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Corruption-Growth Nexus in SAARC Nations: A Panel Autoregressive Distributed Lag Model (ARDL) Landscape

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Abstract

Purpose: This study aims to analyze the dynamic impact of corruption on the economic growth of SAARC nations (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Srilanka) using the data between 2002-2022. This study is also devoted on the determination of the impact of foreign direct investment and trade of coastal countries on the overall economic growth of SAARC nations.

Research Methods: It employed panel ARDL (Autoregressive Distributed Lag) method without location dummy, with location dummy and, with interaction variables such as coastal FDI (Foreign Direct Investment) and coastal TR (Trade) along with the Dumitrescu-Hurlin (D-H) test of causality to explain the nature of data econometrically.

Results: Results of the findings show that corruption does not have any significant effect on the economic growth of SAARC nations in the short-run, however, corruption has found to impede the economic growth in the long-run significantly. One unit increase in control of corruption leads economic growth to decrease by 45.09 units and 22.91 units respectively (with dummy and with interaction variables). Moreover, the GDPPC (Gross domestic product per capita) of coastal countries is found to be 653.93 units more than that of landlocked countries. D-H test result shows the existence of no causal relationship between economic growth and corruption in the short-run, but corruption has a bidirectional causal relation with dependency ratio.

Implications: The paper will provide a fruitful enquiry both in theory and methodology for researchers, academicians, and students to further their studies in the same field.

Originality- It stands for a theoretical basis and strategies founded on the analyzed links between the variables.

Keywords: Corruption, economic growth, location dummy, panel ARDL and D-H test

Introduction

Corruption is a word derived from the Latin verb "Corrumpere" which means to break. Transparency International has defined corruption as the abuse of entrusted power for private gain. It can be divided as grand, petty and political on the basis of the quantity of money and property lost and, the sector where it occurs (Tripathi, 2022). Jain (2001) indicated corruption as the heads of hydra's dragon which represents itself in many shapes but originates from the same body politic. Corruption exists in several forms such as dishonesty, fraud,

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bribery, embezzlement, blackmailing, nepotism and favouritism. (Mauro, 1995) concluded that corruption is calamitous to the growth and development of nations that lowers the quality of infrastructure projects and public services. However, an activity perceived as corruption in one nation may not be perceived as such in the other (Gyimah-Brempong, 2002). Economic individuals have various concepts regarding corruption that rely on their cultural background, discipline and political leaning (Gyimah-Brempong, 2002). The concept of corruption is not only burdensome and complex to define but, it also provokes meticulous debates among the scholars and, as a result of this, many scholars begin their studies with an attempt to clarify the concept of corruption (Jain, 2001).

SAARC is the geographically and ethnically cultured southern region of Asia including eight distinct nations viz. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Srilanka founded on 1985. The inauguration of SAARC was intended to establish the economic and regional integration among its member countries. These countries' global economic strength is likely to perpetuate approximately with combined macroeconomic impacts guided by the worst case scenario of vicious circle of poverty (Kalim et al., 2022). Despite of all these, according to World Bank, growth in SAARC nations is estimated to be at 6.0% in 2024, mainly followed by robust growth in India and recoveries in Pakistan and Sri Lanka. However, SAARC governments have been confronting with corruption concerns in their respective countries possibly dampening their economic potential. Civil war, religious war, terrorism, illegal money laundering and many ups and downs have become indispensible characteristics of south Asian nations (Tripathi, 2022).

Corruption is an economic, cultural, moral and political problem which is considered as a universal phenomenon that exists in all developed and developing countries in non-profit and charity organizations as well as public and private sectors (Christos, 2018). However, Rock and Bonnett (2004) described Asian Paradox as the rapid increase in economic growth despite of high surviving dose of corruption. Gyimah-Brempong (2002) also disclosed the reality of one country's high dose of corruption benefitting other country in the significant way. Hence, corruption has not only a single deteriorating impact rather; it has its two sides which were better elaborated long ago by Leff (1964), Leys (1965) and Mrydal (1968) that led to the birth of two hypotheses viz. greases the wheel and sands the wheel hypotheses, which has been ruling the world of economic research in corruption (Alfada, 2019). Meanwhile, the macroeconomic study on the concept of corruption and economic growth in SAARC nations sparsely exists and, this is a matter of significant perturbation. The previous empirical researches were only confined to study the relationship of corruption and economic growth with a set of control variables. Past studies conducted by Huang (2012), Thach, Duong and Oanh (2017), Nguyen and Luong (2020), Mumtaz and Smith (2021), Miah, Ratna and Majumder (2021) and Siddiqui (2023) ignored the cross-country time invariant factor like location and, comparison of partial interacting effect of selected variables in SAARC nations. Thus, considering common and uncommon cross country characteristics, time invariant properties (here location in terms of coastal and landlocked) and, expected long-run and short run dynamics, we have the following research objectives.

Objective of the Research Paper

The overarching objective of this study is to investigate the short-run and long-run dynamic impact of corruption, foreign direct investment, and trade on the economic growth along with unidirectional and bidirectional causality of the other variables of SAARC nations (Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka) using data from 2002 to 2022.

Literature Review

Economists have been empirically established the mixed effects of corruption on economic

growth and hold contrasting views regarding the role of corruption in economic growth (Khalil & Rehman, 2019).

Theoretical Review of Corruption

Leff (1964) gave the first theoretical framework on the concept of corruption and economic growth considering two opposing hypotheses (greases the wheel hypothesis and sands the wheel hypothesis), which has been popularizing its impact in the theoretical review in the research of corruption (Alfada, 2019). Whether, corruption has lubing or sanding effects on the wheels of economic growth is a hot topic of perpetual debate that inspires more studies (Bardhan, 1997). Greases the wheel hypothesis believes that corruption fosters the efficiency of economic growth by enabling private sector players to evade burdensome laws and increases commerce that could not have occurred otherwise (Meon & Weill, 2010). For example, when there are incomplete contracts or market failures, a certain amount of corruption might be necessary to allocate resources in its best way. This viewpoint is somewhat justified by the argument that unlawful payments are necessary in order to move things quickly and favorably via the state bureaucracy (Amundsen, 2019). Another example of the greases the wheel hypothesis is 'the Asian paradox' which means that Asian nations have a reputation for growing quickly despite having high perceived corruption scores (Rock & Bonnett, 2004). Sands the wheel hypothesis argues with the greasing wheel hypothesis of corruption by the fact that corruption impedes or muddies the path toward sustainable development and long-term economic growth (Reinikka & Svensson, 2005). The transmission mechanisms of these negative impacts include reduction in domestic and foreign investment, increment in the cost of production, misallocation of national and natural resources, high level of poverty and inequality and, uncertainty in decision making (Ajie & Wokekoro, 2012).

