6 corresponds to the value of Firm investments 2016, FI7 corresponds to the value of Firm investments 2018, FI8 corresponds to the value of Firm investments 2019. Similarly, codes have been attributed to the innovation indicator „employment impacts", starting from EI1 to EI8 which correspond to the values of „employment impact" indicator from 2012 to 2019. Specifically, EI1 corresponds to the value of Employment impacts 2012, EI2 corresponds to the value of Employment impacts 2013, EI3 corresponds to the value of Employment impacts 2014, EI5 corresponds to the value of Employment impacts 2015, EI6 corresponds to the value of Employment impacts 2016, EI7 corresponds to the value of Employment impacts 2018, EI8 corresponds to the value of Employment impacts 2019. Regarding the summary innovation index, a similar approach has been employed. In this sense, SII1 corresponds to the value of Summary Innovation Index 2012, SII2 corresponds to the value of Summary Innovation Index 2013, SII3 corresponds to the value of Summary Innovation Index 2014, SII5 corresponds to the value of Summary Innovation Index 2015,

SII6 corresponds to the value of Summary Innovation Index 2016, SII7 corresponds to the value of Summary Innovation Index 2018, SII8 corresponds to the value of Summary Innovation Index 2019.

For revealing the mean and standard deviation, the variables have been computed. In this sense, the value representative for the innovation indicator „firm investments" from years starting from 2012 to 2019 has been noted with „FI". Similarly, we have noted with „EI" the value representative for the innovation indicator „employment impacts" from years starting from 2012 to 2019 and with „SII" the value representative for the overall innovation indicator „summary innovation index" from years starting from 2012 to 2019.

The descriptive statistics is represented in Table 3, which presents the values of the mean and the standard deviation. The Cronbach alpha's score for these variables is „0.978", which indicates that the data is reliable and has a very good internal consistency. The mean score is approximately 4 for all variables, which translates into underlying the importance of firm investment and employment impact towards the summary innovation index. The highest value of the mean score is obtained for firm investment as innovation indicator and the standard deviation obtained a lower value, which means that the data is reliable.

Table 3. Descriptive statistics

	Mean	Std. deviation	Analysis N
FI	4.09	1.981	37
EI	3.89	1.969	37
SII	3.79	1.707	37

Source: Author's development

The Pearson correlation analysis indicates a positive, strong correlation between firm investment and overall innovation index, respectively a positive, moderate correlation between the employment impact and the overall summary innovation index. In addition, the scale was further tested for normal distribution and reliability. In this sense, the Kaiser-Meyer-Olkin (KMO) test has been performed in SPSS in order to establish the adequacy of the data used. The exploratory factor analysis performed shows an overall good value for KMO, namely "0.812", which shows a good adequacy (Table 4). In this sense, from Table 4 we can depict that the data is relevant for the exploratory factor analysis and that the variables used are measuring the two concepts evaluated, namely the firm investments and the employment impact. The Bartlett's Test of Sphericity with a significant p value, less than "0.001", shows that the results are statistically significant. This test is another indicator of the strength of the relationship between the variables.

Table 4. KMO and Bartlett's Test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.812
Bartlett's Test of Sphericity	Approx. Chi-Square	2046.665
	df	276
	Sig.	0.000

Source: Author's development

Table 5 below presents the communalities between all factors analysed. Communalities are defined by the proportion of the variance in the variables examined.

Communalities represent an output of the factor analysis employed and the results reveal the amount of variance for each variable, measured before and after the extraction. In this sense, the initial values for communalities are represented by an estimation of the variance for each variable considered. The values for extraction communalities are estimations of each variable's variance included by the factors in the factor solution. The second column of table 5 entitled "Extraction" represents the common variance in the structure of the data analysed. The values obtained show that each variable scored high values, from "0.802" to "0.999", which indicates that the collected data is acceptable for research and the factors are well defined. Considering the values that resulted from the analysis, we can infer that the variables fit well with the factor solution. In addition, we can state that the values following the extraction show that there is a growing, fluctuating trend in terms of measuring the values for innovation indicator for each year analysed.

Table 5. Communalities

Communalities		
	Initial	**Extraction**
FI1	0.994	0.874
FI2	0.993	0.868
FI3	0.977	0.924
FI4	0.985	0.948
FI5	0.988	0.946
FI6	0.986	0.929
FI7	0.988	0.969
FI8	0.988	0.934
EI1	0.994	0.976
EI2	0.998	0.999
EI3	0.997	0.995
EI4	0.970	0.902
EI5	0.958	0.871
EI6	0.983	0.845
EI7	0.984	0.802
EI8	0.959	0.810
SII1	0.991	0.971
SII2	0.995	0.979
SII3	0.991	0.962
SII4	0.994	0.985
SII5	0.992	0.982
SII6	0.993	0.966
SII7	0.992	0.940
SII8	0.993	0.934

Source: Author's development

As a chapter conclusion, the analysis employed shows that we can accept the hypothesis according to which the selected innovation indicators are connected to the overall innovation index. In this sense, the results show that there is a positive correlation between the innovation indicators employed for analysis and the summary innovation index.

