Determinant and priority factors of innovation for the development of nations

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Abstract

Purpose – This study aims to identify the countries' innovation factors that are determinant for them to achieve higher levels of development. In addition, the research identified which of these factors should be prioritized so the countries can move up in the rank of the most competitive.

Design/methodology/approach – The study used the indicators of innovation and the stage of development of 137 countries proposed by the Global Competitiveness Report published by the World Economic Forum and techniques of multivariate data analysis.

Findings – The results indicated that all the factors tested are determinant to lead the countries throughout their stages of development. The research highlights that the factors "Quality of scientific research institutions" and "Patent Cooperation Treaty (PCT) patent applications" should be equally prioritized for the countries' development.

Practical implications – The results suggested that the factors Capacity for Innovation, Quality of Scientific Research Institutions, Company Spending on Research and Development (R&D), University–Industry Collaboration in R&D, Government Procurement of Advanced Technology Products, Availability of Scientists and Engineers and PCT Patent Applications are decisive for positioning countries in terms of their stage of development and should be part of their public policy and enterprises' strategic planning.

Originality/value – The findings show that countries should prioritize the factors Quality of Scientific Research Institutions and PCT Patent Applications, as these factors, when acting together, predict the evolution to higher stages of development.

Keywords Development stages of nations, Innovation and stages of development, Development of nations

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Introduction

Competitiveness is a relevant aspect of the growth and development stage of companies and countries (Carvalho, Serio, & Vasconcellos, 2012). Originally, literature established three factors of production for the development of nations: cheap labor, abundant raw materials and capital available for investment. Schumpeter (1934) introduced a fourth variable to consider when explaining a nation's development: innovation. Today, competitiveness in the international context is based on the ability of countries and companies to innovate (Ichijo & Nonaka, 2007; Nelson & Winter, 1982; Schumpeter, 1934). Porter (1993) also supports this view by arguing that nations are powerful when the companies in their territory are powerful.

Given the importance of this theme, the World Economic Forum (WEF) produces and disseminates the Global Competitiveness Report (GCR) (Schwab, Sala-i-Martín, Samans, & Blanke, 2016). The yearly report presents an evaluation and ranking of countries regarding competitiveness, analyzing approximately 150 countries. In the report for 2017–2018, the following developed countries were in the first five positions: Switzerland, Singapore, the USA, the Netherlands and Germany. Although the ranking of competitiveness is based on several pillars, such as the quality of infrastructure, the macroeconomic or institutional environment and the educational level, it also has a specific pillar regarding the innovation of the countries.

Several studies point to the importance of the innovation process for competitiveness (Griliches, 1979; Mairesse & Robin, 2009; Parisi, Schiantarelli, & Sembenelli, 2006; Wakelin, 2001; Zhang et al., 2011), which, in turn, depends on how productive a nation or organization is (Porter, 1990). In this sense, the effects of research and development (R&D) expenditure on productivity are related to innovations and their incorporation into the productive process.

Several factors characterize the innovation process of countries. Among them are capacity for innovation, quality of scientific research institutions, company spending on R&D, university–industry collaboration in R&D, government procurement of advanced technology products, availability of scientists and engineers and patent applications, having been considered in studies on innovation, stage of development and competitiveness of nations (Schwab, Sala-i-Martín, & Samans, 2017).

Given the importance of innovation for the development stage and competitiveness of nations, it is important to determine the factors that influence innovation so that countries' efforts and resources can be prioritized and assertively directed. In this sense, this study seeks to answer the following research question:

RQ1. Which of the countries' innovation factors influence their stage of development?

The objective of the study is to investigate the countries' innovation factors that are determinant for them to reach higher levels of development, using the indicators of innovation observed in the GCR and techniques of comparisons of means and discriminant analysis. Also, the study checks which of these factors should be prioritized for a country to be considered the most competitive one. Therefore, this work aims to contribute to the promotion of advances in practice and academic discussions regarding the importance of innovation and its factors related to the development of countries.

