

## Gravity Model Analysis of India's Bilateral Trade with Special Reference to Selected Saarc Countries

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### Abstract

South Asian Association for Regional Cooperation (SAARC) was established in 1985. One of the major objectives of SAARC was to improve economic growth and development in South Asian countries. This study aims to examine the bilateral trade flows between India and selected SAARC nations for the period of 1996-2016. Gravity model of trade is used to determine the trade flow. The findings of this study have shown that the trade flow depends positively on GDP of host nation and partner nation. This study makes use of panel data analysis for double log function of Gravity model for trade between India and selected SAARC nations.

**Keywords:** Gravity Model, Bilateral Trade flow, SAARC, Panel Data

### Introduction

The objective of the SAARC is to promote the welfare of the people of South Asia and to improve their quality of life, social progress and economic development. Present study aimed to examine the bilateral trade flow of India with selected SAARC countries. Study has excluded Afghanistan from the analysis as the data of Afghanistan was not available from year 1996. Trade is beneficial for the economy's growth and development and this is known to everyone who understands even a little about economy. Regional cooperation and integration can facilitate the way for expanding markets and creating trade opportunities. The South Asian Association for Regional Cooperation was established in 1985 with the objective of accelerated growth and welfare of all the people in region. SAARC has taken several initiatives for enhancing integration like SAPTA, SAFTA and SATIS. Several studies have been carried out to know and empirically analyse the impacts of these arrangements.

Bhattacharya (2004) carried out comparative static analysis using a gravity model that was developed by Frankel et al. (1993). Akhtar and Ghani (2010) used Gravity model to measure the bilateral trade flows and trade potential between the SAARC countries for years 2003 to 2008.

They concluded that trade benefits can be increased by diverting the trade agreements to non-member countries as well.

Peera (2009) compared the impacts of different trade policy options on Sri Lanka using the Global Trading Analysis Project (GTAP) model. Moinuddin (2013), examined the determinants and trade effects of SAFTA using empirical

methods like Gravity model and Computable General Equilibrium (CGE) models. She included 43 countries in her study which had importance with regard to South Asia's trade and created a panel framework to cover trade variations among sample countries. Kien (2009) examined the determinants of export flows of countries in the ASEAN Free Trade Area (AFTA) through estimations of panel data using a gravity model.

### Objectives

The main objectives of the study are to examine the trade flows in terms of exports from India to partner SAARC nations with the help of gravity model of trade. Further the trade can depend on several variables, so the objectives are:

- To examine the impact of GDP of host and partner nation on the trade between India and related SAARC nations.
- To examine the impact of per capita GDP of host and partner nation on the trade between India and selected SAARC nations
- To study the impact of population of host and partner nation on the trade between India and selected SAARC nations
- To examine how free trade agreement have impact on the bilateral trade flows between India and selected SAARC nations
- To study the impact of common official language on the trade flows between India and selected SAARC nations
- To examine the influence of distance between the host and partner country on the bilateral trade flows

### Hypotheses

- H<sub>0</sub>: Bilateral trade of India with selected SAARC countries does not have significant impact of GDP, per capita, distance, common official language, and free trade agreement of Host and partner countries
- H<sub>1</sub>: Bilateral trade of India with selected SAARC countries is a significantly affected factor of GDP of Host and Partner Countries.
- H<sub>2</sub>: Bilateral trade of India with selected SAARC countries is a significantly affected factor of per capita income of Host and Partner countries
- H<sub>3</sub>: Bilateral trade of India with selected SAARC countries is a significantly affected factor of free trade agreement
- H<sub>4</sub>: Bilateral trade of India with selected SAARC countries is a significantly affected factor of common official language
- H<sub>5</sub>: Bilateral trade of India with selected SAARC countries is a significantly affected factor of distance

## Theoretical Background

### Gravity Model

The gravity model of trade is an important model in the arena of international economics. It is like the other gravity models that are present in the domain of social sciences. It makes predictions on the bilateral trade flows and these predictions are based on the distance within two units as well as their respective economic dimensions. The bilateral trade between two countries is proportional to their respective sizes, measured by their GDP, and inversely proportional to the geographic distance between them. While the role of economic size is well understood, the role played by distance remains a mystery.

The equational representation of the Gravity model of trade is as follows:

$$\text{Trade}_{ij} = \alpha \frac{Y_i^\beta Y_j^\gamma}{D_{ij}}$$

$\text{Trade}_{ij}$  is the bilateral trade between the country I and j,  $\alpha$  is the constant,  $Y_i$  is the GDP of country I,  $Y_j$  is the GDP of country j and  $D_{ij}$  is the geographical distance between the country I and j. This is the basic gravity model, but we can add other variables also that can have impact on the trade flow.

