

RESEARCH BRIEF

# Global Competitiveness Index and Its Impact: Evidence From South Asian Region

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Competitiveness is one of the most central preoccupations for both advanced and developing countries (Porter, 1990) and thus, the policymakers express serious concerns about it (Lall, 2001). It is the set of institutions, policies, and factors that determine the level of productivity and prosperity that a country or an economy can achieve. The original idea of Klaus Schwab (1979) on the Global Competitiveness Index (GCI) is developed by Xavier Sala-i-Martin and Elsa V. Artadi and published first in 2004 in collaboration with World Economic Forum (WEF). The GCI unites 114 indicators that capture concepts regarding productivity and long-term prosperity. These components are grouped into 12 pillars of competitiveness, namely, (1) institutions, (2) infrastructure, (3) macroeconomic environment, (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. Again, these 12 pillars are categorized into three sub-indices: basic requirements (1–4), efficiency enhancers (5–10), and innovation and sophistication (11–12). These three sub-indices are given different weights for the computation of GCI and divide countries based on their stages of development. According to the GCI, the economy is factor-driven in the first stage where the first four pillars are considered for the development of an economy. The efficiency

enhancers include those pillars which are important for countries in the efficiency-driven stage and finally, the innovation and sophistication sub-index includes those factors which are essential for an economy to reach the innovation-driven stage. The present study examines the impact of three sub-indices on GCI of the South Asian Region countries. South Asia is characterized by great diversity and includes one of the world's 10 largest economies.

## Literature Review

The significance of GCI is increasing at a higher pace in the areas of modern economics as well as other growth issues. The academicians, as well as the professionals, try to examine the relationship of the conception by considering a range of factors that persuade it. The economic strength of an entity is frequently analyzed in comparison to its competitors worldwide where commodities, services, human intelligence, and innovation are in motion without restraint across the geographical borders (see Saboniene, 2009; Malakauskaite & Navickas, 2010; Xia, Zhang & Wu 2012). Competitiveness is the capability of a firm to invent, produce, and promote products which are better than those recommended by the rivals (see D'Cruz, 1992). A small number of studies point out several factors like business environment, dynamic capabilities,

flexibilities, agility, speed, and adaptableness which are assumed to be significant foundations for competitiveness in changing the business environment (Barney & Hesterly, 2006; Snieska & Draksaite, 2007). Porter (1990) stated that national competitiveness is the vital cause of anxieties for both advanced and developing countries and thus, the strategic planners express their attention to it (Lall, 2001). Berger (2008) identified four hypothetical constructs for national competitiveness and found large differences among them. According to Smit (2010), the researchers have identified the weak aspects of Porter's diamond model (see Dunning, 1993; Rugman, 1990; Rugman & Verbeke, 1993; Rugman & D'Cruz 1993; Waverman, 1995; Boltho, 1996; Davies & Ellis, 2000). The World Economic Forum itself applied that technique which is closely linked with Porter's diamond model. According to the World Economic Forum, "competitiveness is the set of institutions, policies and factors that determine the level of productivity and brings prosperity of a country" (Schwab, 2016, p.4).

The application of GCI starts not only at the firm level but also in the national, regional, and global markets (see Hvidt, 2013; Fagerberg, 1996; Roessner, Porter, Newman, & Cauffiel, 1996). Silke (2011) explained that global competitiveness is the ability of a country to offer a high level of opulence to the nation. Measuring the global competitiveness entails quantifying the impact of various key factors that contribute to the creation of conditions for competitiveness. Helleiner in 2008 opined that global competitiveness determines the policies and issues that contribute to sustainable economic success. Hertog in 2011 said that it is significantly influenced by the way in which a country employs its resources. Similarly, Alvarez et al., in 2009 defined that global competitiveness is the capability of a country to compete in global trade by exporting its products and services. So, competitiveness means productivity and prosperity of a nation. Colton (2011) opined that global competitiveness is a new paradigm in economic performance studies and it is used to capture the responsiveness of risks and challenges that are caused by rivalry at the global level.

Alfaki and Ahmed (2013) evaluated the relationship between global competitiveness and technological readiness in the Gulf region (see also Aleksandra & Magdalena, 2015) and found that UAEs achieve

gigantic success in technological readiness in terms of its GCI. Wysokińska (2003) examined the concept of global competitiveness in terms of its productivity and sustainable development in Central and Eastern Europe and European Union and observed that higher productivity leads to improve competitiveness in the global as well as local markets. Taner, Oncu, and Civi (2010) also checked the performance of GCC nations based on international competitiveness and concludes that the notion of the global competitiveness is multifaceted because of the wide array of indicators and factors that influence it.