Discussion and conclusion

Overall, the data published by the European Innovation Scoreboard 2020 database and employed for this study shows that there is a positive correlation between firm investment and employment impact, as innovation indicators and overall Summary Innovation Index. The results show that there is a stronger correlation between firm investment and the overall innovation process when compared to the moderate correlation between employment impact and the whole summary innovation index. In this sense, as shown in previous studies (Dachs and Peters, 2014; Harrison et al., 2014; Lim and Lee, 2019) the relationship between innovation and employment depends on various factors. This is why firms should employ more resources into innovation activities and focus on the creation of new products that would in turn generate more need for workforce. This implies consequent focus on firm investment. This finding is supported by the research of Demirkan (2018), which highlights the idea that people as a resource can represent a driving factor of innovation, especially when addressing the introduction of new products. In addition, the author suggests that employment positively impacts innovation by contributing to the creation of relationships and exploration of new opportunities. Further research is required in this sense, in order to understand the exact determinants of firm investment and their consequent impact on employment. This paper has proposed an analysis for two innovation indicators, whose values were obtained from the European Innovation Scoreboard 2020 database and analysed in IMB SPSS. The analysis has shown that there is a positive correlation between the selected indicators and the overall index of innovation for each European country member of the EU. All in all, the analysis performed leads to the recommendation for firms to allocate more creative and financial resources into innovative activities in order to create economic growth and impact positively the employment at country level. This finding is aligned with the discoveries of Hall et al. (2013). In their paper, the authors address the issue of investment, having as purpose the firm development, and compare the current situation of Europe with the one in the United States. In this sense, the authors recommend a growth in investment for European countries especially in the ICT sector, because it is related to the adoption of innovation at organizational level. The R&D sector is also mentioned by Hall et al., (2013), as a crucial element for developing new innovative products, hence the suggestion to stimulate the investment in this sector. Furthermore, the recommendation to allocate resource for firm growth is supported by the findings of Chen and Xhu (2004), who reveal in their paper that firm investment and particularly IT investment results in firm performance and development.

Considering the fact that Romania is perceived as a moderate innovator and that it is placed in lower positions compared to other European countries in terms of innovative endeavours, the results of this study attempt to lead future research on depicting the relationship between firm investment and employment impact on Romanian start-up small enterprises. Considered at the basis of Romania's developing economy, these enterprises are of particular interest in terms of innovative drivers. In this sense, the concept of open innovation, which fosters the collaboration between small and domestic enterprises and technology companies, could represent a future research area. Hochleitner et al. (2017) describe open innovation as an important factor for assuring firm performance and increasing competitiveness due to the relationship between inbound practices and access to external firm knowledge. The authors further argue that this relationship is beneficial to the

development of new innovative products, applicable especially in the case of small and medium enterprises, for which gaining market share is of critical importance. In addition, open innovation is of interest, especially because it refers to a different innovation indicator, used for computing the overall summary innovation index, namely the linkages (Lenaerts and Merlevede, 2015). When addressing the issue of linkages, Zygmunt (2019) states the relevance of this particular metric for small and medium enterprises. In this sense, the authors highlight the cooperation between enterprises as pivotal for "building innovation capability". Moreover, the author's research concludes the positive impact of linkages and intellectual assets on innovation performance. In addition, Demirkan (2018) highlights that the resources existing in the firm are of considerable influence in terms of employment. Moreover, the author suggests that investing in the employee's skills and knowledge can result in a competitive advantage for any business. In addition, in their paper, Lenaerts and Merlevede (2015) illustrate that the domestic firm size is not of crucial importance; however, usually start-ups and small enterprises attempt to obtain foreign investments. In addition, the size of the foreign firms is of importance, because it is a factor that could measure the strength of the linkage with the selected domestic firm. Contrary to common belief, the authors highlight that, specific for the case of Romania, the foreign investors are relatively small enterprises "with less than 50 employees". In this sense, future research could focus on the innovation indicator "firm investments" in order to obtain a thorough understanding of its impact on the Romanian enterprises.

