

Global Competitiveness Index and its Determinants: A Comparative Study

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Abstract

This study seeks to compare the impact of the Sub-indices of the Global competitiveness index on the global competitiveness index of India, Pakistan and China during the period of 2008 to 2017. The study uses multiple regression equations to examine the impact of sub-indices of GCI on the GCI of India, Pakistan and China. It uses comparative analysis to find out the result. The global competitiveness index ranks a country based on its competitiveness capacity. This index is released every year by the World Economic Forum to measure competitiveness among countries. The study first tests the normality of the data by using the Jacque-Bera test. The stationarity of the data is checked by using the unit root test. The study examines multicollinearity, autocorrelation, and heteroscedasticity in the regression model. The study uses a residuals test to check the validity of the regression model. The study applies BDS (Brock-Dechert-Scheinkman) independence test to examine the non-linear pattern of the residuals distribution. It is found that series are not independently identically distributed. And it is observed that variables are stationary at the first difference, and there is a significant impact of sub-indices of GCI ON the GCI of India, Pakistan and China.

Keywords: GCI, Sub-Indices, Competitiveness, Multiple Regression

Introduction

It is generally accepted that India, Pakistan and China are developing countries. However, China is far ahead of these countries regarding per capita income. The main

reason is that China has proved itself as a manufacturing giant at the global level. It has been made possible due to many reasons. However, one of the reasons is that it is highly competitive because the government of China ensures that all the factors that are significant for a country to be highly competitive and have production capacity.

According to the world economic forum (WEF), that competitiveness has become a very significant element for countries in this era. Because it leads to long-term prosperity and growth of a country. There are many authors who have given their views about competitiveness. Competitiveness is one of the most central preoccupations for both advanced and developing countries (Porter, 1990) and thus, policymakers express serious concerns about it (Lall, 2001).

The global competitiveness index is published by the world economic forum every year, and ranks are given to countries based on their country's competitiveness strength. The original idea of Klaus Schwab (1979) on the Global Competitiveness Index (GCI) is developed by Xavier Sala-i-Martin and Elsa V. Global competitiveness index (GCI) is a set of institutions, policies, and factors that determine the level of productivity of a country, conditions of public institutions and technical conditions (by world economic forum). Highly competitive countries rank higher in the global competitiveness index (GCI). In this study, rankings of GCI from 2008 to 2017 of India, Pakistan and China are considered for analysis. The ranking of a country is computed by considering 140 indicators, and these indicators are categorized into 12 pillars of competitiveness (institution, infrastructure, macroeconomic environment, health and primary education, higher education and training, goods market

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efficiency, labour market efficiency, financial market development, technological readiness, market size, business sophistication, and innovation. Again, these 12 pillars are categorized into 3 sub-indices such as basic requirement, efficiency enhancers and innovation and sophistication. GCI gives ranks and scores according to their performance.

This study focuses to determine the important factors which are significantly affect Global Competitive Index (GCI) and then compare the result between the countries to find out which country is highly competitive and what are the main reasons for this.

This paper is structured into seven (7) parts. Following the first section, section 2 explains the details literature review and research gap. Section 3 deals with the objective. Data and study period are explained in section 4. Section 5 deals with methodology. Section 6 analyses the results. The conclusion and recommendation are given in section 7.