The concept of global competitiveness is assessed by looking at how it influences specific economic parameters (Wysokińska, 2003) like trade balances, national economic performance (Taner et al., 2010), and technological readiness (Alfaki & Ahmed, 2013). The former studies mostly dealt with various definitions of GCI and investigated diverse factors for formulating GCI. Some studies (Barney & Hesterly, 2006; Snieska & Draksaite 2007) inspected the impact of a few factors (productivity, trade balances, economic growth, and GDP) on GCI.

This study examines the impact of sub-indices (basic requirements (BR), efficiency enhancers (EE), and innovation & sophistication (IS)) on GCI in the context of South Asian countries/economies and also checks the comparative performance of the countries.

## Methods

The study uses the yearly score of GCI and its three sub-indices, particularly, BR, EE, and IS in the context of South Asian economies. There are six countries (India, Sri Lanka, Nepal, Bangladesh, Pakistan and Bhutan) according to the report of the World Economic Forum which was published in the year 2016–2017 (Schwab, 2016). I considered five countries for the study because the data relating to the annual score of Bhutan is not available uniformly. The study period covers from 2010–2011 to 2016–2017, and the annual scores of GCI and its sub-indices are collected from the official website of the World Economic Forum ([www.weforum.org](http://www.weforum.org)).

To examine the impact of sub-indices on GCI, panel data regression technique is applied. Here, GCI is the countries' competitive performance indicator that depends on the performances of the remaining

independent indicators. There are five cross-sectional units (Countries/ economies) and seven time periods (2010–2011, 2011–2012, 2012–2013, 2013–2014, 2014–2015, 2015–2016, & 2016–2017). So, the number of observations is (N x T = 5 x 7) 35, or in other words, five countries are followed by seven years. If each cross-sectional unit has the same number of time series observations, then such a panel data is called a balanced panel. In this case, it is a balanced panel because each country in the sample has seven observations. It is assumed that GCI is expected to be positively related to BR, EE, and IS. Polling, or combining, all 35 observations, the basic model of the determinants of GCI is the following:

$$GCI_{it} = \alpha_{i1} + \beta_1 BR_{it} + \beta_2 EE_{it} + \beta_3 IS_{it} + e_{it} \quad (1)$$

Here i and t refer to cross-sectional and time series aspects of data respectively. As the number of cross-sectional units (N) is 5 and number of years (T) is 7, we have 35 observations on each variable (NT = 35).  $e_{it}$  is the disturbance term which is independently and identically distributed [ $e_{it} \sim i.i.d. (0, \sigma^2)$ ].

**Estimation of Panel Data Regression Model**

To estimate regression equation 1, there are three important approaches, which are Constant Coefficients Model (CCM), Fixed Effects Model (FEM), and Random Effects Model (REM). These models differ with regard to their assumptions regarding intercept, the slope coefficients, and the disturbance term. Here, CCM model is not considered because of its unrealistic assumptions regarding coefficients or it ignores the space and time dimensions of panel data set. In reality, the homogeneity assumption may not be true because different cross-sectional units may have different values for intercept and/or slope coefficients. However, this problem may be avoided by applying FEM or REM. These two models seek to make a more rational specification regarding heterogeneity among the cross-sectional units which is explicitly recognized, although the methods of doing so are different and thus, these models are viewed as proper panel data models.

**Fixed Effects Model (FEM)**

The FEM or least-squares dummy variable model allows for heterogeneity or individuality among five countries by allowing its own intercept value. The term

fixed effect is because the intercept may differ across the countries but it does not vary over time.

According to the equation 1,  $GCI_{it}$  is the Global Competitive Index of the  $i^{th}$  country in period “t.”  $BR_{it}$  is the vector of the control variables such as institutions, infrastructure, macroeconomic environment, and health and primary education.  $EE_{it}$  is the vector of control variables such as higher education and training, goods market efficiency, labor market efficiency, financial market development, technological readiness, and market size.  $IS_{it}$  is another vector of control variables that includes business sophistication and R&D innovation.  $e_{it}$  is the disturbance term.

**Random Effects Model (REM)**

The REM does not use dummy variables to capture the presence of individual effect because it represents a lack of knowledge about the (true) model. Hence, disturbance term is used to capture the abovementioned effect. This is precisely the approach suggested by the proponents popularly known as error components model (ECM) or REM.