Theoretical Review of Economic Growth

The vastness of the theories of economic growth can be realized sailing on the unfathomable literature of economics' multiverse. Thus, the theoretical understanding of economic growth comprises of different concepts emerging from classical school of thought to endogenous growth theory.

"An enquiry into the nature and causes of the wealth of nation" by Adam Smith (1776) is regarded as the mark point for the rise of classical economics. The wealth of nation is based not on gold, but on trade is the most rudimentary message in Smith's influential book. He concluded that division of labor creates more productive processes and leads to economic growth. Malthus (1798) in his famous book "An Essay on the Principal of Population" considered that an unwanted increase in population is the leading cause that impedes economic growth (Lavrov & Kapoguzov, 2006). David Ricardo gave the idea to enhance economic growth with the aid of comparative cost advantage theory in his book "Principle of Political Economy and Taxation" in 1817. Joseph Alois Schumpeter coined the term "innovation" into the economy and introduced the entrepreneur's new importance in economic growth (Lavrov & Kapoguzov, 2006). John Maynard Keynes in his book "General Theory of Employment, Interest and Money" in 1936 focused on the effective demand as the central point for the stimulation of economic growth. Harrod gave the concept of economic growth in his book "An Essay in Dynamic Theoy" in 1939 which is inclined to the study of the economy's growth trajectory based on the theory of accelerator. Evsey Domar propounded the theory of economic growth in his book "Essays in the theory of economic growth" in 1957, which shows the dual effects of investment, one on the demand side of the economy and the other on the supply side of the economy. Nation should focus on the growth rate of growth of investment which makes growth of income equal to the growth rate of productive capacity (Domar, 1946). The Solow-Swan model is also known as the exogenous/ neo-classical growth model that was developed separately by Robert M. Solow and Trevor Swan during 1950s. The Solow-Swan growth model is the overcome to Harrod-Domar growth model which depends on the Cobb-Douglas production function at its

root and represents the long run economic growth by considering the significant effect of capital accumulation, labor or population growth and increase in productivity that largely depends on the technological progress (Apostol et al., 2022). Human capital theory developed by Schultz, Mincer and Becker during 1960s is actually a modern extension of idea of wage differentials given by Adam Smith in 1776. This theory seeks to analyze and explain the economic gains of investing in health and education to improve the nation's productivity and considered human capital as an engine of growth (Lucas, 1988). The endogenous growth theory is a pivotal in the development of the theory of economic growth during 80s and 90s, which defines economic growth along with quality of human capital, protection of intellectual property right, underpin for scientific and technological development, creation of appreciative investment climate and attraction for new technologies by the government (Sharipov, 2015).

Empirical Review

The empirical literature review for this research is done both on the global/ non-Asian context and Asian context.

Global Context/ Non-Asian Context

Anoruo and Braha (2005) explored the effect of corruption on economic growth in eighteen African countries by using panel data from the period of 1998 to 2000. They investigated this relationship with the help of Phillips-Hansen fully modified OLS (FMOLS) technique and showed that corruption inhibits investment and lowers productivity, which directly and indirectly impede economic growth. In the same way, Ertimi, et al. (2016) studied the impact of corruption on economic growth of 14 OIC countries. They employed TSLS (two stage least square) method for the analysis panel data of 2003-2010 and showed that economic growth is negatively affected by corruption i.e., higher the level of corruption lower the economic growth. Obamuyi and Olayiwola (2019) examined the effects of corruption on economic growth in Nigeria and India by the aid OLS regression method in Mo's Framework (2001) for panel data from the period 1980-2015 The results of their findings demonstrated that, in both nations, corruption has a negative impact on economic growth through investment and human capital. Meanwhile, Alfada (2019) analyzed the effect of corruption on economic growth in nine ASEAN nations from 1999 to 2016. They used threshold model, ME estimation and TSLS to empirically determine the growth-enhancing or growth-deteriorating effect and, concluded that corruption does not have any discernible negative impact on the economic growth at the lower threshold but, has venomous negative impact at the higher threshold level. Haw, Kueh and Ling (2020) made a non-linear investigation on the corruption and growth relationship of ASEAN countries over the period of 1996-2018 using panel ARDL and concluded that that there is a significant U-shaped relationship between control of corruption and economic growth of ASEAN countries. They also showed that corruption will be detrimental to the growth only beyond the threshold level.

Dada, Adedeji and Fatola (2020) studied the relation of corruption, government expenditure and economic growth in selected 10 ECOWAS countries over the period of 2005 to 2018. They employed panel ARDL model for the empirical analysis and found a positive but insignificant relation of corruption with economic growth in the short-run, while negative and significant relation in the long-run. Simo-Kengne and Bitterhout (2020) investigated the impact of corruption on economic growth in the BRICS countries using a panel dataset covering the years from 1996 to 2014. Researchers employed first difference GMM and system GMM method of analysis and, concluded that there exists a negative relation between economic growth and the corruption. However, researchers depicted a positive and considerable relationship when both heterogeneity and endogeneity (GMM parameters) are considered. Belloumi and Alshehry (2021) explored the causal relationship between corruption, investment and economic growth in GCC countries over the period of 2003-2016 by using FMOLS and panel VECM and, concluded that corruption does not cause economic growth in the short-run but, has a strong unidirectional causality to economic growth in the long-run. However, Ahamd et

al. (2023) investigated institutional quality and economic development in 70 developing countries from the period of 2002 to 2018 by employing CS-ARDL model and, showed that institutional quality and globalization positively affect economic development while, corruption negatively affects economic development in the long-run. Densumite (2023) studied the relationship of corruption and economic growth in 12 countries (considering each continent) from 1995 to 2020. By using Panel VECM model researcher indicated that there exist a negative, significant and causal relationship between perceived corruptions and the economic growth both in the short-run and long-run.

