Jagannath University Journal of Social Sciences
Vol. 13. Issue 1, 2024-2025, https://doi.org/10.3329/jnujss.v13i186083

Impact of Export Processing Zones on Industrial Value Addition of Bangladesh: An Empirical Analysis Using the Autoregressive Distributed Lag–Bound Testing Approach

Soma Bhattacharjee[*]
Professor, Department of Economics
Jagannath University, Dhaka, Bangladesh.

Fazle Rabbi
MSS Student, Department of Economics
Jagannath University, Dhaka, Bangladesh.

Abstract

The study examines the impact of Export Processing Zones (EPZs) on Bangladesh's industrial value addition over a 36-year period from 1986-1987 to 2021-2022. The dependent variable is industry value added, while the independent variables are employment, investment, exports, and imports of EPZs. Data are gathered from the World Bank, Bangladesh Bank, and BEPZA publications. The auto regressive distributive lag - bound testing approach is used in this study. The study's findings support the long-term relationship between Bangladesh's EPZs industrial value addition, employment, exports, and imports. In particular, this analysis reveals that employment, imports, and exports of EPZs have a significant effect on Bangladesh's industrial value addition, with employment and imports having a positive influence and exports having a negative one. This study also discover that employment have a favorable short-term impact on Bangladesh's industrial value addition. The study's findings have some important policy implications for future practice.

Keywords: *ARDL model, Bangladesh, export processing zones, gross domestic product, industrial value addition*

1. Introduction

For any developing nation, industrial development serves as an important driver for economic transformation. It helps to reduce poverty by generating jobs, advancing technology, fostering shared prosperity and enhancing global trade integration (UNIDO, n.d.). Developed and developing countries follow very different paths regarding industrialisation: advanced economies use high levels of productivity, innovation, and environmentally friendly production systems while emerging economies experience structural changes from traditional sectors to technology-driven industries. According to this framework, industrial value addition, defined as added values created by the manufacturing process emerges as a critical indicator of industrial health and

[*] **Corresponding Author:** Soma Bhattacharjee, Email: soma430@yahho.com
Submission: 19.12.2024; Acceptance: 24.08.2025

economic development. According to the European Central Bank (2016), industrial value addition considers a sector's gross domestic product (GDP) contribution in addition to its capacity to promote innovation, competitiveness, and job creation.

Bangladesh's economy has seen a significant increase in the industry sector's GDP contribution over the past few decades, with an expected GDP contribution of 37.95% for FY 2023-2024. The government aims to become an industrially developed higher middle-income nation by focusing on growth in all industrial sectors, including manufacturing, fuel, agriculture, forestry, mining, tourism, service, construction, ICT, and labour-intensive and export-oriented industries. Export Processing Zones (EPZs) are central to this policy, created to attract foreign direct investment (FDI) through duty-free manufacturing and expedited customs procedures. EPZs aimed to increase exports, and create jobs (Madani, 1999). Since 1980, Bangladesh has created eight EPZs, overseen by the Bangladesh Export Processing Zones Authority (BEPZA). According to Finance Division (n.d.) and Hasan and Ali (2019), EPZs have stimulated FDI inflows, generated over 500,000 jobs, and contributed significantly to export diversification, particularly in the ready-made garment sector, which accounts for 82% of national export earnings.

Bangladesh is set to leave the Least Developed Country (LDC) designation in 2026, potentially leading to a $1.6 billion annual export loss and increased international competition. This transition will remove preferential trade privileges, such as duty-free access to the EU under the Generalised System of Preferences (GSP) (Razzaque & Rahman, 2019). Policymakers are advising diversification of exports beyond the RMG and enhancing industrial value addition to improve product quality, technological sophistication, and global competitiveness (World Bank, 2023). The EPZs are considered for such transformation and their specific impact on industrial value addition remains underexplored, creating a critical research gap.

Empirical studies on Bangladesh’s EPZs have largely focused on their macroeconomic contributions, such as FDI inflows, employment generation, and export diversification (Islam, (2018); Majumder, Rahman, and Martial (2022). For instance, Hasan and Ali (2019) highlight EPZs’ role in reducing trade deficits, while Fakir, Miah, and Hossain (2013) link them to export diversification. However, these studies fall short of evaluating the direct impact of EPZs on industrial value addition, a key indicator of industrial upgrading and productivity growth.

The majority of these studies use descriptive or correlational approaches, ignoring thorough econometric analyses of the microeconomic effects of EPZs on industrial value addition. This is crucial because industrial value addition is a metric that is essential for evaluating sectoral upgrading and technological absorption. Additionally, most of the research that is currently available is based on out-of-date datasets.