The basic idea is to start by considering model 1:

$$GCI_{it} = \alpha_{i1} + \beta_1 BR_{it} + \beta_2 EE_{it} + \beta_3 IS_{it} + e_{it} \quad (2)$$

Instead of treating  $\alpha_{i1}$  as fixed, it is also assumed that the individual effect is a random variable with a mean value of  $\alpha_1$ . Then the intercept of  $i^{th}$  cross-sectional unit may be expressed as under:

$$\alpha_{i1} = \alpha_1 + \mu_i \quad i=1,2,\dots,5 \quad (3)$$

where  $\mu_i$  is a random error term with a mean value of zero and variance of  $\sigma_\mu^2$ . The study considers five countries and they have a common mean value for the intercept ( $=\alpha_1$ ) and the individual differences in the intercept values of each country are reflected in the error term  $\mu_i$ . Now substituting equation 3 into equation 2, we obtain:

$$GCI_{it} = \alpha_1 + \beta_1 BR_{it} + \beta_2 EE_{it} + \beta_3 IS_{it} + \mu_i + e_{it} \quad (4)$$

$$= \alpha_1 + \beta_1 BR_{it} + \beta_2 EE_{it} + \beta_3 IS_{it} + \omega_{it} \quad (5)$$

where,  $\omega_{it} = \mu_i + e_{it}$  is the composite error term that has two components—one is  $\mu_i$  which is the cross-section or country-specific error component and

$e_{it}$ , which is the combined time series and cross-sectional error component, sometimes called the idiosyncratic random term because it varies over cross-sectional units as well as time.

The usual assumptions that are made with regard to  $\mu_i$  and  $e_{it}$  are:

$$\begin{aligned} \mu_i &\sim N(0, \sigma_\mu^2) \\ e_{it} &\sim N(0, \sigma_e^2) \end{aligned} \quad (6)$$

$$E(\mu_i e_{it}) = 0 \quad E(\mu_i \mu_j) = 0 \quad (i \neq j)$$

$$E(e_{it} e_{is}) = E(e_{it} e_{jt}) = E(e_{it} e_{js}) = 0 \quad (i \neq j; t \neq s)$$

Here,  $\sigma_\mu^2 = \text{var}(\mu_i)$  and  $\sigma_e^2 = \text{Var}(e_{it})$

These assumptions imply that individual error components are not correlated with each other and also not correlated across the cross-sectional and time series units. Using these properties of  $\mu_i$  and  $e_{it}$ , we can work out the properties of  $\omega_{it}$ .

$$E(\omega_{it}) = 0 \quad (7)$$

$$\text{Var}(\omega_{it}) = \sigma_\mu^2 + \sigma_e^2 \quad (8)$$

Now if  $\sigma_\mu^2 = 0$ , there is no difference between model 1 and 4. Then pool all the (cross-sectional and time series) observations and run the pooled regression like Model 1. It is observed that  $\omega_{it}$  has zero mean and constant variance (homoskedasticity). However, it can be shown that  $\omega_{it}$  and  $\omega_{is}$  ( $t \neq s$ ) are correlated; that is, the error terms of a given cross-sectional unit at two different points in time are correlated. The value of such a correlation coefficient ( $\rho$ ),  $\text{corr}(\omega_{it}, \omega_{is})$  is:

$$\rho = \frac{\sigma_\mu^2}{\sigma_\mu^2 + \sigma_e^2} \text{ for } t \neq s \quad (9)$$

If this correlation structure is ignored and estimate the REM (Model 4) by OLS method, the resulting estimators will be inefficient. The most appropriate method to estimate the REM is through the Generalized Least Squares (GLS) method.

### The Hausman Test

The suitable model between the two models (FEM & REM) is determined by applying the Hausman Test. It is pointed out earlier that REM is not preferred if the composite error term ( $w_{it}$ ) gets correlated with the explanatory variable(s). Hausman (1978) developed a test based on the idea that if there is no correlation between  $w_{it}$  and explanatory variable(s) then both OLS and GLS are consistent but OLS is inefficient. On the contrary, if such correlation exists then OLS is consistent but not GLS. Hausman assumed that there are two estimators, namely,  $\hat{\beta}^{FEM}$  and  $\hat{\beta}^{REM}$  of the parameter vector  $\beta$  and, thus, two approaches are conducted for testing hypothesis as under:

- H0: Both  $\hat{\beta}^{FEM}$  and  $\hat{\beta}^{REM}$  are consistent but  $\hat{\beta}^{FEM}$  is inefficient
- Ha:  $\hat{\beta}^{FEM}$  is consistent and efficient but  $\hat{\beta}^{REM}$  is inconsistent

Here,  $H_0$  (random effects are consistent and efficient) against  $H_a$  (random effects are inconsistent, as fixed effects will always be consistent). Hausman considered  $\hat{q} = (\hat{\beta}^{FEM} - \hat{\beta}^{REM})$  as the basis for the relevant test statistic and it may be written as:

$$H = \hat{q}' [ \text{Var}(\hat{\beta}^{FEM}) - \text{Var}(\hat{\beta}^{REM}) ]^{-1} \hat{q} \sim \chi^2(k) \quad (10)$$

where,  $k$  is the number of explanatory variables. The decision rule is if the computed value of Chi-square is greater than the theoretical value of Chi-square at a chosen level of significance  $\gamma$  with degrees of freedom  $k$ , that is,  $\chi^2 > \chi_\lambda^2(k)$  then reject  $H_0$ , meaning that REM is consistent and accept the fixed effect estimator. Otherwise, accept  $H_0$  if  $\chi^2 \leq \chi_\lambda^2(k)$  which means random effect estimator is preferable.

The study further checks the model superiority between the fixed effect and Pooled OLS regression. One way to take into account the individuality of each country or each cross-sectional unit where the intercept is allowed and varies for each country, but still it is assumed that the slope coefficients are constant across the countries. Here, the difference in the intercept may be due to the countries' performances. It is also noted that the slope coefficients of the regression equation 1 do not vary across countries. This situation can be solved if the dummy variable is used and then equation 1 will be:

$$GCI_{it} = \alpha_1 D_{1t} + \alpha_2 D_{2t} + \alpha_3 D_{3t} + \alpha_4 D_{4t} + \alpha_5 D_{5t} + \beta_1 BR_{it} + \beta_2 EE_{it} + \beta_3 IS_{it} + e_{it} \tag{11}$$

Here, the intercept is considered as a variable and uses dummy variables to account for differences among the countries with regard to the value of intercept. The study considers five cross-sectional units and, thus, five dummy variables are used to avoid the dummy variable trap. Now,  $D_1=1$  if the observation belongs to India, 0 otherwise;  $D_2=1$  if the observation belongs to Sri Lanka, 0 otherwise;  $D_3=1$  if the observation belongs to Nepal, 0 otherwise;  $D_4=1$  if the observation belongs to Bangladesh, 0 otherwise; and  $D_5=1$  if the observation belongs to Pakistan, 0 otherwise. At this point, the dummy variable is used to estimate the fixed effects and the model is termed as least-squares dummy variable model or covariance model where BR, EE, and IS are known as covariates.

Now a question arises regarding the appropriateness of the model between pooled OLS regression and fixed effect model. This can be judged by applying the Wald test and the hypothesis for judging superiority are:

- $H_0$ : Pooled OLS regression model meaning that all dummy variables will be 0
- $H_a$ : Fixed Effect Model

### Results

The result of FEM and REM are presented in Table 1. It is observed that the coefficients of BR and EE are

positive and statistically significant to explain the GCI of the South Asian countries based on FEM. However, IS factor is positive and statistically insignificant to explain the GCI. Similarly, in the case of REM, BR and EE factors are positive and statistically significant to explain the GCI. However, IS factor is negative and insignificant to explain the GCI. The  $R^2$  (0.995406) value of FEM is slightly higher as compared to the REM (0.989454). The estimated D-W statistic is quite low based on the FEM model which means that positive autocorrelation exists in the data.

Table one also presents the Hausman test statistic. It is observed that the Hausman test statistic is 8.196921 and the probability value is 0.0421 which is less than 5%, meaning that the null hypothesis is rejected and can accept the alternative hypothesis. Thus, FEM is an appropriate model to explain the GCI function.

