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Exploring Analysis of the Global Innovation Index Considering Manufacturing Industry in Jordan

(2011-2020)

التحليل الاستكشافي لمؤشر الإبداع العالمي بالنظر إلى الصناعة التحويلية في الأردن خلال الفترة

(2020 - 2011)

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Abstract

The main aim of this study is to review the Jordan Global Innovation Index ranking compared to the developed Arab countries during the period 2011-2020. This review will help determine the strength and weakness level of correlations between the Innovation Index and its sub-components. It will also help explore the relationships between Innovation and Industrial Production Indexes for selected manufacturing industries using descriptive analysis and quantitative methods such as correlation and multiple regression. The main results indicate a high and positive correlation between the Jordan Innovation Index and Industrial Production Index for manufacturing in Jordan during 2011-2020. Therefore, private and public sectors are recommended to promote innovation output components: knowledge, technology, and creativity, which can play a vital role in enhancing productivity in the manufacturing industries sector in Jordan.

Keywords: Innovation index, manufacturing industries, knowledge and technology, creativity, Jordan.

الملخص:

الهدف الرئيسي من هذه الدراسة هو مراجعة في ترتيب مؤشر الابتكار العالمي للأردن، مقارنة ببعض الدول العربية المتقدمة خلال الفترة الزمنية 2011-2020. وكذلك تحديد مستوى القوة والضعف للارتباطات بين مؤشر الابتكار ومكوناته الفرعية، ومحاولة استكشاف العلاقات بين مؤشر الابتكار ومؤشر الإنتاج الصناعي لبعض الصناعات التحويلية باستخدام التحليل الوصفي والأساليب الكمية مثل الارتباط والانحدار المتعدد. النتائج الرئيسية تشير إلى وجود علاقة ارتباط قوية وإيجابية بين مؤشر الابتكار الأردني ومؤشر الإنتاج الصناعي للصناعات التحويلية في الأردن خلال الفترة الزمنية 2011-2020. ومن أبرز توصيات الدراسة المشاركة في القطاعين الخاص والعام في الحث أو التحفيز من أجل تعزيز مكونات مخرجات الابتكار وهما: (المعرفة والتكنولوجيا) و (الإبداعية)؛ التي يمكن أن تلعب دورًا حيويًا من أجل تعزيز الإنتاجية في الصناعات التحويلية في الأردن.

الكلمات المفتاحية: مؤشر الابتكار، الصناعات التحويلية، المعرفة والتكنولوجيا، الإبداع، الأردن.

Introduction

The manufacturing industries share at least 82% of the whole industrial sector value in Jordan and contribute about 17.6% of the GDP, according to the recent publication of the Department of Statistics (2020). The manufacturing industries suffered from low growth, around 1.2% in 2019, while it became minus 3.2% in the third quarter of 2020, synchronically with Covid-19 (DoS, 2021). Therefore, this paper explores the impacts of innovation on the productivity of manufacturing industries in Jordan (97% of SMEs; Jedco, 2020).

The Global Innovation Index is an annual classification comprising 131 world countries based on the capabilities and capacities that stimulate innovation in such countries. This report is issued by Cornell University, INSEAD Institute, and WIPO. Innovation can be considered one of the main important linked topics to the economic and social conditions in the context at the local and global levels due to the economic challenges such as creating new jobs, productivities, business opportunities, and improving SMEs ecosystem. Therefore, policies that support an innovation environment can secure new feasibility techniques that address the above challenges.

Studies have documented that the innovation factors are considered an engine of economic growth and welfare and are vital for economic progress of competitiveness for both developed and developing economies. Moreover, it is documented that investments in innovations are crucial factors for firms and nations to compete and secure a competitive advantage in the context of an increasingly globalized and uncertain economy with environmental issues. Thus, business establishments or companies are invited not only to innovate products and production processes but also improve organizational structure, administrative processes, and managerial practices as well (Tellis et al., 2008, Birkinshaw et al., 2008, Damanpour &

Aravind, 2012, Hamel, 2007, Franco et al., 2017). Moreover, it is vital to enhance entrepreneurship to transform the economy into the next economic development stage, which is "Innovation Driven." It is a larger mission to be tackled by the public sector's institutions alone. Therefore, the private sector side by side civil society organizations are expected to contribute to improvement (GEM Jordan National Report, 2020).

Many articles also documented focusing on the positive impact of innovation, exports on SME's rate growth and exploring the positive effects of innovation on sales growth (Lu & Beamish, 2001; Becchtti & Trovato, 2002; Yasuda, 2005, Colovko & Valentini, 2011).

According to the results and the indicators of this study, it is essential for policymakers and academic researchers in different related fields to be aware of the strengths and weaknesses of innovation components. It is also imperative for them to know the processing level of achievement during the last 10 years in Jordan compared to other countries, especially in the Arab region.

The Aim of this Study

1. To review the Jordan Global Innovation Index ranking among Arab countries during the period 2018-2020.
2. To determine the strengths and weaknesses level of correlations between the innovation sub-input components and the innovation input index separately.
3. To determine the strengths and weaknesses level of correlations between the innovation sub-output components and the innovation outputs index separately.
4. Explore the relationships between the Innovation Index and the Industrial Production Index for selected main manufacturing.
5. Estimate the impact of sub- inputs and outputs index separately on manufacturing industries using the Industrial Production Index.

Data and Methods

The Department of Statistics (DoS) is the source of the Industrial Production Index (time series). At the same time, the global annual reports are the source of the General and Sub-Innovation Index during the period 2011-2020. The explorer analysis was performed by using descriptive and quantitative methods such as correlation and multiple regression using the Cobb–Douglas model as the following:

$$Q = f(i, O)$$

$$\mathrm{Ln}(Q) = (\beta o) + (\beta 1)\,\mathrm{Log}(i) + (\beta 2)\,\mathrm{Log}(o)$$

Where:

Q: Industrial Manufacturing Production Index (2010=100)

i: Innovation Input Sub -Index

O: Innovation Output Sub -Index

B1, B2 are the elasticity

The power B1, B2 are interoperated as elasticity, which can be considered features of the Cobb–Douglas model (Jacques, 2006).A Brief Conceptual Framework of the Global Innovation Index (GII)

According to the Global Innovation Report (2011; see Figure 1) prepared to explain the Global Innovation Index (GII), the conceptual framework consists of an Input Sub Index and Output Sub-Index. Each of the separate sub-indexes is built around pillars. Five inputs on one side hand pillars capture the elements of components that enable innovative activities as follows: (1) Institutions, (2) Human capital and research, (3) Infrastructure, (4) Market sophistication, and (5) Business sophistication. On the other hand, the two elements' components pillar capture innovation outputs: (1) Scientific outputs (2) Creative outputs. Moreover, each pillar consists of sub-pillars, and each sub-pillar is composed of individual indicators. "Sub-pillar scores are calculated as the weighted average of individual indicators; pillar scores are calculated as the simple average of the sub-pillar scores" (Innovation Index report, 2016). The pillar on the top is the Innovation Efficiency Index which is the ratio of innovation outputs to innovation inputs.