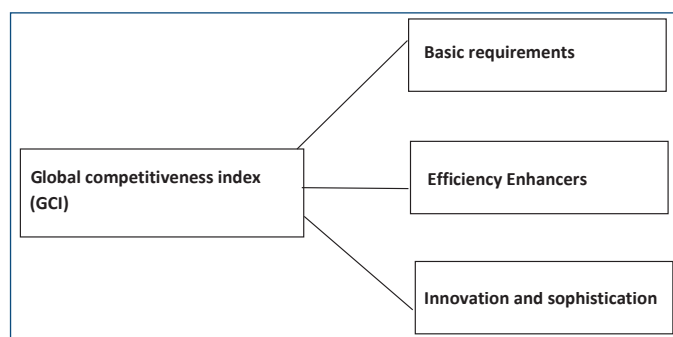


Fig. 1: GCI and its Sub-Indices

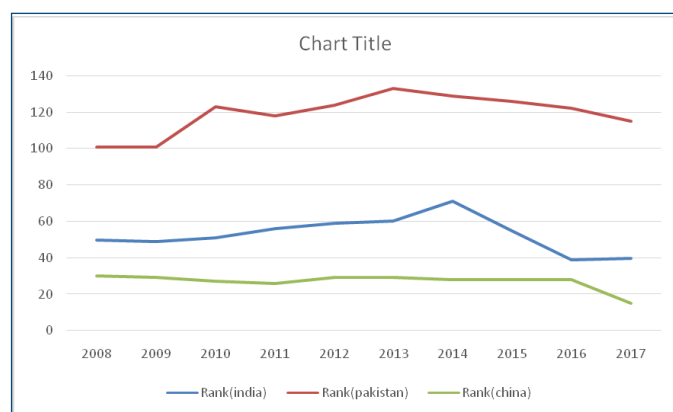


Fig. 2: Ranks of India, Pakistan, China in GCI from 2008 to 2017

Literature Review

Dadgar et al. (2018) investigates the impact of competitiveness on economic growth for two groups of countries, including Iran, and a particular special focus is given to Iran. The countries included in this research are high-income and upper-middle-income countries. Leamer test and F Statistics are used for the analysis. Data is obtained from the various report over a period from 2006 to 2016 of WDI and WEF. The results drawn from the study show that there is a significant and positive relationship between competitiveness and economic growth. In addition to competitiveness, labour force, physical capital, and human capital have a positive relationship with economic growth. Emsinaa (2014) tries to find the relationship between Labour productivity, competitiveness and economic growth during the post-crisis, pre-crisis, and crisis periods of European nations (Latvia, Lithuania & Estonia). The time period taken into account ranges from 2004 to 2012. The study period is subdivided into three periods, particularly pre-crisis (2004-2008), during the crisis (2008-2010) and post-crisis period that starts from 2011. Data (productivity and economic growth) is collected from the Euro state database and GCI reports published by WEF. The findings of the research are that there are weak or no relations between labour productivity and economic growth in the pre-crisis period and the first phase of post crises period. However, it is found that there is a positive relationship between labour productivity and economic growth during the crisis period. The competitiveness of selected countries that are declined and increased after crises due to an increase in labour productivity. Fang et al. (2022) seek to compare the regional competitiveness of nations and the factors that influence the regional competitiveness by comparative analysis of each other. The study uses grey relational analysis (GRA). The data is collected over the period from 2008 to 2016 from ASEAN, South Asian nations, Australia, and New Zealand. Here four (4) major variables are being taken, which are further subdivided into 14 sub-factors. It is found from the study that ASEAN Countries have the highest competitiveness than south Asia and Australia, and New Zealand. Mustafin et al. (2021) aim to examine the development of competitiveness of selected countries. In this paper, Russia, Slovakia and Germany are considered, and the data is collected for the period 2008-2017. A comparative analysis technique is used to examine. It is found that the development of GNI in

Russia is very fluctuating than in Germany. In Russia, the GNI is very inconsistent in comparison to Germany, and in the context of Slovakia, GNI is rising. Based on GCI, it is found that Germany's ranking is much better than other selected countries. Sofrankova et al. (2017) try to examine the competitiveness of Slovakia for the period of 2006 to 2016 by using GCI Rankings and the effect of individual pillars of GCI on the development of competitiveness of Slovakia and which pillar proves to be strongest and weakest of GCI for the competitiveness for Slovakia. In addition, the paper also examines the development of R & D Expenditure in Slovakia and EU Countries and the impact of R&D expenditure on individual pillars of GCI Indicators. The correlation analysis technique is used in this paper to find out the relations between individual pillars and GCI indicators of Slovakia. The study uses STATISTICA and MS EXCEL. The correlation matrix and Kendell's test are employed to test the strength of the relationship among the indicators. It is found that in the analyzed period 2006 to 2016, the most vital pillar is the fourth pillar (health and primary education) because its average value is maximum, and the weakest pillar is the Twelfth pillar (R&D and Innovation). Gonzales et al. (2017) aim to examine how to improve competitiveness. What the strategy should a county consider? They try to evaluate competitiveness among Ecuador (ECU), Colombia (COL) and Peru (PER) and how these selected countries can gain competitiveness. Moreover, the strategy has to be adopted to be competitive. The period taken for the study is four years (2010-2013). Data is collected from various sources such as World Bank (WB), IMF, IDB, and WEF. A double diamond (DD) model is used for the study. PLS-SEM procedure is also used. It is found that among these three countries, Columbia is highly competitive. Peru is in the second position, and Ecuador is the least competitive among the three. Eva et al. (2017) aim to find out the innovation performance of Slovakia at the regional level. Because innovation is one of the key indicators that help in achieving competitiveness. Time series data has been used in this paper for the period 2005-2014. Slovak regions have been assessed throughout this period to see innovation performance.

