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## **INNOVATION SOURCES IN THE ECONOMY OF BOSNIA AND HERZEGOVINA: AN EMPIRICAL ANALYSIS ON A SELECTED SAMPLE OF ENTERPRISES**

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### **Abstract**

*Innovations are considered one of the key factors contributing to an organization's success. Their importance has been recognized in the development of entrepreneurial activity, increasing market share, achieving competitive advantage, and ensuring growth and development. The aim of this paper is to present the level of innovativeness in enterprises located in Bosnia and Herzegovina and to examine whether internal or external sources of innovations are more significant for them. Additionally, the paper aims to determine whether the role of externally generated innovations increases with the enterprise size. The research included 50 enterprises of different sizes from across Bosnia and Herzegovina, and the data was collected through questionnaires. Based on the processed results, it was concluded that internally generated innovations dominate the economy of Bosnia and Herzegovina. The importance of externally generated innovations does not increase with enterprise size, as shown by the Chi-square test of independence of variables.*

**Keywords:** innovation, internal sources of innovations, external sources of innovations, enterprise size, Chi-square test of independence of variables

**JEL CLASSIFICATION:** C14, M21, O31

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## 1. INTRODUCTION

The key resources for generating innovations are knowledge and information. These resources can be provided internally, externally, or developed in collaboration with other institutions. Implicit knowledge held by employees plays a crucial role in the internal generation of innovations. Unlike explicit knowledge, implicit knowledge is not formal and is not available in written form. It is based on an individual's observations and experience, and it is applied at a subconscious level. External innovation generation and co-developing innovations with other institutions imply networking with stakeholders. Networking leads to access to external sources of information and knowledge, and it serves as an important complement to internal sources. By networking, the enterprise gains access to others' implicit knowledge, thus increasing the likelihood that the market will adopt its innovation. External sources of innovations can include customers, suppliers, research institutions, competitors, etc. It is assumed that small enterprises rely more on internal sources of innovations because they do not have sufficiently developed business network. Considering that small enterprises dominate in the economy of Bosnia and Herzegovina, it is assumed that they are more oriented towards internal sources of innovations. Therefore, the first research question in this paper is:

RQ1: Do Bosnian enterprises rely more on internal sources of innovations?

As the enterprises size increase, they develop their business networks, so it is assumed that they rely more on these networks when generating innovative ideas. Therefore, the second research question in this paper is:

RQ2: Do larger enterprises in Bosnia and Herzegovina rely more on external sources of innovations?

The next section presents a literature review on similar topics and the results of other researchers. The "Data and Methodology" section describes the research methods used in this paper, followed by the results of a survey conducted on a sample of Bosnian enterprises, with concluding considerations.

## 2. LITERATURE REVIEW

The first modern definition of innovation was given by Joseph Schumpeter in his work *The Theory of Economic Development*, where he stated that innovations can take the following forms: a new product or an improvement of an existing product, a new production process (method of production) or a significant improvement of an existing process, a new market, the conquest of a new source of raw materials or semi-finished products, and a new type of industrial organization. Among more recent definitions of innovation, the most accepted is OECD's definition, which distinguishes product, process, marketing, and organizational innovations<sup>1</sup>. Product innovation encompasses both the innovation of goods and services and refers to the introduction of new products or significant improvements to existing ones in terms of characteristics or intended use. Process innovation represents the application of a new or improved method of production or delivery. Marketing innovation involves significant changes in promotion, design, packaging, or pricing. Organizational innovation refers to the implementation of a new organizational method in business practices, external relations, or workplace organization.

An important issue related to innovation is the sources of innovative ideas. In his 1988 book *Sources of Innovation*, Von Hippel identified four sources of innovations: manufacturer, user, supplier, and third parties (independent inventors, universities, etc.). In 2001, Arundel emphasized that the information needed for innovations can be obtained from internal sources (in-house research and development activities) and from external sources (customers, patent databases, research with other enterprises or research institutions, etc.). Some authors have tried to determine which sources of innovations most significantly affect innovative activities. They classified sources of innovations into customers, suppliers, workers, universities, and other entities within the industry, and innovations into product, process, and marketing innovations. Research conducted among business entities in the United States showed that both internal and external sources are needed for the development of different types of innovations, with the role of workers and universities<sup>2</sup> standing out particularly.

