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An investigation of the mutual impact of technological readiness and innovation in global competitiveness field

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Abstract: Today, in global economy, competitiveness is a critical criterion to evaluate the degree of success of countries in political, economic and commercial competitive contexts that its determinants are very complex. The purpose of this study is to investigate the mutual impact of technological readiness and innovation in global competitiveness field in the total countries of the global economy. The statistical population is based on 140 countries reported in 2016-2017 by World Economic Forum. This research is practical and its methodology is "secondary analysis" and is "descriptive-analytical". The time horizon of survey in this research is "cross-sectional" and a "focal correlation analysis" method was used to answer the research questions and among the correlation methods "correlation matrix analysis" was used. The findings show that in "conventional correlation analysis", there is a positive and significant relationship between the indicators of "technological readiness" and "innovation". At the end, it is concluded that the development and improvement of "technological readiness of a country" will enhance the "innovation" among the countries of the world and in this study, because of using the report of World Economic Forum, it can be said that this research has high generalizability and accuracy.

Keywords: Technological Readiness, Innovation, Global Competitiveness

1. Introduction

In the era of globalization, economic competition among countries and economic firms has been intensified globally (Schwab & Porter, 2008). In the literature of strategic management, Michel Porter pointed to the competitiveness of nations in addition to the competitiveness of firms and the role of policy making and state laws in this field (Porter, 1990). Countries and firms and industrial organizations have been admitted the relationship between innovation and economic success. The development of technology allows innovation to move in the forefront of the market. Therefore, in global competition, the application of technology is one of the key factors of success. On the other hand, technology is the reason of creating wealth. More effective use of technology affects the conditions of competition greatly (Khalil, 1999) and the process of innovation requires integration of technology and available inventions to create product (Jain & Triandis, 1990).

In global economy, competitiveness means the possibility to obtain appropriate and sustainable situation in international markets and this concept is considered when there is a good place in the world markets for the products of the country (Karimi Hastiche, 2007). Over the years, economic theorists have been trying to find out what determines the nations' wealth. Financial markets are just one of the elements of national competitiveness (Schwab & Porter, 2008). Global Competitiveness Index achieves the endless dimension of competitiveness by providing a weight average of various

factors. These factors are grouped into 12 competitiveness elements (Schwab, 2011), that in this study, the mutual impact of only two elements of technological readiness and innovation is compared. Technological readiness element evaluates the agility of an economy in improving the productivity of its industries by applying available technologies (Schwab, 2011) and technological innovation element refers to the creation of a concept, combination or a specific knowledge that is hardly repeated by competitors (Xin, 2011).

According to the report of World Economic Forum, in 2016-2017, the rank of Iran in world competitiveness is 74 (with 9 steps ascent); whereas, it has still inappropriate place among 140 countries in the field of technological readiness and innovation that in technological readiness element, the rank is 99 (with 8 steps ascent). Also, according to the study of Vares et al. (2011), it seems that technological readiness in the countries of the world can help their innovations or it seems that the innovation of the countries has a direct impact on their technological readiness (Vares et al, 2011). Therefore, in this study, the mutual impact of technological readiness and innovation in global competitiveness field was investigated based on the report of World Economic Forum in 2016-2017 that will help many countries including Iran to find a good pattern for technological readiness in order to obtain innovation in global context and finally the relationships of the variables are presented based on a conceptual model:

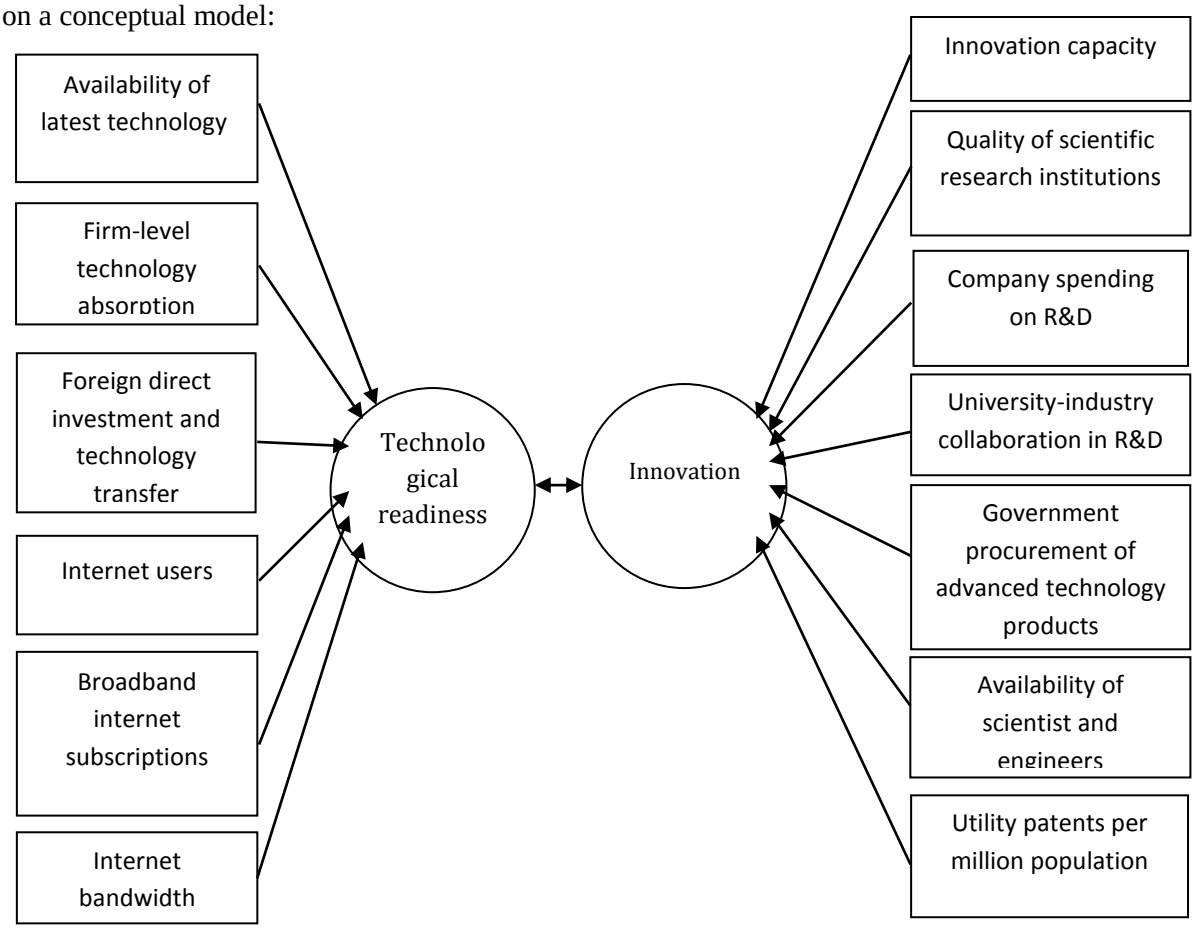

Figure 1- Suggested conceptual model framework of research

2- Research Background and Hypotheses

Over the years, economic theorists have been trying to find out what determines the wealth of nations. Thousands economic studies and researchers show that financial markets is one of the elements of national competitiveness (Schwan & Porter, 2008). Competitiveness is a critical criterion to evaluate the degree of success of countries in political, economic and commercial competition contexts. This

means that each country, region or firm that has high competitive ability, it can be said that it has high competitiveness (Dadashpour & Ahmadi, 2010).

The concept of competitiveness includes stable and variable elements: as the productivity of a country determines the ability of that country to achieve and maintain high income and it also determines the capital returns; it is a key factor which determines the potential of economic growth (Vares et al., 2011). Since 1979, the annual reports of global competitiveness provided by World Economic Forum, investigate many factors which help to achieve stable economic growth and long-term improvements. During the years, the purpose of this economic forum is to provide benchmarking tools for leaders and policy makers of business in order to identify the barriers of competitiveness improvement and motivate and increase the topics related to the strategies which help to eliminate those barriers.

Main factors and determining foundations of competitiveness refer to the amount of domestic products and national per capita (Porter & Schwab, 2008). The model that was used in this study has been suggested by Mike Porter and Charles Schwab which was published by World Economic Forum. In this model, global competitiveness index is grouped into 12 competitiveness elements which include: 1. Institutions, 2. Infrastructure, 3. Macroeconomic stability, 4. Health and primary education, 5. Higher education and training, 6. Goods market efficiency, 7. Labor market efficiency, 8. Financial market development, 9. Technological readiness, 10. Market size, 11. Business sophistication and 12. Innovation (Schwab, 2010). Among these elements 9^{th} and 12^{th} elements are included in this research.

Technology means the use of tools and methods, development, and the use of devices, machinery and techniques for service and manufacturing processes (Encarta, 2009). Burgelman et al. (2004) defines technology as a practical and theoretical knowledge, skills and artificial that can be used to develop products and services as well as production systems and their delivery.

Christensen and Raynor (2003) define technology as a process in which each company uses labor, material, capital, energy and process that converts input data to more valuable output. Porter claims that technological changes are one of the main motivators of competition. Technological level is a big equalizer that reduces the competitive advantage in some of the companies and moves some others forward. On Porter's opinion, among the factors that can change the competition rules, technological changes is the main factor (Smith & Sharif, 2007).

In today's globalized world, technology has been changed to an essential component for competition and development of companies. Technological readiness element represents the agility of economics in attracting available technologies to enhance the productivity of their industries, and it has a specific emphasize on the capacity of countries' economy to apply information technology and communications in every day's activities and productive processes in order to achieve productivity and competitiveness. Therefore, availability of information technology and communications and its usage are essential components of technological readiness. The important point is that active companies in the country must access to advanced products and their usage capability. Among main resources of foreign technology, foreign direct investment has a key role. It is important to point out that accessible technology level for the firms of a country must be distinguished from the capability of that country for innovation and expanding the boundaries of knowledge. The dimensions of "technological readiness" element based on the world competitiveness report include: 1. Availability of latest technologies, 2. Firm-level technology absorption, and 3. foreign direct investment (FDI) and technology transfer, 4. Internet users, 5. Broadband internet subscription and 6. Internet bandwidth (Schwab, 2011). According to the published report of global competitiveness (2016-2017) by World Economic Forum, Luxembourg is the best country and the rank of Iran is 99. In fixed subscription of internet, the rank of Iran is 70 (the best) and in the variable of technology absorption by firms, its rank is 132 (the worst). It is also obvious that the situation of our country is inappropriate in the variable which is related to firms. The last element is innovation competitiveness. Although it is possible to achieve significant and basic benefits by improving institutions, creating enterprise infrastructures, reducing instability or improving human capital, but it seems that finally all of these factors will be saturated (Janatifard et al., 2010).