The data for the study is taken from the Slovak Statistical Office database. To assess the innovation performance of the region of Slovakia, the multi-criteria scoring method has been used. The economic growth in Slovakia is very good, but innovations are not comparable with other EU Countries. Substandard funding and basic research

are the factors that need to be changed for innovation in the Slovak region. The regional disparity may be eliminated by cooperation for increasing innovation among Slovak regions. Farinha et al. (2016) observe that cooperation between academia and industry cooperation for knowledge and innovation transfer is important for regional competitiveness. This paper has used a case study to find out the cooperation between academia and industry to foster regional competitiveness. This study used a triple helix network. Data were collected from 2009 to 2012. It is observed that the cooperation between A-I (Academia and industry) helps to increase regional competitiveness. Dima et al. (2018) try to find the effect of different factors such as GDP per capita, R&D expenditure as a percentage of GDP, population by tertiary education attainment, gender and age, lifelong learning, debt to equity and the level of energy intensity on world competitiveness index (GCI) of European economies for the period 2006 – 2015 by using Pearson coefficient and panel data regression model. The finding of the research is that innovation and education play a very important role in the competitiveness of European economies. It is also found that focus on R & D and policies of lifelong learning for citizens of the EU also contribute most to the development of competitiveness of EU Nations. Khyareh et al. (2021) examine the effect of macroeconomic factors on competitiveness and how innovation and macroeconomic factors help to be competitive at the national level for 16 emerging economies. This research is being done using GMM (General method of the moment). The study uses panel data for 12 years (2007-2018). Data is collected from the World Economic Forum (WEF), World Development Indicators (WDI), and World Intellectual Property Organization (WIPO). It is found from the research that macroeconomic indicator increases innovation, and innovation leads to the overall competitiveness of countries. This study is limited to only 16 emerging economies. Future research can be done on specific countries / specific regions. Djogo et al. (2016). Seeks to find out that GCI Report is the correct measure of competitiveness. In order to do this study, the finding of the GCI report has been compared with the composite index of competitiveness, which has been named 6 BIC (Basic indicators of competitiveness), such as the balance of the current account, unemployment rate, the annual cost of salary per worker, external debt, economic growth rate and investment rate. This index is developed on the theoretical basis provided by Krugman, Fagerbergs,

Scott, Lodge, Aiginger and others. Our finding revealed that the GCI is not giving the correct rank to the countries for competitiveness. Countries are either overestimated or underestimated in the middle and short term. The data has been collected for 39 European countries (Baier et al., 2007).

Tries to find out that free trade agreements among nations do increase trade. The gravity equation has been used to find out the results. Moreover, it is found that FTA between nations doubles their trade after 10 years of coming into that agreement. Kramulova et al. (2015) seek to show that different indicators and methods are available for assessing the competitiveness of a country. However, there is no single procedure available for this. In this paper, the AHP model is used to assess the competitiveness of selected countries, which is also compared with the ranking of IMD competitiveness rankings. 59 countries are taken for the analysis. Results indicate that there are very slight differences.

Moreover, the results computed by the AHP Model correspond with the results of IMD competitive rankings. Kalim et al. (2019) try to find out the contribution of competitiveness to economic growth with respect to the real sector such as agriculture, service and industry for sixteen (16) low-income countries. Data collected for the study is from 2006-2015. In order to find out the research Panel GMM Moderator model is used. The data on economic growth and real sector are taken from world development indicators, and GCI rankings of selected countries are taken from the global competitiveness report. The result of the study is that competitiveness helps the industry and agriculture sectors to become more competitive, leading to growth, while the productivity of the service sector is reduced. Because due to competitiveness monopoly established by the service sector has reduced, and many new service-providing companies have come into existence offering services at low cost. Huang et al. (2014) try to find the regional competitiveness of Hungary. Eight aspects are taken into account to assess the regional competitiveness of Hungary Economics, Education and Learning, Innovation, labour market efficiency, Infrastructure, Health, Farm, Environment Protection and Crimes. In order to find out the results, this paper has used an index which uses two methodologies based on GCI developed by WEF and the European competitiveness index developed by the European commission. The paper has used PCA Test to normalize

the indicators taken for regional competitiveness. From the study, it is found that Central Hungary is the most competitive region, and Northern Hungary is the least competitive region in Hungary. Several measures can be taken for the northern region to be competitive in the context of infrastructure construction, labour mobility, institution efficiency, promotion of innovation, business environment, improvement of education and health and environment protection. In 2018, Loo tried to find out business opportunities in ASEAN and the associated risk with it. Comparative analysis is done between ASEAN and Canada by using the global competitive index published by WEF to analyze the strength and weaknesses of ASEAN countries for Canadian investors to find opportunities where they can invest money and get maximum returns. Primary data and secondary data are used in the paper. Data has been collected for the study ranging from 2000-2016/17. Results show that several opportunities are available in ASEAN for Canadian investors where they can invest and make money. In this paper, only the GCI report is used to assess the business opportunity in ASEAN. However, another index can be analyzed to get a better picture of ASEAN countries, such as the corruption perception index (CPI) and the Fragile state index, to analyze the social, political, and cultural environment. Vu et al. (2016) try to analyze the competitiveness of the Vietnam G&T (garments and textile) Industry and comparison with the china textile industry. This paper has used the Generalized double diamond model (GDDM) for comparison with china. A total of 27 proxies have been selected for assessing the competitiveness between china and Vietnam's G&T Industry. One year of data for 27 proxies has been collected for the study. The result shows that Vietnam is superior to China in only 5 proxies, such as wages, employment rate, average G&T export growth, DTF point and average import tariff rate out of 27 proxies.