This study, hereby, addresses three gaps. Firstly, there is no prior studies that specifically examine the impact of EPZs on industrial value addition in the context of Bangladesh. While various studies explore the macroeconomic roles of EPZs, none have directly analyzed how EPZ-related factors—investment, exports, imports, and employment— influence industrial value addition, which is a crucial metric for productivity and industrial upgrading. Secondly, prior research lacks advanced econometric frameworks to disentangle short- and long-term effects. For that reason,

the autoregressive distributed lag (ARDL) model is employed here to offer a nuanced analysis of dynamic relationships between EPZ variables (investment, exports, imports, employment) and industrial value addition. Thirdly, most studies predate 2020, and overlooked recent policy shifts and post-pandemic economic realities. This study utilizes a 36-year dataset (1986–2022) to capture evolving trends.

The main objective of this study is to look at the impact of EPZs on the industrial value addition of Bangladesh in Short-Run (SR) and Long-Run (LR). The specific objectives are:

1. to examine how investment, exports, imports and employment in EPZs are playing role in the industrial value addition of Bangladesh in the SR;
2. to examine how investment, exports, imports and employment in EPZs are playing role in the industrial value addition of Bangladesh in the LR.

The second section of the study presents a review of the related literature, whereas the third section describes the research methodology. The fourth section presents data analysis while the fifth section discusses major findings, and the final section presents conclusion and recommendations.

2. Review of Related Literature

EPZs have been crucial in industrial sectors in Bangladesh by attracting investment, facilitating trade, and creating job opportunities. This literature review examines the effects of EPZs across four principal dimensions: investment, import, export, and employment. Research shows the regions' capacity to draw FDI, improve export performance, and provide substantial job possibilities. Nonetheless, issues like restricted backward connections, reliance on imports, and variable employment circumstances have been observed. This analysis examines these parameters to clarify the contributions and limits of EPZs in fostering industrial value addition in Bangladesh.

EPZs and Investment

EPZs have played a crucial role in luring investors in Bangladesh. Hasan and Ali (2019) observed that EPZs have attracted significant FDI by enhancing essential infrastructure, including roads, electricity supply, and telecommunications, which subsequently stimulated complementary private sector developments in adjacent regions. Likewise, Islam (2018) underscored the significance of EPZs in facilitating capital creation and encouraging investment-led growth. Wang (2013) illustrated a comparable situation in China, where EPZs substantially enhanced FDI and industry output, mirroring the experiences of Bangladesh. Begum, Aktar, and Sultana (2020) highlighted BEPZA's pivotal role in promoting foreign investment, while Aggarwal (2005) pointed to governance, infrastructure, and incentives as key advantages. McCallum (2011) found EPZs more effective than non-EPZs in attracting FDI. Islam and Sarkar (2023) showed that Uttara EPZ drives local development, exports, and FDI. Sumi et al. (2024), using the ARDL model and Wald test, found a strong link between exports, GDP, FDI, and investment from 2011–2022, with bidirectional causality between FDI and exports. In FY2023–2024, BEPZA zones—spanning only 3,445 acres—contributed 29% of Bangladesh’s total FDI, amounting to $424.29 million (Farhin, Rahman & Sadekin, 2024).

EPZs and Import

Despite the fact that exports continue to be the primary emphasis of economic zones (EPZs), imports nevertheless play a significant part in the process of industrial value addition. Imports supply the raw materials and intermediary goods that are necessary for manufacturing. Sivalingam (1994) brought attention to the difficulties that Malaysia's Economic Zones (EPZs) encountered as a result of a lack of backward connections. This resulted in local companies having difficulty supplying intermediate goods at prices that were competitive. In a similar vein, Jayanthakumaran (2003) made the observation that the majority of nations, with the exception of the Philippines, were unable to make substantial increases in local purchases of raw materials and machinery. As a result, imports became an essential component of production processes that were driven by EPZs. Elishi (2019) found that in Namibia EPZs has created jobs and generated foreign exchange profits from exports and manufacturing. EPZs have numerous beneficial spillover effects in host economies, such as multinational companies and local businesses in China benefit the most from proximity to EPZs and the commerce in import-and-assembly processes within these zones (Wu & Hong, 2022).

EPZs and Export

EPZs have a substantial impact on the expansion of exports, and Bangladesh is not an exception to this rule. Hasan and Ali (2019) highlighted the fact that economic special zones (EPZs) have increased the country's exports, which in turn has raised the country's foreign exchange revenues and industrial value addition. Within a similar vein, Islam (2018) highlighted the significant impact that the expansion of exports has in propelling the economic development of Bangladesh. According to Madani (1999), export-oriented zones (EPZs) are able to achieve development driven by exports by increasing workforce productivity through on-the-job training. Nevertheless, Aggarwal (2004) made the observation that even while EPZs in India had significant gains in export volume, maintaining constant growth rates remained a concern. Further evidence presented by Wang (2013) revealed that China's Economic Special Zones made a considerable contribution to value-added exports, which is comparable to the potential of similar zones in Bangladesh. Braga, Gouvea, and Gutierrez (2023) stated that in more than 150 nations worldwide, EPZs are driving export growth, attracting foreign investment, and creating job opportunities, thereby enhancing global economy integration by supporting the development and extension of global supply and value-added chains. The overall value of exports from EPZs of Bangladesh in FY 2023–2024 was USD 7,075.09 million, or around 17.34% of all exports from the country. According to Sarkar (2024), the rising export values of EPZs highlight how important EPZs are to boosting Bangladesh's foreign exchange profits and competitiveness in international commerce.