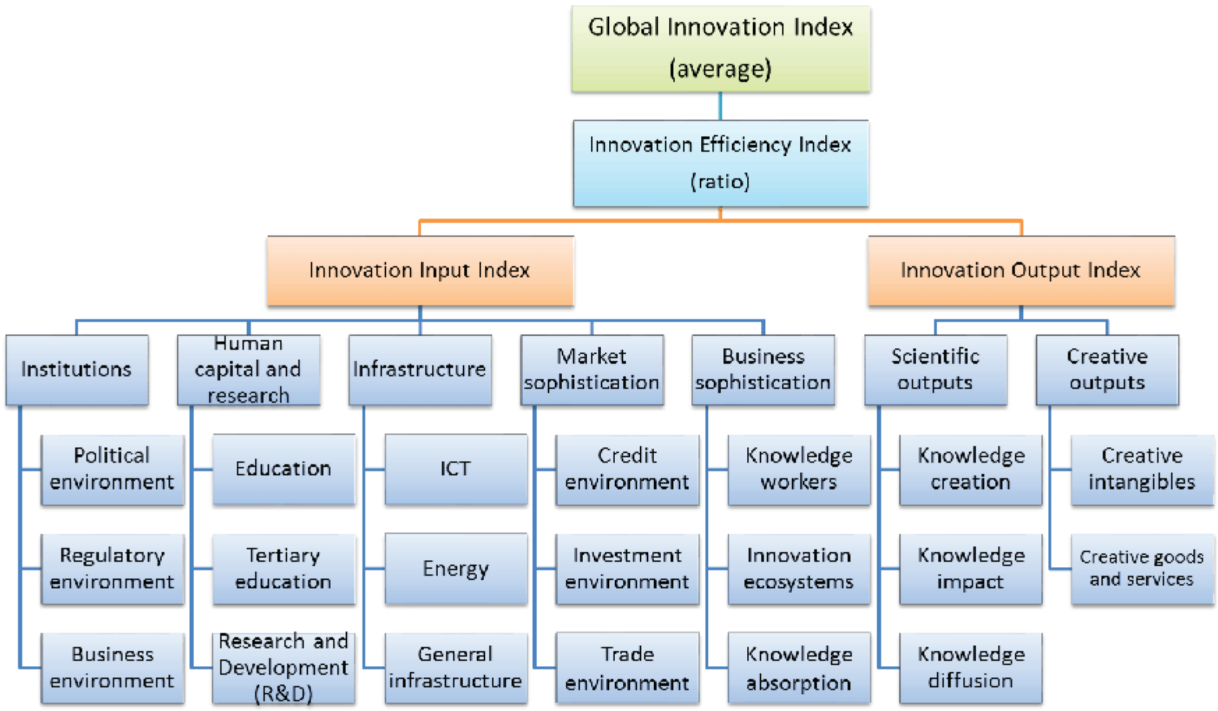

Figure (1):
Framework of the Global Innovation Index (GII) 2011.

Background

It is well-known that innovation is a prerequisite for competitiveness and economic growth, and there are several possible ways to measure and evaluate the innovation performance of a country (Janoskova K. & Kral P., 2019). Even though there are many published research on global innovation, extensively on input and output sub-index relationships (Araújo & Costa, 2013), less interest was paid to improving innovation on productivity within the national economy sectors.

A published article on innovation indicators, "Correlational Study between the indicators of innovation activity and agricultural production in Russian regions" prepared by Simonov et al. (2020), focused on the correlation analysis between the innovation activity and the volume of agricultural production in Russia. Results were extracted from both methods, correlation and regression analysis, between the condition of the innovation activity and agriculture volume of the Russian regions where federations are r=51, significant on the level of significance >99%. Thus, utilizing the outcome can define main issues that matter food security policies & evaluate regional plans in the country.

Another published article, "Econometric Models for Forecasting Innovative Development of the Country performed by Nevezhin et al. (2019), developed models to predict the level of innovation of developing countries and identify the most significant factors that are influencing innovative development. An econometric analysis was prepared such as multiple regression models (linear, polynomial, hyperbolic and logarithmic) based on a sample of 30 countries due to Global Innovation Index report 2018. The study chose the Global Innovation Index as an explained factor, while all the seven factors (inputs sub-Index & outputs sub- Index) were explanatory factors comprising institutions, human capital and research, infrastructure, domestic market development, business development, science and technology, and results in the field of intangible and development creative activity. Therefore, all of explanatory factors were examined, the most important were "field of creative activity" and the field of "science and technology" which are both considered as an output-sub index.

A published article, "Analysis of Innovation

Indicators as a Cornerstone for Knowledge Economy Adoption in Algeria" prepared by Jawhara et al. (2019), aimed to estimate a relationship between global innovation (GII) and sub-indicators during the period (2011 - 2016) in order to clarify which of these sub-indicators contribute to improving the level of innovation in Algeria (GII). The results showed that most of the innovation sub-indicators (inputs or outputs) have no significant impact on the country (Algeria) innovation index (GII) except for the indicator of the regulatory environment and environmental sustainability. The study also focused on the human factor that can be paramount in raising the level of innovation by encouraging and supporting culture of innovation in the country. Raising the level of investment in information and communication technology and providing a strong infrastructure in this field were the main recommendations of this study.

A published article titled "Using "Cobb-Douglas" Function to Measure the Impact of Exports and Indirect Taxes on the Jobs Creation of the Manufacturing Industrial Sector in Jordan" prepared by Al-Zu'be et al. (2019) aims to measure the impact of exports and indirect taxes on induced job opportunities in Jordan manufacturing sector. The main results indicated that the increased 10% of manufacturing exports would increase induced job opportunities by 12.4%. In comparison, it's reverse in the situation for the indirect taxes, when it increased by 10% will tend to decrease induced job opportunities by 12.9 % in the sector. The study also reviewed the indicator of high-technology exports (% of manufactured exports) issued by the world bank – Open Data. It was clearly shown that the quality of industrial products/ high–tech in Jordan is relatively low compared to similar Arab countries in the region, ranked less than Saudi Arabia, Lebanon, and Morocco. Therefore, it's an obstacle in order to improve the competitiveness of Jordan export commodities, which calls for a review of the industrial approach in terms of raising the level of quality by establishing or inducing programs motivating low taxes for manufacturers to encourage them to increase exports of high technology products.

The published study performed by Roulami et al. (2018) titled "The reality of government innovation in the Arab countries and ways to develop it, the experience of Algeria, the UAE & Morocco" highlights the reality of innovation in the governments of three Arab countries: Algeria, Morocco, and United Arab Emirates. It relied on comparing the Global Innovation Index with the Global Development Indicators of Science and Technology and tried to explore the importance of innovation in presenting public service and economic development. The study made some suggestions that may help these governments invest in government innovation. This is to develop their performance, such as strategies aimed to promote and develop new technologies and information systems that focus on the principle of social transformation involving large sectors of citizens to benefit from the Internet services and knowledge exchange.

Moreover, Franco and Oliveira (2017) performed a study titled "Inputs and Outputs of innovation: Analysis of the BRICS Theme 6 -Innovation technology and competitiveness." This paper aims to understand the development of innovation of the BRICS (Brazil, Russia, India, China, and South Africa) during the period 2008- 2013, from the annual reports of the Global Innovation Index. Data were collected in order to analyze Innovation which was measured by inputs and outputs as sub-indexes. A regression analysis between inputs and outputs for each country is done. The results show that all R^2 is lower than 35%, showing that the output cannot be well satisfactorily explained by the inputs analyzed. Moreover, the results pointed out the necessary needs for cooperation between BRICS countries in order to stimulate the development of the innovation process work.

A published article, "Efficiency of National Innovation Systems – Poland and Bulgaria in the Context of Global Innovation Index" prepared by Jankowska et al. (2017), aims to interpret how national innovation system for different countries can transform innovation input into innovation output according to the Global Innovation Index (GII). The research assumes that despite how high the innovation input goes, it will not necessarily result in a higher innovation output attained by a country, as for the cases of Poland and Bulgaria. Poland is a country where the innovation efforts (inputs) are satisfactory. In contrast, these efforts' results (outputs) are still not satisfactory to attain ranking among countries with a high innovation in outputs. On the other hand, it is reversed in the situation of Bulgaria. The country is still behind in development ranking within the countries in which innovation is on the inputs side. On the other hand, the country had achieved a satisfactory level of technology and knowledge, which are both on the outputs side.