Some data for both nations are not available. In this research, the data related to specific G&T Industries, such as inward FDI, outward FDI and R&D expenditure, are unavailable for the study. Future research may be done by taking the above proxies into consideration. Liu et al. (2009) compare the competitiveness of South Korea and Taiwan. In order to find the result, the paper has used a generalized double diamond model. Data has been collected for the period of 2000-2004. The sources of data include Indicators of Science and Technology, Taiwan, the Korean National Statistical Office, and

related statistical data obtained from various government agencies after Analyzing the factors for competitiveness between Taiwan and South Korea. It is found that Taiwan is superior in most of the factors in comparison with South Korea. Guerrero et al. (2014) analyze the impact of university entrepreneurial activity on competitiveness. Structure equation modelling (SEM) has been used to find out results. 102 Universities are selected for the study from European countries. The same time period for the study is not taken in this paper because samples considered for the study are not allowing to use of robust dynamic analysis. After analyzing the factors, it is found that the university's entrepreneurial activity led to competitiveness. In 2015 Loo tried to analyze the competitiveness of BRIC (Brazil, Russia, India, China) Nations considering three factors such as democracy, colonialism and religion, that may influence the competitiveness. Time series data for 15 Years (2000-2015) is taken for the study. This study uses WEF and IMD measurements to assess the competitiveness of BRIC nations after analyzing the competitiveness of BRIC countries on the basis of ranking provided by the GCI and IMD. It is found that china has the highest average ranking of 15 years, starting from 2000 to 2015, followed by India.

Research Gap

It is observed from the extensive literature survey that most of the studies have dealt with a particular aspect of GCI. It may be inferred that those studies are not able to highlight the effect and causal relationship of particular countries like India, China and Pakistan. This study is considered a group of countries, moreover, by applying some theoretical and empirical models. The present study explores the gaps that will add value to the existing literature.

Objectives

This study is designed to achieve the following objective

- To examine the impact of sub-indices of GCI on GCI for India, Pakistan, China.
- To Compare the impact of sub-indices of GCI on GCI for India, Pakistan, China.

Data and Study Period

The study considers the annual data of GCI and its sub-indices of GCI for India, Pakistan and China from 2008

to 2017. The annual data of GCI and its sub-indices are collected from the GCI report published every year by the world economic forum (WEF). Annual data is converted into quarterly form and then into a log form.

Hypothesis Formulation

To examine the above stated objective. The study formulates the following hypothesis for testing:

H_0 : There is no significant impact of sub-indices of GCI on GCI for countries.

H_a : There is significant impact of sub-indices of GCI on GCI for countries.

Methodology

In this paper, the study aims to analyze the impact of sub-indices of GCI on GCI of India, Pakistan and China and compares the result of each other to find which indicators are performing well and which needs attention to improve. In order to achieve this, the study uses reports of the global competitiveness index published by the world economic forum showing data on GCI and its sub-indices for the respective countries for the analysis. A multiple regression equation is used to study the impact of sub-indices of GCI on GCI for the period 2008-2017.

The study uses various statistical tools to examine the above objectives. Here J-B test is used to check the normality of the time series.

$$J-B \text{ TEST} = n \left(\frac{s^2}{6} + \frac{(k-3)^2}{24} \right) \quad (1)$$

Where n = Number of observations

S = Skewness of the residuals

$$\left(S = \frac{\mu_3}{\sigma^3} = \frac{\mu_3}{(\mu_2)^{3/2}} \right) \quad (2)$$

K = Kurtosis of the residuals

$$\left(K = \frac{\mu_4}{\sigma^4} = \frac{\mu_4}{(\mu_2)^2} \right) \quad (3)$$

Then unit root test is also used to check the stationarity of the time series data as given below:

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{i=1}^m \gamma_i \Delta Y_{t-i} + e_t \quad (4)$$

The study uses multiple regression equation to estimate the regression coefficients by using OLS estimator and

thus the following regression equation is used as below:

$$\Delta LGCI(1) = \alpha + \beta_1 \Delta LBR(1) + \beta_2 \Delta LEE(1) + \beta_3 \Delta LIS(1) + e_i \tag{5}$$

Where, α represents intercept.