Asian Context

Huang (2012) analyzed the relationship of corruption and economic growth within 10 Asian countries over a period of 1995 to 2010 by using Panel VECM model and, concluded that corruption increases economic growth. Thach, Duong and Oanh (2017) studied the effect of corruption on the economic growth of Asia. For this, they analyzed the panel data of 19 Asian nations from 2004 to 2015 using D-GMM and quantile regression technique and, indicated that corruption has positive impact on economic growth at low quantiles while, negative impact at high quantiles. In the same way, Nguyen and Luong (2020) examined corruption, shadow economy and economic growth of 17 selected emerging and developing Asian countries during the span of 2000- 2015 by applying Generalized Methods of Moments (GMM) and, showed a significant and positive relation of corruption with the economic growth. Furthermore, Mumtaz and Smith (2021) studied the impact of corruption on economic growth of 42 Asian countries within a period of 1996 to 2018. They applied country-fixed effect OLS (ordinary least square) and the system GMM techniques and, revealed that a high level of corruption is degrading the economic growth in Asian countries.

Meanwhile, Miah, Ratna and Majumder (2021) explored the effect of corruption on economic growth of Bangladesh, India and Pakistan. The study was conducted within a period of 1990 to 2016 by employing ARDL-ECM model to analyze the data empirically and, illustrated that corruption is positive but insignificant in the long-run. Likewise, Siddiqui (2023) analyzed the relationship between corruption and economic growth in the context of six Asian countries from 1996 to 2021 by using pooled OLS regression model and, found a significant and negative impact of corruption on economic growth.

Research Methodology

This research is devoted to analyze the short-run and long-run dynamics of corruption and economic growth using annual data of SAARC nations (viz. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Srilanka) over the period of 2002 to 2022. The reason for selecting SAARC nations for the study is due to the high vulnerability in economic growth. Out of various vulnerable factors, a vicious circle of corruption is at the core of economic growth in this region (Tripathi, 2022). In the same way, the present study is confined to deter the impact only after 2002 due to lack of data. Data for GDPPC (Gross domestic product per capita), CORR (Control of corruption), DR (Dependency Ratio), FDI (Foreign direct investment, net inflows as the % of GDP), BMS (Broad money as the % of GDP), TR (Trade i.e. sum of exports and imports as the % of GDP) and POA (Political Stability and Absence of Violence) are taken from the World Bank dataset, while GE (Government expenditure as the % of GDP) is taken from IMF.

Description of Variables

The list of variables used in the study is described as below:

Dependent variable

Gross Domestic Product Per Capita (GDPPC): The World Bank defines GDPPC the ratio of the sum of all goods and services produced within an economy during a time period to the mid-year population of that economy. Plethrora of previous studies eg. Alfada (2019), Barro and Sala-i-Martin (2004), Simo-Kengne and Bitterhout (2020) have used GDPPC as the proxy variable for economic growth.

Independent variable

Corruption (CORR)

Control of corruption in percentile rank indicates the rank 0 for the country with lowest control in corruption and, rank 100 representing the country with highest level of control of corruption among all countries considered by the World Bank. Haw, Kueh and Ling (2020), Mumtaz and Smith (2021) have used control of corruption as a proxy variable for corruption.

Control Variables

Dependency Ratio (DR)

Dependency ratio is defined as the ratio of dependent population below 15 years and above 64 years of age to the total working age population (15-64). The value of data of dependency ratio indicates the proportion of dependents per 100 working age population. Different studies done by Ray and Webster (1978), Bidisha et al., (2020), Ginting et al. (2020) used dependency ratio as a potential variable to analyze economic growth and found significant results.

Foreign Direct Investment (FDI)

Foreign direct investment is the total amount of investment made to the nation by the foreign sectors or nations. It is measured in terms of the percentage of GDP. Different studies done by Boussalham (2018), Spyromitros and Panagiotidis (2022), Makar et al. (2023) have used FDI to study the impact of corruption on economic growth.

Government Expenditure (GE)

GE is the final consumption (recurrent and capital) expenditure of the government and, in this study it is taken as a percentage of GDP. Different researches done by Neanidis, et al. (2017), Emara (2020), Keita and Laurila (2021) have used government expenditure as a control variable to study the impact of corruption on economic growth.

Broad Money Supply (BMS)

The World Bank defines broad money as the demand deposits of other (excluding central government), currency outside banks, deposits (time, savings and foreign currency) of residence sectors except the central government, bank and traveler's check and, certificates of deposit, securities and commercial paper. Here, BMS is undertaken as a share of GDP. Ahmed et al. (2018), Spyromitros and Panagiotidis (2022) have taken the money supply as a policy variable to measure the impact of corruption on the economy.

Trade (TR)

Trade can be defined as the sum of exports and imports of goods and services measured as a share of gross domestic products. Ertimi, et al. (2016), Alfada (2019), Haw, Kueh and Ling (2020) have used trade as a potential variable to analyze economic growth.

Political Stability and Absence of Violence (POA)

The World Bank defines political stability and absence of violence as the estimation of occurrence political stability or, absence of violence influenced by politics (including terrorism). It is measured by percentile rank indicating 0 (with lowest rank) represents most unstable and 100 (with the highest rank) represents most stable. Grossman (1991), Alesina et al. (1996), Mandal (2022) used this variable to analyze economic growth.

Dummy Variables

Location dummy

Location dummy (i.COASTAL; 1 for coastal and, 0 otherwise) and (i.LANDLOCKED; 1 for landlocked and, 0 otherwise) is introduced to understand the impact of location on GDPPC. Sala-i-Martin, Gernot and Miller (2003), Barro and Sala-i-Martin (2004), Ertimi, et al. (2016) used location dummy for estimation of economic growth.