Literature review

The current economic competitiveness paradigm is based on the ability of countries and their respective companies to innovate (Ichijo & Nonaka, 2007; Nelson & Winter, 1982; Schumpeter, 1934). Porter (1993) corroborated this concept when he postulated that it is not nations that are powerful but rather the companies that operate within their territories.

Therefore, innovation is important for promoting growth and development of countries, both for developed and developing economies. Some explanations for low levels of development are related to the countries' low rate of innovation, which is measured particularly by the investments in R&D and patent applications. Thus, many countries have R&D and innovation at the center of their growth strategies (Dutta, Lanvin, & Wunsch-Vincent, 2016).

Development stage of nations is preponderant in decision-making regarding the choice of the country that can yield better results for investments (Carvalho *et al.*, 2012). Foreign investments of multinationals in subsidiaries located in other countries can also improve performance by generating knowledge spillover in the country that receives new technologies, increasing productivity and development (Blomstrom, 1986; Blomstrom & Kokko, 1998; Liu, 2008; Suyanto, Bloch, & Salim, 2012; Suyanto & Salim, 2013).

The development stage of a nation is a result of long-term and country-specific trends, the strength and influence of national productive structures, its innovation system, its technical infrastructure, the availability of scientists and engineers and other externalities, which are elements that support the firms and countries to build their dynamic capabilities and develop the basic attributes of their competitiveness (Melo, Correa, Carvalho, & Possas, 2017).

In the context of National Innovation System (NIS) emerges the importance of university–industry collaboration, besides the contribution of several players. According to Freeman (1989), the NIS is a network of public and private institutions with activities and relationships aimed at spreading new technologies. Several characteristics such as the operation, the players and their roles, as well as incentives, are studied to evaluate the maintenance and improvement of the national capacity to innovate (Edquist, 2001; Freeman, 1989; Lundvall, 1992; Nelson, 1993).

The interaction of scientific and technological production is fundamental for the consolidation of the NIS. It involves both the absorption of the knowledge produced in universities and research institutes by the productive sector (Cohen, Nelson, & Walsh, 2002; Klevorick, Levin, Nelson, & Winter, 1995; Lundvall, 1992; Narin, Hamilton, & Olivastro, 1997) and the ability of this sector to offer questions for scientific research and universities to improve quality of the answers (Bastos & Britto, 2017; Rosenberg, 1982).

Many authors relate the performance of firms and nations and the increase in their development to technological innovation (Nelson & Winter, 1982; Pavitt, 1984; Rosenberg, 1982; Schumpeter, 1934). Part of the literature on innovation has been produced in studies on the development of firms' organizational capacities, as a response to the challenges imposed by the increasingly competitive market. Therefore, the role of companies inside a nation is very important since they can make changes in their business based on information from the environment, disseminating innovation and new technologies (Crossan & Apaydin, 2010; Ichijo & Nonaka, 2007; Panayides, 2006).

Studies situate the importance of innovation's role to improve firms' performance. According to Porter (1993), the most competitive companies are those that know best how to use the technologies and are more effective in developing and launching innovations. Thus, countries will be more advanced and developed as they create business environments for their firms so they can innovate faster than rivals elsewhere.

Firms absorb and adapt knowledge in their processes, transforming their structure and generating innovative products (Armstrong & Lengnick-Hall, 2013; Brettel, Greve, & Flatten, 2011; Cohen & Levinthal, 1990; Najafi-Tavani, Sharifi, & Ismail, 2014; Ritala & Hurmelinna-Laukkanen, 2013; Zahra & George, 2002). In addition to the absorption of existing knowledge, firms' investment in R&D is an element of innovation diffusion, helping to improve performance (Bae, 2016; Bertrand & Mol, 2013; Ha, Lee, & Kim, 2016).