Peter Droker considers innovation like each objective activity besides talent which requires knowledge, attention and hard work of all stakeholders. Innovation is a set of process of discovering, inventing, improving product, creating and improving the process and organizational changes as well as releasing and updating these processes (Organization for Economic Co-operation and Development, 1993).

Innovation is one of the most important dimensions of national competitiveness for countries. Although it is possible to obtain significant and high incomes by improving institutions, creating infrastructures, reducing instability of macroeconomics, or improving human capital; but all of these factors ultimately deal with descending returns. This issue is also true for the productivity of labor markets, financial markets and goods markets. In a long time, living standards can be developed only by technological innovation (Schwab & Porter, 2008). According to the published report of global competitiveness by World Economic Forum, the dimensions of innovation element include: 1. Capacity for innovation, 2. Quality of scientific research institutions, 3. Company spending on R&D, 4. University-industry collaboration in R&D, 5. Government procurement of advanced technology products, 6. Availability of scientists and engineers, and 7. Utility patents per million population (Schwab, 2011). According to the published report of global competitiveness (2016-2017) by World Economic Forum, the rank of Iran in this indicator is 90, and the first rand belongs to Swiss. In the variable of availability of scientist and engineers, the rank of Iran is 43 (the best) and in the variable of firms' development, its rank is 105 (the worst).

Razavi et al. (2011), in an international paper, investigated the mutual relationships between "technological readiness" and "innovation" in global competitiveness using the conventional correlation analysis. The findings of this paper suggest that there is a significant relationship between the set of technological readiness indicators and the set of innovation, and the two sets have positive impact on each other.

With the aim of investigating global competitiveness indicators, Vares et al. concluded that how an efficiency-driven economy can be achieved to an innovation-driven economy and they found out that in order to go through a country with second-level economy of economic development towards a country with third-level economy of economic development, the most influential factors are technological readiness and innovation (Vares et al., 2011).

Duggal et al., with the aim of examining the relationship between infrastructure and productivity concluded that the most effective factors are technological readiness and innovation, and they declared that the rate of technology growth has been considered as a non-linear function of private and state infrastructure (Duggal et al., 2007).

In an international paper, Torres-Fuchslocher (2010) investigates the understanding of technology development on suppliers in the resources based on developing economics.

Aiming to investigate the effect of technology improvements on business researches and marketing strategy, Rust and Espinoza concluded that technology has a big influence on business researches and specially on marketing and they claimed that technological development leads to the enhancement of the influence of information technology that will help to provide the growth of services and communications importance in economy (Rust & Espinoza, 2006).

In his article, Kamijani investigates the mutual relationship between financial market development and innovation in national competitiveness using conventional correlation analysis method (Kamijani, 2011).

According to the above explanations, the hypothesis of this research is:

H_1: There is a positive significant relationship between technological readiness and innovation among the countries of the world.

3- Methodology

Jandivi considers research as a process of regular search to identify a position (Sarmad, 2004). The present study was done in two stages. Since in the first stage, the mutual relationship of technological readiness and innovation in global competitiveness is investigated and the investigation of these elements improves our knowledge and understanding of the relationship between the two concepts, so

in this stage, in terms of orientation, our research is developmental. In the second stage, we seek to apply the findings obtained from the first stage in order to improve the national competitiveness in Iran, and then in terms of purpose, this study is practical.

3-1 Sample

The intended population of this research is all the countries or in other words all the nations of the world. But in the report of global competitiveness in 2016 that is the resource of data collection in this research, only the data of 140 countries of the world is available, so the intended population which really exists is 140 countries of all over the world that their data are available in the report of global competitiveness in 2016-2017. Also because the data of the whole members of intended population have been used, the total population was aimed.

3-2 Data and Measurement Scale

This research is done in the form of library and local studies. Thus, firstly, by studying the literature, the backgrounds of the study and the theories about the concepts of competitiveness, technological readiness, innovation and focal correlation technique are investigated. To collect the data of global competitiveness, the data of report of global competitiveness (belonged to World Economic Forum) in 2016-2017 was used that the data about 140 countries of the world was available and the data of Iran was also included in this report.

3-3 Validity of the Research

The term validity refers to the purpose for which research was done to achieve it. Actually, the validity of an evaluation is the adequacy and appropriateness of interpretations and uses of the measurement results (Danaeifard et al. 2008). The validity of global competitiveness indicator belonging to World Economic Forum was previously evaluated and confirmed by researchers and statisticians and econometricians in "the Unit of Econometrics and Applied Statistics at the European Commission Joint Research Centre". These researchers compared 1200 runs by Monte Carlo simulation, that each run was responsible for different weights set of three main sub-indicators if this indicator. The main result obtained of this investigation shows the calculated intervals at 90% confidence level (Schwab, 2010).

3-4 Reliability of the Research

The reliability of each elements of competitiveness was measured too. Each time, zero weight was given to one of the elements, and then the obtained score of total indicator was calculated. Based on the results of this evaluation, the impact of each element on the total indicator of competitiveness is moderate. By changing the weight of each element, 75% of countries ascent 5 steps above the ranking table and it means that all 12 elements influence on the total score of global competitiveness (Schwab, 2010).