Interacting variables

Two interacting variables i.e. COASTAL*FDI and COASTAL*TR (created by multiplying value of coastal dummy with foreign direct investment and trade respectively) are introduced to analyze the impact of coastal countries' foreign direct investment and coastal countries' trade on economic growth of SAARC nations. The source of data with their expected sign is presented below in Table 1 as;

Table 1

Sources of Data

Variables	Full Form	Source	Expected Sign
GDPPC	Gross domestic product per capita as a proxy for economic growth	World Bank	Dependent variable
CORR	Control of corruption as a proxy for corruption	World Bank	+ve (Positive)
DR	Dependency Ratio	World Bank	-ve (Negative)
FDI	Foreign direct investment, net inflows (% of GDP)	World Bank	+ve (Positive)
GE	Government expenditure(% of GDP)	IMF	-ve (Negative)
BMS	Broad money (% of GDP)	World Bank	-ve (Negative)
TR	Trade (sum of exports and imports as a % of GDP)	World Bank	+ve (Positive)
POA	Political Stability and Absence of Violence	World Bank	+ve (Positive)
i.COASTAL	Location dummy (1 for coastal and, 0 otherwise)		+ve (Positive)
COASTAL*FDI	Foreign direct investment of coastal countries		+ve (Positive)
COASTAL*TR	Trade of coastal countries		+ve (Positive)

Models Specification and Tests

Referring the framework in Barro (1991), Levine and Renelt (1992) and Sala-i-Martin (1997), y_i (economic growth) of country i over a certain range t is modeled as:

$$y_i = \gamma_0 + z_{it}\gamma_k + \beta_i x_{it} + \varepsilon_{it} \ldots (1)$$

where, $\varepsilon_{it} \sim N(0,\sigma^2_\varepsilon)$

In equation (1), y_i represents the average growth rate of GDP of country i over a time period of t. According to Levine and Renelt (1992), z_i represents a vector of regressors over the same year range of country i, which is believed to influence economic growth and will include the variables that are never excluded in the regression. X_i represents a subset of the control variables chosen from a pool of variables identified by past studies as a potential driver of economic growth. Now, incorporating variables of interest in the above framework given by eq^n (1) we get,

$$GDPPC_{it} = \alpha_0 + \gamma CORR_{it} + \beta_k Z_{it} + \lambda_1 i.COASTAL + \lambda_2 COASTAL*FDI + \lambda_3 COASTAL*TR + \varepsilon_{it} \ldots (2)$$

Where,

$GDPPC_{it}$ = Dependent variable, $CORR_{it}$ = Independent variable and,

Z_{it} = Control Variables = DR_{it}, FDI_{it}, GE_{it}, BMS_{it}, TR_{it} and POA_{it};

k = 1 2,…,8, i = 1,2,…8 and, t =1,2,…,T

Equation (2) is the required regression model on which the entire study is depend.

Panel ARDL

Pesaran and Smith (1995) mentioned in their research paper that for T > N, the traditional procedures for estimation of pooled model such as fixed effects methods, instrumental variables methods or Generalized Method of Moment (GMM) estimators proposed by Anderson and Hsiao (1981,1982), Arellano (1989), Arellano

and Bover (1995), Keane and Runkle (1992) and, Ahn and Schmidt (1995) produce inconsistent and potentially misleading estimates of the mean values of the parameters of the dynamic panel data model. Thus, for the data having T > N, panel ARDL gives the best estimate by capturing true dynamic property and considering the problem of both endogeneity and heteroscedasticity.

Furthermore, some necessary conditions needed to be fulfilled in order to run panel ARDL model are described as;

Unit Root Test

Before performing a panel ARDL, the data must be stationary of the order I (1) and I (0) (i.e. a mix of I(1) and I(0)). The unit root (stationary) test based developed by Levin-Lin-Chu (2002) and Im-Pesaran-Shin (2003) are carried out in this study.

$$\Delta y_{it} = \varphi_i y_{i,t-1} + z'_{it}\gamma_i + \sum_{j=1}^{p_i} \rho_{ij}\ \Delta y_{i,t-j} + \varepsilon_{it};$$

Constant and trend … (11)

$$\Delta y_{it} = \varphi_i y_{i,t-1} + \sum_{j=1}^{p_i} \rho_{ij}\ \Delta y_{i,t-j} + \varepsilon_{it};$$

No constant… (12)

Where,

y represents the selected variable, i represents country and, t represents year

i = 1,…, N represents panels

t = 1,…,T represents time

y_{it} = test varible

ε_{it} = stationary error term.

The term zit in eqn (11) represents panel specific means and, a time trend. If $z_{it} = 1$ then, $z'_{it}\gamma_i$ represents panel specific means (fixed effects). If trend is specified in eqn (11) as $z_{it} = (1, t)$ then, $z'_{it}\gamma_i$ represents the presence of specific means and linear time trends. The condition of no constant omits the $z'_{it}\gamma_i$ term as in eqn (12) (StataCorp, 2021).

ARDL Model

The method of panel ARDL is more advanced regardless of the order of regressors i.e. I(1), I(0) or a mixture of both (Pesaran and Shin, 1998). The main equation of panel ARDL is written below (Pesaran, Shin and Smith, 1999),

$$\Delta y_{it} = \varphi_i y_{i,t-1} + \beta_i' x_{it} + \sum_{j=1}^{p-1} \lambda_{ij}^{*} \Delta y_{i,t-j} + \sum_{j=0}^{q-1} \delta_{ij}^{*\prime} \Delta x_{i,t-j} + \mu_i + \varepsilon_{it} \ldots (13)$$

where, i = 1,2,…,N and t = 1,2,…,T

$\varphi_i = -\left(1 - \sum_{j=1}^{p} \lambda_{ij}\right)$, $\beta_i = \sum_{j=0}^{q} \delta_{ij}$

$\lambda_{ij}^{*} = -\sum_{m=j+1}^{p} \lambda_{im}$, j = 1,2,…,p−1 and, δ_{ij}^{*}

$= -\sum_{m=j+1}^{q} \delta_{im}$, j = 1,2,…, q−1

x_{it} represents k×1 vector of regressors for group i, μ_i represents the fixed effects, λ_{ij} is the coefficients of the lagged regressand and are scalars, δ_{ij} are coefficient vectors of order k×1 and, T must be greater than N. Similarly, other types of fixed regressors and time trends (seasonal dummies) can be included in eqn (13) (Pesaran, Shin and Smith, 1999).