Review of Jordan Global Innovation Index Ranking Among Arab Countries

Table 1 and figure 2 indicate the rank of Jordan Global Innovation Index among the Arab countries during the years 2018-2020, as follows:

The United Arab Emirates ranked number one during the years 2018-2020; the same table shows that Tunisia jumped from level 5 in the year 2018-2019 to the second level in the year 2020, while Jordan is a level behind as it showed 9, 9, 8 in years 2018, 2019, 2020 respectively.

Table (1):

Jordan Global Innovation Index Ranking among Arab Countries

2018	2019	2020
United Arab Emirates	United Arab Emirates	United Arab Emirates
Qatar	Kuwait	Tunisia
Kuwait	Qatar	Saudia Arabia
Saudi Arabia	Saudia Arabia	Qater
Tunisia	Tunisia	Morocco
Oman	Morocco	Kuwait
Bahrain	Bahrain	Bahrain
Morocco	Oman	Jordan
Jordan	Jordan	Oman

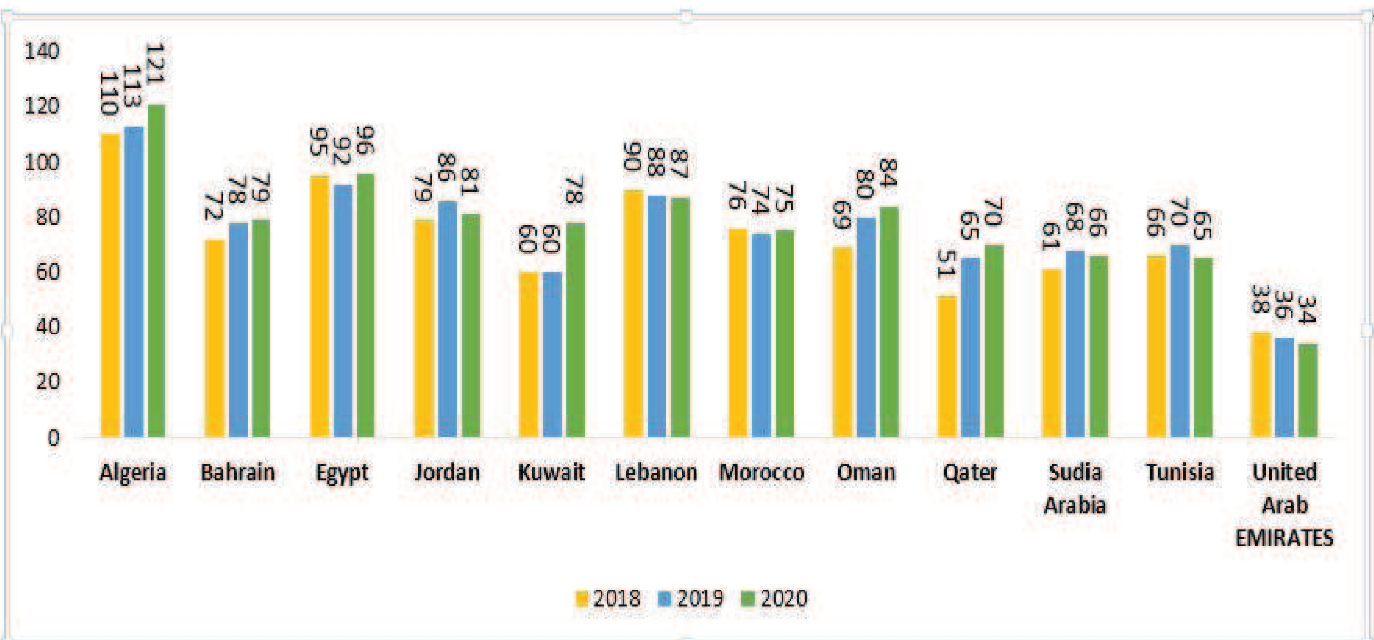

Figure (2):

Jordan Innovation Index Ranking Among Selected Arab Countries (2018-2020)

Review of Jordan Innovation Efficiency Ratio Index Ranking among Arab Countries

Table 2 and figure 3 indicate the rank of Jordan Innovation efficiency ratio index among the Arab countries during the period 2018-2020, which shows as follows:

Kuwait ranked number one during the period

2018-2019; also, Tunisia jumped from level 5 in 2019 to the first level in 2020. In contrast, Jordan ranked number 3, 3 in 2018, 2019 respectively and then dropped to level 8 in 2020.

Table (2):
Jordan Innovation Efficiency Ratio Index Ranking among Arab Countries

2018	2019	2020
Kuwait	Kuwait	Tunisia
Egypt	Egypt	Morocco
Jordan	Jordan	Egypt
Tunisia	Morocco	Lebanon
Morocco	Tunisia	Qatar
Qatar	Lebanon	Kuwait
Bahrain	Qatar	United Arab Emirates
Oman	United Arab Emirates	Jordan
Lebanon	Bahrain	Saudi Arabia

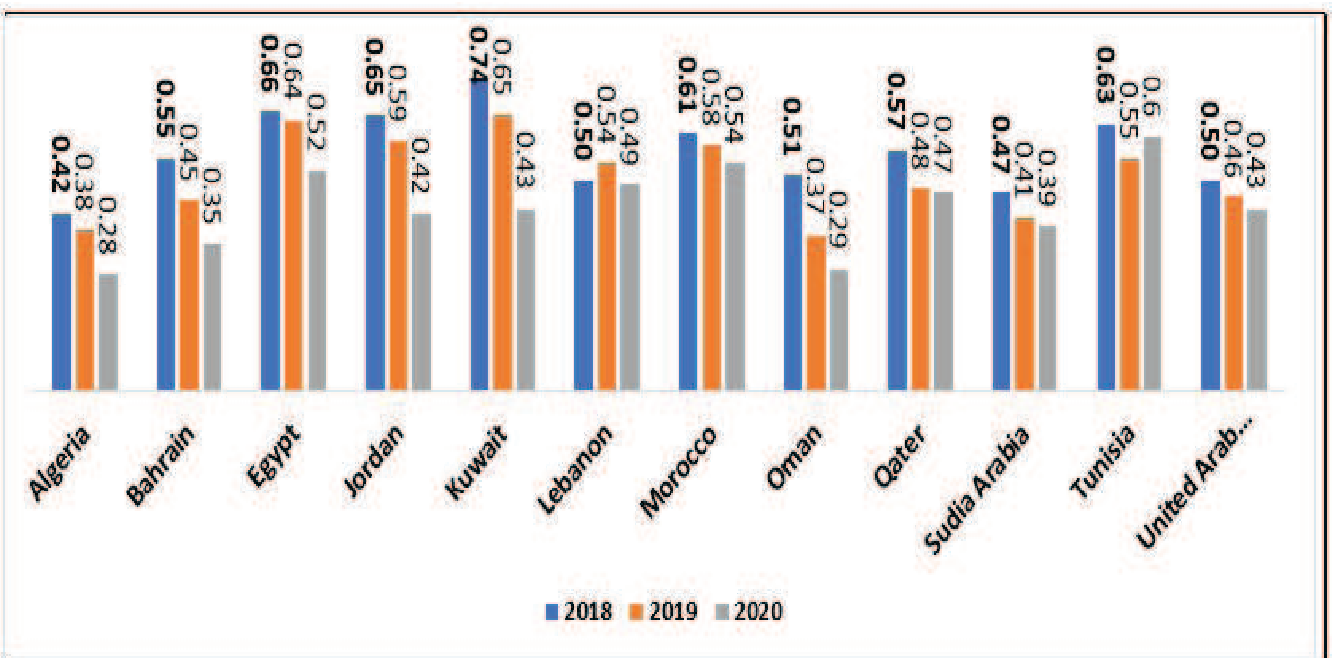

Figure (3)
Jordan Efficiency Ratio Among Arab Countries (2018-2020)

Jordan Global Innovation Index (2011-2020)

Figure 4 shows a decrease in the general trend of Jordan's Global Innovation Index indicator over the period 2011-2020; the index reached about 38.4 in 2011 and then slowly decreased until it became 27.8 in 2020.

