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CORRELATION BETWEEN INNOVATION INPUTS AND THE ECONOMIC GROWTH OF COUNTRIES

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Abstract: There is an intrinsic connotation of a positive relationship between the terms of economic development and innovation. However, the full understanding of the phenomenon, despite multiple studies, is far from complete. One of the factors that contributes to this shortcoming is the difficulty of properly conceptualizing and measuring innovation, so much so that the empirical studies carried out have found that the benchmark for innovation is only the level of investment in Research and Development (R&D). This work provides a new and original vision of how to relate these two variables characterizing innovation with the inputs (pillars) that originate it according to the theoretical framework of the Global Innovation Index and economic development with GDP per capita. The article is a correlational, non-experimental study, with longitudinal data ranging from 2010 to 2022 from five Latin American countries. Among the main results were: The correlation with the "Institutions" pillar is the one with the greatest weight, there are two pillars whose correlation is rejected, these results can be explained by the type of countries that make up the sample or by the construction of the indicator. It must be noted that in addition to its originality due to its focus on innovation, it is one of the few studies carried out in developing countries. Its main limitation is not having characterized causality.

INTRODUCTION

Innovation is a multidimensional concept that has been approached from various perspectives and refers to the successful application of new ideas that can take shape as both a result and/or a process. Innovation is not itself an invention, but rather an idea that leads to something new and provides a financial gain or benefit. (Opland et al., 2022)

Another interesting approach is the one given by (Xiao et al., 2021) which says: "innovations are produced through the recombination of knowledge components, each of which is associated with a central scientific or technological concept." It must be noted that at first the word innovation was related exclusively to the concept "technological development" and used indifferently both for the original idea and its application in a product, service or process. (Fagerberg, 2006) expressed the importance of differentiating between innovation and invention, and proclaimed that invention is the first idea one has regarding a new product or process, while innovation is the first attempt to put it into practice. (pp. 4-5)

From the above, it is easy to infer the difficulty of proposing a concept of what innovation really is, and what better way to express it than in the words of different authors over time: Innovation is the introduction into the market of a new product or process, capable of to provide some differentiating element, the opening of a new market or the discovery of a new source of raw materials or intermediate products. (Schumpeter, 1949, p. 66)

Later (Freeman, 1971) divided innovations into five categories: systematic, important, minor, incremental and unrecorded; In contrast, (Abernathy & Clark, 1985) divided innovations into four categories: regular, niche, revolutionary and architectural. However, the classification proposed by (Schumpeter, 1949) is the most accepted by researchers and offers two concepts of innovation: incremental and radical.

For (Porter, 1990), in his work "The competitive advantage of nations" he wrote "Companies achieve competitive advantages through innovation. His approach to innovation is carried out in a broad sense, including new technologies and new ways of doing things." (p. 75)

Another notable meaning is that of (Drucker, 1994)

Innovation is the specific tool of innovative entrepreneurs; the means by which to exploit change as an opportunity for a different business (…) It is the action of providing resources with a new capacity to produce wealth. Innovation creates a 'resource'. There is no such thing until man finds the application of something natural and then gives it economic value. (p.19,30)

It must be mentioned that from the first years that researchers began to study innovation, it was clear that technological innovation plays a key role in economic growth. (Yoo & Yi, 2022)

This direct positive relationship between technological advances and economic prosperity, according to (Romer, 1990) is the product of forming suitable human capital; which has been provided with sufficient resources to develop Research and Development (R&D), whose purpose is to obtain technical changes (innovations), which generates competitive advantages and consequently economic growth.

Confirming the previous ideas, (Charreau, 2001) states that innovation is the engine of national prosperity, which is why investment in research is more than justified. But, he also points out the obligation to "redefine development in terms of the quality of ideas generated and selected, as well as the spectrum and its scale in industry application." (p. 269)

In turn, in the work of (Quinde-Rosales et al., 2019) in which (Villareal & Ramos de Villareal, 2002) is cited, innovation is defined as:

The cornerstone within the competitiveness of companies and nations, making it necessary to invest in the design and development of cutting-edge products and processes. To achieve innovative activity, it is necessary to achieve conducive environments for its activity, through the support of both the public and private sectors. (p. 9)

In the same line of thought (Montoya, 2004) argues that scientific and technological innovations are instruments that promote economic growth in developing nations; At the same time, it considers that it becomes a factor of inequality when nations do not access innovative processes.