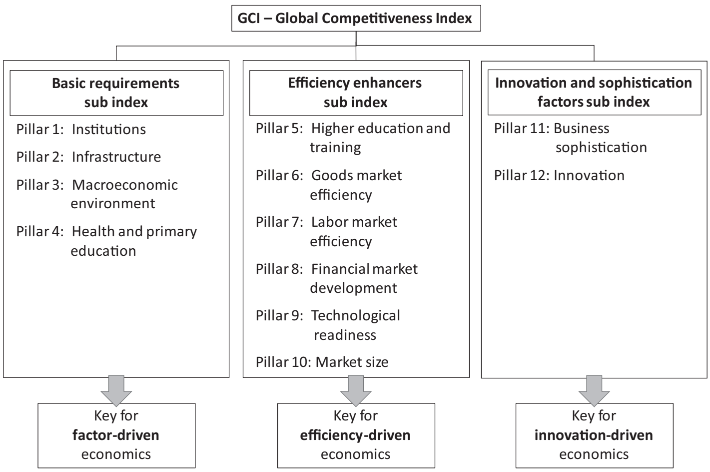
Calmanovici (2011) points out that the adoption of long-term industrial policy in strategic areas of emerging economies is fundamental for their stage of development and efforts in innovation in basic science and technology should be prioritized.

GCR is the instrument which reflects worldwide attention toward innovation, stage of development and competitiveness of nations. It was first proposed by Klaus Schwab and has been developed by Xavier Salai-Martín in collaboration with The World Economic Forum in 2005. The report is based on the Global Competitiveness Index, which combines 114 indicators grouped into 12 pillars that capture concepts that are significant for productivity and long-term prosperity. The pillars are Institutions, Infrastructure, Macroeconomic environment, Health and primary education, Higher education and training, Goods market efficiency, Labor market efficiency, Financial market development, Technological readiness, Market size, Business sophistication and Innovation, as shown in Figure 1.

According to GCR, competitiveness is a set of institutions, policies and factors that determine the level of productivity of an economy, which in turn sets the level of prosperity that the country can achieve (Schwab *et al.*, 2017).

In line with the well-known economic theory of stages of development, GCR assumes three stages: in the first one, the economies are factor-driven, and countries compete based on their factor endowments: primarily unskilled labor and natural resources. In the second stage, which is key for efficiency-driven economies, a country becomes more competitive, increasingly observing the Pillars 5–10. Finally, in the innovation-driven economies, the countries' wages are high as well as the standards of living. Therefore, the businesses' competitiveness is only possible when adopting the most sophisticated production processes (Pillars 11 and 12) (Schwab *et al.*, 2017).

The pillar of Innovation is particularly important for economies as they approach the frontiers of knowledge, but the possibility of generating more value by merely integrating and adapting exogenous technologies tends to disappear. In these economies, firms must design and develop cutting-edge products and processes to maintain a competitive advantage and move toward even higher value-added activities. This progression requires an environment that is conducive to innovative activities and supported by both the public and the private sectors. This pillar of the GCR presents seven items described in Table 1.



Source: Adapted from Schwab *et al.* (2017)

Figure 1.
Pillars of GCI

Given the alignment of the researched literature with the items that form the GCR's pillar of innovation, as well as observing the way the countries are grouped by the report regarding their stage of development, this study presents the following hypothesis:

H1. The seven items that form innovation *individually* contribute to determining the country's stage of development.

Considering that the individual influence of factors may not reflect their relative importance, there is a need to deepen the study to evaluate the degree of influence of each one, allowing the focus of economic resources on those that are most relevant. Thus, the second hypothesis of this study is proposed:

H2. The seven items that form innovation *together* are important in determining the country's stage of development.

Methodology

According to the hypotheses raised and the classification of a country regarding its stage of development, the study observed the relevant factors of innovation for the countries of a given group to advance in terms of development. Initially, the analysis of variance (ANOVA) and multiple comparisons were used to verify the individual impact of each factor that forms the variable Innovation, to identify whether they would be important, individually and to characterize the stages of development.

In the next step, a multivariate discriminant analysis was carried out, which is an analysis used to select variables acting together, i.e. to choose the most relevant factors to differentiate the studied groups. This technique seeks to find linear combinations of a set of independent variables to find the best way to discriminate the countries in the groups according to the pre-established criterion stages of development. This analysis technique was adopted because it allows identifying, among the several independent variables, those that may be more important to help to discriminate the groups (Fisher, 1936; Hair, Black, Babin, Anderson, & Tathan, 2009).