Another group of authors divided innovations into technological and non-technological ones and also established that both internal and external sources of innovations are equally important for their development. The greater

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<sup>1</sup> OECD (2005), p. 48-50.

<sup>2</sup> Demircioglu, Audretsch and Slaper (2019), p. 1373.

the number of information sources used, both external and internal, the greater the probability of innovation<sup>3</sup>. The research showed that innovations are influenced by sources from the enterprise, as well as by suppliers, customers, and the internet. However, information from high education institutions and government does not affect the development of innovations. The reason for this is that this research was conducted among Chilean enterprises, which do not have strong ties or built trust with government institutions and universities. Additionally, researchers concluded that the size of the enterprise positively influences the intention to develop innovations. Larger enterprises are more inclined toward innovations, possibly because they have a greater capacity to plan innovation development. Several other studies have shown that enterprises are more likely to develop product or process innovations when using a wider range of information<sup>4</sup>.

Some authors have demonstrated the connection between external sources of information and the introduction of innovations, establishing that internal competencies within enterprises are not linked to the introduction of innovations. They found a link between the introduction of product innovations and freely available external sources of information (internet, media, exhibitions, fairs, etc.), as well as a link between process innovations and information obtained from different financial organizations. In the case of market innovations (entering a new market), the result is the same as with product innovations, while regional educational and research organizations are crucial for organizational innovations<sup>5</sup>. In 2017, Volpi classified the external sources into scientific and market sources of information. His research results showed that information sources oriented towards science (universities and public research institutes) are more important for large, research-and-development-oriented, and highly qualified companies that aim for radical innovations. Similar results were found by Tödtling, Lehner, and Kaufmann in 2009. Their findings show that for more advanced innovations, enterprises need collaboration with universities and research organizations, while for innovations at the enterprise level (incremental changes), practical knowledge is more important. External innovations are also the basis of the open innovations concept, which suggests that enterprises should not rely solely on internal ideas but also on external ideas to improve their technology<sup>6</sup>. Open innovations allow enterprises to enhance their innovative performances

<sup>3</sup> Quiroz-Rojas and Teruel (2024)

<sup>4</sup> See more details in Leiponen (2001); Amara and Landry (2005); Bigliardi and Dormio (2009).

<sup>5</sup> Varis and Littunen (2010), p. 146.

<sup>6</sup> Chesbrough (2006), p. 1

by helping them access new ideas and knowledge beyond their borders, reduce research and development costs, and share risks<sup>7</sup>.

### 3. DATA AND METHODOLOGY

The answer to the first research question in this paper will be obtained by comparing the number of enterprises that used internal sources of innovations with the number of those that generated their innovations externally. To answer the second research question, it is necessary to examine the dependence between the sources of innovative ideas and enterprise size. To test the hypothesis of a dependence between non-metric variables, the Chi-square ( $\chi^2$ ) test is most commonly used. Unlike the correlation coefficient, it determines the probability, not the strength, of the relationship between variables. However, if the Chi-square test is statistically significant, the correlation is considered significant as well, regardless of whether it is low or high. For both observed variables, it is necessary to determine the modalities and the frequency of their occurrence. Based on these data, a contingency table is created. This table contains, in its rows and columns, the frequencies of the characteristics of the observed variables. From the contingency table, the number of degrees of freedom is determined using the following formula:

$$DF = (r-1) * (k-1),$$

where  $r$  is the number of rows and  $k$  is the number of columns.