Scholars have discussed the topic of business development and innovation since the 1970s (Kraus et al., 2022); (Clauß et al., 2020); (Foss & Saebi, 2017). Therefore, the contribution to the concept of business innovation made for the Oslo Manual of the Organization for Economic Cooperation and Development (OECD, 2018) is of utmost value.

It is the introduction of a new or significantly improved product (good or service), a process or both, which differs significantly from the previous product or the previous process and which has been introduced to the market or the use of the company (p. 68)

With all these premises, it is understood that innovation is not only technological development, it is a concept with many dimensions and approaches, whose visible effect is a virtuous circuit in which innovation provides competitive advantage that in turn is transformed into economic growth, producing more advantages and therefore more innovations repeating the sequence.

However, delving deeper into the theoretical part, not all authors consider that the relationship between economic growth and innovation is important and direct, as expressed by (Galindo-Martín et al., 2012). There are works carried out by classic authors who consider innovation as a exogenous factor that indirectly affects the economy and its actions are limited to the impact it exerts on the variables that most directly affect growth, such as the division of labor. Others claim

that innovation reduces prices, but endangers employment.

However, the majority of empirical studies on this topic corroborate a positive correlation; from multiple angles and methodologies; such as that of (Coe et al., 1995) which is based on a multi-country model examining the effect of R&D spillovers from industrialized countries to those that are not.

Others used panel data; Among the most notable are the works of (Frantzen, 2000) "Innovation, international technological diffusion and changing influence of R&D on productivity", that of (Griffith et al., 2001) with "Mapping the two faces of R&D: productivity growth in a panel of OECD industries" or that of (Zachariadis M., 2003) with "R&D, Innovation and technological progress: a test of the Schumpeterian framework without scale effects". Among the most recent studies are those carried out with dynamic panel models, in which endogeneity is controlled and cumulative effects are captured, such as the article called "Innovation and regional economic growth: evidence for Mexico" by (German-Soto and others, 2021)

In short, what these investigations seek is to try to close this knowledge gap; determining factors that can affect this innovation-growth relationship, considering not only quantitative variables, but also qualitative ones.

On the other hand, within universally accepted knowledge; The method to determine the degree of innovation that is produced by a country is found in the Global Innovation Index or simply (GII) for its acronym in English, with its indicators and qualitative and quantitative inputs that promote it.

At the same time, what better indicator of a country's growth than its Gross Domestic Product per capita; At this point the question arises: Is there a significant and relevant correlation between the pillars that encourage innovation and the gross domestic product per capita?

To answer this question, a more exhaustive bibliographic review was carried out in which the inclusion variable was that the works to be considered had an empirical nature, finding the work of (Horowitz, 1967) that positively associated those regions with a constant growth rate. of R&D activity with a consistent pattern of economic development in the United States.

Using panel data for OECD countries (Zachariadis M., 2004) showed that R&D effort exerts a strong positive effect on productivity and production. Other studies reinforced the previous idea, such as (Falk, 2007) "R&D spending in the high-tech sector and economic growth," in which he found evidence of a positive relationship between the R&D effort in the technological area and GDP. per capita of OECD countries.

However, more recent works consider other factors that affect innovation, such as the research by (Risso & Sánchez-Carrera, 2018), which includes the GINI index, human capital, physical capital, government consumption spending, a variable dummy on the country's income level and innovation itself and which is considered as R&D spending as a percentage of GDP.

Following the route, another interesting approach is the one proposed by (Xiong et al., 2020); which exposes the social filter as a factor, which is defined as "The sets of socioeconomic elements that favor or discourage the development of a regional innovation system" (Crescenzi & Rodríguez-Pose, 2013) (Rodríguez-Pose, 1999), arrives to this premise because some researchers maintain that not all regions are capable of transforming investment in R&D into economic development in the same way (Rodríguez-Pose, 1999) (Shearmur & Bonnet, 2011). For (Zeng et al., 2019), it is the absorption capacity, however for the study by

(Duan et al., 2019), the moderating effect is the transfer speed.

GLOBAL INNOVATION INDEX

The Global Innovation Index (GII) was launched in 2007. Its objective was to find and determine metrics and methods that could capture as complete a picture of innovation in society as possible. The GII adopts a broad notion of innovation, originally developed in the Oslo Manual developed by the European Communities and the Organization for Economic Cooperation and Development (OECD).