The database used in the research was developed from indicators presented in GCR 2017–2018 (Schwab *et al.*, 2017), which contains data on 137 countries. The research considered the stages of development in terms of groups' compound by countries (Table 2):

Factors	Definition
Capacity for innovation	The companies' capacity to innovate in a country
Quality of scientific research institutions	The quality of scientific research institutions in a country
Company spending on R&D	The company's investment in (R&D) in a country
University–Industry collaboration in R&D	The collaboration between companies and universities in R&D in a country
Government procurement of advanced technology products	How much government purchasing decisions promote innovation in the country
Availability of scientists and engineers	The availability of scientists and engineers in the country
PCT patent applications	The number of applications filed under the PCT per million population in a country 2013–2014 average

Source: Adapted from Schwab *et al.* (2017)

Table 1. Items forming the pillar of innovation

- Group 1: Stage 1 (50 countries);
- Group 2: Stage 2 (51 countries); and
- Group 3: Stage 3 (36 countries).

The GCR indicators derived from the survey as well as a number of other World Economic Forum indexes, such as the Networked Readiness Index, the Enabling Trade Index, the Travel & Tourism Competitiveness Index, the Gender Gap Index and the Human Capital Index as well as several other reports, including The Inclusive Economic Growth and Development Report and a number of regional competitiveness studies. The survey captured more than 14,000 business executives in several economies between February and June 2017 (Schwab *et al.*, 2017).

The questions of the survey asked respondents to evaluate, on a scale of 1–7, one particular aspect of their operating environment. At one end of the scale, 1 represents the worst possible situation; at the other end of the scale, 7 represents the best. The survey is administered by the World Economic Forum and conducted at the national level by the Forum's network of Partner Institutes. Partner Institutes are recognized research or academic institutes, business organizations, national competitiveness councils, or other established professional entities and, in some cases, survey consultancies. These institutes have the network to reach out to the business community, are reputable organizations and have a firm commitment to improving the competitiveness conditions of their economies (Schwab *et al.*, 2017).

It is important to highlight that the work was dedicated to be a photograph of the development stage of the countries at a given moment in time, allowing to analyze the factors that are important to characterize the innovation process and contributing to guide public policies and enterprises' strategic planning.

Analysis and discussion of results

The initial analysis to identify the individual contribution of each factor of innovation to the development stage of countries used the ANOVA technique, comparing the means of each factor for each pair of groups, as observed in Table 3.

The mean difference values represent the difference among the scores of each factor in the different pairs of the groups analyzed. When considering that – regarding the stages of development – Group 1 is inferior to Group 2, which is inferior to Group 3, the differences result in negative values.

The results show that four Innovation factors do not present differences between Groups 1 and 2, but there are differences between these and Group 3. The four factors are Company Spending on R&D, University–Industry Collaboration in R&D, Government Procurement of Advanced Technology Products and Patent Cooperation Treaty (PCT) Patent Applications. As for the three remaining factors (Capacity for Innovation, Quality of Scientific Research Institutions and Availability of Scientists and Engineers), the three groups showed differences. Therefore, all seven items contribute individually to determine a country's stage of development, confirming *H1*.

It was observed that three of the factors (Capacity for Innovation, Quality of Scientific Research Institutions and Availability of Scientists and Engineers), may be more relevant to indicate the countries' stage of development, as they can differentiate the three groups from each other.

The results corroborate Knabb and Stoddard (2005), Lucas and Lucas (2009), Vila, Perez, and Morillas, (2012) and Wiseman and Anderson, (2012) who argued that countries have increasingly focused on science and technology for capacity building to support their development and innovation.