β indicates slope coefficient

e_i is the disturbance term with 0 mean and constant standard deviation.

The study uses Durbin-Watson d-statistic to check the autocorrelation problem in the regression residuals as below:

$$d = \frac{\sum_{i=1}^{n-1} (e_i - e_{i-1})^2}{\sum_{i=1}^{n-1} e_i^2} \tag{6}$$

The study uses correlation matrix, VIF (variance inflation factor) and TOL(Tolerance) to examine the correlation between the variables.

$$VIF = 1/(1 - R^2) \tag{7}$$

$$TOL = 1 / VIF \tag{8}$$

The study uses various residuals test like autocorrelation, heteroskedasticity and normality to examine the model validity by considering the regression residuals.

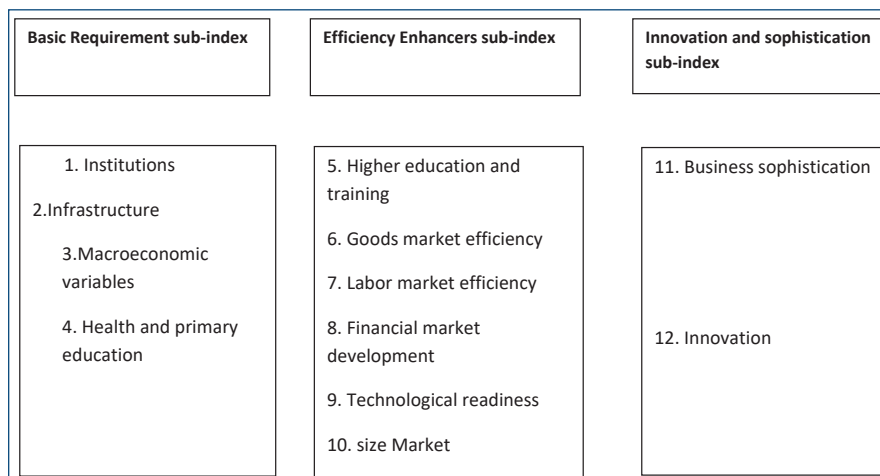


Fig. 3: GCI Sub-Indices and 12 Pillars

The variables and their unit values are given in the Table 1.

Table 1: Variables and Their Unit Value

Symbols of Variables	Variables
LGCI	log of Global competitiveness index
LBR	log of Basic requirements
LEE	log of Efficiency Enhancers
LIS	log of Innovation and sophistication

Finally, the study applies BDS (Brock-Dechert-Scheinkman) independence test by considering the standardise residuals, which are derived from multiple regression equations to examine the non-linear pattern of the residuals distribution. Brock et al. (1996) say that a sample of i.i.d. distribution $\{x_t: t = 1, 2, 3, \dots, n\}$ can be written as:

$$BDS = \sqrt{n - m + 1} \frac{b_{m,n}(\xi)}{\sigma_{m,n}(\xi)} \rightarrow N(0,1)$$

Where, $b_{m,n}(d) = C_{m,n}(d) - C_{1,n-m+1}(d)^m$, $C_{m,n}(d)$ and $C_{1,n-m+1}(d)^m$ are the correlation integrals. $\sigma_{m,n}(d)$ is the standard error of $b_{m,n}(d)$. d is the distance and m is the dimension. Here, $d = 0.7$ and $m = 2$ to 6 (consider) and the testable hypothesis (H_0): series is independently identically distributed (i.i.d.) that means for a given d and $m > 1$, $C_{m,n}(d) - C_{1,n-m+1}(d)^m$ is 0. The null hypothesis is rejected if the computed BDS statistic is significant that means residuals series are not distributed independently and identically.

Result and Analysis

Table 2 presents the outcome of the data. The study considers four variables global competitiveness index, basic requirement, efficiency enhancers and innovation & sophistication of India, Pakistan and China. The study first converts the annual data into the quarter form. Then in log form, it is found that the probability value of J-B Statistics of the variables is less than five percent (5%),

showing that the data are abnormal. Only Variable LIS for India (0.0706) and variable LGCI (0.23760), LBR (0.3367) and LIS (0.0520) for Pakistan are normal because the P-value of J-B statistics of that variable are more than five percent (5%).