The project was conceived by Professor Soumitra Dutta during his time at the head of the INSEAD institute, later in 2011 he partnered with the World Intellectual Property Organization (WIPO) and began publishing together. Years later, to be exact, in 2013, ``Universidad de Cornell``joined as co-editor until 2020, since from 2021 it was published by WIPO in association with the Portulans Institute, several corporate and academic partners of the network, and the Advisory Board. of GII. (WIPO, 2021, p. 175)

The GII model is based on two inputs that are averaged and which are intended to represent a complete image of the innovation; the Innovation Input Subindex and the Innovation Output Subindex. The first are five pillars of inputs that facilitate innovative activities, while the second are two variables that are the result of innovative activities within the economy. (WIPO, 2021, p. 177)

In turn, these pillars are supported by another list of variables called subpillars and these are provided with hard data in most cases; all this to strengthen the rigor and reliability of the indicator, but these are not exempt from problems. According to the report from (WIPO, 2021), "Direct official measures that quantify the results of innovation remain extremely scarce. There are no official statistics on the amount of innovative activity, defined as the number of new products, processes or other innovations." (p. 176)

Despite the above, the GII is the most complete indicator and accepted by the academic world, the effort made by the editors to constantly review the inputs that feed the pillars stands out.

MATERIALS AND METHOD

The present research proposal is of a correlational, non-experimental nature, based on longitudinal data in which the quantitative indicators of the World Bank databases and the Global Innovation Index were used as inputs, its line of research belongs to the fields of Economics and Administration and its general objective is to verify the existence of a positive correlation between the gross domestic product per capita of five Latin American countries and the innovation analyzed from the pillars considered in the theoretical framework of the GII.

A correlation study according to (Martínez-Ortega et al., 2009) measures the degree of association between two quantities, with the same criterion (Santabárbara, 2019) refers to correlation as the degree of dependence existing between two or more variables. Likewise, it is important to distinguish the concepts of causality and correlation. "The presence of a statistical correlation between two variables does not necessarily imply causality" and it is also necessary to highlight that "the correlation coefficient, as well as other statistical tests, is dependent on the sample size. Correlations of 0.20 can be significant with larger sample sizes, while this will not be significant if the sample is small." (Roy-García et al., 2020, p. 357)

Therefore, it is important in the research design to consider the sample size and statistical power. (Cárdenas & Arancibia, 2016); However, in many cases, the process

of sample size calculation and power analysis is too complex and difficult to make common programs feasible. (Kang, 2021)

To calculate sample size or perform power analysis, some programs require extensive knowledge of statistics and/or software programming, and other commercial programs are too expensive to use in practice, so the use of powerful software and freely available is a quite viable option. Both premises are met with the GPower program, which in addition to being intuitive to use, allows for the post hoc analyzes carried out in this study.

On the other hand, it must be noted that the pillars to consider are the indicators that promote innovation according to the GII. and that although its measurement is quantitative, the inputs that feed it are mixed.

All the works mentioned in the review used the investment made in R&D as an innovation variable, generally taken from the World Development Indicators published by the World Bank report, an exclusively quantitative indicator.

Given the above, the article must be considered an original approach to the relationship between innovation and economic development, both because it examines developing countries and not industrialized ones, and because of the dimensions with which innovation is studied (mixed and not only as an R&D expense).

Among the limitations of this work that must be weighed for subsequent studies is the demonstration of causality of the phenomenon and not only its correlation, as well as expanding the base of countries to observe both in America and in the world, among multiple other options.

Once the theoretical framework was detailed, the null hypotheses to be worked on were declared in accordance with the research question and these are:

Ho 1 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Institutions"

Ho 2 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Human Capital and Research"

Ho 3 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Infrastructure"

Ho 4 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Market sophistication"

Ho 5 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Business Sophistication"

Ho 6 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Knowledge and Technology Products"

Ho 7 There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Creative Results"

For this work, five Latin American countries were chosen: Chile, Colombia, Ecuador, Mexico and Peru, in a study period that goes from 2010 to 2022, that is, 13 observations from 5 countries are 65 inputs to corroborate or deny a correlation.

It must be clarified that the innovation input indicators for 2010 were valued on a scale from 1 to 6; where 6 was the optimal result and one was the worst performing, it was normalized with a rule of three where 6

was 10 and that result was multiplied by 10, since from that year on the value of the pillars are rated out of 100.