Group 1–50 countries		Group 2–51 countries		Group 3–36 countries	
Algeria	Madagascar	Albania	Malaysia	Australia	Qatar
Azerbaijan	Malawi	Argentina	Mauritius	Austria	Singapore
Bangladesh	Mali	Armenia	Mexico	Bahrain	Slovenia
Benin	Mauritania	Bosnia and Herzegovina	Montenegro	Belgium	Spain
Bhutan	Moldova	Brazil	Morocco	Canada	Sweden
Botswana	Mongolia	Bulgaria	Namibia	Cyprus	Switzerland
Brunei Darussalam	Mozambique	Cape Verde	Oman	Czech Republic	Taiwan, China
Burundi	Nepal	Chile	Panama	Denmark	United Arab Emirates
Cambodia	Nicaragua	China	Paraguay	Estonia	United Kingdom
Cameroon	Nigeria	Colombia	Peru	Finland	United States
Chad	Pakistan	Costa Rica	Poland	France	
Congo, Democratic Rep.	Philippines	Croatia	Romania	Germany	
Ethiopia	Rwanda	Dominican Republic	Russian Federation	Greece	
Gambia, The	Senegal	Ecuador	Saudi Arabia	Hong Kong SAR	
Ghana	Sierra Leone	Egypt	Serbia	Iceland	
Guinea	Tajikistan	El Salvador	Seychelles	Ireland	
Haiti	Tanzania	Georgia	Slovak Republic	Israel	
Honduras	Uganda	Guatemala	South Africa	Italy	
India	Ukraine	Hungary	Sri Lanka	Japan	
Kazakhstan	Venezuela	Indonesia	Swaziland	Korea, Rep.	
Kenya	Viet Nam	Iran, Islamic Rep.	Thailand	Luxembourg	
Kuwait	Yemen	Jamaica	Trinidad and Tobago	Malta	
Kyrgyz Republic	Zambia	Jordan	Tunisia	Netherlands	
Lao PDR	Zimbabwe	Latvia	Turkey	New Zealand	
Lesotho		Lebanon	Uruguay	Norway	
Liberia		Lithuania		Portugal	

Source: Elaborated by the authors

Table 2.
Groups' composition

Factors	Compared groups	Mean differences	Sig.
Capacity for innovation	Group 1 vs Group 2	−0.248	0.045
	Group 1 vs Group 3	−1.350	<0.001
	Group 2 vs Group 3	−1.102	<0.001
Quality of scientific research institutions	Group 1 vs Group 2	−0.433	0.002
	Group 1 vs Group 3	−2.030	<0.001
	Group 2 vs Group 3	−1.597	<0.001
Company spending on R&D	Group 1 vs Group 2	−0.213	0.178
	Group 1 vs Group 3	−1.652	<0.001
	Group 2 vs Group 3	−1.439	0.000
University–Industry collaboration in R&D	Group 1 vs Group 2	−0.171	0.354
	Group 1 vs Group 3	−1.475	<0.001
	Group 2 vs Group 3	−1.303	<0.001
Government procurement of advanced technology products	Group 1 vs Group 2	0.065	0.857
	Group 1 vs Group 3	−0.596	<0.001
	Group 2 vs Group 3	−0.661	<0.001
Availability of scientists and engineers	Group 1 vs Group 2	−0.371	0.003
	Group 1 vs Group 3	−1.286	<0.001
	Group 2 vs Group 3	−0.915	<0.001
PCT patent applications	Group 1 vs Group 2	−3.967	0.917
	Group 1 vs Group 3	−118.676	<0.001
	Group 2 vs Group 3	−114.709	<0.001

Source: Elaborated by the authors

Table 3.
Results of pairwise comparisons

As for research institutions, they contribute significantly to innovation processes in the NIS. This is because of the quality of universities and public research agencies that play a key role in the production of inventions and innovations necessary for the development of a competitive industrial system in an increasingly knowledge-based society (Etzkowitz & Leydesdorff, 2000; Raghupathi & Raghupathi, 2017).

Also, the relationship between the spending on R&D and a country's efforts toward innovation has been emphasized in growth models. The study showed that while R&D is an important indicator of innovation, only a few countries innovate by increasing their spending on R&D. Others promote innovation by absorbing technology and know-how produced by other countries (Guloglu & Tekin, 2012). In addition, developing countries spend much less on R&D than the developed ones in terms of GDP share (Goñi & Maloney, 2017).