Regarding the limitations of this study, this paper focuses on understanding the business implication of two innovation indicators, namely firm investment and employment impact. In this sense, we acknowledge the positive correlation between these innovation indicators used to measure the innovation impact and the overall innovation process, measured through the summary innovation index. The data obtained from the European Innovation Database Scoreboard (EIS) 2020 database comprises the values of various innovation indicators measured for each country member of the European Union. In this sense, a first limitation of this study refers to the innovation indicators addressed in the research. Future research could focus on all indicators depicted in the EIS 2020 database, which would allow to grasp a better understanding of the business implications. In addition, as Edquist et al. (2018) highlight in their paper, innovation performance can further be understood by analysing the inputs and outputs. In this sense, the authors agree that the Summary Innovation Index illustrates to a certain amount the innovation performance concept; however, further in-depth analysis is required. In this regard, in order to grasp a deeper understanding of the implications of innovation input and output, future research should focus on identifying a new measurement for describing the relationship between these two notions. Moreover, future research could focus on creating new models or frameworks for measuring an overall metric for innovation. As depicted in the paper of Edquist et al. (2018), a holistic point of view can prove to be useful when creating a "ratio of aggregate outputs to aggregate inputs" in order to define innovation performance.

Secondly, another limitation is represented by the selected research methodology. In this regard, for this paper a quantitative research approach has been preferred, especially because a major objective of this paper was to understand if there is a correlation between the chosen innovation indicators and the overall innovation process. Therefore, this paper provides a generalization in terms of results. Future research can address these findings from a more thorough perspective, by depicting individual perceptions and viewpoints,

with a focus on specific companies or activity sectors. This can be achieved through the use of a qualitative methodology, based on case studies or interviews. Moreover, starting from the findings of this paper, future research attempts focus on the particular case of Romania in order to depict the situation al local level and understand which areas and innovation indicators are of interest for start-ups and small enterprises in Romania.

References

Andersson, P. & Forslud, H. (2018) Developing an indicator framework for measuring sustainable logistics innovation in retail. *Measuring Business Excellence*, 22(1), p. 1-13.

Andrei, J. V., Mieila, M., & Panait, M. (2017). The impact and determinants of the energy paradigm on economic growth in European Union. PloS one, 12(3), e0173282.

Baltazar Herrera, M. E. (2016) Innovation for impact: Business innovation for inclusive growth. *Journal of Business Research*, 69, 1725-1730.

Chen, Y. & Zhu, J. (2004) Measuring Information Technology's Indirect Impact on Firm Performance. *Information Technology and Management*, 5, p. 9-22.

Dachs, B. & Peters, B. (2014) Innovation, employment growth, and foreign ownership of firms A European perspective. *Research Policy*, 43, 214-232.

Demirkan, I. (2018) The impact of firm resources on innovation. *European Journal of Innovation Management*, 60, p. 1-24.

Dima, A.M., Maassen, M.A. & Petrariu, R. (2018) Dependencies models on innovation and economy indicators in the European Union. *Strategica: Challenging the status quo in management and economics*, p. 1426-1440.

Dziallas, M. & Blind, K. (2019). Innovation indicators throughout the innovation process: An extensive literature analysis. *Technovation*, 80-81, 3-29.

Edquist, C., Zabala-Iturriagagoitia, J. M., Barbero, J. & Zofio, J.L. (2018) On the meaning of innovation performance: Is the synthetic indicator of the Innovation Union Scoreboard flawed?. *Research evaluation*, 27(3), p. 196-211.

European Commission. (2020). *European Innovation Scoreboard 2020 - Methodology Report*. Maastricht Economic and Social Research Institute on Innovation and Technology – MERIT.

Field, A. (2018). *Discovering Statistics Using IBM SPSS Statistics* (5th edition). London, SAGE Publications Ltd.

Gagliardi, L. (2019) The impact of foreign technological innovation on domestic employment via the industry mix. *Research Policy*, 48, p. 1523-1533.

Garcia-Granero, E.M, Piedra-Munoz, L. & Galdeano-Gomez, E. (2018) Eco-innovation measurement: A review of firm performance indicators. *Journal of Cleaner Production*, 191, p. 304-317.

Grupp, H. & Schubert, T. (2010) Review and new evidence on composite innovation indicators for evaluating national performance. *Research Policy*, 39, p. 67-78.

Hall, B.H., Lotti, F. & Mairesse, J. (2013) Evidence on the impact of R&D and ICT investments on innovation and productivity in Italian firms. *Economics of Innovation and New Technology*, 22(3), p. 300-328.

Harrison, R., Jaumandreu, J., Mairesse, J. and Peters, B. (2014) Does innovation stimulate employment? A firm-level analysis using comparable micro-data from four European countries. *International Journal of Industrial Organization*, 35, p. 29-42.

Hashi, I. & Stojcic, N. (2013) The impact of innovation activities on firm performance using a multi-stage model: Evidence from the Community Innovation Survey 4. *Research Policy*, 42, 353-366.

Hauge, E.S., Kyllingstad, N., Maehle, N. & Schulze-Krogh, A.C. (2017) Developing cross-industry innovation capability: regional drivers and indicators within firms. *European Planning Studies*, 25(3), p. 388-405.