GII	Input Type	Pillar	Subpillar
Global Innovation Index	Entry	Institutions	Regulatory Environment
			Regulatory Environment
			Business environment
	Entry	Human Capital and Research	Education
			Tertiary education
			Investigation and development
	Entry	Infrastructure	Tic´s
			General Infrastructure
			Ecological Sustainability
	Entry	Market Sophistication	Credit
			Investment
			Trade, competition and market size
	Entry	Business Sophistication	Knowledge Workers
			Innovation Links
			Absorption of Knowledge
	Exit	Knowledge and Technological Outputs	Knowledge Creation
			Knowledge Impact
			Knowledge Diffusion
	Exit	Creative Results	Intangible assets Creative Goods and Services
			Online creativity

Table 1 Global Innovation Index Framework

Taken from (Cornell University, INSEAD, and WIPO, 2020, pág. 205)

Since the sample was greater than 50, the Kolmogorov-Smirnov test was used to determine the normality of the data set, yielding a value less than 0.05 for most variables, which denotes that the distribution of the data is not normal, so the method chosen to measure the correlation will be Spearman's.

Once the method to determine whether there is a significant correlation was determined, the SPSS version 25 program was run to determine the level of correlation between variables using the following syntax:

In the presentation of results, the level of correlation and its significance are verified, a value that determines whether the data is produced by chance or not. The program has a characteristic that makes it a very friendly tool that represents those significant relationships. with one or two asterisks depending on whether the significance is less than 0.01 or 0.05 bilateral.

Continuing, once the case verifications were carried out, a post-hoc analysis was carried out to evaluate the statistical power and the size of the effect with the GPower version 3.1 software.

RESULTS

CONCLUSIONS AND DISCUSION

The objective of this research work is to determine if there was a positive correlation between the pillars that make up the Global Innovation Index and the Gross Domestic Product per capita; for which a set of hypotheses were declared, namely:

According to the theoretical framework of the GII (WIPO, 2021) "the availability of credit, an environment that supports investment, access to the international market, competition and market scale are fundamental for companies to prosper and innovation to occur. ". (p. 206).

These are the bases that constitute the "Market Sophistication" pillar. As you can see, the indicators that support this pillar are very different for developed countries than for