The null hypothesis for testing dependence using the Chi-square test is:

*H<sub>0</sub>: The sources of innovative ideas are independent of enterprise size.*

Accordingly, the alternative hypothesis is:

*H<sub>1</sub>: The sources of innovative ideas depend on enterprise size.*

The conditions that must be met for the application of the Chi-square test are as follows:

- the data must be randomly drawn from the population (sampling frame),
- the frequencies must be independent,
- there is no universally accepted limit for sample size; the

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<sup>7</sup> Elia, Petruzzelli and Urbinati (2020)

minimum size typically ranges from 20 to 50<sup>8</sup>,

- the sum of the expected frequencies must be equal to the sum of the observed frequencies,
- at least 80% of the expected frequency values must not be less than five; if this assumption is not met, alternative tests can be used instead of the Chi-square test - Fisher's Exact Test or the Likelihood Ratio Chi-square Test<sup>9</sup>. The likelihood ratio is especially recommended for small samples.

#### 4. RESULTS AND DISCUSSION

In order to answer research questions, a questionnaire was created and sent to the addresses of 50 enterprises located in Bosnia and Herzegovina. According to the rules for applying the Chi-square test, the minimum sample size ranges from 20 to 50, which means the sample size in this study meets the required criteria. The sample is representative in terms of the distribution of enterprises across the territorial units of Bosnia and Herzegovina (the entities Republic of Srpska and Federation of Bosnia and Herzegovina and the Brcko District), as well as in terms of enterprise size classification<sup>10</sup> (micro, small, medium, and large enterprises). The largest number of enterprises in the sample are located in the territory of the Federation of Bosnia and Herzegovina, and most of them fall under the category of micro enterprises, which is consistent with the characteristics of the overall population.

The goal of the survey was to collect data on innovativeness, sources of innovative ideas, types of innovations and the usefulness of innovations in enterprises in Bosnia and Herzegovina. In response to the question of whether they had introduced any innovation in the past 12 months, **80% of enterprises answered positively**. Among the 20% of non-innovative enterprises, the majority were micro enterprises (90%), which indicates that the need for

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<sup>8</sup> Bolboaca et al (2011), p. 529.

<sup>9</sup> McHugh (2013), p. 148.

<sup>10</sup> Micro, small, and medium enterprises (MSMEs) in Bosnia and Herzegovina represent over 99% of the total number of enterprises, while large enterprises represent less than 1%. In Bosnia and Herzegovina, the classification of enterprises is under the jurisdiction of the entities, and both entities have aligned their classification with the European Commission – both in terms of the criteria and their thresholds. The criteria used for classification are the number of employees, annual revenue, and the value of business assets. If the number of employees conflicts with the financial criteria, the number of employees is considered the decisive factor. Micro enterprises are those that employ fewer than 10 people, small enterprises employ fewer than 50, and medium-sized enterprises employ fewer than 250 workers. Large enterprises are defined as those employing 250 or more people.

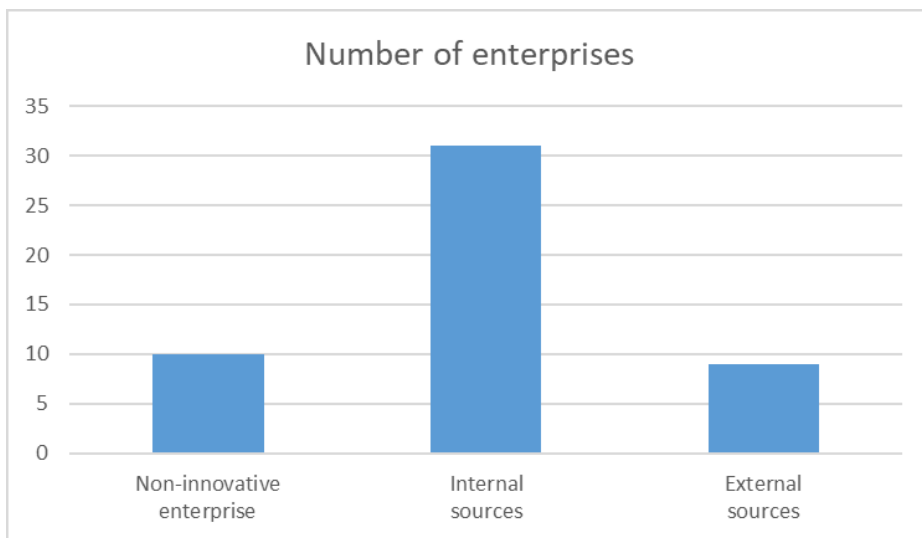
innovation increases with enterprise size.