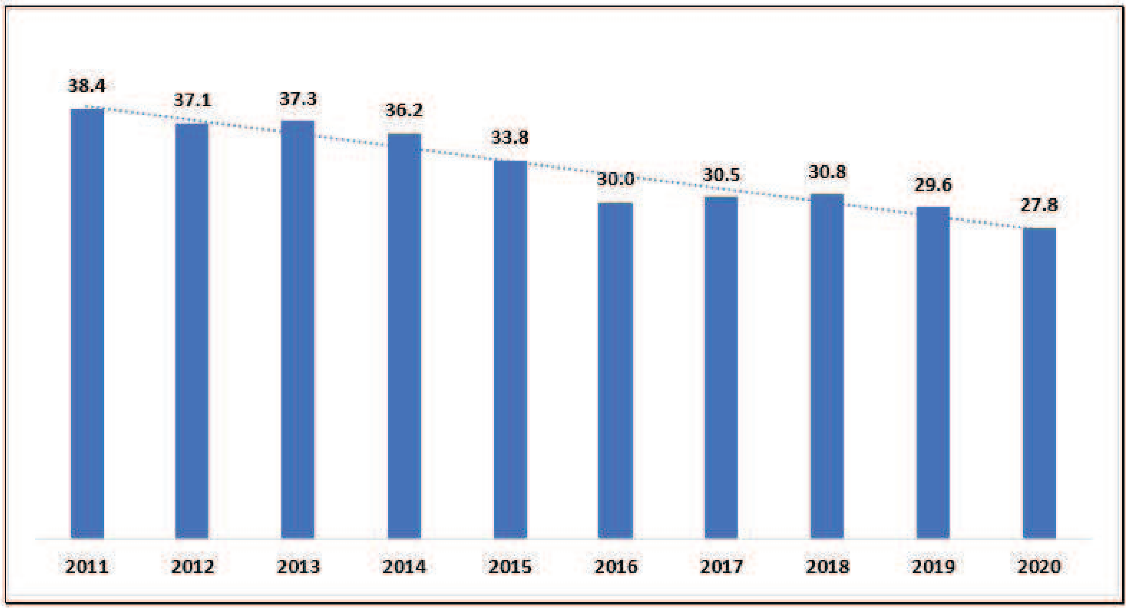

Figure (4)

Jordan Innovation Index (2011-2020)

Jordan Innovation Sub-Index (inputs, outputs)

Figure 5 shows a slight decrease of the trend in the innovation sub-inputs while it shows a sharp decrease in the trend of the innovation sub-outputs over the period 2011-2020. The gap between the two sub-indicators became increasingly wide during the above period, from 5.8 points in 2011 to 22.4 in 2020.

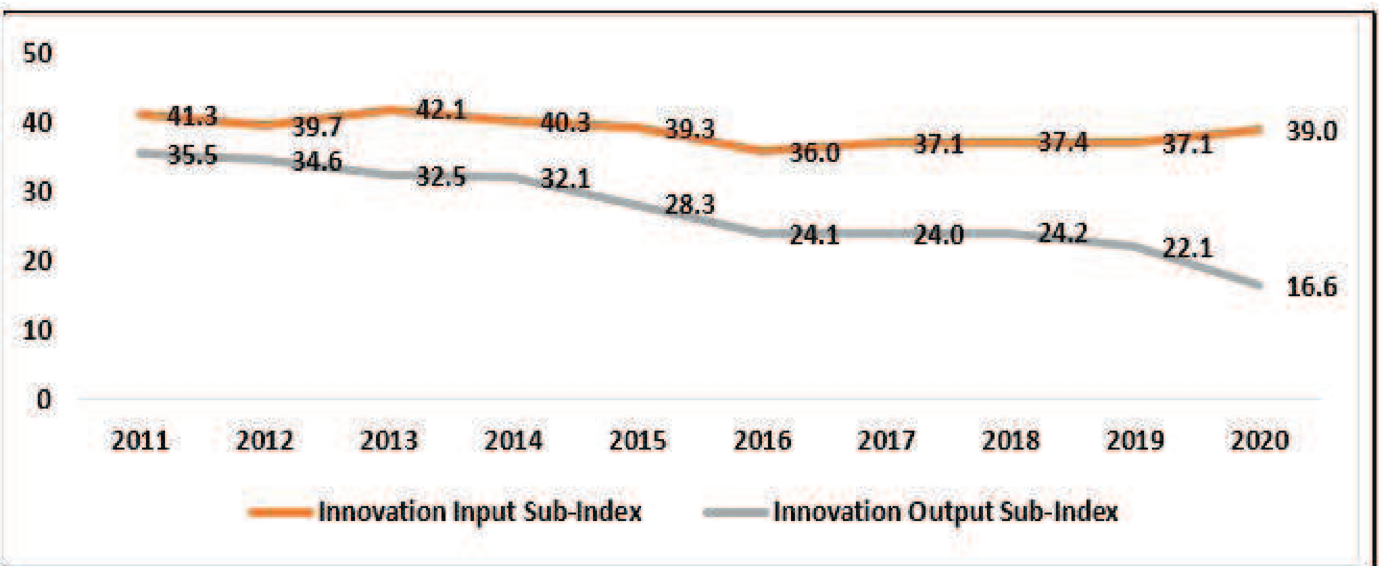

Figure (5)

Jordan Innovation Sub-Index (inputs, outputs)

Jordan Innovation Efficiency Ratio

The efficiency ratio is calculated by dividing the innovation output sub-index by the innovation inputs sub-index. Figure 6 shows a decrease in the trend of the innovation efficiency ratio of Jordan over the period 2012-2020. This ratio reached about 0.87 in 2012 and then decreased slowly until it became 0.42 in 2020.

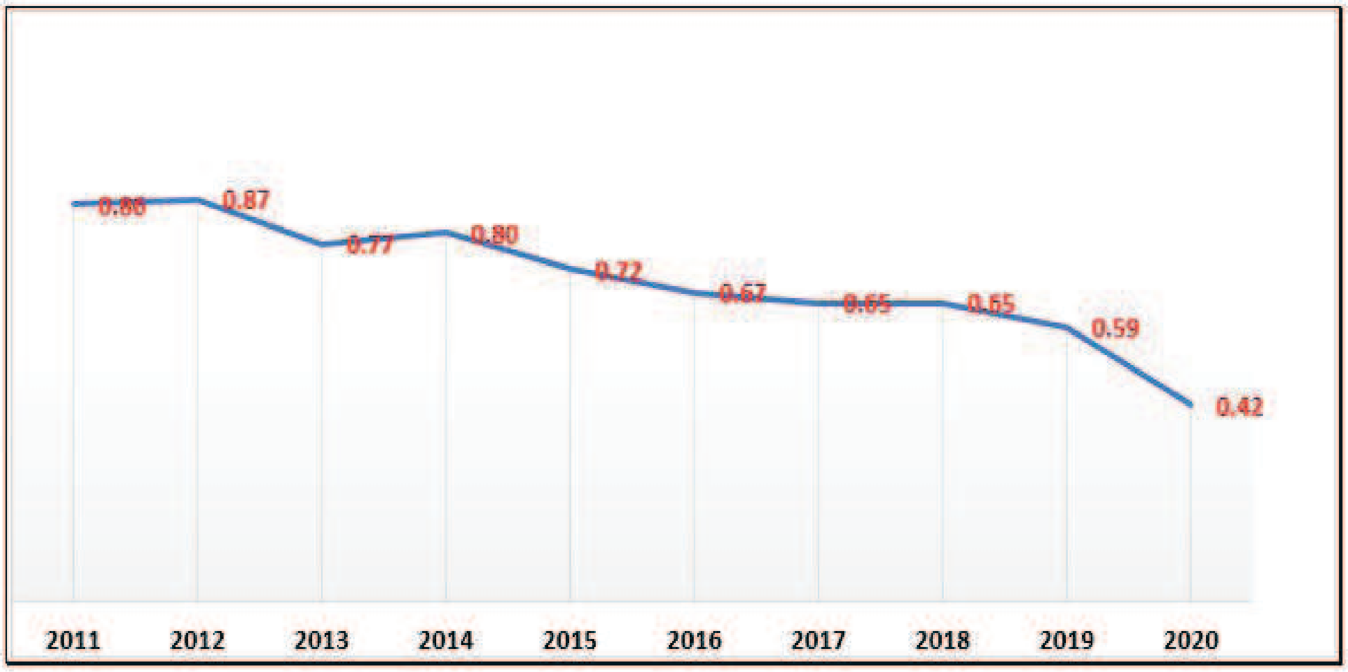

Figure (6)