Table 2: Descriptive Statistics for India, Pakistan and China

Var	Obser	Mean	Median	Std. Dev.	Min	Max	Skew.	Kurt.	J-B Stat.	P -Value
<i>INDIA</i>										
LGCI	40	1.4698	1.4620	0.0255	1.4374	1.5260	1.2029	3.3088	9.8066**	0.0074
LBR	40	1.4678	1.4480	0.0386	1.4303	1.5475	1.1600	2.7930	9.0425**	0.0108
LEE	40	1.4828	1.4906	0.0266	1.4327	1.5085	-1.1598	2.8024	9.0334**	0.0109
LIS	40	1.4010	1.3812	0.0415	1.3506	1.4586	0.3159	1.3325	5.2994	0.0706
<i>CHINA</i>										
LGCI	40	1.5862	1.5820	0.0312	1.5475	1.6677	1.5384	5.1804	23.7035	0.000007
LBR	40	1.6685	1.6686	0.03703	1.6114	1.7578	0.9347	4.3167	8.7153	0.0128
LEE	40	1.5446	1.5368	0.0407	1.4838	1.6486	1.3657	5.0350	19.3366	0.000063
LIS	40	1.4426	1.4219	0.0642	1.3987	1.6292	2.4763	7.5266	75.03405	0.0000
<i>PAKISTAN</i>										
LGCI	40	1.2603	1.2541	0.0263	1.2267	1.3083	0.4296	2.0070	2.8739	0.2376
LBR	40	1.2410	1.2354	0.0406	1.1847	1.3083	0.2634	1.9858	2.1770	0.3367
LEE	40	1.2943	1.2988	0.0153	1.2612	1.3110	-1.0555	2.9500	7.4314	0.0243
LIS	40	1.2396	1.2412	0.0177	1.2178	1.2809	0.8883	3.6245	5.9109	0.0520

Significance at 5 percent level.

Source: Author's own calculation.

Generally, for time series data, the study faces the problem of non-stationary and unit roots. Thus the standard OLS regression procedure can easily make incorrect estimates of the parameters (spurious regression). So before using multiple regression analysis, the study ensures that the data must be stationary. So, to make data stationary, the study uses the ADF test and PP test. Table 3 presents the results of the unit root test based on two methods (ADF & PP TEST) that data are stationary at first difference operator of all three countries tested by ADF and PP Test

except LEE for China.

It is observed from the table that the variables are stationary after the first difference except for efficiency enhancers in China which are stationary at the first difference at difference according to the PP test. However, it is stationary at the second difference based on ADF Test. it is opined that all the variables are stationary at the first difference; therefore, LEE is considered in the first difference in the regression equation.

Table 3: Unit Root Test of India, China and Pakistan by ADF & PP Test

Var	ADF TEST				PP TEST			
	Level Form		First Diff		Level Form		First Diff	
	T-Stats	Prob	T-Stats	Prob	T-Stats	Prob	T-Stats	Prob
<i>INDIA</i>								
LGCI	-0.1138	0.9408	-6.1649	0.0000	-0.0902	0.9435	-6.1649	0.0000
LBR	0.2246	0.9708	-6.3861	0.0000	0.3438	0.9777	-6.4112	0.0000
LEE	-1.5117	0.5172	-6.0001	0.0000	-1.5861	0.4800	-6.0001	0.0000
LIS	-1.3823	0.5810	-6.0000	0.0000	-1.4134	0.5659	-6.0000	0.0000

Var	ADF TEST				PP TEST			
	Level Form		First Diff		Level Form		First Diff	
	T-Stats	Prob	T-Stats	Prob	T-Stats	Prob	T-Stats	Prob
CHINA								
LGCI	-0.0385	0.9490	-6.4369	0.0000	0.2151	0.9702	-6.4610	0.0000
LBR	-0.5471	0.8707	-6.4225	0.0000	-0.4654	0.8872	-6.4728	0.0000
LEE	1.1257	0.9970	-0.3224	0.8997	-0.0524	0.9476	-6.5370	0.0000
LIS	-0.0730	0.9453	-6.1705	0.0000	-0.0376	0.9491	-6.1705	0.0000
PAKISTAN								
LGCI	-1.3717	0.5861	-6.0042	0.0000	-1.4728	0.5366	-6.0042	0.0000
LBR	-1.3606	0.5914	-6.0007	0.0000	-1.3979	0.5734	-6.0007	0.0000
LEE	-1.8177	0.3667	-6.3020	0.0000	-1.9418	0.3077	-6.0032	0.0000
LIS	-0.3767	0.9033	-6.1705	0.0000	-0.3159	0.9133	-6.3067	0.0000

Significance at 5 percent level.

Source: Author’s own calculation.

Table 4 shows the results of multiple regression test. It is observed from the table the scope coefficient of all the variables are statistically significant that means the independent variables are positively affected the GCI performance of all the countries. Here, the selected

countries are able to increase the performance of the GCI factors efficiently. It is also found that the variables are jointly influence the GCI performance as depicted by F statistics.