Codificación para correr la orden Correlación Bivariada en SPSS versión 25

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NONPAR CORR
  /VARIABLES=PIBperPPP with  Instituciones Cap.Hum.Inv Infraestructura
MarketSoph Neg.Soph ScoreSal
    Con.Tecn.Inno ProductInnov
  /PRINT=SPEARMAN TWOTAIL NOSIG
  /MISSING=PAIRWISE.
```

Figure 1 Coding to run the Bivariate Correlation order in SPSS version 25

Note: This syntax is used to improve the presentation of results

Ident.	Población M	PIB per Capita	Instituciones	Cap. Hum. Inv	Infraestructura	Market Soph.	Neg. Soph.	Con. Tecn. Inno	Product Innov
CHI2010	16.8	$21,152.00	74.43	52.71	49.14	59.86	62.43	40.00	32.00
CHI2011	17.1	$22,246.00	85.20	34.90	31.10	47.40	41.90	20.40	38.80
CHI2012	17.4	$23,389.00	73.10	32.80	42.70	44.00	41.50	27.90	49.10
CHI2013	17.8	$23,927.00	72.20	31.50	41.00	52.50	36.40	26.30	42.60
CHI2014	17.8	$24,099.00	71.70	32.40	48.20	53.30	36.60	27.30	38.30
CHI2015	17.8	$24,330.00	73.80	32.30	50.00	50.90	37.70	28.30	38.60
CHI2016	17.9	$24,430.00	73.60	32.20	51.70	47.10	36.60	26.00	31.20
CHI2017	18.1	$24,412.00	70.30	32.80	52.10	49.80	36.50	26.00	32.10
CHI2018	18.1	$25,035.00	73.60	31.20	48.90	48.50	33.60	27.20	29.70
CHI2019	18.2	$24,931.00	73.00	32.50	51.00	51.70	33.10	22.90	27.20
CHI2020	19.0	$23,239.00	73.30	33.10	46.40	51.70	30.40	19.90	21.60
CHI2021	19.1	$25,821.00	72.70	35.20	47.40	46.40	30.60	22.30	25.30
CHI2022	19.2	$26,513.00	66.50	33.90	50.30	37.70	29.90	25.10	23.60

Figure 2 Indicators of innovation inputs according to the GII Report of Chile

Note: The identifier is the country and year of the report; The population is given in millions: GDP per capita is in constant 2011 dollars, in 2022 its overall score is 34.00 and it is ranked 50th worldwide

Ident.	Población M	PIB per Capita	Instituciones	Cap. Hum. Inv	Infraestructura	Market Soph.	Neg. Soph.	Con. Tecn. Inno	Product Innov
COL2010	44.5	$11,783.00	52.86	46.86	40.14	54.43	55.57	34.71	23.29
COL2011	46.3	$12,481.00	55.70	30.00	35.70	36.80	35.40	14.10	37.70
COL2012	46.1	$12,853.00	55.30	30.40	46.30	40.30	39.00	23.10	34.40
COL2013	48.1	$13,390.00	62.90	26.80	42.20	45.80	34.90	25.30	32.90
COL2014	47.7	$13,852.00	60.40	29.40	44.80	51.80	30.80	24.40	30.70
COL2015	48.9	$14,096.00	58.20	31.20	48.40	53.70	35.80	23.70	31.00
COL2016	48.2	$14,195.00	58.20	27.90	52.50	49.40	30.80	21.20	27.90
COL2017	48.7	$14,171.00	58.50	31.70	52.50	53.10	32.90	19.10	28.60
COL2018	49.1	$14,315.00	62.70	26.70	51.40	51.90	32.40	20.90	24.20
COL2019	49.5	$14,572.00	64.00	27.00	51.30	50.40	32.60	19.50	22.30
COL2020	50.3	$13,400.00	65.10	25.90	46.40	51.20	29.80	17.90	18.20
COL2021	50.9	$14,705.00	66.20	28.40	44.90	50.80	29.40	19.20	19.80
COL2022	51.3	$15,922.00	54.60	27.40	46.00	32.50	35.60	20.50	17.90

Figure 3 Indicators of innovation inputs according to the GII Report of Colombia

Note: The identifier is the country and year of the report; The population is given in millions: GDP per capita is in constant 2011 dollars, in 2022 its overall score is 29.20 and it is ranked 63rd worldwide

Ident.	Población M	PIB per Capita	Instituciones	Cap. Hum. Inv	Infraestructura	Market Soph.	Neg. Soph.	Con. Tecn. Inno	Product Innov
ECU2010	13.5	$10,341.00	47.00	33.71	34.86	45.86	42.29	30.86	26.43
ECU2011	13.8	$10,984.00	42.80	27.00	26.40	30.40	36.30	18.50	31.40
ECU2012	15.0	$11,431.00	34.40	25.10	31.30	31.60	33.40	18.40	33.50
ECU2013	15.1	$11,819.00	43.30	29.10	31.80	41.10	23.80	20.40	43.30
ECU2014	15.5	$12,078.00	43.60	21.60	35.90	43.70	23.80	14.40	28.10
ECU2015	16.0	$11,896.00	44.50	22.30	39.00	47.70	24.70	13.40	22.80
ECU2016	16.1	$11,552.00	44.60	21.40	38.70	40.70	24.20	13.20	27.40
ECU2017	16.4	$11,618.00	43.30	22.80	43.40	45.80	25.10	14.30	33.10
ECU2018	16.6	$11,562.00	44.70	21.40	41.60	44.90	24.80	14.40	21.80
ECU2019	16.9	$11,371.00	44.70	21.10	43.40	43.30	24.60	15.00	20.40
ECU2020	17.4	$10,325.00	44.60	21.00	37.30	47.80	20.60	12.30	15.60
ECU2021	17.6	$10,615.00	44.10	20.50	39.60	50.30	19.90	13.20	18.50
ECU2022	17.9	$11,529.00	39.40	20.20	42.40	23.30	23.20	11.30	10.40

Figure 4 Indicators of innovation inputs according to the GII Report of Ecuador

Note: The identifier is the country and year of the report; The population is given in millions: GDP per capita is in constant 2011 dollars, in 2022 its overall score is 20.30 and it is ranked 98th worldwide

Ident.	Población M	PIB per Capita	Instituciones	Cap. Hum. Inv	Infraestructura	Market Soph.	Neg. Soph.	Con. Tecn. Inno	Product Innov