Granger Causality Test

Konya (2006) and Dumitrescu-Hurlin (2012) have proposed quite significant methods to test granger causality in panel data. Granger causality test by Konya (2006) considers cross sectional dependencies while D-H test does not account for the cross country heterogeneity across panel data. In our case, we had balanced panel data, thus, to ignore cross sectional slope heterogeneity, we employed Dumitrescu-Hurlin (D-H) test (2012) to assess the causality between the selected variables of interest. This method is suitable for both T > N and N > T, (Akbas et al., 2013).

$$y_{it} = \sum_{k=1}^{K} \gamma_i^{(k)}\ y_{i,t-k} + \sum_{k=1}^{K} \beta_i^{(k)}\ x_{i,t-k} + \varepsilon_{it}$$

Here, K represents for the lag length. Moreover, the panel for the test should be balanced. $\gamma_i^{(k)}$ is an autoregressive parameter whereas, $\beta_i^{(k)}$ is a regression coefficient pitch.

Results and Discussion

Descriptive Statistics Result

All of the variables in the study are essentially summarized in the descriptive statistics in table 2 with respect to the number of instances, minimum and maximum values, means, and the degree to which the means accurately reflect the data that was gathered (the standard deviation).

Table 2

Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
GDPPC	168	2214.648	2439.128	182.174	11780.817
CCP	168	34.92	22.569	0.529	93.333
DR	168	62.708	17.862	35.399	109.448
TR	168	64.112	38.039	23.129	184.09
FDI	168	1.986	2.998	-.639	16.783
GE	168	22.799	9.21	7.7	49.899
BMS	168	55.803	18.407	23.344	120.657
POA	168	26.295	27.649	0.472	94.686

Note. BMS = Broad Money Supply, CCP = Control of Corruption, DR = Dependency Ratio, FDI = Foreign Direct Investment, GDPPC = Gross Domestic Product Per Capita, GE = Government Expenditure, POA = Political Stability and Absence of Violence and, TR = Trade (sum of exports and imports as a % of GDP); Source: - authors' calculation using STATA 17

The data consists of 168 observations of SAARC nations in which GDPPC is measured in current $, CCP and POA are measured in percentile rank, DR is dependency ratio % of working age population while all other remaining variables are measured in the % of GDP. The average value of GDPPC is found to be 2214.65 $ (nearly stands with Bangladesh during 2020) with the maximum value of 11780.82 $ recorded for Maldives at 2022 while that of minimum value 182.17$ recorded for Afghanistan at 2002. Similarly, the corruption control (CCP) is 93.33 at its maximum for Bhutan recorded at 2020 and minimum recorded at 0.53 for Bangladesh during 2003 while the average is 34.92 recorded for Nepal during 2003. The maximum value of DR is 109.45 for Afghanistan recorded at 2003 and the minimum is 35.4 recorded for Maldives during 2004 while the average stands at 62.71 for Nepal during 2016. Meanwhile, the maximum value of trade (TR) is found to be 184.09% associated with Maldives during 2007 and the minimum of 23.13% for Pakistan during 2003 while the average 64.11% is recorded for Srilanka during 2008. Also, the average value of FDI is found to be 1.99% associated with Afghanistan (during 2007) and India (during 2016) and, the maximum value of 16.78% is associated with Maldives during 2019 while the minimum is -0.64% for Bhutan during 2016. In the same way, the average value of government expenditure (GE) is found to be 22.80% stands with Nepal during 2008 and the maximum value is 49.90% for Maldives during 2020 and, the minimum value of 7.7% is associated for Afghanistan during 2002. The maximum value of BMS is 120.66% for Nepal recorded at 2021 and the minimum is 23.34% recorded for Afghanistan at 2006 while the average stands at 55.80% for Bangladesh at 2017. Lastly, the average value of POA is found to be 26.30 (nearly stands with Nepal during 2018) with the maximum value of 94.69 recorded for Bhutan during 2006 while that of minimum value 0.47 recorded for Afghanistan and Pakistan during (2009, 2018, 2020 and 2022) and (2010 and 2011) respectively. Table 2 shows that BMS, CCP, GE, TR and DR are found to be highly volatile during the sample period.

Co-relation Matrix Result

Correlation of dependent variable with other regressors is glanced for the further processing of data in research and the result of Pearson's correlation analysis is shown in Table 3.

Table 3

Co-relation Matrix

Variables	GDPPC	CCP	DR	TR	FDI	GE	BMS	POA
GDPPC	1.000							
CCP	0.223	1.000						
DR	-0.631	-0.525	1.000					
TR	0.700	0.351	-0.304	1.000				
FDI	0.835	0.034	-0.393	0.752	1.000			
GE	0.510	0.692	-0.559	0.581	0.439	1.000		
BMS	-0.059	0.360	-0.451	-0.180	-0.152	0.436	1.000	
POA	0.535	0.799	-0.558	0.623	0.317	0.748	0.248	1.000

Note. Authors' calculation using STATA 17

Table 3 displays that GDPPC has strong positive correlation with TR and FDI, medium positive correlation with GE and POA, weak positive correlation with CCP while, strong negative correlation with DR but very weak negative correlation with BMS.

Panel Unit Root Test Result

The Im-Pesaran-Shin (IPS) and Levin-Lin-Chu (LLC) unit root tests are carried out to check the stationarity of data and result is displayed in Table 4.

Table 4

Panel Unit Root Test

	IPS Test		LLC Test		Conclusion
	Constant	Constant & Trend	Constant	Constant & Trend	
Test in levels					
GDPPC	2.770	0.255	0.734	-0.574	
CCP	-2.835***	-3.123***	-2.638***	-4.079***	I(0)
DR	-0.517	-5.011***	-5.029***	-6.149***	I(0)
TR	-2.091**	-0.905	-2.259**	-3.176***	I(0)
FDI	-2.521***	-3.078***	-3.506***	-4.975***	I(0)
GE	-0.727	-1.281	-2.248**	-2.842***	I(0)
BMS	0.260	0.019	-1.171	-1.17	
POA	-0.298	-0.061	-0.234	-2.053**	I(0)
Tests in first differences					
GDPPC	-4.908***	-4.69***	-4.189***	-4.343***	I(1)
CCP	-	-	-	-	
DR	-	-	-	-	
TR	-	-	-	-	
FDI	-	-	-	-	
GE	-6.699***	-4.794***	-6.414***	-4.524***	I(1)
BMS	-4.313***	-3.014***	-3.726***	-2.621***	I(1)
POA	-4.768***	-4.385***	-4.106***	-3.646***	I(1)

Note. *** represent at less than 1% level of significance and ** represent less than 5% level of significance.