The development of partnerships between universities – via their academic units – and the productive sector is essential for technological development. The complementarity between the areas of knowledge contributes to generating technologies with higher chances of commercial application because even though firms can carry out their R&D, innovation may require specific knowledge that they are not able to build (Gusberti, Dorneles, Dewes, & Cunha, 2014).

In addition to the benefits for companies when collaborating with universities, knowledge flows generate new project possibilities and allow new research agendas. Among the elements that influence companies to interact with academic institutions are the proximity between the university and the productive sector, and the quality of the research (Garcia, Araujo, Mascarini, & Santos, 2014; Klevorick *et al.*, 1995).

As for the factor Government Procurement of Advanced Technology Products, demand is a significant potential source of innovation, yet the critical role of demand as a key driver of innovation has yet to be recognized in government policies. Public procurement is one of the key elements of demand-oriented innovation policies. The rationales and justifications of public procurement policies spur innovation considering the challenges and potential pitfalls as well as institutional arrangements and strategies (Edler & Georghiou, 2007).

Projections are analyzed for the future supply and demand of scientists and engineers. The demographics of the college-age population combined with estimates of the percentage of students who will pursue careers in science and engineering indicate significant shortfalls between supply and demand for the next several decades at both the baccalaureate and PhD levels. If these projections are realized, the shortage of technical personnel will have a major impact on economic growth, development and national security. Various strategies for recruiting and retaining students in science and engineering must be considered (Atkinson, 1990; Butz *et al.*, 2003).

The companies concentrate their patent applications in countries that present a greater degree of technological advancement and offer mature patent protection systems (Moura & Galina, 2009). Some studies corroborate the idea of innovation as a determinant of the performance of a company or a country and a determinant of the relation between their technological behavior and their development. This reinforces the importance of the group of countries that are less dynamic in terms of innovation to pursue better indicators in this area to increase their stage of development (Melo *et al.*, 2017).

As for *H2*, the research adopted the discriminant analysis (Gouvêa, Farina, & Varela, 2007). Initially, some premises were checked. The linearity and multicollinearity conditions were obtained using the Fisher's function. Regarding homoscedasticity, it was observed by the significance of Box's *M* test, with a p-value < 0.001 (Ladeira, Araujo, & Santini, 2015). Finally, the normality was identified using the skewness and kurtosis measurements as in Hair *et al.* (2009). The indices were considered adequate because the absolute values were below 3 for skewness and below 10 for kurtosis.

As for the use of the discriminant analysis, Table 4 presents the Wilks' Lambda test, which shows the importance of all factors individually (p-value < 0.001).

The stepwise technique was used to obtain the discriminant functions, which allowed to select the factors that are relevant when analyzed together. The factors Quality of Scientific Research Institutions and PCT Patent Applications were the ones identified in the two steps of the analysis. Also, the first discriminant function is shown with a good explanation of variance level, 98.15% (Hair *et al.*, 2009), as observed in Table 5.

H2, therefore, was not confirmed. Although, there is individual importance of each factor (*H1*), the study concludes that, together, only two of the seven factors interfere in the determination of the countries' stage of development.

Obtaining the discriminant function, it is possible to classify the countries in a predictive way, according to the stage of development. In the analysis, the factors Quality of Scientific Research Institutions and PCT Patent Applications were used to classify the countries,

Variables	Wilks' lambda	F	df1	df2	Sig.
Capacity for innovation	0.463	77.748	2	134	<0.001
Quality of scientific research institutions	0.370	114.006	2	134	<0.001
Company spending on R&D	0.428	89.664	2	134	<0.001
University–Industry collaboration in R&D	0.500	66.930	2	134	<0.001
Government procurement of advanced technology products	0.827	13.983	2	134	<0.001
Availability of scientists and engineers	0.542	56.566	2	134	<0.001
PCT patent applications	0.483	71.784	2	134	<0.001

Source: Elaborated by the authors

Table 4. Tests of equality of group means

reaching 67.2% of accuracy regarding the grouping that already existed in the GCR. In particular, Group 3 has greater accuracy – 83.3% (Table 6).