EPZs and Employment

EPZs significantly contribute to employment generation. Studies in Bangladesh by Hasan and Ali (2019) and Islam (2018) confirm their positive impact on employment and unemployment rates, consistent with global trends. In Malaysia, EPZs indirectly boosted labor demand in other sectors and improved workplace conditions (Sivalingam, 1994). However, employment outcomes vary;

Cirera and Lakshman (2017) found disparities in earnings, gender equity, and job security. Still, EPZs often offer better conditions and wages than non-EPZ industries (Milberg & Amengual, 2008). Kusago and Tzannatos (1998) noted EPZs effectively absorb surplus labor during early industrialization, though their influence diminishes over time. Madani (1999) emphasized their role in job creation, foreign income growth, and human capital development. Fakir et al. (2013) examined the legislative framework for EPZs in Bangladesh from 2001-2011, suggesting EPZs benefit developing nations by upgrading labor and management skills, and acquiring superior technology.

Challenges of EPZs

Many East Asian EPZs have been increasingly accepted as policy tools, despite falling short of their main goals. Despite significant government expenditure and revenue loss, many EPZs continue to contribute to economic growth through exports and FDI. Kemboi (2022) found that despite substantial incentives given to Kenya's EPZs, FDI does not ultimately result in economic growth, highlighting the need for further development in these zones. The analysis of Asia's Free Trade Zones (FTZs) shows that while most Asian countries have established EPZs and FTZs, not all have benefited from these arrangements, with some experiencing unstable employment, low labor quality, high costs, and a lack of modern technology (Rondinelli, 1987). A study based on data from 1966 to 2003 showed that in India the success of the zone has not been greatly affected by a supportive policy environment. Despite significant increases in employment, gross exports, and foreign exchange earnings, their growth rates significantly decreased, with a decline in export performance (Aggarwal, 2004).

Many studies have been conducted on EPZs, but no one has done any study to evaluate the impact of EPZs on the industrial value addition of Bangladesh. There is a research related to the contribution of EPZs to Bangladesh's export diversification based on the secondary data from 2001 to 2011 (Fakir et al. 2013). Hasan and Ali (2019) did a descriptive analysis on how EPZs play role in the national economy of Bangladesh based on a limited time period of 2005-2018. Islam (2018) also did this same descriptive analysis based on data from 2002 to 2017. Recently, a research has analyzed the effects of FDI inflows on EPZs in terms of exports and employment in EPZs using secondary data from 1997 to 2018 (Majumder et al. 2022). Begum et al. (2020) examined the performance of EPZs on the economic development of Bangladesh based on data from 2011 to 2019. This study, therefore, evaluates the impact of EPZs on industrial value addition of Bangladesh and also uses a long span of data (36 years ranging from 1986-87 to 2021-22) and unique econometric methodology to investigate the LR as well as SR impact of EPZ on industrial value addition in Bangladesh which has not been done before.

3. Methodology

To examine the impact of EPZ on the industrial value addition of Bangladesh, this study uses 36-year time period data ranging from 1986-87 to 2021-22. As the industrial value addition is measured by industrial value added, this study uses the industry value added (% of GDP) as

dependent variable and the independent variables are investment, export, import and employment of EPZs. These data are collected from BEPZA's publications, the World Bank's reports and the reports of Bangladesh Bank.

3.1 Variable description and data sources

The detail variable description and data sources are given below:

Table 1: Variable Description and Data Sources

Variable in Abbreviation	Details of the Variable	Unit of Analysis	Data Source
IN_VA	Industry value added	% of GDP	World Bank
INV	Investment in EPZs	Billion USD	BEPZA
EX	Export from EPZs	Billion USD	BEPZA
EM	Employment of EPZs	Billion	BEPZA
IM	Import to EPZs	Billion USD	Bangladesh Bank

3.2 Model specification

Form the following model we are going to examine the impact of EPZs on the industrial value addition of Bangladesh:

$IN\_VA = f(INV, EX, EM, IM)$ ..... (1)

3.2.1 Test of unit root

A range of potent instruments can be employed in time series data to verify the presence of stationary. The Augmented Dicky-Fulller (ADF) test is used in this study.

3.2.2 Selection of time lag

Prior to creating a time series model, determining the series' lag order is a crucial step. The optimum lag order selection can be done by using minimum information criterion, such as sequential modified LR test statistics, Akaike information criterion (AIC), Schwarz information criterion (SIC), Hannan- Quinnn information criterion (HQC).

3.2.3 Cointegration test/ bound testing

The presence of long run relationship can be detected by using co-integration test. Now-a-days, the ordinary least square (OLS) based on ARDL model turned into the most popular approach (Qamruzzaman & Wei, 2018). The most important benefit of this model is that, this model can be used when the variables are mixed kind of stationary (Pesaran, Shin, & Smith, 2001).