The IPS and LLC unit root tests combinely show that the variables CCP and FDI are stationary at level both at constant and, constant and trend. LLC test shows that DR and TR are stationary at level both at constant and trend while, IPS test shows that DR is stationary at level at constant and trend and, TR is stationary at level at constant only. In the same way, the remaining variables (GDPPC, GE, BMS and POA) are stationary at first difference both at constant and, constant and trend. This shows that variables have mixed order of integration i.e. I(0) and I(1) which fulfills the preliminary condition to perform panel ARDL.

Panel ARDL Model Result

Table 5 shows the results of short-run and long-run relationship of dependent variable GDPPC with independent variable CCP along with the control variables DR, TR, FDI, GE, BMS and POA. The results are shown for the PMG and DFE as supported by STATA 17. The significance of Hausman test allows us to elaborate PMG estimates for the concerned ARDL model.

Table 5

GDPPC = f (CCP, DR, TR, FDI, GE, BMS, POA)

Variables	Pooled Mean Group		Hausman Test		Dynamic Fixed Effects	
D.GDPPC	Long-Run	Short-Run	χ^2 test	p-value	Long-Run	Short-Run
ECT	-0.255**				-0.253***	
D1. CCP		-0.114				5.434
D1. DR		236.076**				168.411***
D1. TR		4.028				0.271
D1. FDI		-19.697				54.060**
D1. GE		-1.748				-30.646***
D1. BMS		-28.593**				-37.990***
D1. POA		-2.520				2.007
CCP	2.275				-61.010***	
DR	-51.532***				-95.721***	
TR	-3.902				-8.173	
FDI	7.378				26.639	
GE	-71.927***				-95.490***	
BMS	29.800***				18.103	
POA	10.373				32.853*	
Constant		675.970***				137.030***
Hausman Test			0.013	0.99		

Note. *, ** and *** represents 10%, 5% and 1% level of significance. Source: - authors' calculations using STATA 17

Table 5 shows the significant long-run relationship of GDPPC with the concerned variables and the system converges to equilibrium at the speed of 25.5% per annum in the long-run. However, control of corruption does not seem to have any significant effect on GDPPC both in the short-run and long-run, which is similar to the result obtained by Dada, Adedeji and Fatola (2020) for the selected 10 ECOWAS countries in the short-run and, Miah, Ratna and Majumder (2021) for Bangladesh, India and Pakistan both in the short-run and long-run. Meanwhile, a significant short-run causality of DR and BMS shows that one unit increment in DR increases GDPPC by

236.07 units while one unit increment of BMS decreases GDPPC by 28.59 units in the short-run. In the same way, other variables do not show any short-run causality toward GDPPC. Meanwhile, one unit increment in DR decreases GDPPC by 51.53 units, one unit increment in GE decreases GDPPC by 71.93 units while one unit increment in BMS increases GDPPC by 29.80 units in the long-run. Thus, it can be concluded that there is both a long-run and short-run causal relationship of DR and BMS to GDPPC while only a long-run causal relationship exists from BMC to GDPPC.

Panel ARDL Model with Location Dummy Result

Table 6 shows the results of short-run and long-run relationship of dependent variable GDPPC with independent variable CCP along with the control variables DR, TR, FDI, GE, BMS and POA and, a dummy variable i.e. location dummy (i.COASTAL; 1 for coastal; 0 otherwise). The results for the PMG and DFE estimators are displayed in Table 6 as supported by STATA 17. The significance of Hausman test in Table 6 allows us to elaborate PMG estimates for the concerned ARDL model.

Table 6

Panel ARDL with Location Dummy

GDPPC = ƒ (CCP, DR, TR, FDI, GE, BMS, POA, i.COASTAL)

Variables	Pooled Mean Group		Hausman Test		Dynamic Fixed Effects	
D.GDPPC	Long-Run	Short-Run	χ^2 test	p-value	Long-Run	Short-Run
ECT	-0.090				-0.254***	
D1. CCP		1.822				5.598
D1. DR		38.764				168.284***
D1. TR		3.453				0.305
D1. FDI		-25.756				53.749**
D1. GE		-5.312				-30.356***
D1. BMS		-28.875**				-38.010***
D1. POA		-0.482				1.969
D1. iCOASTAL		-50.942				-74.111
CCP	-45.092***				-61.425***	
DR	-35.679*				-95.874***	
TR	-28.863***				-8.273	
FDI	33.431				29.085	
GE	-238.374***				-96.175**	
BMS	52.325***				17.947	
POA	83.712***				33.012*	
iCOASTAL	653.932***				-55.148	
Constant		910.602**				3168.272***
Hausman Test			0.05	0.99		

Note. *, ** and *** represents 10%, 5% and 1% level of significance. Source: - authors' calculation using STATA 17

Table 6 shows that there is no significant short-run relationship of GDPPC with CCP however, a long-run, negative and significant relation of control of corruption (CCP) is found to exist with GDPPC. The finding is consistent with the findings of Huang (2012), Nguyen and Luong (2020), Haw, Kueh and Ling (2020), Simo-Kengne and Bitterhout (2020) and, Belloumi and Alshehry (2021) indicated that in the long-run, one unit increase in control of corruption decreases

GDPPC by 45.09 units at 1% level of corruption. Meanwhile, the finding is in contrast with the study of Anoruo and Braha (2005), Ertimi, et al. (2016), Obamuyi and Olayiwola (2019), Alfada (2019), Mumtaz and Smith (2021), Siddiqui (2023) and, Ahamd et al. (2023). A significant short-run causality of BMS shows that one unit increment in BMS decreases GDPPC by 28.88 units in the short-run. In the same way, one unit increment in DR, TR and GE leads to decrease in GDPPC by 35.68, 28.86 and 238.37 units respectively in the long-run. While, one unit increases in BMS and POA increases GDPPC by 52.32 and 83.71 units respectively in the long-run. Similarly, Dummy variable i.COASTAL is positively significant and shows that the GDPPC of coastal countries is on an average 653.932 units more than landlocked country. Thus, it can be concluded that there is a long-run positive and short-run negative causal relationship of BMS and GDPPC while, a long-run and significant causal relationship exists from all other variables (except FDI) to GDPPC. However, the long-run convergence of the model with location dummy is not significant.