Based on the findings, the main focus for the countries to improve their stage of development should be the investment in research institutions, jointly with the incentive to increase the applications in the international patent systems.

This means enough investment in R&D, especially by the private sector, and the presence of high-quality scientific research institutions that can generate the basic knowledge needed to build new technologies. In addition, it is important to promote extensive collaboration in research and technological developments between universities and industry, as well as to offer protection regarding intellectual property (Schwab *et al.*, 2017).

Collaboration between the productive and academic sectors (universities and other research institutes) has intensified, with governments' support through public incentive policies. This phenomenon indicates the relevance of the quality of teaching and research institutions in the NIS (Mowery & Sampat, 2005). Thus, countries that want to advance in the ranking of development stage must count on universities that interact with society.

In its turn, the number of patent applications is a widely used indicator that allows comparing the performance of countries, companies and research institutions regarding their technological development (Gusberti *et al.*, 2014). Technology is singled out as one of the crucial elements for understanding competitive differentials among nations (Posner, 1961). Therefore, the effort of a country to increase its stage of development must reduce its technological gap in comparison to the countries that perform better. Innovations, developed through research institutions and materialized by patent applications, lead countries to gain or maintain their positions in the international scenario (Dosi, Grazzi, & Moschella, 2014).

Conclusion

This study observed the indicators proposed by the WEF-GCR to identify the countries' innovation factors that are determinant for them to achieve higher levels of development. Among these factors, the research verified which ones should be prioritized so that the countries are among the most competitive.

Table 5. Discriminant functions

Function	Eigenvalue	Variance (%)	Cumulative (%)	Canonical correlation
1	2.053[a]	98.153	98.153	0.820
2	0.039[a]	1.847	100.000	0.193

Note: [a]First two canonical discriminant functions were used in the analysis
Source: Elaborated by the authors

Table 6. Predictive analysis of discriminant function

	Predicted group membership			
GCR's groups	1	2	3	Total
1	*29* (58.0)	21 (42.0)	0 (0.0)	50 (100.0)
2	17 (33.3)	*33* (64.7)	1 (2.0)	51 (100.0)
3	0 (0.0)	6 (16.7)	*30* (83.3)	36 (100.0)

Notes: 67.2% of original grouped cases correctly classified (ratio of the sum of the cases in the main diagonal by the total number of countries); italic value signify 0.95%
Source: Elaborated by the authors

This work contributes to promoting advances in practice and academic discussions regarding the importance of innovation and its components for the development and competitiveness of the countries. Thus, it is clear that countries should promote policies based on the innovation components, to encourage innovation, improving their stage of development and competitiveness in the international market.

The results suggested that the factors Capacity for Innovation, Quality of Scientific Research Institutions, Company Spending on R&D, University–Industry Collaboration in R&D, Government Procurement of Advanced Technology Products, Availability of Scientists and Engineers and PCT Patent Applications are decisive for positioning countries in terms of their stage of development and should be part of their public policy and enterprises' strategic planning.

Furthermore, the findings also show that countries should prioritize the factors Quality of Scientific Research Institutions and PCT Patent Applications, as these factors, when acting together, predict the evolution to higher stages of development.

Therefore, public policies should direct and prioritize resources to promote improvements in the management of research institutions, encouraging basic and applied research, training, qualifying and remunerating researchers, improving infrastructure, improving rules and laws to facilitate partnerships and interaction of research institutes with society. In addition, create mechanisms for the knowledge developed to be transferred to society for economic and social values.

On the other hand, companies should include in their strategies actions that involve partnerships with research and development institutions to promote the increased patent application. Such actions may include training for a professional qualification, designation of specific areas for partnership development and management, R&D laboratories and means of evaluating results.

As for the research limitation, it is important to mention that the study used the indicators proposed by the GCR as the only data source, which represents an opportunity for future studies on the subject to explore other data sources and research methodologies. Also, other precedents of the development stage of nations may be added and tested, together with innovation, to expand the range of components relevant to the development of countries.

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