Jordan Innovation Efficiency Ratio (2011-2020)

Jordan Innovation Inputs Sub-Index - Main Components (2011-2020)

Five innovation input sub-index are presented as follows:

Institution

Figure 7 shows the innovation input sub-index (institution), which took a volatility shape during the period 2011-2020. The peak reached about 65.8 in 2011, while in 2018 it plummeted to the bottom and reached about 60.6.

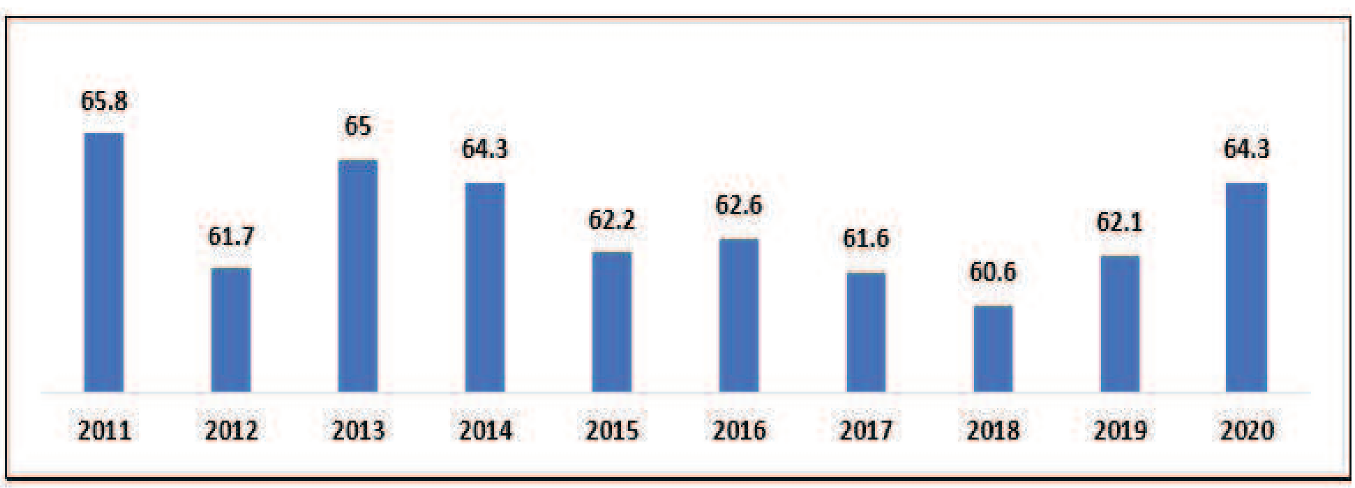

Figure (7): Institution

Human Capital & Research

As observed in figure 8, the general trend of the human capital and research inputs sub-index decreased during 2011-2020. It reached its peak in 2012 to up to 42, while it came at the bottom at 25.4 in 2016.

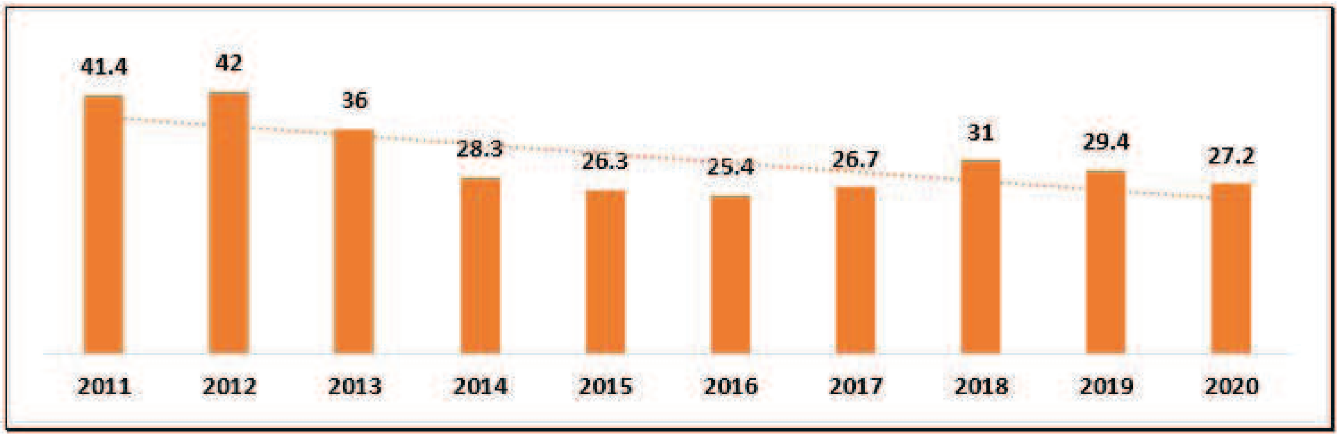

Figure (8)

Human Capital & Research

Infrastructure

Figure 9 showed the general trend of the infrastructure as an inputs sub index, which increased during the period 2013-2018 until it reached its peak of about 40.4 in 2018, followed by a decrease reaching 32.8 in 2020.

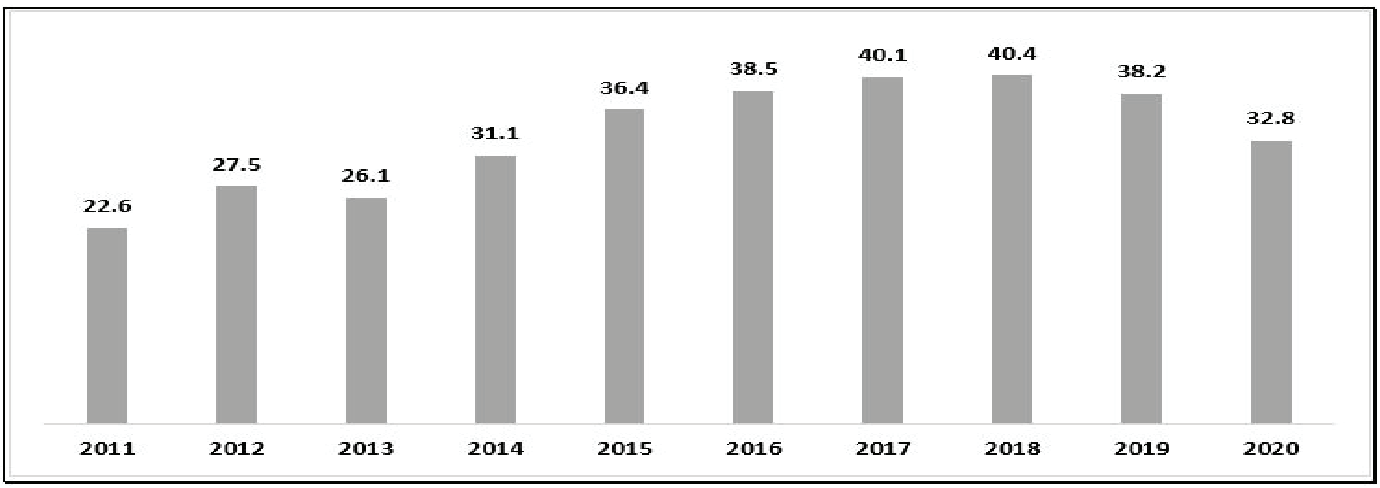

Figure (9)

Infrastructure

Market Sophistication

Figure 10 shows the innovation input sub-index, Market Sophistication, which took a volatility shape during the period 2011-2020. The peak reached about 50.1 in 2020, while it hit bottom at about 32 in 2016.