3.2.4 The Estimation of the model using ARDL approach

This research uses the ARDL model because the variables of this model are mixed kind of stationary both I(0) and I(1).

The general model of the study is as follow:

$$In\_VA_t = \beta_0 + \beta_1 INV_t + \beta_2 EX_t + \beta_3 IM_t + \beta_4 EM_t + e_t \quad (2)$$

Here, e_t represents error term

As in ARDL model the SR and LR relationships among the variables are explicitly separated. Therefore, this model can be used to find out the objectives of 1 and 2 of this study.

a) Short-Run Relationship

The SR dynamics illustrate how, both in the present and past, changes in the independent variables have a transient impact on the dependent variable.

The Error Correction Model (ECM) form of ARDL is represented by the coefficients of the differenced variables, which capture either immediate or lagged impacts.

From the ECM form of ARDL:

$$\Delta In\_VA_t = \alpha_0 + \sum_{i=0}^{n} \alpha_{1i}\, \Delta INV_{(t-i)} + \sum_{i=0}^{n} \alpha_{2i}\, \Delta EX_{(t-i)} + \sum_{i=0}^{n} \alpha_{3i}\, \Delta IM_{(t-i)} + \sum_{i=0}^{n} \alpha_{4i}\, \Delta EM_{(t-i)} + \sum_{i=1}^{n} \alpha_{5i}\, \Delta ln\_VA_{(t-i)} + \xi_1 ECT_{(t-1)} + e_t \quad (3)$$

Here Δ represents difference operator, α_0 is a constant, $\alpha_1 - \alpha_4$ are coefficient and ε_t is error term.

Where α_1 to α_4 are SR coefficients which show how investment, exports, imports and employment in EPZs are playing role in the industrial value addition of Bangladesh in the SR (objective 1).

On the other hand, in the ECM form:

$$ECT_{(t-1)} = ln\_VA_{(t-i)} - \omega_0 - \omega_1 INV_{(t-1)} - \omega_2 EX_{(t-1)} - \omega_3 IM_{(t-1)} - \omega_4 \Delta EM_{(t-i)} \quad \text{.....(4)}$$

Where ω is the LR multiplier.

The ECT_{t-1} is one period lag error correction term. The coefficient of ECM_{t-1} is the speed of adjustment parameter. If the sign of this parameter is negative and significant then there will be cointegration in the variables of this model. The short-run dynamics can be found from equation (3).

b) Long-Run Relationship

After all adjustments are made, the long-run relationship shows how dependent variable reacts over time to a permanent change in independent variable, reflecting the equilibrium connection between variables.

The LR relationship can be represented by the ARDL model's levels form. The LR coefficients are obtained by dividing the distributed lag coefficients by the coefficients of the lagged dependent variable. The levels model for estimating LR coefficients are given below:

$$\ln\_VA_t = \sigma_0 + \sum_{i=0}^{n} \sigma_{1i}\, INV_{(t-1)} + \sum_{i=0}^{n} \sigma_{2i}\, EX_{(t-1)} + \sum_{i=0}^{n} \sigma_{3i}\, IM_{(t-1)} + \sum_{i=0}^{n} \sigma_{4i}\, EM_{(t-1)} + \sum_{i=0}^{n} \beta_{1i}\, In\_VA_{(t-1)} + e_t \quad (5)$$

Where σ_1 to σ_4 are LR coefficients which show how investment, exports, imports and employment in EPZs are playing role in the industrial value addition of Bangladesh in the LR (objective 2).

3.2.5 The Diagnostic test

Some econometrics tests like, serial correlation, heteroscedasticity, normality and stability test have been done to check the desired properties of an econometric model (Greene, 2000; Gujarati & Sangeetha, 2007). All of these tests are done in this study.

4. Data Analyses

4.1 Unit root test

Time series data are generally non-stationary, meaning they cannot be predicted or modelled since they are unpredictable. When non-stationary time series data are used, the outcome might be erratic and less trustworthy. Thus, the study's finding ought to be reliable and consistent. Therefore, the data should be converted into stationary data if they are nonstationary.

The stationary is checked in this study using the ADF test. The formal unit root test yielded the following is the summary of the results:

Table 2: Augmented Dickey Fuller Test

Variables	ADF	
	Level	1st difference
	Trend and intercept	Trend and intercept
INV	-0.3466	-0.9002***
EX	-0.1806**	-0.9533*
IM	-0.2054	-2.1133***
EM	-0.0572	-0.6872***
In_VA	-0.3466	-0.9002***

Note: ***, ** and * represent significant at 1%, 5% and 10% level respectively.

Source : Author's calculation

This table 2 shows that variables are mixed kind of stationary (combination of I (0) and I (I)). As a result, the ARDL model will be used in this study.

4.2 Lag length selection

The choice of lag is highly important and delicate. As a result, choosing the right criterion for the lag is crucial. There are several aspects available to choose from when choosing a lag. This study will employ the lag that the greatest number of criteria recommends.