Table 4: Results of Multiple Regression Equation

Variables	Coeff	T-Stats	Prob	R ²	F Stats	Dur Wat
INDIA						
LBR	0.577679	141.7424	0.0000	0.999014	12160.76 (0.0000)	0.780751
LEE	0.326848	46.39899	0.0000			
LIS	0.061660	12.49481	0.0000			
C	0.050865	5.233769	0.0000			
CHINA						
LBR	0.4211	8.7393	0.0000	0.9932	1776.217 (0.0000)	0.5790
LEE	0.2930	5.5787	0.0000			
LIS	0.0728	5.5406	0.0000			
C	0.3258	15.1886	0.0000			
PAKISTAN						
LBR	0.5811	186.6794	0.0000	0.9992	16658.02 (0.0000)	0.6952
LEE	0.3621	44.1899	0.0000			
LIS	0.0899	13.3707	0.0000			
C	-0.0409	-3.2550	0.0000			

Significance at 5 percent level.

Source: Author’s own calculation.

Table 5 shows the results of multicollinearity tests. Here the study considers the Pearson correlation matrix, Variance inflation factor (VIF) and Tolerance (TOL) to check the association between the variables. According to the rule of thumb, if the value of the correlation coefficient is less than 0.90. it shows the absence of multicollinearity. In

this case, only multicollinearity exists between LBR and LEE IN China. VIF values of the independent variables should be less than 10, if the values of VIF are more than 10, it leads to the problem of severe multicollinearity in the variables. It is found from the study that the values of VIF of the independent variable for all three countries

are less than 10 except the values of VIF of China for variable LBR (17.48) and LEE (25.114) are more than 10 showing the presence of multicollinearity in the regression model—the values of TOL of independent variables of three countries. The study also uses TOL to test the multicollinearity in the variable. Suppose the values of

TOLs (TOLERANCE) of independent variables are more than 0.10. In that case, it represents the multicollinearity Problem. In the study, the value of TOL in Table 4 for three countries is more than 10% showing the presence of the multicollinearity problem.

Table 5: Correlation Matrix, VIF and TOLs for India

Variables	LBR	LEE	LIS	VIF	TOL
<i>INDIA</i>					
LBR	1	-0.0073	0.4003	1.386429	0.7283
LEE	-0.00730	1	0.6411	1.976623	0.5059
LIS	0.4003	0.6411	1	2.353874	0.4248
<i>CHINA</i>					
LBR	1	0.9660*	0.7557	17.48	0.0572
LEE	0.9660*	1	0.8375	25.114	0.04
LIS	0.7557	0.8375	0	3.9083	0.2559
<i>PAKISTAN</i>					
LBR	1	0.3467	0.1350	1.1538	0.8667
LEE	0.3467	1	0.0599	1.1369	0.8795
LIS	0.1350	0.0599	1	1.0187	0.9816

Significance at 5 percent level.

Source: Author's own calculation.

Table 6 presents the outcomes of the residual tests (i) the Breusch-Godfrey test for serial correlation BGLM, (ii) the Breusch-Pagan-Godfrey test for heteroskedasticity and (iii) the Jarque-Bera test for normality. It is observed that the probability value of the corresponding observed R2 is statistically significant, and the probability value of the BGLM test is less than 5% for India (0.0001), China (0.000) and Pakistan (0.0000). It shows that autocorrelation exists in the residuals. HAC Test is used to remove the autocorrelation problem. It is also found from the BPG heteroskedasticity test that the probability value of the corresponding observed R2 is statistically

significant. The values of India (0.0413), China (0.0000) and Pakistan (0.0001) are lower than five percent, which means rejection of the null hypothesis shows heteroskedasticity problem exists in the residuals of the regression equation. The HAC test is also used in the study to remove heteroscedasticity. It is observed that the probability values corresponding to the J-B statistics are insignificant. Thus the null hypothesis is accepted, meaning that the residuals are normally distributed, which is desirable for India (0.1805), China (0.9032) and Pakistan (0.2442).

Table 6: Parameter Tests

<i>BGLM Test</i>		<i>BPG Het. Test</i>		<i>Normality Test</i>	
<i>Obs*R-Squared</i>	<i>Prob</i>	<i>Obs*R-Squared</i>	<i>Prob.</i>	<i>J.B TEST</i>	<i>Prob</i>
<i>INDIA</i>					
14.21548	0.0001	3.087289	0.0413	3.4230	0.1805
<i>CHINA</i>					
18.99015	0.0000	33.84059	0.0000	0.2034	0.9032
<i>PAKISTAN</i>					
17.9901	0.0000	18.0419	0.0001	2.8187	0.2442

*Significant at 5 percent level.

Source: Author's own calculation.

Table 7 shows the outcome of BDS test for India China and Pakistan. it is found from the P Value of the respective countries that series are not independently identically

distributed (i.i.d.) because P value of BDS test of India, China and Pakistan are less than five percent (5%).