PMG-ARDL Model with Interaction Variables Result

Table 7 shows the results of short-run and long-run relationship of dependent variable GDPPC with independent variable CCP along with the control variables DR, TR, FDI, GE, BMS and POA, a dummy variable i.e. location dummy (i.COASTAL; 1 for coastal; 0 otherwise) and, interaction variables COASTAL*TRADE and COASTAL*FDI. The results for the PMG and DFE estimators are displayed in Table 7 as supported by STATA 17. The significance of Hausman test in Table 7 allows us to elaborate PMG estimates for the concerned ARDL model.

Table 7

Panel ARDL Model with Interaction Variables

*GDPPC = ƒ (CCP, DR, TR, FDI, GE, BMS, POA, COASTAL*TRADE, COASTAL*FDI)*

Variables	Pooled Mean Group		Hausman Test			
D.GDPPC	Long-Run	Short-Run	χ^2 test	p-value	Dynamic Fixed Effects	
					Long-Run	Short-Run
ECT	-0.212**				-0.252***	
D1. CCP		5.206				3.764
D1. DR		163.851				165.576***
D1. TR		-0.440				-2.462
D1. FDI		8.889				5.600
D1. GE		2.252				-30.784***
D1. BMS		-30.096**				-38.552***
D1. POA		-4.727				0.954
D1. COASTAL*TRADE		6.341				2.228
D1. COASTAL*FDI		-39.401				71.463
CCP	-22.905***				-56.937***	
DR	-9.857*				-93.106***	
FDI	-11.543				41.963	
TR	-1.035				-8.634	
GE	-22.981***				-86.788**	
BMS	17.436***				18.210	
POA	20.205***				34.384*	
COASTAL*TRADE	-53.984***				1.013	
COASTAL*FDI					-4.093	
Constant		1229.621*				2969.164*
Hausman Test			0.036	0.99		

Note. **, ** and *** represents 10%, 5% and 1% level of significance. Source: - authors' calculation using STATA 17.*

Table 7 shows a significant long-run relationship of GDPPC with the concerned variables when interaction variables COASTAL*TRADE and COASTAL*FDI are introduced in the model with a convergence speed of 21.2% per annum. In the short-run, control of corruption is not found to effect GDPPC significantly, while, in the long-run there is a significant and negative relation of control of corruption with GDPPC i.e. one unit increase in control of corruption (CCP) decreases GDPPC by 22.91 units in the long-run at 1% level of significance. The finding is compatible with the findings of Huang (2012), Nguyen and Luong (2020), Haw, Kueh and Ling (2020), Simo-Kengne and Bitterhout (2020) and, Belloumi and Alshehry (2021) while, in contrast with the result obtained by Anoruo and Braha (2005), Ertimi, et al. (2016), Obamuyi and Olayiwola (2019), Alfada (2019), Mumtaz and Smith (2021), Siddiqui (2023) and, Ahamd et al. (2023). That is, the result is similar to result of Asian paradox (Rock & Bonnett, 2004). A significant short-run causality of BMS shows that one unit increment in BMS decreases GDPPC by 30.1 units in the short run. In the same way, one unit increment in DR and GE leads to decrease in GDPPC by 22.91, 9.86 and 22.99 units respectively in the long-run. While, one unit increases in BMS and POA increases GDPPC by 17.44 and 20.21 units respectively in the long-run. Similarly, COASTAL*TRADE is significant only in the long-run and shows that one unit increase in the trade of coastal countries leads to 53.98 units decrease in overall GDPPC of SAARC nation in the long-run while, the significance of COASTAL*FDI shows that one unit increment in foreign direct investment of coastal countries increases overall GDPPC of SAARC nation by 368.63 units only in the long-run. Thus, it can be concluded that there is a short-run negative and long-run positive causal relationship of BMS and GDPPC while, a long-run and significant causal relationship exists between GDP and all other variables except FDI and TR. However the long-run convergence of the model with interaction variables is significant, thus, model stands to be good.

Table 8

D-H Causality Test

Variables	GDPPC	CCP	DR	TR	FDI	GE	BMS	POA
GDPPC			(20.4208)	(2.4439)	(3.3700)	(2.3527)	(2.6712)	(2.8387)
			{38.8416}**	{2.8878}***	4.7401}***	{2.7053}***	{3.3424}***	{3.6774}***
CCP	(1.3379)		(7.7019)	(1.4106)	(1.2705)	(0.7862)	(0.9807)	(1.0868)
	{0.6757}		{13.4039}***	{0.8213}	{0.5410}	{-0.4276}	{-0.0387}	{0.1735}
DR	(7.5508)	(2.2834)		(1.7658)	(3.1651)	(4.0000)	(2.0234)	(3.1138)
	{13.1015}***	{2.5667}***		{1.5317}	{4.3302}***	{5.9999}***	{2.0468}**	{4.2276}***
TR	(0.8419)	(2.8924)	(14.6769)		(3.4269)	(1.0282)	(0.9116)	(1.1076)
	{-0.3162}	{3.7848}***	{27.3538}***		{4.8537}***	{0.0563}	{-0.1769}	{0.2152}
FDI	(1.5552)	(1.2235)	(3.7286)	(1.2805)		(0.8438)	(1.5619)	(1.1296)
	{1.1104}	{0.4470}	{4.1282}***	{0.5610}		{-0.3125}	{1.1239}	{0.2592}
GE	(1.8108)	(1.0885)	(4.1060)	(1.4492)	(3.9660)		(3.2741)	(4.3204)
	{1.6215}	{0.1771}	{6.2120}***	{0.8985}	{5.9320}***		{4.5482}***	{6.6407}***
BMS	(4.7461)	(2.1109)	(7.8724)	(0.6976)	(0.9883)	(1.6743)		(1.5919)
	{7.4923}***	{2.2219}**	{13.7449}***	{-0.6049}	{-0.0234}	{1.3485}		{1.1837}
POA	(0.4093)	(1.6282)	(2.8802)	(1.2797)	(0.9771)	(1.0326)	(2.5357)	
	{-1.1813}	{1.2564}	{2.7786}***	{0.5594}	{-0.0458}	{0.0652}	{3.0713}***	