Hochleitner, F.P., Arbussa, A. & Coenders, G.(2017) Inbound open innovation in SMEs: indicators, non-financial outcomes and entry-timing. *Technology Analysis & Strategic Management*, 29(2), p. 204-218.

Ivanova, I., Strand, O., Kushnir, D. & Leydesdorff, L. (2017) Economic and technological complexity: A model study of indicators of knowledge-based innovation systems. *Technological forecasting and social change*, 120, p. 77-89.

Janger, J., Schubert, T., Andries, P., Rammer, C. & Hoskens, M. (2017) The EU 2020 innovation indicator: A step forward in measuring innovation outputs and outcomes?. *Research Policy*, 46, 30-42.

Lenaerts, K. & Merlevede, B. (2015) Firm size and spillover effects from foreign direct investment: the case of Romania. *Small Bus Econ*, 1-17.

Liao, T. & Rice, J. (2010) Innovation investments, market engagement and financial performance: A study among Australian manufacturing SMEs. *Research Policy*, 39, 117-125.

Lim, J. and Lee, K. (2019) Employment effect of innovation under different market structures: Findings from Korean manufacturing firms. *Technological Forecasting & Social Change*, 146, p. 606-615.

Markovic, D., Janackovic, G., Simeunovic, N. & Lalic, B. (2020) Identifying and ranking novel indicators of MSMEs innovation potential. *Technology analysis & strategic management*, 32(5), p. 529-541.

Matsunaga, M. (2010) How to Factor-Analyze Your Data Right: Do's, Don'ts, and How-To's. *International Journal of Psychological Research*, 3(1), 98-111.

Mercado-Caruso, N., Segarra-Ona, M., Ovallos-Gazabon, D. & Peiro-Signes, A. (2020) Identifying Endogenous and Exogenous Indicators to Measure Eco-Innovation within Clusters. *Sustainability*, 12(15), p. 1-20.

Mollaahmetoğlu, E. & Akçalı, B. Y. (2019) The missing link between financial development and economic growth: financial innovation, Procedia Computer Science, 158, 696-704.

Păunescu, C. & Acatrinei (Pantea) C. (2012) Managing Process Maturity for Sustainability in Romanian Organizations. *Journal of Business Economics and Management*, 13(2), 223-241.

Păunescu, C. & Argatu, R. (2020) Critical functions in ensuring effective business continuity management. Evidence from Romanian companies. *Journal of Business Economics and Management*, 21(2), 497–520.

Păunescu, C. & Matyus E. (2020) Resilience measures to dealing with the COVID-19 pandemic. Evidence from Romanian micro and small enterprises. *Management & Marketing. Challenges for the Knowledge Society*, 15(SI). 439-457.

Pellegrino, G. & Savona, M. (2017) No money, no honey? Financial versus knowledge and demand constraints on innovation. *Research Policy*, 46, 510-521.

Rusu, B. (2016) The Impact of Innovations on the Business Model: Exploratory Analysis of a Small Travel Agency. *Procedia - Social and Behavioral Sciences*, 221, 166-175.

Sajjad, M., Orangzab & Chanl, M.I. (2020) Business innovations for unfolding stratums of human development indicators: a worldwide empirical analysis. *Marketing and management of innovations*, 3, p. 11-21.

Sebjan, U. & Tominc, P. (2015) Impact of support of teacher and compatibility with needs of study on usefulness of SPSS by students. *Computers in Human Behavior*, 53, 354-365.

Silva, M.D., Gaviao, L.O., Gomes, C.F. & Lima, G.B. (2020) Global Innovation Indicators analysed by multicriteria decision. *Brazilian journal of operations & production management*, 17(4), p. 1-17.

Smol, M. Kulczycka, J. & Avdiushchenko, A. (2017) Circular economy indicators in relation to eco-innovation in European regions. *Clean technologies and environmental policy*, 19(3), p. 669-678.

Szopik-Depczyńska, K., Kędzierska-Szczepaniak, A., Szczepaniak, K., Cheba, K., Gajda, W. & Ioppolo, G. (2018) Innovation in sustainable development: an investigation of the EU context using 2030 agenda indicators. *Land Use Policy*, 79, 251-262.

Zhu, X., Asimakopoulos, S. & Kim, J. (2020) Financial development and innovation-led growth: Is too much finance better?. *Journal of International Money and Finance*, 100, 102083.

Zubair, S., Kabir, R. & Huang, X. (2020) Does the financial crisis change the effect of financing on investment? Evidence from private SMEs. *Journal of Business Research*, 110, 456-463.

Zygmunt, A. (2019) External linkages and intellectual assets as indicators of firms' innovation activities: results from the Czech Republic and Poland. *Oeconomia copernicana*, 10(2), p. 291-308.