Table 7: Results of BDS Test

<i>Dimensions</i>	<i>BDS Stats</i>	<i>STD Error</i>	<i>Z STATS</i>	<i>Prob Value</i>
<i>INDIA</i>				
2	0.1171	0.0070	16.6327	0.0000
3	0.1814	0.0112	16.1708	0.0000
4	0.2093	0.0133	15.6331	0.0000
5	0.2158	0.0139	15.4330	0.0000
6	0.2112	0.0135	15.6300	0.0000
<i>CHINA</i>				
2	0.1394	0.0108	12.8106	0.0000
3	0.2242	0.0173	12.8962	0.0000
4	0.2735	0.0208	13.1504	0.0000
5	0.3032	0.0217	13.916S2	0.0000
6	0.3177	0.0211	15.0395	0.0000
<i>PAKISTAN</i>				
2	0.1333	0.0128	10.4122	0.0000
3	0.2127	0.0204	10.3899	0.0000
4	0.2543	0.0245	10.3676	0.0000
5	0.2729	0.0257	10.6046	0.0000
6	0.2649	0.0249	10.6021	0.0000

*Significant at 5 percent level.

Source: Author's own calculation.

Conclusions and Recommendations

The study examines the impact of sub-indices of GCI on GCI for India, China and Pakistan. It contributes to a better understanding of the global competitiveness index and its sub-indices, such as basic requirements, efficiency enhancers, innovation, and sophistication. It builds from the previous studies, which are limited to some aspects of GCI. Moreover, however, studies have demonstrated the links between GCI and its sub-indices. The study points out the significant impact of sub-indices of GCI on GCI for India, China and Pakistan. Because sub-indices of GCI include all the indicators for computing the GCI score. The GCI score represents how competitive a country is compared to other countries. India and China are performing significantly good in the global competitiveness index than Pakistan. Especially China's performance.

Hypothesis H1 Regarding the significant impact of sub-indices of GCI on GCI can be confirmed as the study has

observed a statistically significant impact of sub-indices of GCI on GCI by using multiple regression results. There is a need to pay attention to innovation and sophistication sub-indices because all three countries are performing poorly in innovation and sophistication sub-indices of GCI compared to other EU Member countries and other developed countries.

Suppose the study includes only a few sub-indices of GCI. It determines only partly the performance of GCI scores, which is necessary for ascertaining the competitiveness capability of India, China and Pakistan. Therefore, the study considers all three sub-indices of GCI. The study considers India, China and Pakistan to measure their competitiveness and are developing countries and sharing borders with each other. Therefore, future studies can include other SAARC member countries or other developing and developed countries.

It is found that the variables are stationary at their first differences for all the countries when ADF and PP test is used. Multiple regression results shows that there is a

significant relationship between sub-indices of GCI and with Global competitiveness index in India, China and Pakistan.

The study uses a correlation matrix, Variance inflation factor (VIF) and Tolerance (TOLs) to check the multicollinearity. It is observed that there is multicollinearity between LBR and LEE for China, and the rest are positively related to each for all the countries when the correlation matrix is used. The result of VIF shows that there is a multicollinearity problem exists in the variables. The result of TOLs also shows a multicollinearity problem. BGLM Test's result shows the problem of autocorrelation in residuals.

BPG (Breusch-Pagan-Godfrey) test is used to check the heteroscedasticity problem in residuals, and it is found that the p-value of the corresponding R2 is significant. Moreover, it is observed that the heteroscedasticity problem. The multicollinearity, heteroscedasticity and autocorrelation problems can be removed by using HAC Test. In the study, HAC is not used, but for future research, if the study faces multicollinearity, heteroscedasticity, and autocorrelation. The study might be completed by using HAC Test.

However, the residuals are normally distributed for all the countries. Finally, the results of the BDS test present that the series is not independently identically distributed (i.i.d.).

Thus, it may be said from the above analysis that the value of a dependent variable (LGCI) is almost 100% dependent on independent variables such as LBR, LEE and LIS. It shows that with an increase in the performance in the sub-indices, the overall score for the respected countries can be increased, and a country might become a competitive country and ranks high in the global competitiveness index.

China is doing well in all aspects as compared to India and Pakistan. India is also performing well but not as compared to China. Pakistan's performance is not at par standard. Pakistan needs to focus on all sub-indices to score well in overall weights. Pakistan ranking in the studied period is very poor compared to China and India.

Finally, it may be recommended that the policy makers should frame proper policies by considering (Basic requirements, efficiency enhancers and innovation &

sophistication) sub-indices of GCI. Because these jointly enhance the score of GCI and leads to long-term prosperity and growth. This framework can also be used to study other developing and developed countries.

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