Note. *, ** and *** represents 10%, 5% and 1% level of significance, ( ) w-stats and { } z-bar stats.
Source: - authors' calculation using STATA 17

Table 8 shows that, there is no any causal relationship exist between GDPPC and CCP in the short-run. This finding is compatible with the findings of Dada, Adedeji and Fatola (2020), Belloumi and Alshehry (2021) and Miah, Ratna and Majumder (2021) but, in contrast with the findings of Anoruo and Braha (2005), Ertimi, et al. (2016), Obamuyi and Olayiwola (2019), Alfada (2019), Ahamd et al. (2023), Huang (2012), Nguyen and Luong (2020), Haw, Kueh and Ling (2020), Simo-Kengne and Bitterhout (2020) and, Belloumi and Alshehry (2021). However, there exists bidirectional causality from GDPPC to DR and BMS and, unidirectional causality from GDPPC to TR, FDI, GE and POA. Similarly, CCP is found to have bidirectional causality to DR meanwhile, DR has bidirectional causality to GE, BMS, POA and FDI. Furthermore, TR has found to have a unidirectional causal relation with CCP, DR and FDI. While, GE has found to have a unidirectional causal relationship to FDI, BMS and POA. In the same way, BMS and POA have a unidirectional causal relation with CCP and BMS respectively.

Conclusion

Given the sparse literature on the corruption growth nexus in the context of SAARC nations, the present research has focused to know the dynamic impact of corruption on the economic growth of SAARC nations with certain control variables, location dummy and its interaction variables (COASTAL*TRADE and COASTAL*FDI). Due to lack of data for the measure of corruption, this study is constrained only for the period of 2002 to 2022. The study employs PMG estimation technique (panel ARDL) developed by Pesaran, Shin and Smith (1999) to capture the long-run and short-run dynamics of variables under consideration and, hence we assume three different models viz. without dummy, with dummy and with interaction variables for the same set of dependent and regressors. Control of corruption does not seem to have any significant effect on economic growth of SAARC nations i.e. it does not support any of the two main hypotheses (greases the wheel or sands the wheel hypothesis) on the empirical background with the panel ARDL without dummy. However, this model is found to be highly significant for the convergence of system towards equilibrium at the speed of 25.5% per annum in the long-run. This model also concludes that there is both a long-run and short-run causal relationship of DR and BMS to GDPPC while only a long-run negative causal relationship exists from GE to GDPPC. To the contrary, introduction of location dummy (i.COASTAL; 1 for coastal and, 0 otherwise) in the model shows no long-run convergence of the system but, supports sands the wheels hypothesis as one unit increase in corruption leads GDPPC to decrease by 45.09 in the long-run. Dummy variable i.COASTAL is positively significant and shows that the GDPPC of coastal countries is on an average 653.93 unit more than landlocked country. This model concludes that there is a long-run positive and short-run negative causal relationship of BMS and GDPPC while, a long-run and significant causal relationship exists from all other variables (except FDI) to GDPPC. Whilst, the introduction of interaction variables (COASTAL*TRADE and COASTAL*FDI) shows the significance of model to converge towards equilibrium at the speed of 21.2 % per annum. Meanwhile, this model also supports sand the wheels hypothesis as one unit increase in corruption leads GDPPC to decrease by 22.91 units in the long-run. And, one unit increase in the trade of coastal countries decreases the overall GDPPC by 53.98 units but, one unit increase in the foreign direct investment of coastal countries increases the overall GDPPC by 368.63 units. This model concludes that there is a short-run negative and long-run positive causal relationship of BMS and GDPPC while, a long-run and significant causal relationship exists between GDPPC and all other variables except FDI and TR. In the same way, granger causality results of D-H test shows no any significant causality of CCP to GDPPC but, bidirectional causality exists from CCP to DR. While, there is bidirectional causality exists from GDPPC to DR and BMS whereas, unidirectional causality exists from GDPPC to TR, FDI, GE and POA respectively. Thus, corruption has been found

to support the grease the wheel hypothesis in the long-run in the SAARC economy.

Policy Implications of the Study

Hence, on the basis of above research study and its conclusions, following recommendations should be made for the policy implications in the context of SAARC nations. First, government should apply flexible and users' friendly laws to control corruption and break its vicious circle. Educating from the primary level, running different awareness campaigns, and creating a respectful surrendering environment for corrupt officers and politicians could be an effective and moral treatment. Secondly, government should need to launch effective programs and strong policies to reduce the dependency ratio in the long-run by creating employment opportunities and better workable environment in the domestic countries. This will attract and compel significant labor force to return to domestic country. Thirdly, coastal countries trade should be made elastic and viable for other landlocked countries to make a balanced growth and utilize regional cooperation fully. Fourthly, Broad money supply should be made only up to a required amount and sufficient Research and Development activities should be promoted in the proper guidance of experts. Nevertheless, real markets and agricultural productivity should be prioritized to make the ultimate balance between money market and goods market. And, finally, political stability and absence of terrorism should not only be limited in the meetings and seminars rather, it is immunized at its very root level. Higher and innovative educations and increase in living standard, moral and psychological counseling time and again could be the remedial measure for political stability. The result of this research study is constrained to the analysis of data only over the period of 2002-2022. In the same way, the knowledge to run software is constrained only to the available YouTube videos, blogs and discussions in the research gate. Moreover, most of the genuine and latest articles and other research materials are available only in a heavy paid basis. However, this research can be a bench mark for using time variant dummies, forecasting the result for the extended period and conducting similar research for other regional groups in the international scenarios.

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