3-5 Analysis Method

In this study, each of the research questions is tested by using the information gathered from mentioned resources. Spearman correlation and conventional correlation analysis are used to estimate the relationship between two elements of technological readiness and innovation in global competitiveness. Mostly, conventional correlation is a suitable method to identify the relationship between the set of variables in which a set is called independent (or predictive) and the other is called dependent (or criterion). SAS and STATISTICA software were used for this analysis.

3-5-1 Correlation Coefficient

In this research, considering that the data is ranked (rank of counties is in the report), Spearman correlation coefficient using STATISTICA 7 software is used to test first, second and third sub-hypotheses of the research. These hypotheses consider internal correlation measurement of indicators of technological readiness and innovation in the set of national competitiveness.

3-5-2 Focal Correlation Analysis Method

Focal correlation analysis can be considered as a kind of multi-variable regression generalization; because the relationship of a dependent variable with a number of independent variables is measured, while in conventional correlation method the relation of a number of dependent variables with a number of independent variables is measured. The input of this method should be the variables' values

of two groups for various observations that their measurement scale will necessarily be metric. Mostly, conventional correlation is a suitable method to identify the relationship between two sets of variables in which a set is called independent (or predictive) and the other is called dependent (or criterion). Therefore, the purpose of this analysis is determining the impacts of the set of predictive variables on criterion variables. The aim of conventional correlation is obtaining linear combination of predictive variables that has the highest correlation with linear combination of criterion variables. Meanwhile, in order to obtain the reliability in conventional correlation analysis, sensitivity analysis was done on independent variables. In a way that each time one of the variables of the set of technological readiness is omitted and the conventional correlation analysis was done again, that in each time, no prominent change was occurred in the value of structural coefficients of other variables, thus the reliability of data was confirmed.

4. Findings

Using statistical tests related to research method and the type of variables which was previously explained, the mutual impact between technological readiness and innovation in global competitiveness field was investigated based on the report of World Economic Forum in 2016-2017, that its results will help different countries including Iran to achieve appropriate pattern for technological readiness in order to obtain innovation in global competitiveness.

4-1 Descriptive Analysis

In this part, STATISTICA software was used to calculate the correlation of two elements of technological readiness and innovation, and internal variables of technological readiness, and internal variables of innovation, thus first, second and third sub-questions are answered. Then using SAS software with conventional correlation analysis method, the amount of conventional correlation between two intended elements is calculated. In addition, to calculate the total predicted value, STATISTICA software is used that in this part, main question of the research and fourth and fifth sub-questions are answered. Since the research hypotheses correspond to some research questions, so the hypotheses corresponding to each question will be tested at the same time. Ultimately, in order to obtain validity of conventional correlation analysis, sensitivity analysis was done for independent variables (technological readiness). In continue research questions and hypotheses will be reviewed:

4-1-1 Main Research Question

Is there a positive significant relationship between the set of technological readiness and the set of innovation among the countries of the world?

4-1-2 Sub-questions for the relationships between indicators

Sub-question 1: Is there a positive correlation between the indicators of technological readiness set and indicators of innovation set among the countries of the world?

Sub-question 2: How are the relationships among the indicators of technological readiness set with each other?

Sub-question 3: How are the relationships among the indicators of innovation set with each other?

4-1-3 Sub-questions for identifying the importance of indicators in creating the relationship between sets

Sub-question 4: Among the indicators of technological readiness set, which indicators have the highest influence and which ones have the lowest influence on creating the significant relationship between two technological readiness set and innovation set?

Sub-question 5: Among the indicators of innovation, which indicators have the highest influence and which ones have the lowest influence on creating the significant relationship between two technological readiness set and innovation set?

4-1-4 an Investigation of the Research Hypotheses

Main hypotheses of the research are as follows:

Main Hypothesis: There is a positive significant relationship between the element of technological readiness and the element of innovation among the countries of the world.

Sub-hypotheses of the research are as follows:

- ✓ **Sub-hypothesis 1:** There is a positive correlation between the indicators of technological readiness and the indicators of innovation among the countries of the world.
- ✓ **Sub-hypothesis 2:** There is a positive correlation between the indicators of technological readiness.
- ✓ **Sub-hypothesis 3:** There is a positive correlation between the indicators of innovation.

4-2 Inferential Analysis

4-2-1 Interpretation of Correlation Coefficients between the Indicators of Technological Readiness and Innovation

To answer sub-question 1 and its corresponding hypothesis (sub-hypothesis 1), Pearson correlation coefficients between the indicators of technological readiness and innovation are interpreted. According to the output of STATISTICA, as it is shown in table (1-4);

Table (1-4): Correlation coefficient between variables of technological readiness and innovation

Variables	**Case studies in Pearson correlation test**	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	Utility patents per million population
Availability of latest technology	Correlation coefficients	.758**	**.802****	.739**	**.827****	.636**	.681**	.528**
	Mutual significant level	.000	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142	142
Firm-level technology absorption	Correlation coefficient	**.766****	**.783****	**.783****	**.819****	.696**	.709**	.575**
	Mutual significant level	.000	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142	142
Foreign direct investment and technology transfer	Correlation coefficient	.420**	.528**	.462**	.548**	.634**	.457**	.195*
	Mutual significant level	.000	.000	.000	.000	.000	.000	.020
	Sample volume	142	142	142	142	142	142	142
Internet users	Correlation coefficient	.747**	.747**	.682**	.732**	.487**	.630**	.562**
	Mutual significant level	.000	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142	142
Broadband internet subscription	Correlation coefficient	.772**	.772**	.717**	.752**	.435**	.628**	.649**
	Mutual significant level	.000	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142	142

