Role of Agriculture and Manufacturing Sectors in the Economic Growth of Bangladesh and India: An ARDL Approach

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Abstract

Agriculture and manufacturing are two vital components of the economy. This article empirically explored the long-run and short-run impact of these two sectors on the economic development of Bangladesh and India by employing the ARDL model over the period from 1975 to 2019. The outcome of the F-bounds test confirmed the existence of a long-run relationship among the variables examined for both Bangladesh and India. The study then analyzed the short-run impact of the agriculture and the manufacturing on economic growth for Bangladesh and India. The short-run coefficients revealed that there exists a positive impact of the agriculture and the manufacturing sectors on economic growth for both Bangladesh and India. Findings further showed that both agriculture and manufacturing led to the long-run economic development of Bangladesh. Whereas, in India, only the manufacturing sector proved to have a positive long-run impact on economic advancement as, in the long run, India's agriculture demonstrated an insignificant and weak influence on economic development. Hence, it is noteworthy that the manufacturing sector solely served as the engine of economic growth of India. On the other side, both agriculture and manufacturing led to Bangladesh's growth. The study concluded that Bangladesh should provide equal importance to both the agricultural and manufacturing sectors to achieve long-run economic development. This paper also recommended that the Indian Government should promote long-term agriculture development projects. Above all, to attain steady economic growth, agriculture, along with the manufacturing sector should be developed concurrently.

Keywords: agriculture, manufacturing, economic growth, ARDL model. F-bounds test.

JEL Classification: C10, E23, O13, O14.

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1. Introduction

No agriculture, no food; and no food, no life. Without the development of the agriculture, no developing country can afford to feed its vulnerable people. Agriculture also contributes to income generation and producing raw material. The agriculture sector is largely comprised of the subsectors of agriculture (combining crops and livestock), forestry and fisheries (Scialabba, 1998, p.viii). Apart from agriculture, the manufacturing industries drive productivity growth and innovation. Manufacturing sector refers to changing primary products or components into a secondary form, such as mechanical, chemical and physical form, excluding the construction sector (Levinson, 2017, p.2). The manufacturing section produces most of the capital goods, and the consumer goods. This sector may also help phase out economic depression, minimize inequalities, and earn foreign currency through export. In the context of the countries of emerging economy, the manufacturing sector is undoubtedly one of the indispensable sectors for economic development. Nevertheless, agriculture and manufacturing can be two fundamental pillars for developing countries. The development of agriculture and the manufacturing sector can help boost employment with the expansion of production activities and thus lead to the growth of the economy.

Both Bangladesh and India are countries of the emerging economy (IMF, 2019). Bangladesh accomplished magnificent success since its emancipation from Pakistan. Concurrently, India, the neighbor of Bangladesh has gone past notable progress. Since 1975, Bangladesh and India experienced a boost in GDP per capita. Per capita value added of agriculture and manufacturing sectors also underwent steady growth. However, the population of these two countries also grew big during that period. Since 1975, Bangladesh's GDP per capita has increased three-fold, whereas India's GDP per capita multiplied four-fold. Per capita value added of agriculture and manufacturing sectors also underwent steady growth. (World Bank, 2020).

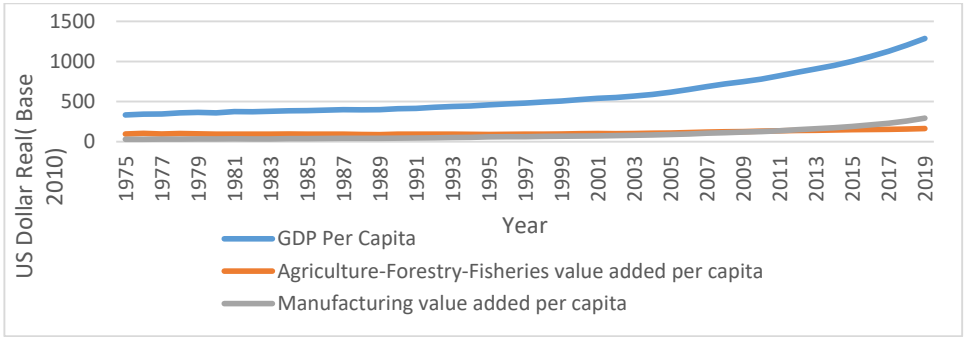

Figure 1. Trend of GDP per capita, Agriculture, forestry, fisheries value-added per capita and manufacturing value-added per capita in Bangladesh
Source: World Bank and author's computation