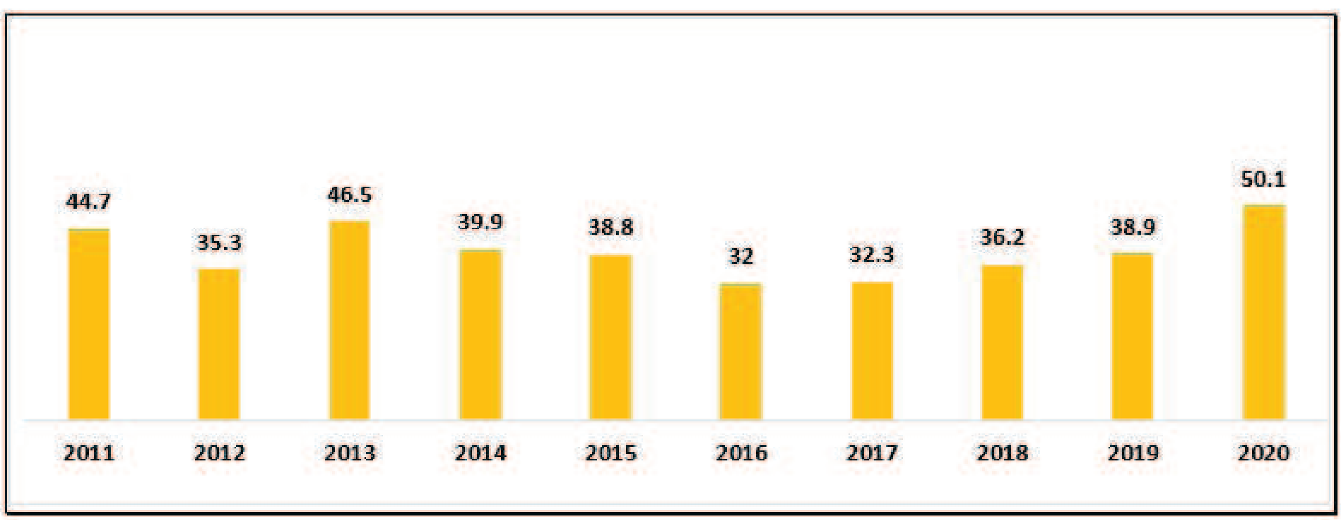

Figure (10) Market Sophistication

Business Sophistication

Figure 11 showed that the general trend of the Business Sophistication inputs sub-index had decreased in 2011-2020. It peaked at 37.8 in 2014, while it was at the bottom at 16.9 in 2019.

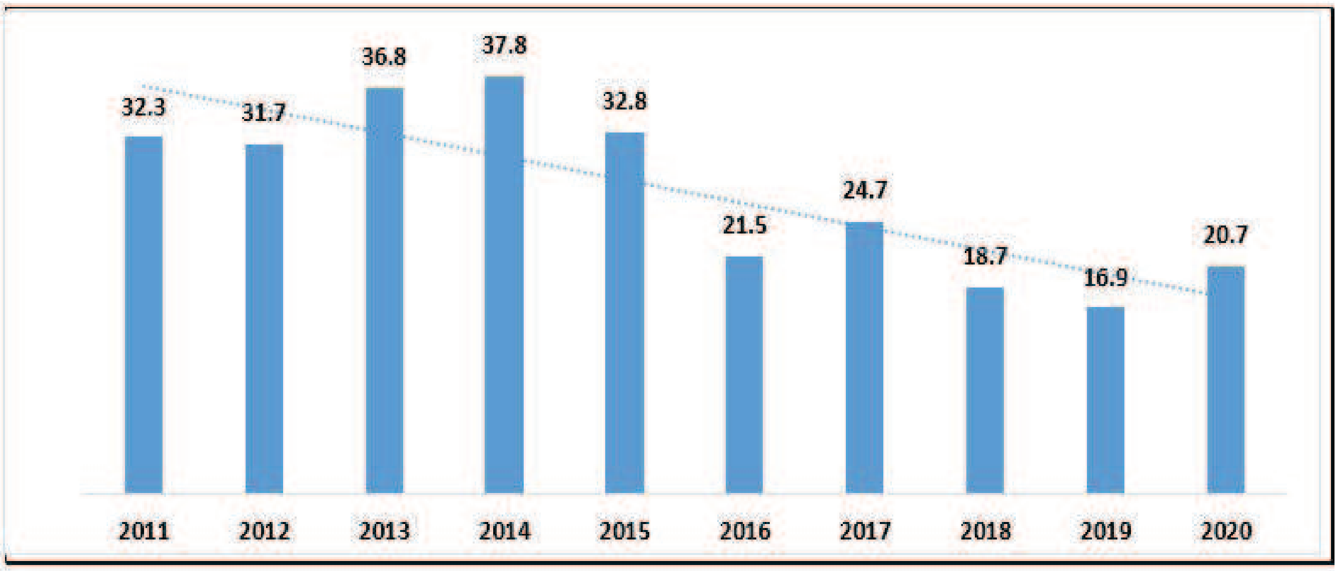

Figure (11)
Business Sophistication

Pearson Correlation Analysis (Innovation Inputs Index & Sub -component)

This part of the research is to detect the relationship between the Innovation (input Index) on the one hand and its five components during the period 2011-2020 on the other hand to highlight the strong positive or negative correlation. Table 3 indicates that the Business Sophistication component is the strongest correlation (r=0.826; sig.0.003), followed by Institution (r=0.741; sig.0.014), then Market Sophistication (r=0.681; sig.0.03), while infrastructure showed a negative correlation (r= -0.899; P< 0.001).

Table (3):
The Correlation between Innovation Input Index with Five Sub-Components.

	R	P value
Institution	0.741*	0.014
Human Capital & Research	0.632*	0.05
Infrastructure	-0.899**	0.000
Market Sophistication	0.681*	0.030
Business Sophistication	0.826**	0.003

*Correlation is Significant at the 0.05
**Correlation is Significant at the 0.01

Jordan Innovation Outputs Sub-Index (2011-2020)

The components of the innovation outputs sub-index are Knowledge and Technology and Creative. In spite of the Creative index being higher than the Knowledge and Technology during the period 2011-2020, the general trend index for both decreased during the same period. The gap became narrow during the period mentioned above, from 26.8 points in 2011 to 1.9 points in 2020, as it is shown in Figure 12.