Internet bandwidth	Correlation coefficient	.460**	.459**	.440**	.479**	.294**	.380**	.339**
	Mutual significant level	.000	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142	142

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

According to table (1-4), the results of Pearson correlation method show that there is strong correlation among most of the indicators of the two technological readiness and innovation elements; therefore, sub-hypothesis 1 is accepted. Also, the most correlations among the indicators of technological readiness and innovation are related to following factors:

- ✓ "Availability of latest technology" and "University-industry collaboration in R&D" with correlation coefficient of 0/827 at significant level of 99%.
- ✓ "Firm-level technology absorption" and "University-industry collaboration in R&D" with correlation coefficient of 0/819 at significant level of 99%.
- ✓ "Availability of latest technology" and "Quality of scientific research institutions" with correlation coefficient of 0/802 at significant level of 99%.
- ✓ "Firm-level technology absorption" and "University-industry collaboration in R&D" with correlation coefficient of 0/783 at significant level of 99%.
- ✓ "Firm-level technology absorption" and "Company spending on R&D" with correlation coefficient of 0/783 at significant level of 99%.
- ✓ "Firm-level technology absorption" and "Capacity for innovation" with correlation coefficient of 0/766 at significant level of 99%.

Also, the least correlations among the indicators of technological readiness and innovation are related to following factors:

- ✓ "Foreign direct investment and technology transfer" and "Utility patent per million populations" with correlation coefficient of 0/195 at significant level of 99%.
- ✓ "Internet bandwidth" and "Government procurement of advanced technology products" with correlation coefficient of 0/294 at significant level of 99%.
- ✓ "Internet bandwidth" and "Availability of scientists and engineers" with correlation coefficient of 0/380 at significant level of 99%.

4-2-2 Interpretation of Correlation Coefficients between the Indicators of Technological Readiness

To answer sub-question 2 and its corresponding hypothesis (sub-hypothesis 2), Pearson correlation coefficients between the indicators of technological readiness are interpreted. According to the output of STATISTICA, as it is shown in table (2-4);

Table (2-4): Correlation coefficients between the variables of technological readiness

Variables	**Case studies in Pearson correlation test**	Firm-level technology absorption	Foreign direct investment and technology transfer	Internet users	Broadband internet subscription	Internet bandwidth
Availability of latest	Correlation coefficients	**.935****	.618**	**.807****	.783**	.499**

technology	Mutual significant level	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142
Firm-level technology absorption	Correlation coefficient		.648**	.727**	.686**	.459**
	Mutual significant level		.000	.000	.000	.000
	Sample volume		142	142	142	142
Foreign direct investment and technology transfer	Correlation coefficient			.434**	.334**	.194*
	Mutual significant level			.000	.000	.021
	Sample volume			142	142	142
Internet users	Correlation coefficient				**.901****	.512**
	Mutual significant level				.000	.000
	Sample volume				142	142
Broadband internet subscription	Correlation coefficient					.611**
	Mutual significant level					.000
	Sample volume					142

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

According to table (2-4), the results of Pearson correlation method show that there is strong correlation among almost all of the indicators of technological readiness; therefore, sub-hypothesis 2 is accepted. Also, the most correlations among the indicators of technological readiness set are related to following factors:

- ✓ "Availability of latest technology" and "Firm-level technology absorption" with correlation coefficient of 0/935 at significant level of 99%.
- ✓ "Broadband internet subscription" and "Internet users" with correlation coefficient of 0/901 at significant level of 99%.
- ✓ "Availability of latest technology" and "Internet users" with correlation coefficient of 0/807 at significant level of 99%.

Also, the least correlations among the indicators of technological readiness set are related to following factors:

- ✓ "Foreign direct investment and technology transfer" and "Internet bandwidth" and "Availability of scientists and engineers" with correlation coefficient of 0/194 at significant level of 99%.
- ✓ "Foreign direct investment and technology transfer" and "Broadband internet subscription" with correlation coefficient of 0/334 at significant level of 99%.

4-2-3 Interpretation of Correlation Coefficients between the Indicators of Innovation

To answer sub-question 3 and its corresponding hypothesis (sub-hypothesis 3), Pearson correlation coefficients between the internal indicators of innovation are interpreted. According to the output of STATISTICA, as it is shown in table (3-4);

Table (3-4): Correlation coefficients between the variables of technological readiness

Variables	**Case studies in Pearson correlation test**	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	Utility patent per million population
Capacity for innovation	Correlation coefficient	.**900****	.**955****	.890**	.667**	.756**	.721**
	Mutual significant level	.000	.000	.000	.000	.000	.000
	Sample volume	142	142	142	142	142	142
Quality of scientific research institutions	Correlation coefficient		.864**	**.942****	.682**	.772**	.615**
	Mutual significant level		.000	.000	.000	.000	.000
	Sample volume		142	142	142	142	142
Company spending on R&D	Correlation coefficient			.884**	.692**	.747**	.759**
	Mutual significant level			.000	.000	.000	.000
	Sample volume			142	142	142	142
University-industry collaboration in R&D	Correlation coefficient				.719**	.725**	.634**
	Mutual significant level				.000	.000	.000
	Sample volume				142	142	142
Government procurement of advanced technology products	Correlation coefficient					.562**	.411**
	Mutual significant level					.000	.000
	Sample volume					142	142
Availability of scientists and engineers	Correlation coefficient						.573**
	Mutual significant level						.000
	Sample volume						142

**. Correlation is significant at the 0.01 level (2-tailed).

According to table (3-4), the results of Pearson correlation method show that there is strong correlation among all of the indicators of innovation; therefore, sub-hypothesis 3 is accepted. Also, the most correlations among the indicators of innovation set are related to following factors:

- ✓ "Company spending on R&D" and "Capacity for innovation" with correlation coefficient of 0/955 at significant level of 95%.
- ✓ "Quality of scientific research institutions" and "University-industry collaboration in R&D" with correlation coefficient of 0/942 at significant level of 99%.
- ✓ "Quality of scientific research institutions" and "Capacity for innovation" with correlation coefficient of 0/900 at significant level of 99%.