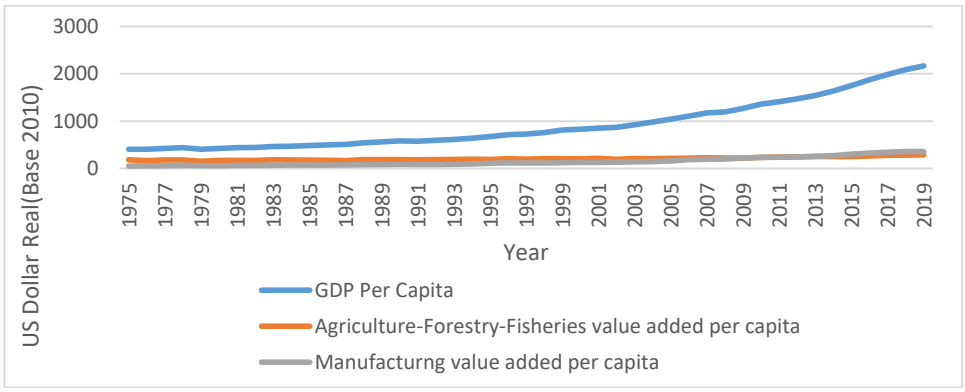

Figure 2. Trend of GDP per capita, Agriculture, forestry, fisheries value-added per capita and manufacturing value-added per capita in India
Source: World Bank and author's calculation

Thus, assessing the effect of agriculture and the manufacturing sector on economic development is essential for the best policy implications. Empirical analysis is also required to determine which between two sectors promoted economic growth. The objective of the study was to explore the long-run and short-run impact of agriculture and manufacturing sectors on the economic growth, and to find out which sector drove the economy of Bangladesh and India.

2. Literature Review

The linkage between the economic growth and various sectors has been a long-debated issue within the development literature. Subramaniam and Reed (2009) adjudicated to identify agricultural inter-sector linkages and their importance on the economic advancement of Poland and Romania. They adopted a VECM approach and justified the relationship between agriculture, manufacturing, service, and trade sectors, and identified the existence of long-run and short-run inter-sectorial association by using the Johansen procedure of co-integration. Chebbi (2010) dissected the relationship among agriculture and non-agricultural sectors in Tunisia. His findings showed that agriculture promotes long-run growth of other economic sectors, but short-run impact on other sectors is not intense.

Increasing productivity in modern sectors expedites economic growth (Zeira and Zoabi, 2015). Mohsen (2016) studied the impact of agriculture and industry export on the economic advancement of 34 developing countries during the period 1970-2014. He found that industrial export has a greater positive impact on economic growth than agriculture export. Michael (2017), by using ARDL model studied the relationship among agriculture, petroleum sector and economic growth of Nigeria, and effect of agriculture and petroleum sectors on the economy. He demonstrated a positive impact of agriculture and petroleum on the economy both in long-run and short-run. However, manufacturing sector was denied in the study.

Szirmai and Verspagen (2015) investigated the manufacturing sector and economic growth in Ethiopia for the period 1950-2005, presenting a result of positive and significant relationships between the manufacturing sector and economic growth. Recently, Singariya and Sinha (2015) explored the causal relationship among per capita GDP, the value-added share of agriculture, and the manufacturing sector on GDP for the period 1970-2013 in India. They found that agriculture influences the manufacturing sector and per capita GDP, and per capita GDP proved to have long-run impact on the manufacturing sector. But, they did not conclude which sector has a large contribution to GDP per capita. However, with the development of Bangladesh and India, population size has also increased. So, effect of per capita value added of agriculture and manufacturing on economic growth should be analyzed. Also, contribution of agriculture and manufacturing to economy in the context of Bangladesh and India is hardly empirically inquired. Hence, this paper tried to fill this gap by assessing the per capita value addition impact of agriculture and manufacturing on GDP per capita.