MEX2010	106.4	$17,790.00	56.14	48.00	39.71	53.43	53.29	39.29	29.71
MEX2011	110.6	$18,186.00	58.60	34.70	27.00	37.20	29.90	16.70	30.10
MEX2012	109.7	$18,595.00	55.90	31.80	38.40	36.80	36.10	22.30	29.50
MEX2013	117.8	$18,600.00	61.80	31.90	35.50	45.60	28.90	23.40	42.40
MEX2014	120.8	$18,888.00	61.80	32.50	39.90	46.90	29.90	26.90	32.90
MEX2015	123.8	$19,269.00	61.50	34.30	39.50	47.00	36.90	29.40	35.00
MEX2016	127.0	$19,539.00	60.50	33.70	42.80	45.70	29.80	23.30	29.90
MEX2017	128.6	$19,721.00	58.50	33.70	49.70	50.00	30.80	21.50	32.60
MEX2018	129.2	$19,928.00	62.30	33.80	48.00	48.00	29.50	23.50	29.20
MEX2019	130.8	$19,675.00	62.80	33.40	48.30	49.90	29.40	25.50	29.20
MEX2020	127.6	$17,878.00	61.30	32.10	43.00	48.40	27.10	23.40	26.20
MEX2021	128.9	$18,545.00	61.00	33.20	41.80	48.80	27.20	24.80	28.50
MEX2022	130.3	$20,820.00	48.20	33.60	44.20	36.30	25.20	24.30	24.70

Figure 5 Indicators of innovation inputs according to the GII Report of Mexico

Note: The identifier is the country and year of the report; The population is given in millions: GDP per capita is in constant 2011 dollars, in 2022 its overall score is 31.00 and it is ranked 58th worldwide

Ident.	Población M	PIB per Capita	Instituciones	Cap. Hum. Inv	Infraestructura	Market Soph.	Neg. Soph.	Con. Tecn. Inno	Product Innov
PER2010	28.8	$10,066.00	53.71	44.86	34.57	60.71	53.00	32.43	27.57
PER2011	29.5	$10,617.00	57.50	25.70	31.40	42.70	37.90	14.50	28.80
PER2012	30.0	$11,176.00	56.20	21.90	38.00	54.80	40.60	20.30	31.40
PER2013	30.1	$11,724.00	61.50	20.90	34.00	52.90	33.40	19.30	43.50
PER2014	30.0	$11,877.00	61.10	27.20	38.20	58.50	29.10	20.20	33.10
PER2015	30.8	$12,110.00	60.40	26.80	42.00	56.60	31.60	19.20	33.30
PER2016	31.4	$12,404.00	60.40	27.50	45.00	50.00	32.90	16.40	27.20
PER2017	31.8	$12,507.00	58.70	26.60	45.20	54.80	35.70	15.80	27.40
PER2018	32.2	$12,781.00	60.50	20.00	43.20	55.20	36.80	17.10	23.80
PER2019	32.6	$12,858.00	61.20	30.40	46.70	57.60	36.60	15.30	23.40
PER2020	32.5	$11,290.00	61.40	32.30	39.70	51.90	33.80	10.90	16.60
PER2021	33.0	$12,648.00	62.50	34.30	38.80	52.20	34.30	14.90	21.20
PER2022	33.4	$13,410.00	58.00	36.80	40.50	40.20	32.10	13.70	19.50

Figure 6 Indicators of innovation inputs according to the GII Report of Peru

Note: The identifier is the country and year of the report; The population is given in millions: GDP per capita is in constant 2011 dollars, in 2022 its overall score is 29.10 and it is ranked 65th worldwide.

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistics	gl	Sig.	Statistics	gl	Sig.
GDP/ per PPP	.191	65	.000	.873	65	.000
Institutions	.109	65	.054	.959	65	.029
Capital for Human investment	.148	65	.001	.903	65	.000
Infrastructure	.057	65	.200*	.971	65	.136
Market soph.	.126	65	.013	.948	65	.008
Neg. Soph.	.158	65	.000	.892	65	.000
Con. Technology innovation	.061	65	.200*	.957	65	.024
Product innovation	.091	65	.200*	.986	65	.681

*. This is a lower limit of the true significance.
a. A) Lilliefors significance correction

Figure 7 *Normality Test*

Indicator	Inst.	Cap. Hum. Invest.	Infra.	Market Soph	Neg. Soph.	Con. Tecn. Inno	Prod. Innov
Correlation coefficient	.766**	.581**	.583**	.023	.146	.588**	.260*
Sig. (bilat)	.000	.000	.000	.858	.247	.000	.036
Sample	65	65	65	65	65	65	65
$\rho > 0.50$	0.875	0.762	0.763	0.151	0.382	0.766	0.509
$1 - \beta > 0.80$	1.00	1.00	1.00	0.98	0.99	1.00	0.99

Table 2 Analysis of relationship, significance, effect size and statistical power

** The correlation is significant at the 0.01 level (two-sided)

*The correlation is significant at the 0.05 level (two-sided)

Number of Ho	Declaration	Decision
Ho 1	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Institutions"	In this case, the null hypothesis is rejected and the correlation between Institutions and Gross Domestic Product per capita is accepted. The data are not results of chance since their significance is less than 0.01 bilaterally. The correlation is high since the size of the effect is found to be $0.7< p < 1$ and also its statistical power is located at unity.
Ho 2	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Human Capital and Research".	Here the null hypothesis is also rejected and the correlation between Human Capital and Research and Gross Domestic Product per capita is accepted, its data are not results of chance since its significance is 0.000, the correlation is high since the effect size is $0.7< p < 1$ and also with the value of its power it is inferred that it is correctly rejected.