Also, the least correlations among the indicators of innovation set are related to following factors:

- ✓ "Government procurement of advanced technology products" and "Utility patent per million populations" with correlation coefficient of 0/411 at significant level of 99%.
- ✓ "Government procurement of advanced technology products" and "Availability of scientists and engineers" with correlation coefficient of 0/562 at significant level of 99%.

4-2-4 Interpretation of Conventional Correlation between the Elements of Technological Readiness and Innovation

To answer main question of the research and its corresponding hypothesis (main hypothesis of the research), the output of STATISTICA and SAS.9 for the interpretation of conventional correlation between two elements of technological readiness and innovation is shown in table (4-4);

Table (4-4): Summary of conventional correlation between the elements of technological readiness and innovation

Innovation	Technological readiness	N=140
7	6	The number of variables
94.8329%	**100%**	Extracted variance
64.7224%	**57.8517%**	Total prediction
Capacity for innovation	Availability of latest technology	Variables 1
Quality of scientific research institutions	Firm-level technology absorption	2
Company spending on R&D	Foreign direct investment and technology transfer	3
University-industry collaboration in R&D	Internet users	4
Government procurement of advanced technology products	Broadband internet subscription	5
Availability of scientists and engineers	Bandwidth internet	6
Utility patent per million population		7

Table (4-4) shows the rate of covered variance in the data provided by conventional correlation method. The rate of extracted variance in two technological readiness and innovation sets states that conventional roots cover 100% of internal set variance of technological readiness and more than

94.8% of internal element variance of innovation, that in terms of statistics, this rate is significant and confirms the appliance of conventional correlation analysis method.

Table (5-4): Statistical tests table of technological readiness and innovation

Conventional roots	Chi-square Tests With Successive Roots Removed					
	Canonical R	Canonical R^2	Chi-sqr	Df	p	Lambda Prime
0	**0.887987**	**0.788520**	325.1500	42	**0.00000**	0.088346
1	0.648839	0.420992	116.9640	30	**0.00000**	0.417753
2	0.445956	0.198877	43.7411	20	**0.001639**	0.721498
3	0.246480	0.060752	14.0278	12	0.298990	0.900608
4	0.199712	0.039885	5.6292	6	0.465994	0.958861
5	0.036142	0.001306	0.1752	2	0.916149	0.998694

As it is shown in table (5-4), based on the P-value in this study, first, second and third conventional variables are statistically significant (less than 0.05). In addition, statistical tests such as "Lambda" and "K2" confirm this claim too; therefore, main hypothesis of the research is confirmed. Of course, because second and third focal variables have weak structural coefficients and weak prediction indicator, it was not used for the interpretation and according to chart (1-4); only the first conventional variable has been considered. Therefore, to interpret the inputs, according to table (5-4) and chart (1-4), we focus on the parts which are related to first conventional variable. The amount of importance of relationship between technological readiness and innovation sets are identified by conventional correlation (R_c) and specific value (R_c^2). According to table (5-4), conventional correlation of the first conventional variable is 0.8879 and its specific value is 0.7885. Since the conventional correlation (R_c) cannot directly provide the shared variance between two sets, so the prediction indicator is used. Corresponding prediction indicator (R^2) is multiple in regression analysis. Based on table (4-4), prediction indicator shows that the average of the capability of "technological readiness" set for predicting the changes of "innovation" set is more than 64.72%. The above findings pointed out that there is a significant relationship between "technological readiness" and "innovation" and "technological readiness" element has a positive impact on "innovation" element. Also, based on table (4-4), prediction indicator shows that the average of the capability of "innovation" set for predicting the changes of "technological readiness" set is more than 57.85%.