Table 3: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-180.2925	NA	0.037264	10.89956	11.12402	10.97611
1	-10.26977	280.0375	7.49e-06	2.368810	3.715599*	2.828104
2	24.35611	46.84679*	4.71e-06*	1.802582*	4.271694	2.644620*

Note: LR: sequential modified LR test statistic; FPE: Final prediction error; AIC: Akaike information criterion; SC: schwarz information criterion; HQ: Hannan-Quinn information criterion

Source : Author's calculation

From table 3, Akaike Information Criterion, Hannan-Quinn Information Criterion and LR test statistic shows the optimal lag is 2. Therefore, this study uses lag 2 for this model.

4.3 Bound testing

Since our data consist of I (0) and I (1), the ARDL bound test is the only one that can be used in this investigation. The bound testing provides evidence for the co-integration of the variables under investigation. Here the null hypothesis is no level relationship between the variables. And the alternative hypothesis is there is relationship between variables.

Table 4: Bound Test

Lag length		**F-statistic**	
ARDL (2,0,1,1,1)		11.68391	
Level of Significance		Critical Values	
	Number of Variable(k=4) and sample size(n=1000)	Lower bound	Upper bound
10%		3.03	4.06
5%		3.47	4.57
2.5%		3.89	5.07
1%		4.4	5.72
	k=4, n=35		
10%		3.374	4.512
5%		4.036	5.304
1%		5.604	7.172
	k=4, n=30		
10%		3.43	4.624
5%		4.154	5054
1%		5.856	7.578

Note: k is the number of independent variable is this model and the sample size is 34

Source : Author's calculation

As the F-statistic in the table is 11.68391, which is greater than the upper bound at 1 per cent, 5 per cent and 10 per cent, this study is not accepting the null hypothesis and acknowledge the existence of a long-term association. Thus, this study use ARDL to conduct long run, short run, and ECM model here.

4.4 ARDL estimation

Table 5: Long-Run Coefficient of ARDL (2,0,1,1,1) Model

Dependent variable: ln_VA					
Contant	**Trend**	**INV**	**EX**	**IM**	**EM**
19.92284	-0.213710	-0.05798	-4.2935	5.9518	0.0264
(3.784049)***	(-2.44479)**	(-0.019092)	(-2.829790)***	(2.394384)**	(1.853533)*
R^2 = 0.995676					
Adjusted R^2 = 0.993796					
F-statistic = 529.6325***					

Note: The number indite the parenthesis is the value of t- ratio

***, ** and * represent significant at 1%, 5% and 10% level respectively.

Source : Author's calculation

Table 5 shows that the EX has negetive and significant relation with In_VA. The ecefficient value of EX is -4.2935 which implies that 1 percent increase in the value of export from EPZ leads to 4.29 percent decrease of industry value added in the long run at 1 percent level of significance. IM has positive and significant relation with In_VA . The value of the coefficient of IM is 5.9518 which implies that 1 percent increase in the value of import to EPZ leads to 5.95 percent increase of industry value added in the long run at 5 percent level of significance. EM has positive and significant relation with In_VA with the coefficient value of 0.0264 which implies that if employment increase by 1 percent, the industry value added would also increase by 0.0264 percent in the long run at 10 percent level of significance. The model's statistical significance is strongly supported by the F-statistic value with zero probability.

4.5 Error correction model

Table 6: Error Correction Regression

Dependent variable: In_VA	
Regressors	**ARDL(2,0,1,1,1)**
C	19.92284***(8.070403)
Trend	-0.213710***(-7.820613)
D(IN_VA(-1))	0.230527**(2.293715)
D(IM)	0.741371 (1.338618)
D(EX)	-0.496665 (-1.015361)
D(EM)	0.027941***(5.086810)
ECT	-0.629351*** (-8.281273)
R^2	0.747580
Adjusted R^2	0.691487
F-statistic	13.32743***

Note: The number indite the parenthesis is the value of t- ratio
***, ** and * represent significant at 1%, 5% and 10% level respectively.
Source : Author's calculation

Table 6 includes the findings from the ARDL model's error correcting representation . The first difference coefficients of the variables reflect the short-run elasticity. It shows insignificant SR effect for both export from EPZ and import to EPZ that is import has positive effect and export has negative effect on industry value added. However, employment has both a positive and significant relationship with dependent variable. The coefficient 0.027941 implies that a 1 percent increase in the value of employment leads to a 0.028 percent increase in industry value added at the 1 percent level of significance.

The error correction term, denoted by ECT in this case, is shown to be negative, with a corresponding coefficient of -0.629351. This suggests that 62.94 percent of any shifts into

disequilibrium are resolved in a single period of time. This study also finds that the coefficient is very significant because of the extremely immense t-statistic, which is -8.281273. Since the explanatory variables in the model can account for 75 percent of the variation in In_VA, as indicated by the R^2 value of 0.75, the ARDL model of error correction regression fits this data set quite well.