3. Methodology

3.1 Source and Description of data

This paper used secondary data, sourced from the World Bank data series covering the period of 1975 to 2019 to conduct the research. The data cover the information on GDP per capita, agricultural, forestry, fisheries value-added per capita, and manufacturing value-added per capita. GDP Per Capita (constant, 2010 USD) was considered as proxy of economic growth; agricultural, forestry, fisheries value-added per capita (constant, 2010 USD) represented agricultural sector, and manufacturing value-added per capita (constant, 2010 USD) represented manufacturing sector. GDP per capita was directly taken from the dataset whereas agricultural, forestry, fisheries value-added per capita was derived from the figures of agricultural, forestry, fisheries value-added and population. The same method was applied for manufacturing value-added per capita. Consequently, the value added per capita for these two sectors were estimated by the following formula:
Value-added per capita = Yearly value-added/Yearly Population (1)

3.2 Methods of Data Analysis

3.2.1 Unit Root Test

Before performing the ARDL model, we employed the Augmented Dickey-Fuller unit root test and Phillips-Perron unit root test to check stationarity of series for the specified variables.
Augmented Dickey-Fuller test can be specified as follows:

$$\Delta Y_t = \mu + \delta Y_{t-1} + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \ldots + \beta_p \Delta Y_{t-p} + \varepsilon_t \quad (2)$$

H_0:.$\delta=0$, against H1:$\delta<0$. If we do not reject H_0, the series is non-stationary whereas rejection means the series is stationary.
The Phillips-Perron test can be specified as follows:

$$y_t = c + \delta t + a\, y_{t-1} + e_t \quad \ldots\ldots\ldots\ldots\ldots \quad (3)$$

The null hypothesis defines $a=1$. Variants of the test, congenial for series having different growth characteristics, restrict the drift and deterministic trend coefficients, c and δ, respectively, to be 0. e_t denotes innovation process.

3.2.2 ARDL Model Specification

The advantage of the ARDL model (Pesaran and Shin, 1998) is, it is applicable for unveiling long-run relationships among variables, irrespective of whether they are stationary at the level or stationary at 1st difference or a combination of both; considering that none of the variables can be stationary at 2nd difference. Based on Akaike- Information-Criterion optimal lag was chosen for each model.

The study involves constructing the following case:
Dependent variable: LGDPC; Independent variable: LAGPC and LMPC

$$\Delta LGDPC_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta \text{LGDPC}_{t-1} + \sum_{i=0}^{n} \alpha_{2i} \Delta \text{LAGPC} + \sum_{i=0}^{n} \alpha_{3i} \Delta \text{LMPC}_{t-1} + \beta_1 \text{LGDPC}_{t-1} + \beta_2 \text{LAGPC}_{t-1} + \beta_3 \text{LMPC}_{t-1} + u_t \quad (4)$$

Where,
LGDPC=Log of GDP Per Capita
LAGPC=Log of Agriculture, Forestry, Fisheries Value-Added Per Capita
LMPC=Log of Manufacturing Value-Added Per Capita
α_0 =Intercept
α_1, α_2, α_3=Short-run coefficients
β_1, β_2, β_3=Long-run coefficients
μ_t=Error term.

Following the ARDL model, the F-bounds test (Pesaran et al. 2001) was conducted to testify the presence of long-run association among the variables. F-statistics exceeding the critical value of both upper bound and lower bound at a 1% level of significance ensures the long-run relationship among variables. After operating the F-bounds approach, long-run coefficients were derived. The error correction model demonstrated error correction term and short-run coefficients. Microsoft Excel and E-views Software were used for data analyses.

4. Results and Discussion

Table 1 and Table 2 reports the unit root test results. It shows that, for Bangladesh, all the variables are stationary at 1st difference, whereas variables are integrated of mixed order in the case of India. None of the variables for any country is integrated at 2nd difference. Hence, the ARDL approach is applicable.

Table 1. Result of Augmented Dickey- Fuller test

	Bangladesh		India	
Variables	**Level**	**1st diff.**	**Level**	**1st diff.**
LGDPC	2.0929	-7.488***	-1.7853	-7.575***
LAGPC	-0.7570	8.669***	-4.1413**	-10.671***
LMPC	0.9842	-4.015**	-2.189	-4.945***

Table 2. Result of Phillips- Perron test

	Bangladesh		India	
Variables	**Level**	**1st diff.**	**Level**	**1st diff.**
LGDPC	2.4862	-7.4089***	-2.183	-13.516***
LAGPC	-0.7570	-8.5275***	-4.038**	-35.919***
LMPC	1.4906	-7.1207***	-1.377	-5.292***

** and *** denote significant at 5%, and 1% level of significance respectively

Source: Authors' calculation using E-views

Table 3 reveals the outcome of F-bounds test. It validates the existence of long-run relationship among manufacturing value-added per capita and agriculture, forestry, fisheries value-added per capita and GDP per capita for both Bangladesh and India. This signifies the fact that the manufacturing sector and agriculture sector have a long-run association with the economic growth of Bangladesh and India.