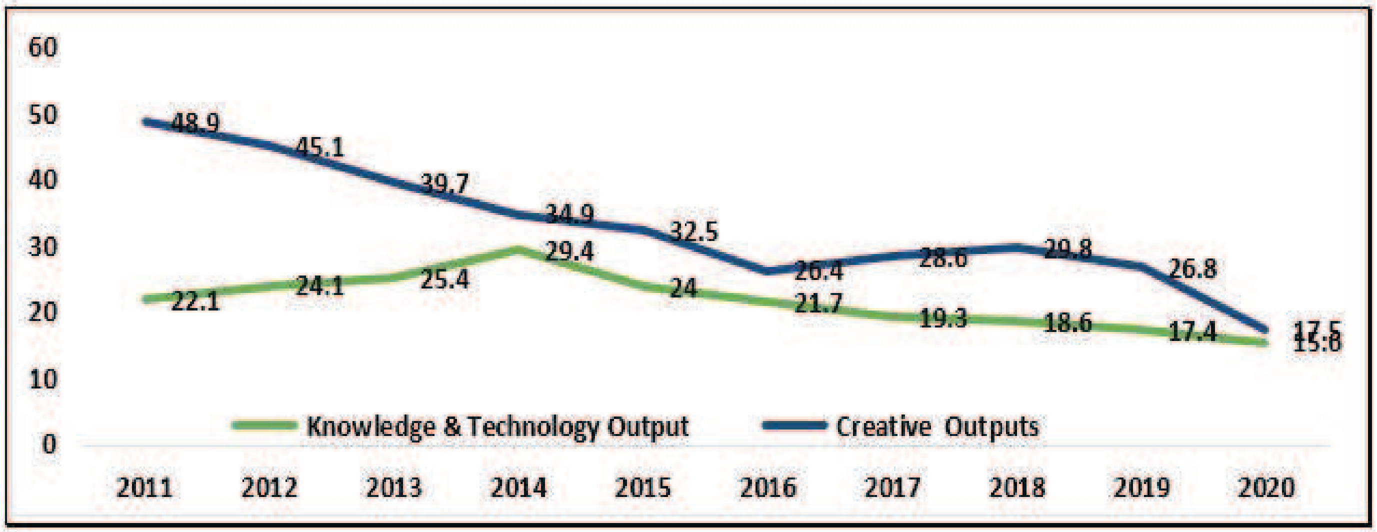

Figure (12)

Jordan Innovation Outputs Sub-Index (2011-2020)

Pearson Correlation Analysis (Innovation Output Index & Sub-Components)

This part detects the relationship between the Innovation output Index and its two components during the period 2011-2020 to highlight the strong positive or negative correlation. Table 4 indicates that "Creative" Outputs component is the strongest correlation (r= 0.965; P< 0.001) while Knowledge and Technology Output showed less level of correlation (r= 0.798; sig.0.006).

Table (4):

The Correlation between Innovation Output Index & Sub with Two Sub-Components.

	r	P value
Knowledge & Technology Output	.798**	.006
Creative Outputs	.965**	.00
**Correlation is significant at the 0.01		

Pearson Correlation Between General Innovation Index & Industrial Manufacturing Production Index

This part detects the relationship between the General Innovation Index (GII) and the Manufacturing Industry sector in Jordan during the period 2011-2020 to highlight the strong positive correlation.

According to Table 5, the results show that the correlation between the whole Manufacturing Industry and its Industrial Production Index was positive and strong (r=0.902; P<0.001). In addition, the correlation of Manufacturing Industry sector component, Activities, indicates that Manufacture of computer, electronic and optical products had the strongest level of correlation which reach about r= 0.97; P< 0.001, followed by Manufacture of food products which had a strong correlation of r= 0.949; P< 0.001. Moreover, results also show that two other industrial activity Manufacture of basic metals and Manufacture of other fabricated metal products n.e.c., have achieved the same correlation value (r= 0.94; P< 0.001).

Table (5):

The Correlation between Innovation Index & Industrial Production Index

Industry	R	P value
Whole Manufacturing Industry	.902**	.000
Manufacture of food products	.949**	.000
Manufacture of paper and paper products	.84**	.002
Manufacture of basic metals	.94**	.000
Manufacture of basic precious & other non-ferrous meta	.89**	.001
Manufacture of computer, electronic and optical Pro.	.97**	.000
Manufacture of electrical equipment	.831**	.003
Manufacture of batteries and accumulators	.843**	.002
Manufacture of electric wires and cables	0.88**	0.001

Industry	R	P value
Manufacture of other fabricated metal products n.e.c.	.94**	.000
Manufacture of coke and refined petroleum products	.88**	.001
*Correlation is Significant at the 0.05 **Correlation is Significant at the 0.01		

Regression Analysis: Estimation of the Impact of sub-inputs and outputs Innovation Index on Manufacturing Industries.

This part of the study aims to estimate the effects of the sub-inputs and outputs Innovation Index (Independent variables) on Manufacturing Industries as a whole sector (Dependent Variable). Furthermore, some (Main) manufacturing industries are selected separately using the "Cobb–Douglas" model as follows:

$Q = f(i, O)$

$Ln(Q) = (\beta o) + (\beta 1) Log(i) + (\beta 2) Log(o)$

Where:

Q: Industrial Manufacturing Production Index (2010=100)

i: Innovation Input Sub -Index

O: Innovation Output Sub -Index

The basic results about the regression model are summarized in Table 6, which equation indicates the following:

Equation No. 1 explained that the Sub-output (independent variable) had i at a significant effect on the whole Manufacturing Industry ($R^2 = 0.97$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 2 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of food products ($R^2 = 0.92$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 3 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of paper and paper products ($R^2 = 0.66$; $P< 0.05$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 5 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of basic precious and other non-ferrous metals ($R^2 = 0.84$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 6 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of computer, electronic and optical products ($R^2 = 0.91$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 7 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of electrical equipment ($R^2 = 0.76$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 8 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of batteries and accumulators ($R^2 = 0.84$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 9 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of electric wires and cables ($R^2 = 0.73$; $P< 0.01$), while the Sub-input (independent variable) is not a statistically significant.

Equation No. 10 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of other fabricated metal products n.e.c ($R^2 = 0.88$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Equation No. 11 explained that Sub-output (independent variable) had i at a significant effect on Manufacture of coke and refined petroleum products ($R^2 = 0.86$; $P< 0.01$), while the Sub-input (independent variable) is not statistically significant.

Table (6):
Regression Results

Equation No.	Industry	Cobb – Douglas Model	Input Sub	Output Sub	R^2	F
1	Whole Manufacturing Industry	$Q = 49.9 * i^{-0.29} * O^{0.42}$	-.32 (-.95)	.56 **(7.7)	.92	24
2	Manufacture of food products	$Q = 0.63 * i^{0.41} * O^{1.05}$	.41 (.56)	1.05 **(6.7)	.92	40
3	Manufacture of paper and paper products	$Q = 1.66 * i^{0.72} * O^{0.43}$	.72 (.8)	.43 *(2.3)	.66	6.8
4	Manufacture of basic metals	$Q = 0.87 * i^{0.42} * O^{0.92}$	.42 (.56)	.92 **(6.07)	.88	34.6
5	Manufacture of basic precious and other non-ferrous metals	$Q = 2.15 * i^{0.04} * O^{1.047}$	.04 (.042)	1.047 **(4.7)	.84	18.3
6	Manufacture of computer, electronic and optical products	$Q = 0.0000014 * i^{2.8} * O^{1.92}$	2.8 (1.704)	1.92 **(5.4)	.91	36.8
7	Manufacture of electrical equipment	$Q = 11.35 * i^{-0.13} * O^{2.04}$	-.13 (-.57)	2.04 **(4.04)	.76	11.4
8	Manufacture of batteries and accumulators	$Q = 365 * i^{-0.42} * O^{4.03}$	-4.2 (-1.2)	4.03 **(5.4)	.84	18.9
9	Manufacture of electric wires and cables	$Q = 0.013 * i^{1.01} * O^{1.37}$	1.01 (.48)	1.37 **(3.04)	.73	9.4
10	Manufacture of other fabricated metal products n.e.c.	$Q = 0.02 * i^{1..38} * O^{0.94}$	1.38 (1.44)	.94 **(4.56)	.88	25.9
11	Manufacture of coke and refined petroleum products	$Q = 18.72 * i^{-0.39} * O^{0.88}$	-.39 (-.51)	.88 **(5.4)	.86	21.7

* Significant at the .05
** Significant at the .01

Conclusions & Recommendations

Results showed the weakness of Jordan Innovation due to the following indicators:

Jordan (GII) ranks are 9, 9, 8, which is behind many Arab countries in 2018, 2019, 2020, respectively, and the Innovation Efficacy Index shows that Jordan ranks 9 among Arab countries as well.