4.6 Diagnostic tests

A crucial stage in time series modeling is performing a significant amount of diagnostic tests. Thus, diagnostic tests on data series provide insights into potential modeling options for this data. Diagnostic tests can be used to evaluate model residuals during an assessment; these tests serve as useful indicators of the model's competency.

Table 7: Diagnostic Test Results of ARDL Model

Test Statistic	Probability Value
Heteroscedasticity Test : Breusch- Pegan- Godfrey	0.1044
Breusch- Godfrey Serial Correlation LM Test	0.2460
Normality test	0.3192

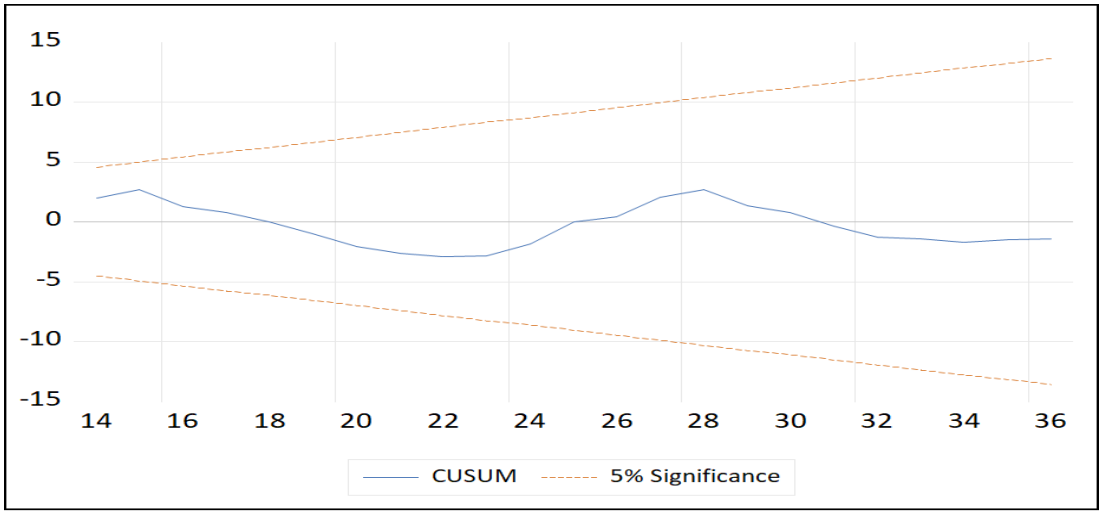
Source : Author's calculation

Multiple tests are used to diagnose the ARDL bound test model. The test findings shown in Table 7 verify that there is no serial correlation or heteroskedasticity issue. Moreover, the distribution of residuals is normal.

4.7 The stability test

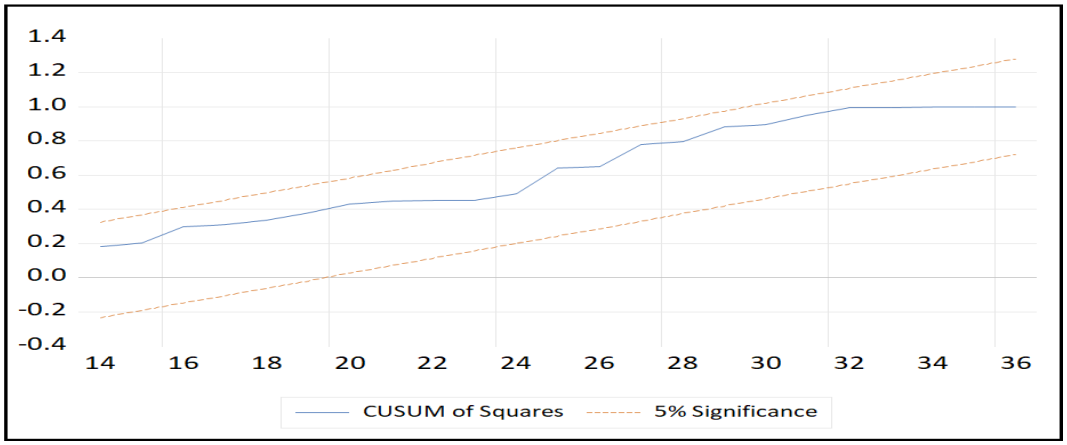
To verify that the model is stable, the study uses the CUSUM and CUSUM Square tests. The CUSUM and CUSUM Square test results are shown in the corresponding figures:-

Figure 1: Cumulative Sum of Recursive Residuals



Source : Author's calculation

Figure 2: Cumulative Sum of Square Recursive Residuals



Source : Author's calculation

The CUSUM and CUSUM SQUARE tests are performed in the study to evaluate the model's stability. As illustrated in figure 1 and 2, the lines fall within the 5 percent significance interval. It implies that this model is stable and robust.