For econometric analysis of the Gravity model, natural log is taken on both sides such that the model becomes:

$$\ln \text{Trade}_{ij} = a + b_1 \ln Y_i + b_2 \ln Y_j + b_3 \ln D_{ij} + m_{ij}$$

### Variables

#### Dependent Variable (lnEXP)

The dependent variable in the gravity model is the bilateral trade flow measured in terms of exports of host country i.e. India to partner country i.e. selected SAARC nations (excluding Afghanistan). Natural log of exports of India was used in the analysis.

#### Independent Variables

##### Natural log of GDP of India (lnGDP<sub>i</sub>)

According to Gravity model of trade, GDP of India is expected to have a positive impact on the trade flows of India. Higher the size of economy higher is the trade expected.

**Natural log of GDP of Partner Country (lnGDP<sub>i</sub>)**

Similarly, gravity model shows proportional relationship between the exports of India and the GDP of the partner economy. It is also evident from economic theory that higher the income of the nation higher it will import from other nations.

**Natural log Distance between India and Partner Country (lnDist<sub>ij</sub>)**

According to traditional gravity model the trade between two nations is inversely proportional to the distance between them. The expected sign of coefficient of distance is negative.

**Natural log of PCGDP of India (lnPCGDP<sub>i</sub>)**

Per capita GDP of India is also expected to have a proportional relationship with exports of India. But this may not be true in case of India as India is hugely populated and has a low per capita income.

**Natural log of PCGDP of partner country (ln PCGDP<sub>j</sub>)**

Similarly, South Asian countries are low income country and have high population which leads to a low per capita income therefore as per the gravity model hypothesis, partner country's per capita may not be found proportional with bilateral trade flow in the present case.

**Natural log of Population of India (lnPOP<sub>i</sub>) and Partner country (lnPOP<sub>j</sub>)**

The effect of population of host and partner country could be positive or negative depending on which is dominant in its absorption effect or economies of scale. A large population may certainly indicate a big domestic market and large resource endowment, so the larger absorption effect of this domestic market may translate to less reliance on international trade transactions, in this case, a negative sign would be justified. On the other hand, a large domestic market allows the advantages of economies of scales to be fully exploited. It then follows that opportunities for trade with foreign partners in a wide variety of goods will increase, and the expected sign of this coefficient would be positive.

**Common official language**

Nations which have same official language will reduce cost of time and transactions would be easier. Dummy variable for common official language is used in the analysis.

### **Free Trade Area (FTA)**

Free trade areas will increase the bilateral trade flow. In this study dummy variable for free trade area is used.

### **Data Source and Sample**

The study makes use of secondary data which is extracted from several sources. Data for trade was used from UNCTAD and WITS, GDP per capita GDP and population data are taken from UNCTAD and the geographical distance data is extracted from geodist software of CEPII. GDP and PCGDP are taken at constant prices (2010) in USD.

Study follows Purposive Sampling technique as the study is based on Selected SAARC countries in which Afghanistan is not included in the sample study as it joined SAARC in April, year 2007. Study makes use of Panel Data for seven SAARC countries: India, Bangladesh, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka from 1996-2016.

### **Study Period**

Study has undertaken the period of study from 1996 to 2016.

### **Methodology**

Study employs panel data to examine the bilateral trade flows from India to SAARC nations. With panel data, it is possible to control some type of omitted variables even without observing them this control for omitted variables that differ between cases but are constant over time. It is possible to use panel data to control for omitted variables that vary over time but are constant between cases. Pooled regression, Fixed and Random effect model has been used for analysis and based on hausman test statistics, appropriateness of fixed effect model on random effect will be checked. Based on the test statistics of Breusch-Pagan (BP) Lagrange multiplier, appropriateness of pooled regression model on random effect will be checked.