A decrease of Jordan’s Global Innovation Index general trend and Innovation Efficiency Index during 2011-2020.

A decrease in Human Capital and Research and Business Sophistication which both are Innovation sub- input Index in Jordan during the period 2011-2020.

A sharp decrease of the Innovation output Index as a trend during the period 2011- 2020 in Jordan, which contains two components Knowledge and Technology and Creativity.

Results indicate a high and positive correlation between Innovation Inputs Index and its sub – 4 components. However, results indicate a negative correlation for the Infrastructure component. Moreover, in the same period (2011-2020), results also indicate a high and positive correlation between the Innovation outputs Index and Its sub – 2 components.

One of the significant results indicates a high and positive correlation between the Jordan Innovation index and Manufacturing Industrial production index in Jordan during 2011-2020.

The Regression Analysis results showed that Innovation Input Index (independent valuable) was mostly not significant on Production. Therefore, the Innovation Input index cannot be satisfactorily explained to affect industrial production. More research is recommended in this issue, considering the results of the Bulgaria case in the study prepared by Jankowska et al. (2017) and Franco and Oliveira (2017). The Innovation output Index in this study was significant as independent valuable logically match the results of the study prepared by Nevezhin et al. (2019). The Global Innovation Index (explained factor) and all explanatory factors were examined; the most significant were "creative activity" and "science and technology," where both are considered as an Innovation output index.

The elasticity was high and more than one for many Manufacturing Industries in this study. This means that an increase in Innovation (Output Index) by 1%, will increase productivity by more than 1%. Results showed that the highest Industries' elasticity for Output Index is as follow: manufacture of batteries and accumulator, manufacture of electrical equipment, manufacture of computer, electronic and optical products, manufacture of electric wires and cables, which elasticity was 4.03, 2.04, 1.92 and 1.37, respectively to the above industries.

It is recommended that private and public sectors participate in the study to promote Innovation output components: Knowledge and Technology and Creative, which can play a vital role in enhancing productivity in manufacturing industries in Jordan. Furthermore, more in-depth studies (Cause-Effect) are recommended to investigate and detect the effects of the Innovation input component on Innovation output considering various expected factors in Jordan economies as well as taking into account the outcome of the study prepared by Al-Zu'be et al. (2019). This indicated quality of industrial products (High -Tech) in Jordan is relatively low compared to similar Arab countries in the region.

References

- Araújo, N. Costa, L. The productivity of innovation in Portugal (2013), Centre of Portuguese Thought Studies, the international Journal of management science and information technology, North American institute of science and information technology (NAISIT), toronto, Canada.
- Becchetti, L.,and Trovato, G. 2002. The determinant of growth for small and medium sized firms; The role of the availability of external finance. Small Business Economics ,19(4).
- Birkinshaw, J., Hamel, G. & Mol, M. J. (2008). Management innovation. The Academy of Management, 825-845.
- Center for Statistic Studies, Deutsche Zusammenarbeit, Jordan Enterprise Development Corporation (2019/2020). Global Entrepreneurship Monitor (GEM), Jordan National Report.
- Colovko, E. and Valentini, G. Exploring the complementary between innovation and export for SMEs' growth, Journal of International Business Studies (2011) 42.
- Damanpour, F. & Aravind, D. (2012). Managerial innovation: Conceptions, processes, and antecedents. Management and Organizational Review, 8 (2), 423-454.
- Department of Statistics (DoS), Jordan. www. http://dosweb.dos.gov.jo/ar/
- Franco, C.& Oliveira, R. (2017), Inputs and Outputs of innovation: Analysis of the BRICS Theme 6 - Innovation technology and competitiveness, Innovation and Management Review (IMR), Brazil.
- Hamel, G. (2007). Future of management. Boston: Harvard Business School Press.
- INSEAD, & WIPO. (2014). The Global Innovation Index 2014.Geneva: The Human Factor in Innovation. Cornell University.

- Jacques Lan, 2006 - Mathematics for Economics and Business, fifth edition, Prentice-Hall.
- Jankowska, B. Matysek-Jedrych, A. Mroczek-Dabrowska, K. (2017), Efficiency of National Innovation Systems – Poland and Bulgaria in the Context of Global Innovation Index. Comparative economic research, Vol. 20, No. 3. Lodz university, Poland.
- Janoskova, K. Kral, P. (2019), An in-depth analysis of summary innovation index in the V4 countries, Journal of competitiveness, Vol. 11 (2), P: 68-83. Zilina University, Slovak Republic.
- Jedco, 2020, Jordan Enterprise Development Corporation, SME's Observatory department.
- Lu, J., & Beamish, P. 2001. International and performance of SMEs, Strategic Management Journal, 22(6l7).
- Nevezhin,Viktor P. Anastasia V. Zhiglyaeva. Valery V . Smirnov and Natalya K. Muravitskaya (2019), Econometric Models for Forecasting Innovative Development of the Country, Journal of reviews on global economics, Vol. 8, P: 797-775.
- Simonov, A. Tarasova, I. Vinogradova, N. Stepnov, A. and Fomenko, O. (2020), Correlational Study between the indicators of innovation activity and agricultural production in Russian regions. Conferences 176, 05017.
- Tellis, G. J., Eisingerich, A. B., Chandy, R. K., & Prabhu, J. C. (2008). Competing for the future: Patterns in the global location of R&D centers b the world`s largest firms. ISBM report. University Park, Institute for the study of Business Markets.
- Yasuda, T. (2005) Firm growth, size, age and behavior in Japanese manufacturing. Small Business Economics, 24(1).

المراجع العربية

– جوهرة، أقطفي، رحال، سلاف، بن عبيد، فريد (2019)، تحليل مؤشرات الابتكار كركيزة لتبني اقتصاد المعرفة في الجزائر، مجلة التنمية والاقتصاد التطبيقي، المجلد(3)، العدد (1)، جامعة المسيلة، الجزائر.

– رولامي، عبد الحميد، فراح، ليلى، بياضي، صفاء (2018) واقع الابتكار الحكومي في الدول العربية وسبل تطويره، تجربة الجزائر، الإمارات والمغرب. مجلة اقتصاديات المال ولأعمال، العدد (7). معهد العلوم الاقتصادية والتجارية وعلوم التيسيير، المركز الجامعي عبد الحفيظ بوالصوف، ميلة، الجزائر.

– الزعبي، بشار، شموط، أمين ، الفاعوري، رغدة (2019)، استخدام دالة (كوب – دوغلاس) في قياس أثر الصادرات والضرائب غير المباشرة على فرص العمل المستحدثة لقطاع الصناعات التحويلية في الأردن، المعهد العربي للتدريب والبحوث الإحصائية، مجلة العلوم الإحصائية ، العدد (9).

المراجع المترجمة

- Jawhara, A., Rahal, S., & Ben Obeid, F. (2019). Analysis of Innovation Indicators as a Pillar for Adopting a Knowledge Economy in Algeria. Journal of Development and Applied Economics, Vol. (3), No. (1), University of M'sila, Algeria.
- Roulami, A., Farrah, L., & Bayadi, S. (2018). The Reality of Government Innovation in The Arab Countries and Ways to Develop It (The Experience of Algeria, UAE, And Morocco). Journal of Financial and Business Economics, No. (7). Institute of Economic, Commercial and Facilitation Sciences, University Center Abdelhafid Boualsoof, Mila, Algeria.
- Al- Zu'bi B.A, Shammout A.O & Alfaouri R. (2019). "Using Cobb-Douglas function to Measure the Impact of Exports and Indirect Taxes on the Jobs Creation of the Manufacturing Industrial Sector in Jordan. Journal of Statistical Science, AITRS, Vol. No (9).