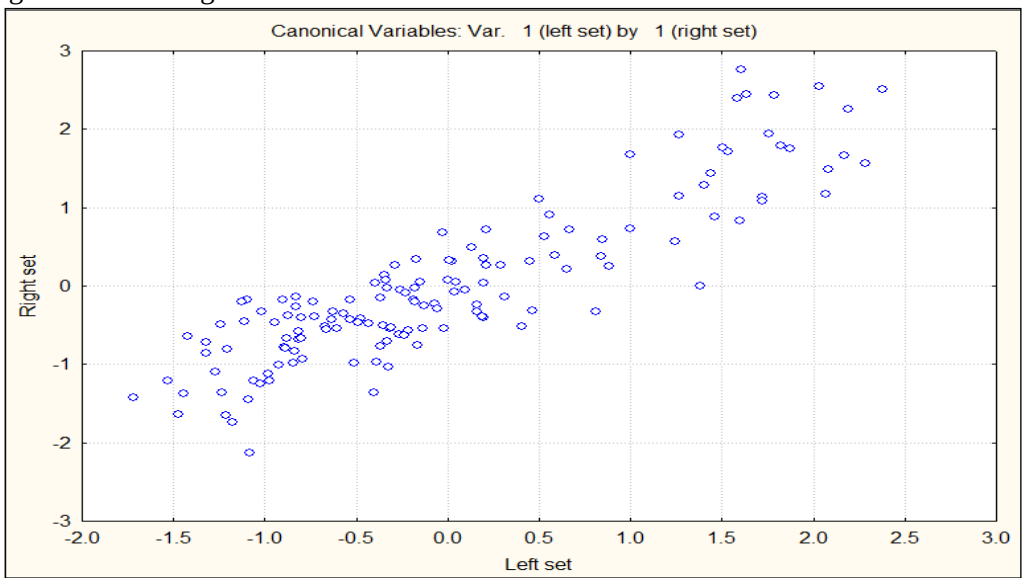

Chart (1-4). Paired correlation between first correlational variables of left side (technological readiness) and right side (innovation)

In continue, to answer sub-questions 4 and 5, structural and inter-structural coefficients for significant conventional variable of technological readiness and innovation elements are analyzed for the first conventional variable (first root).

Table (6-4): structural coefficients for significant coefficient variable of technological readiness and innovation elements

	Structural coefficients of conventional variable 1	Inter-structural coefficients of conventional variable 1	Structural coefficients of conventional variable 2	Inter-structural coefficients of conventional variable 2
Criterion set (innovation)				
Capacity for innovation	0.9426	0.8745	-0.1419	-0.1328
Quality of scientific research institutions	0.9546	08966	0.0116	0.0048
Company spending on R&D	0.9327	0.8559	-0.0136	0.0054
University-industry collaboration in R&D	0.9663	0.9102	0.0971	0.0786
Government procurement of advanced technology products	0.7264	0.5951	0.5427	0.3476
Availability of scientists and engineers	0.8301	0.7236	0.0668	0.0564
Utility patent per million population	0.7561	0.6951	-0.3851	-0.2359
Extracted variance	77.03%		82.06%	
Predictive set (technological readiness)				
Availability of latest technology	0.9263	0.8475	0.1558	0.1244
Firm-level technology absorption	0.9377	0.8820	0.2551	0.2311
Foreign direct investment and technology transfer	0.5852	0.5173	0.7127	0.6278
Internet users	0.5873	0.7721	-0.2099	-0.0832
Broadband internet subscription	0.8878	0.8084	-0.3658	-0.2903
Bandwidth internet	0.5377	0.4532	-0.0794	0.0054
Extracted variance	64.87%		13.02%	
Focal coefficient	0.8879		0.6488	
Prediction indicator for the first conventional variable	60.74%		2.87%	

According to table (6-4), it is shown that all the dimensions of two sets have high inter-structural coefficients and then they are very important in the creating a significant relationship. Also, based on the high value of structural coefficients of the variables of two sets, it can be concluded that the

variables of technological readiness element have high impacts and correlation on the variables of innovation element.

Answer the sub-question (4):
Among the variables of technology readiness, the dimensions of firm-level technology absorption and availability of latest technology have respectively the highest role; and the variable of bandwidth internet has less importance than other variables in creating a significant relationship between two sets.

Answer the sub-question (5):
Also, among the variables of innovation, the variables of university-industry collaboration in R&D, quality of scientific research institutions and capacity for innovation have respectively the highest role and importance; and the variable of government procurement of advanced technology products has less importance than other variables in creating a significant relationship between two above elements.

5- Discussion, Conclusion and Recommendations
The limitations of time and location in all the researches of human and social sciences fields generally and in technology management field specifically has made significant differences in research findings despite available similarities in the variables and method. Accordingly, at first it is necessary that according to time and place conditions, essential indigenization is done related to the results of the studies, so that the applications of the results are fairly accurate. As it was presented in the literature of the study, the results of the present study is in the harmony with the results of many other studies. As an example, based on the results of the study, there is a significant relationship between "technological readiness" and "innovation". Based on a study by Vares et al. (2011), by investigating 139 countries in 2011-2012, it seems that counties' "innovation" has direct impact on their "technological readiness" (Vares et al., 2011). In a research, Razavi et al. (2011) investigated the relationship between these two elements among 139 countries in 2010-2011 that its result showed the high importance of "availability of latest technology" and "capacity for innovation". The preference of this study relative to the study by Razavi et al. (2011) is the proper use of the rank of countries, because the score of the countries in each sub-indicator which was used from the statistics of this study has changed non-parametric statistics to parametric ones by examining relative indicators instead of rating indicators. Therefore, the results of this study are highly accurate and the limitations of their study eliminate in the present study. Considering the current issue in international communities and global competitiveness debate, as well as the importance of globalization and world economy in recent decades, which has recently received special attention from researchers and many international researches have studied its dimensions (e.g. Fagerberg et al., 2007; Schwab & Porter, 2008; Han et al., 2009; Vares et al., 2011; Razavi, 2012; Kwasnicki, 2013). Due to the use of available data of all counties which was investigated in this study and also the data was taken from the World Economic Forum, thus this research has high generalizability.
The findings of the main hypothesis of the study suggest that there is a significant relationship between "technological readiness" and "innovation" and "technological readiness" has a positive impact on "innovation". Therefore, it can be said that the development of "technological readiness of a country" leads to enhancement of "innovation" among the countries of the world. Also, since all the dimensions of "technological readiness" have high inter-structural coefficient as well as high importance in creating the significant relationship, it can be concluded that all the dimensions of "technological readiness" have significant role in the improvement of "innovation" of the countries. As a result, a moderate and balanced attitude toward the improvement of "technological readiness" leads to the enhancement of "innovation" which ultimately provide the improvement and enhancement of competitiveness among those countries which follow this instruction. Investigating the relationship between sub-indicators of two sets in detail, it has been suggested that by increasing "availability of latest technology" and" firm-level technology absorption", "university-industry