### **Analysis and Empirics**

Panel data gravity model has omitted the population variable for India due to multicollinearity. Results of regression for gravity model of panel data of 7 countries for 21 years are summarized in table 1:

$$\ln \text{EXP}_{it} = \alpha_0 + \alpha_1 \ln \text{GDP}_{it} + \alpha_3 \ln \text{PCGDP}_{it} + \alpha_4 \ln \text{PCGDP}_{it} + \alpha_5 \ln \text{Dist}_{ij} + \alpha_6 \ln \text{POP}_{it} + \alpha_7 \ln \text{POP}_{it} + \alpha_9 \text{LAN} + \alpha_8 \text{FTA} + \mu_{ijt}$$

Dependent Variable Trade Flow (lnExp <sub>it</sub> )						
Variables	Pooled OLS		Fixed Effect		Random Effect	
	Coefficients	T	Coefficients	t	Coefficients	t
lnGDP <sub>it</sub>	10.183	2.96*	7.866	2.45*	10.18351	2.96*
lnGDP <sub>jt</sub>	0.0189	0.43	0.036	0.96	0.018998	0.43
lnPCGDP <sub>it</sub>	-9.485	-2.15*	-7.951	-2.02*	-9.48524	-2.15*
lnPCGDP <sub>jt</sub>	-1.443	-7.30*	0.175	0.32	-1.442963	-7.30*
lnD <sub>ij</sub>	2.189	11.96*	-	-	2.189611	11.96*
lnPOP <sub>jt</sub>	0.335	4.74*	1.531	1.33*	0.3350428	4.74*
FTA	0.306	1.44*	0.285	1.55	0.3061777	1.44
LAN	0.828	4.52*	-	-	0.8283088	4.52*
_Cons	-209.159	-3.21*	-170.882	-3.02*	-209.1598	-3.21*
R <sup>2</sup>	0.9728		R <sup>2</sup> (overall)	0.7098	R <sup>2</sup> (overall)	0.9023
			R <sup>2</sup> (within)	0.8387	R <sup>2</sup> (within)	0.8261
			R <sup>2</sup> (between)	0.8086	R <sup>2</sup> (between)	0.9728
X <sup>2</sup> for hausman test	X <sup>2</sup> (6)=10.10 (0.1205) Random Effect is chosen over fixed effect					
$\bar{X}_2$ for BP test	$\bar{X}^2$ (01)=0.00 (1.00)					

Random Effect model is not appropriate

Test Statistics is significant at 5% level

The regression results of pooled PLS, fixed effect model and random effect model are highly significant. The R<sup>2</sup> values are very high showing the goodness of fit of the model. Most of the coefficients of the variables show expected sign as per theory. But variables like per capita GDP of India and partner country are showing negative impact on the trade variable.

The distance variable is showing the positive relation with the trade flow (exports). This is also a contradiction to Gravity model of trade as discussed in theoretical framework. The hausman test shows that random effect model is appropriate and it should be chosen over fixed effect model. Breusch-Pagan test concludes that random effect is not appropriate therefore study has chosen Pooled OLS regression model. The results of pooled OLS regression are highly significant. The R<sup>2</sup> value is 0.9728. The variables are showing expected relationship. The GDP of India and partner country has a positive relation with the exports of the host country. The result in the case of partner country's GDP is not significant at 95% confidence level, so it cannot be said that it has any significant impact on exports of India.

The per capita GDP of India and partner country has negative impact on the exports of India to SAARC nations. According to the regression coefficient, an increase of per cent in the per capita GDP of India will reduce the trade flow by approximately 9 percent.

The distance between India and partner country is also showing positive relation with the exports of India to SAARC nations. The population variable for India is omitted in the analysis due to collinearity but the population of partner country has a positive impact on exports of India. The population of partner country is 0.335 and it's statistically significant at 5%.

Dummy variables are taken for common official language and FTA with value of 1, otherwise 0. Result concludes that it has a positive and significant impact on the exports of India to the partner SAARC countries. Result of FTA is showing the positive relation but not significant. This is because till 2016 SAARC nations did adopt complete tariff reduction. Under SAFTA it was planned that only till 2016 it will be able to have zero tariffs. So the results of FTA will only be seen significant after 2016. This study is limited to the time period 1996-2016.

### **Conclusion**

The gravity model analysis for SAARC nations for the period of 1996-2016 have given the results that were expected. The income of India has positive impact on the trade flows. The interesting thing to note in this analysis was the positive relation of distance with trade flows. The basis of gravity model was on the Newton's law of Gravitation which states that attraction between the particles is proportional to their masses and inversely proportional to the square of the distance between the two.

In this analysis the possible reason for the proportional relation between distance and trade flows is that all the SAARC nations are connected to India and share common borders, either land border or share water bodies. So there is no distance barrier between them that hinders trade flow.

The free trade agreement also had a positive impact on the trade flow. Tariffs are barriers for the trade flow, so any reduction in tariff rate will tend to increase the trade flow between the two countries. And this economic theory is proved by the gravity model analysis.

The population can have any impact on trade flow. It depends on which effect is dominating, absorption or economies of scale. The results show that the population of partner country has positive impact on exports of India. Higher the population of partner country, higher will be the exports of host country as the partner country will demand more goods and services.

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