Table 3. Results of F- Bounds test

Country	F- Statistics	Level of significance	Lower bound	Upper bound	Long- run relationship
Bangladesh	6.426	10%	2.63	3.35	Present
		5%	3.1	3.87	
		2.5%	3.55	4.38	
		1%	4.13	5	
India	18.010	10%	2.63	3.35	Present
		5%	3.1	3.87	
		2.5%	3.55	4.38	
		1%	4.13	5	

Source: Author's calculation using E-views

Table 4 states the short-run and long-run estimates outcome. It depicts that, in the short-run, agriculture, forestry, fisheries value-added per capita and, manufacturing value-added per capita both have positive and significant impact on GDP per capita in Bangladesh. However, Agriculture has greater positive short-run influence than manufacturing on economic development. The coefficient of error correction term of -0.24, which is significant at 1% level of significance is denoting that at 24% speed of adjustment dependent variable LGDPC returns to equilibrium after a change in LAGPC and LMPC. Whereas, in India, both agriculture, forestry, fisheries value-added per capita and manufacturing value-added per capita positively affect GDP per capita, while manufacturing sector provides stronger positive impact than agriculture on economy. The coefficient of error correction term is -0.119 which is significant at 1% level of significance denotes that at 11.9% speed of adjustment dependent variable LGDPC returns to equilibrium after a change in LAGPC and LMPC.

Moreover, in the case of long-run, Table 4 illuminates that in Bangladesh, as agriculture, forestry, fisheries value-added per capita increases 1%, GDP per capita increases by 0.423%, and it is statistically significant at 1% level of significance. Similarly, with a 1% percent increase in manufacturing value-added per capita GDP per capita increases 0.562% holding statistical significance at 1% level of significance. This implies that, in the long run, both the agriculture and manufacturing sector have a positive impact on GDP per capita. Though manufacturing has a relatively stronger influence than the agricultural sector, the contribution of agriculture sector cannot be denied. It also visualizes that both manufacturing and agriculture sectors are the main drivers of the development of Bangladesh. Both these sectors are equally vital to gain economic advancement hence, this findings reveal the effectiveness of both agriculture and manufacturing sectors of Bangladesh.

Contrarily, in India, agriculture, forestry, fisheries value-added per capita has a statistically insignificant relationship with GDP per capita. This reveals that in the long-run, agriculture of India is not consistent with the economic growth. This result is also indicating to the unexplainable relationship between agriculture and economic growth of India. Oppositely, as manufacturing value-added per capita increases by 1%, GDP per capita also rises by 0.968%, significant at a 1% level of significance. Unlike agriculture, findings depict a robust long-run impact of the manufacturing sector on the economic growth of India. Undoubtedly, manufacturing sector solely propelled economic growth of India. This result also unveils that India should put an eye on reforming agricultural strategy.

Table 4. Results of short-run and long-run estimates

Short-run coefficients								
	Bangladesh				**India**			
Variables	Coefficient	Std. Error	t-statistics	p-value	Coefficient	Std. Error	t- statistics	p-value
D(LAGPC)	0.287 ***	0.036	7.777	0.00	0.270 ***	0.034	7.939	0.00
D(LMPC)	0.242 ***	0.035	6.791	0.00	0.358 ***	.040	8.780	0.00
ECT(-1)	-0.24 ***	0.046	-5.309	0.00	-0.119 ***	.013	-8.834	0.00
Long-run coefficients								
	Bangladesh				**India**			
Variables	Coefficient	Std. Error	t-statistics	p-value	Coefficient	Std. Error	t-statistics	p-value
LAGPC	0.423***	0.057	7.369	0.00	0.093	0.511	0.182	0.85
LMOC	0.562***	0.035	15.707	0.00	0.968***	0.176	5.502	0.00

*** denotes significant at 1% level of significance

Source: Authors' calculation using E-views.

Table 5 depicts results of residuals diagnostics tests. Outcome reveals that residuals of each model for Bangladesh and India are homoscedastic, normally distributed, and free of serial correlation. So, the regression models are valid.