collaboration in R&D" can be developed. This issue must be emphasized in our country, because the rank of Iran is 117 in "availability of latest technology" and its rank is 120 in "firm-level technology absorption", then the capability of its rank in "university-industry collaboration in R&D" which is 93 is not that much impossible. Additionally, it is hoped that by increasing "availability of latest technology" and "firm-level technology absorption", the "quality of scientific research institutions" can be improved. Also, "firm-level technology absorption" seems beneficial for the companies to increase "their spending on R&D" and finally to enhance "capacity for innovation".

In order to improve "technological readiness", these recommendations are provided: it seems that "availability of latest technology" strongly improves the amount of "firm-level technology absorption". Also, by reducing "broadband internet subscription" and "availability of latest technology", "internet users" can be increased that leads to have more knowledgeable labor in the country and the readiness of the country to use "information technology" for improving the competitiveness of the country. In order to improve "innovation", these recommendations are provided too: it seems that by encouraging companies to increase "their spending on R&D", the "capacity for innovation" of the countries will be enhanced. Also, by improving "quality of scientific research institutions", companies are more interested to create "university-industry collaboration on R&D". Actually, "quality of scientific research institutions" can be a good reason for the enhancement of "capacity for innovation". Finally, by investigating the relationships of two sets, it has been recommended that: politicians must focus on the dimensions of "firm-level technology absorption" and "availability of latest technology" in "technological readiness" element, and the dimensions of "university-industry collaboration in R&D" and "quality of scientific research institutions" in "innovation" element in order to create good synergy for the development of two sets simultaneously.

In addition to the provided results, considering the position of Iran in competitiveness report, to improve the competitiveness in our country, it can be recommended that Iran is very weak in "technological readiness" element and with 8 steps ascent in 8 years and obtaining the rank of 99 among 140 investigating countries and the rank of 16 among 21 regional countries, its situation is very bad that required specific attention from the related managers and politicians; especially in the dimensions of "firm-level technology absorption" (with the rank of 120), " availability of latest technology" (with the rank of 117) and "foreign direct investment and technology transfer" requires a special programming to achieve the perspective of 1404. In this regard, it is suggested that by considering technological, cultural, social and political requirement, programs of successful pattern of the countries which were obtained good rank in the competitiveness report of 2016-2017 must be used to take advantage of their experiences. Also, in "innovation" element, with 4 steps descent in a year and obtaining the rank of 90 among 140 investigating countries and the rank of 21 among the regional countries, despite its better position than its place in "technological readiness"; Iran needs to pass a long way to become the first county in 1404, while if necessary programming does not provide; such a perspective will not be achieved.

In the dimensions of "availability of scientists and engineers" (with the rank of 37) and "quality of scientific research institutions" (with the rank of 49), Iran has a good potential to improve "innovation", but in the dimensions of "company spending on R&D" (with the rank of 102) and "university-industry collaboration in R&D" (with the rank of 93) does not have a good situation which requires an investigation of successful patterns and presenting suggestions for the improvement of our country in this dimensions. In general, in today's changing situation, one of the main concerns of our country is the enhancement of competitiveness power and as a result the comfort level of the country will be increased. In this regard, it is proposed that in order to increase the competitiveness power, factors influencing the competitiveness are identified and with an analysis of the existing situation, after identifying its strengths and weaknesses, competitiveness condition must be improved and consequently, the comfort of the country must be enhanced. In this regard, global competitiveness report should examine the factors leading to sustainable growth and long-term success of each country and provide tools to identify the barriers of increasing competitiveness power and eliminate these barriers. Thus, more attention and use of this report is suggested to identify its strengths and weaknesses and improve competitiveness condition. According to 1404 perspective document of our

country, the calculation of this indicator makes the comparison of Iran with regional countries and other countries of the world in all competitiveness elements possible. Also, by calculating this indicator, the comparison between industry and other economic different sectors of the country as well as the comparison between different cities in a number of competitiveness elements is becomes possible. Determining the rank of country in global competitiveness report can be a reason for comprehensive and different researches to improve business space and economic policymaking of the country.

6- Further Researches

To do further researches and according to identified problems in this research, following recommendations are provided for the researchers:

1. Investigating the barriers of "firm-level technology absorption" in Iran and providing solutions to eliminate these barriers;
2. Providing solutions for "availability of latest technology in the world for the country";
3. Investigating the barriers and challenges of "foreign direct investments and technology transfer";
4. Investigating the reasons of low "company spending on R&D";
5. Providing a model for the improvement of "university-industry collaboration in R&D" in Iran;
6. Investigating the effects of competitiveness elements on productivity in national level and per capita income of the countries;
7. Investigating cause-effect relationships between competitiveness elements using multi-criteria decision making methods;
8. Ranking the countries in the region using multi-criteria decision making methods;

7- Resources

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