Ho 3	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Infrastructure".	In this case the null hypothesis is rejected and the correlation between Infrastructure and Internal Product is accepted. Gross per capita, its data are not results of chance since its significance is less than 0.01 bilateral, the correlation is high since the effect size is $0.7 < p < 1$ and also the probability of correctly rejecting the null hypothesis it's quite high.
Ho 4	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Market sophistication".	Here there is an anomaly when obtaining the results, which differ from logic and theory; The significance is greater than 0.05, so the null hypothesis is supported; this result will be further explored later..
Ho 5	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Business Sophistication".	Same as in the previous case of the null hypothesis is considered valid, so the reflection about the abnormality is discussed in subsequent paragraphs..
Ho 6	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Knowledge and Technology Products".	The correlation between both variables is validated, by rejecting the null hypothesis, a high level of correlation is confirmed and also the probability of correctly rejecting the null hypothesis is quite high..
Ho 7	There is no significant relationship between the Gross Domestic Product per capita and the pillar of input inputs for innovation called "Creative Results".	In this case the null hypothesis is rejected, but its level of correlation is medium unlike the other pillars in which the correlation was accepted..

Table 3 Table of Decisions of Hypotheses

developing nations. When carrying out this research with Latin American nations, a bias occurs that may lead to a different result than expected.

Another possible response to the anomaly is that, in the search to perfect the indicator, changes have been made over time to some of the inputs that feed the pillar and it does not fully respond to our reality, so a plausible solution is the search and improvement of inputs, which represent all countries and not only the developed ones.

"Business Sophistication" is the pillar that attempts to capture how conducive companies are to innovation activity "by promoting productivity, competitiveness and innovation potential with the hiring of highly qualified professionals and technicians." (WIPO, 2021, p. 207)

Here again the anomalous sequel can be explained by the bias of the sample, the result of its indicators supports it since the object of study is the hiring of qualified personnel by companies; In the region it is an idea that is still taking hold and although it is not the norm, there are cases that stand out, such as the Peruvian one, which almost doubles its indicator with respect to that of Ecuador, which is the lowest of those observed.

Continuing with the analysis, the last pillar to detail its results is the so-called "Creative Results" (also called Innovative Products), the theory states: "The role of creativity for innovation is still greatly underestimated in the measurement of innovation and policy debates. (WIPO, 2021, p. 208). Measuring creativity in itself is extremely complex and the performance of developed nations is totally different from the countries studied in this article. Therefore, the result found is feasible, rejecting the null hypothesis, but with a medium correlation coefficient (0.509).

As a corollary, it can be inferred that the variables that influenced the results are the sample bias, since we only worked with developing Latin American countries, in addition, due to the changes that the inputs that make up the pillars of innovation have undergone. through time; since it is rational that these events distort their quantification to some degree.

It is advisable for the countries studied to work on improving the inputs of the Institutionality pillar, which has the greatest weight in the correlation and is the one with the lowest performance in four of the five cases.

For future studies, it is suggested to consider the option of adding all the countries of America or on a global basis to eliminate bias; Along with quantitative research, it is also advisable to work on strengthening the theory by formulating constructs for better metrics to quantify innovation and creativity.

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