The enterprises' responses to the question of how the idea for the innovation was generated were grouped into two categories:

- **internal sources of innovations** (the idea was created by the manager/owner of the enterprise; the idea was proposed by an employee), and
- **external sources of innovations** (the idea came from a customer/supplier/business partner; the idea was adopted from a competitor).

Among the innovative enterprises, a greater number generated innovations through internal rather than external sources, as shown in Chart 1.

*Chart 1. Innovative Activity and Sources of Innovations in Enterprises in Bosnia and Herzegovina*



Source: Author's analysis

Based on the data on enterprise size and sources of innovative ideas, a contingency table was created. The modalities of the variable "enterprise size" are micro, small, medium, and large enterprises, while the modalities of the sources of innovative ideas are non-innovative enterprises, enterprises with internally generated innovations, and enterprises with externally generated

innovations. All modalities of one variable are combined with all modalities of the other, resulting in a 4×3 contingency table (Table 1).

*Table 1. Contingency Table*

<b>Enterprise size</b>	<b>Micro</b>	<b>Small</b>	<b>Medium</b>	<b>Large</b>
<b>Innovation source</b>				
<b>Non-innovative enterprise</b>	9	1	0	0
<b>Internally generated innovations</b>	21	6	4	0
<b>Externally generated innovations</b>	6	2	0	1

Source: Author's analysis

For creating the contingency table, it is also important to consider the frequency at which the observed characteristic (enterprise innovativeness) did not appear – that is, it is significant to determine the number of non-innovative enterprises. The reason for this is that the sum of expected frequencies (total number of enterprises) must be equal to the sum of observed frequencies (number of innovative enterprises). Since the sample includes enterprises that did not have innovative activities, it is necessary to record their frequency as well. Based on the number of rows and columns in the contingency table, the degrees of freedom are obtained (Table 2):

$$DF = (3-1) * (4-1) = 2*3 = 6$$

The Chi-square test of dependence between sources of innovative ideas and enterprise size was conducted using SPSS Statistics 20. The test results are presented in Table 2. Considering that the assumption that at least 80% of the expected frequencies in the contingency table should be greater than or equal to five was not met, the likelihood ratio Chi-square statistic is examined instead.

Table 2. Chi-square test of independence of variables

	Value	Degrees of freedom	Significance
Pearson $\chi^2$	8,047	6	,235
Likelihood ratio	8,325	6	,215
Number of observations	50		

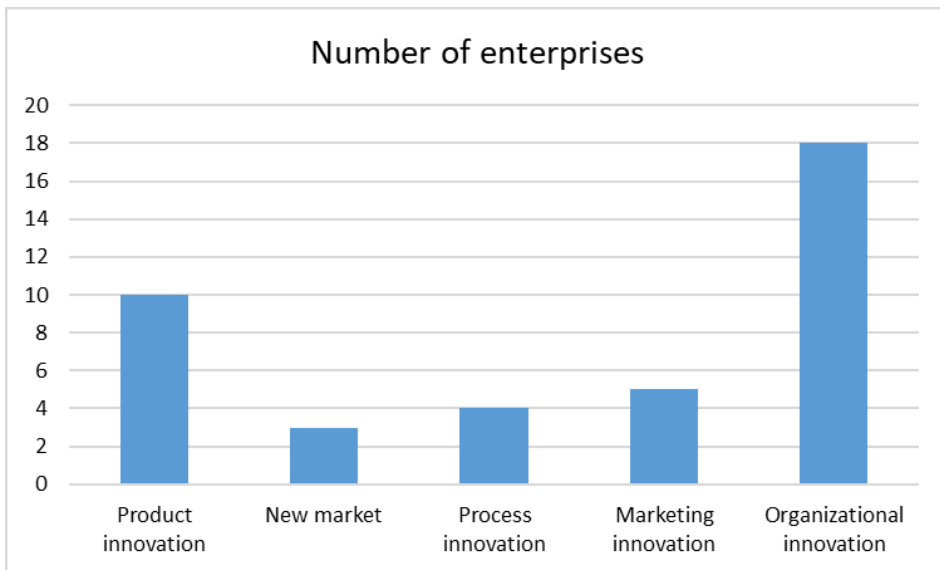
Source: Author's calculation

Since the p-value (significance) is greater than 0.05 and equals 0.215, the null hypothesis for the Chi-square test is accepted. In this case, this means that the sources of generating innovative ideas likely, i.e., with a 5% risk, do not depend on the size of the enterprise. It should be noted that this outcome was largely influenced by the innovation structure in medium-sized enterprises. All surveyed medium-sized enterprises were innovative, and those innovations were internally generated.