Table 5. Residuals diagnostics tests

Test	Bangladesh	Remarks	India	Remarks
Jarque- Bera Test	2.320 (0.313)	Normally distributed	3.714 (0.156)	Normally distributed
Serial Correlation LM Test	7.051 (0.1332)	No serial Correlation	2.073 (0.722)	No serial Correlation
Heteroscedasticity Test: Harvey	10.697 (0.297)	Homoscedastic	3.131 (0.792)	Homoscedastic

Numbers in Parentheses contain P-value
Source: Authors' calculation using E-views

Figure 3 and 4 show the outcome of The CUSUM test and CUSUM of squares test. It is evident that that parameters of regression models for Bangladesh and India proved stable. CUSUM test illuminates the cumulative sum remains inside the critical line. Similarly, CUSUM of squares test shows the movement of the parameters lie within the 5% critical lines. Henceforth, our models are stable.

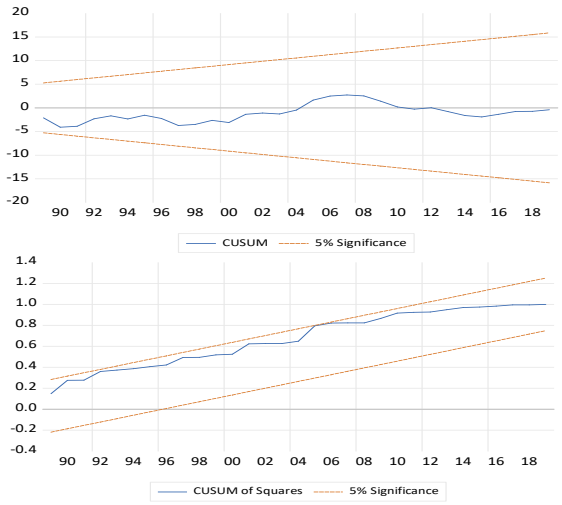

Figure 3. CUSUM Test and CUSUM of Squares test for Bangladesh

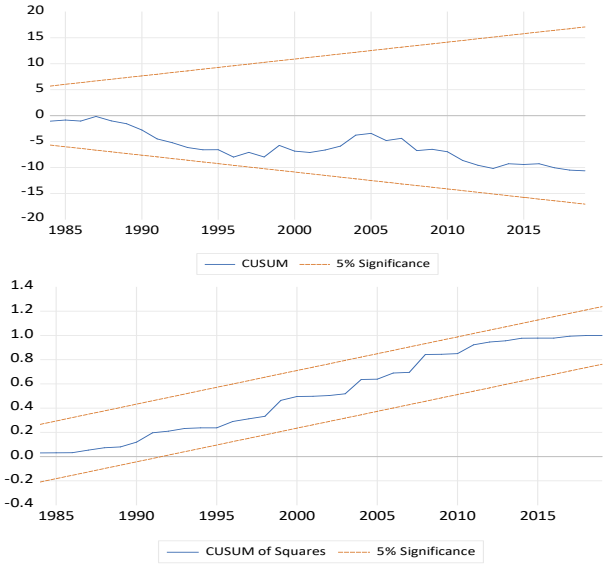

Figure 4. CUSUM test and CUSUM of Squares test for India
Source: Authors' calculation using E-views

5. Conclusion

This paper inquired the impact of agriculture and manufacturing sector on the economy of Bangladesh and India. Augmented Dickey-Fuller Test and Phillips-Perron test ascertained that none of the variables was stationary at 2nd difference. After running the ARDL model, the F-bounds test illuminated that both in Bangladesh and India agriculture, forestry, fisheries value-added per capita, manufacturing value-added per capita, and GDP per capita move together in the long-run. Error correction term was negative and statistically significant for both cases of Bangladesh and India, which also unveils the long-run relationship of the variables. In Bangladesh and India both the agriculture and manufacturing sector showed a positive short-run impact on economic development. Moreover, in Bangladesh, the agriculture and manufacturing sector proved to produce a nearly equal intense positive long-run impact on economic growth, given a slightly higher influence of the manufacturing sector. Contrarily, in India, agriculture illustrated an insignificant long-run force on economic development, whereas manufacturing sector proved to be the accelerator of economic growth. It can be summarized that, both agriculture and manufacturing contributed to economic development of Bangladesh, whereas only manufacturing solely drove economy of India, as agriculture's influence on economic growth proved inconsistent. Hence, Long-run development projects should be taken by the Indian government to tackle the

oddities of agriculture. Agricultural budgetary expansion, advanced technologies, highly productive seeds, proper irrigation facilities, distribution of fertilizer programs ought to be implemented. Also, Bangladesh government should provide equal importance in budget and development projects for agriculture and manufacturing sector.

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