5. Discussion

This study observes from the data analysis section that IM have a positive impact on Bangladesh's industrial value addition. There are several explanations for this outcome. When operating within an EPZ, businesses can often import raw materials, components, and machinery at reduced tariffs or without paying any customs duties at all. As a result, there is a rise in industrial activity in these zones, which lowers production costs for companies focused on exports. Numerous studies have yielded similar conclusions, namely that imports contribute positively to both industrial and economic growth. A working paper by the Asian Development Bank demonstrates a strong and favorable correlation between imports and economic growth (Kim, Lim, & Park, 2007). The data shows that the competitive pressures brought on by imported consumer goods and the technology transfers included in imported capital goods from developed nations are what cause imports to have a productivity-boosting effect. Another Malaysian study demonstrates that imports and economic growth determinants have a notably beneficial relationship (Kogid, Mulok, Ching & Lily, 2011).

Another finding of this study is that there is a presence of significant positive relation between employment and industrial development in Bangladesh. From where we can say that one of the main objectives of EPZs, increase employment, is being fulfilled. Other studies (Sivalingam, 1994; Hasan & Ali, 2019; Cirera & Lakshman, 2017) showed that there is a direct beneficial relationship between job creation and industrial development.

This study also finds that the export of EPZs has a significant negative effect on industrial development in the LR. The reason would be that approximately 54.68 percent of all exports from EPZs are made up of apparel sector. However, the other EPZ sectors—garment accessories,

textiles, footwear and leather goods, electronics, camping gear, and caps—captured a sizable portion of the export revenue, demonstrating the EPZs' status as a center for producing a wide range of items (*BEPZA | Bangladesh Export Processing Zones Authority*, n.d.). As value added is the net output of a sector after adding up all outputs and subtracting intermediate inputs, the relationship between IN_VA and EX would be negative. Moreover, this study result shows that there is a negative impact of EPZs investment on the industrial value addition of Bangladesh. A study about Asia's EPZs revealed that nearly all growing Asian countries have established EPZs and FTZs but not all have benefited from these arrangements (Rondinelli, 1987). A study done by Quaicoe, Aboagye, and Bokpin (2017) on EPZs in Ghana found that free zone investments and exports have a strong inverse association with economic growth. Additionally, there was a strong adverse association between trade openness and economic growth.

Advanced machinery, intermediate items, and raw materials can all be imported into EPZs to increase production capacity. These imports allow industries to produce more value-added outputs when they are used effectively. Importing capital equipment and intermediate commodities has been crucial to raising industrial productivity and value addition in emerging nations (World Investment Report, 2019; UNCTAD Investment Policy Hub, n.d.).

By generating employment possibilities, EPZs improve skill development and labor utilization. Increased employment contributes to industrial value addition by increasing industrial output and production capacity. Because it increases industrial output and value addition, employment creation in EPZs has been recognized as a major force behind economic development (Aggarwal, 2005).

6. Conclusions and Policy Recommendations

EPZs have played a pivotal role in Bangladesh's economic transformation by driving industrialization, attracting foreign investment, and generating employment. Managed by the BEPZA, EPZs have enhanced export capacity and contributed to socioeconomic progress, including women's empowerment and corporate social responsibility. However, challenges such as regulatory inefficiencies, infrastructure gaps, environmental concerns, and labor rights issues persist.

This study analyzes the impact of EPZs on Bangladesh's industrial value addition over 36 years using the ARDL model. Long-run results reveal that employment and imports positively influence industrial value addition, while exports and EPZ investments exhibit negative effects. In the short run, employment significantly boosts industrial value addition, whereas exports show a negative (though statistically insignificant) impact, and imports have a positive but insignificant effect.

The findings suggest several policy measures. First, targeted incentives—such as tax breaks, simplified customs procedures, and flexible labor regulations—should be prioritized for EPZ-based firms. Second, collaboration with educational institutions to develop workforce training programs is critical, as skilled labor is essential for maintaining international production standards. Given employment's consistent positive impact, enhancing labor productivity through training aligns with Bangladesh's labor-intensive economy. Third, regular evaluation of EPZ policies is necessary to adapt to global market shifts, technological advancements, and trade dynamics. Fourth, streamlining administrative processes (e.g., one-stop services for permits) can

reduce bureaucratic hurdles for investors. Additionally, fostering backward linkage industries to support export-oriented production could amplify exports' contribution to industrial growth. Finally, ensuring political stability is vital for sustaining EPZs' long-term viability.

By addressing these challenges and leveraging EPZs' potential, Bangladesh can strengthen its industrial sector and achieve sustainable economic progress.

This study is limited by its use of aggregated data, which may overlook sector-specific variations and their backward linkages to domestic industries. Further research could explore firm-level dynamics, labor market conditions, and technology spillovers to provide a more comprehensive understanding of EPZs' impact on industrial value additions.

References

Aggarwal, A. (2004, November 1). Export processing zones in India: Analysis of the export performance. Retrieved from https://econpapers.repec.org/paper/indicrier/148.htm

Aggarwal, A. (2005). Performance of export processing zones: a comparative analysis of India, Sri Lanka and Bangladesh. Retrieved from https://www.econstor.eu/handle/ 10419/176177

Begum, H., Aktar, M., & Sultana, A. (2020) The Impact of Export Processing Zones on Economic Development of Bangladesh.