When it comes to the type of innovation, enterprises were offered response options that represent a combination of Schumpeter's classification and the OECD classification:

- product innovation (introduction of a new product or modification of an existing product);
- entry into a new market;
- process innovation (introduction of a new production method);
- marketing innovation (new methods of promotion, distribution, pricing, or packaging);
- organizational innovation (new methods of decision-making or human resource management; new ways of organizing work; new financial, accounting, or administrative practices).

Chart 2 shows that the largest number of innovative enterprises carried out organizational innovations, followed by product innovations.

*Chart 2. Types of Innovations in Bosnian and Herzegovinian Enterprises*

Source: Author's analysis

Among the enterprises that introduced innovations, 96% experienced benefits, whether it was an increase in revenue, cost reduction, profit growth, improved customer satisfaction, and/or increased employee satisfaction.

## 5. CONCLUSION

Both the theoretical and empirical analyses presented in this paper show that both internal and external sources of innovations are important for enterprises. Although some authors have favored external sources, the prevailing view is that there is a need for their diversity.

The empirical analysis on a sample of Bosnian and Herzegovinian enterprises showed that one-fifth of the enterprises were non-innovative. Among them, micro-enterprises dominate, which indicates that the need for innovations grows with the size of the enterprise. The majority of innovative enterprises generated innovations more from internal than external sources, so the answer to the first research question ("Do Bosnian enterprises rely more on internal sources of innovations?") is positive. The largest number of innovations implemented in the economy of Bosnia and Herzegovina belong

to the area of organizational innovations, which indicates that Bosnian and Herzegovinian enterprises have most innovations at the enterprise level, while radical innovations are less represented. The answer to the second research question (“Do larger enterprises in Bosnia and Herzegovina rely more on external sources of innovations?”) is negative, given that there is no statistically significant relationship between enterprise size growth and innovations generated from external sources. It can be concluded that Bosnian and Herzegovinian enterprises predominantly rely on internal innovation sources, and although networking is present, it still does not have a key impact on business operations.

## **IZVORI INOVACIJA U PRIVREDI BOSNE I HERCEGOVINE: EMPIRIJSKA ANALIZA NA ODABRANOM UZORKU PREDUZEĆA**

### **Apstrakt**

*Inovacije se smatraju jednim od ključnih faktora koji doprinose uspješnosti organizacije. Prepoznat je njihov značaj u razvoju preduzetničke aktivnosti, povećanju tržišnog učešća, postizanju konkurentske prednosti i obezbjeđivanju rasta i razvoja. Cilj ovog rada je da predstavi nivo inovativnosti u preduzećima sa teritorije Bosne i Hercegovine te da ispita da li su za njih značajniji interni ili eksterni izvori inovacija. Takođe, cilj rada je da utvrdi da li se sa povećanjem veličine preduzeća povećava uloga eksterno generisanih inovacija. Istraživanjem je obuhvaćeno 50 preduzeća različite veličine sa teritorije Bosne i Hercegovine, a podaci su prikupljeni putem anketnih upitnika. Na osnovu obrađenih rezultata došlo se do zaključka da u privredi Bosne i Hercegovine dominiraju interno generisane inovacije. Značaj eksterno generisanih inovacija ne povećava se sa rastom veličine preduzeća, što pokazuje hi-kvadrat test nezavisnosti varijabli.*

**Ključne riječi:** inovacija, interni izvori inovacija, eksterni izvori inovacija, veličina preduzeća, hi-kvadrat test nezavisnosti varijabli

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