The study further checks regarding appropriateness of the model between FEM and pooled regression. Here, the dummy variables are used to estimate FEM. The result of the FEM based on model 2 is given in Table 2. It is found that the coefficients of the BR and EE are statistically significant and the probabilities values are less than 5%, meaning that global competitiveness index is influenced by those variables. Whereas, IS factor is not a significant variable to explain the GCI because the probability value is higher than 5%. Moreover, the estimated coefficients of the countries' dummies are negative and statistically insignificant, which means the variables are not able to explain the GCI function properly in the context of South Asian

**Table 1**  
*Estimation of FEM and REM*

Variable	FEM			REM			Hausman Test	
	Coefficient	t-statistic	R <sup>2</sup>	Coefficient	t-statistic	R <sup>2</sup>	$\chi^2$	df
Constant	-0.231980	-0.983273 (0.3342)	0.995406	0.30293	0.417891 (0.6789)	0.989454	8.196921 (0.0421)	3
BR	0.577376	11.94970* (0.0000)		0.549414	30.07260* (0.0000)			
EE	0.383582	5.552325* (0.0000)	<b>D-W statistic 1.321369</b>	0.465030	12.93166* (0.0000)		<b>D-W statistic 1.161349</b>	
IS	0.100672	1.020537 (0.3165)		-0.031909	-1.101676 (0.2791)			

\*significant at 5% level. Values in parenthesis are the probabilities values.

Source: Author's own calculation

**Table 2**  
*Estimation of FEM Using Dummy Variables*

Variable	Coefficient	t-stat	Prob.	R <sup>2</sup>	D-W	Wald	Test
						F-stat	$\chi^2$
BR	0.577376	11.94970*	0.0000	0.995406	1.321369	0.342341	1.69434
EE	0.383582	5.552325*	0.0000			(0.9432)	(0.9512)
IS	0.100672	1.020537	0.3165				
India	-0.250995	-0.918224	0.3666				
Sri Lanka	-0.319430	-1.228337	0.2299			df=(5, 27)	df=5
Nepal	-0.182414	-0.905993	0.3730				
Bangladesh	-0.188051	-0.866763	0.3937				
Pakistan	-0.219010	-0.927756	0.3618				

\*Significant at 5% level.

Source: Author's own calculation

**Table 3**  
*Estimation of FEM and Cross Section Fixed Effect*

Variable	Coefficient	Probability	Country	Effect
Constant	-0.231980	0.3342	India	-0.019015
Basic Requirements	0.577376	0.0000	Sri Lanka	-0.087450
Efficiency Enhancers	0.383582	0.0000	Nepal	0.049566
Innovation & Sophistication	0.100672	0.3165	Bangladesh	0.043929
			Pakistan	0.012970

Source: Author's own calculation

**Table 4**  
*Comparative Average Performance*

Country	GCI	Rank	BR	Rank	EE	Rank	IS	Rank
India	4.324	1	4.331	2	4.365	1	3.971	2
Sri Lanka	4.225	2	4.534	1	3.981	2	3.973	1
Nepal	3.628	4	3.892	3	3.324	5	2.862	5
Bangladesh	3.715	3	3.830	4	3.614	4	3.040	4
Pakistan	3.478	5	3.388	5	3.632	3	3.452	3

Source: Author's own calculation

regions and it is also observed from the Wald test that the estimated F-statistic (0.342341) and chi-square statistic (1.69434) are insignificant and the probabilities values are higher than 5%, which means the null hypothesis regarding FEM with dummy variable is not an appropriate model to explain the GCI function.

Finally, the fixed effect model without the dummy variable is the appropriate model. It is previously found that the explanatory variables such as BR and EE are the

significant variables that influence the GCI positively in the South Asian countries/economies. Here the IS factor is positive but statistically insignificant. The cross-section fixed effects are non-zero that confirms the presence of a fixed effect.

The comparative average performance of the global competitiveness index and its competitiveness drivers are given in Table 4. It is found that the GCI of India (4.324) is highest as compared to the other countries.

Although, the GCI (4.225) of Sri Lanka is very close to India and ranked second. Pakistan is the worst performer as compared to the others. In terms of basic requirements, Sri Lanka acquires the first position as compared to the others while India is very close to Sri Lanka. According to the EE factor, India stands first as compared to the others and Sri Lanka occupies the first position based on IS driven factor.

## Conclusion

The present study applies panel data regression technique because panel data combines the inter-country differences and intra-country dynamics and have advantages over the cross-sectional or time-series data. It has a greater capacity to capture the diverse complexity of CI than a single cross-section or time series data. The study concludes that FEM is superior as compared to the CCM and REM based on various statistical tests in the context of South Asian countries because FEM perfectly estimates the coefficients of the parameters which are statistically significant and positively affect the GCI.

Based on GCI ranking, India stands first as compared to the other South Asian countries. Finally, it may be recommended that panel data regression model whether it may be FEM or REM accurately estimates the model parameters and it contains more degrees of freedom and more sample variability than cross-sectional or time series analysis.

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