BEPZA Bangladesh Export Processing Zones Authority. (n.d.). https://www.bepza.gov.bd/annual-reports

Braga, H., Gouvea, R., & Gutierrez, M. (2023). Brazilian Export Processing Zones & Green Powershoring: Challenges & Opportunities. *Modern Economy*, *14*(10), 1366–1392. https://doi.org/10.4236/me.2023.1410070

Cirera, X., & Lakshman, R. W. D. (2017). The impact of export processing zones on employment, wages and labour conditions in developing countries: systematic review. *Journal of Development Effectiveness*, *9*(3), 344–360. https://doi.org/10.1080/ 19439342.2017.1309448

Elishi, I. (2019). *An assessment of the impact of export processing zones on Namibia's socio-economic growth* (Doctoral dissertation, University of Namibia).

European Central Bank (2016). European Central Bank Economic Bulletin: Issue 1. Frankfurt:

European Central Bank

Fakir, A. N. M. A., Miah, M. S., & Hossain, M. S. (2013, January 1). *Export Diversification and Role of Export Processing Zones (EPZ) in Bangladesh. | ASA University Review | EBSCOHost*. https://openurl.ebsco.com/EPDB%3Agcd%3A9%3A10228249/detailv2?sid=ebsco%3Aplink%3Ascholar&id=ebsco%3Agcd%3A116350614&crl=c

Farhin, M., Rahman, A., & Sadekin, M. N. (2024). Impact of Cumilla Export Processing Zone on Bangladesh's export and foreign direct Investment: an econometric analysis. *Journal of Science and Technology.*, *10*(2), 23–32. https://doi.org/10.69728/jst.v10.47

Finance Division, Ministry of Finance. (n.d.). Retrieved from https://mof.portal.gov.bd/site/page/ 28ba57f5-59ff-4426-970a-bf014242179e/Bangladesh-Economic-Review-2023

Glossary DataBank. (n.d.). https://databank.worldbank.org/metadataglossary/jobs/series/NV.IND. TOTL.ZS

Greene, W. H. (2000). Econometric analysis. Upper Saddle River, New York University Press: Prentice Hall.

Gujarati, D. & Sangeetha, (2007). Basic econometrics: Cointegration and error correction model. New Delhi: Tata McGraw-Hill Publishing Company Limited.

Hasan, S. B. and Ali, M. K. (2019) The Role of Export Processing Zones on Bangladesh National Economy. Global Scientific Journal, 7(7), pp. 452-467

Islam, N. (2018). Impact of EPZ on national economy of Bangladesh. *IOSR Journal of Business and Management*, *20*(9), 23-35.

Islam, S., & Sarkar, P. (2023). Contribution of the Establishment of Uttara Export Processing Zones to the Social Development of the Nilphamary District and Surrounding Areas in Bangladesh. *Middle East Journal of Business*, 18(1), 16-34.

Jayanthakumaran, K. (2003). Benefit–Cost Appraisals of Export Processing Zones: A Survey of the literature. *Development Policy Review*, *21*(1), 51–65. https://doi.org/10.1111/1467-7679.00198

Kemboi, G. J. (2022). *Impact of export processing zones foreign direct investments on economic growth in Kenya* (Doctoral dissertation, Kenyatta University).

Kim, S., Lim, H., & Park, D. (2007). Could Imports be Beneficial for Economic Growth? Some Evidence from Republic of Korea. Retrieved from https://www.econstor.eu/handle/10419/109303

Kogid, M., Mulok, D., Kok, S. C., & Loganathan, N. (2011). Does import affect economic growth in Malaysia. *ResearchGate*. https://www.researchgate.net/publication/230825213_Does_Import_Affect_Economic_Growth_in_Malaysia

Kusago, T., & Tzannatos, Z. (1998, January 1). Export processing zones: a review in need of update. Retrieved from https://econpapers.repec.org/paper/wbkhdnspu/20046.htm

Madani, D. (1999). A review of the role and impact of export processing zones. *World Bank Policy Research Working Paper*. https://doi.org/10.1596/1813-9450-2238

Majumder, S. C., Rahman, M. H., & Martial, A. a. A. (2022). The effects of foreign direct investment on export processing zones in Bangladesh using Generalized Method of Moments Approach. *Social Sciences & Humanities Open*, *6*(1), 100277. https://doi.org/10.1016/j.ssaho. 2022.100277

McCallum, J. K. (2011). Export processing zones : comparative data from China, Honduras, Nicaragua, and South Africa. *ideas.repec.org*. Retrieved from https://ideas.repec.org/p/ilo/ ilowps/994624793402676.html

Milberg, W., & Amengual, M. (2008). Economic development and working conditions in export processing zones: A survey of trends. *ResearchGate*. https://www.researchgate.net/publication/241522634_Economic_development_and_working_conditions_in_export_processing_zones_A_survey_of_trends

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289–326. https://doi.org/ 10.1002/ jae.616

Qamruzzaman, M., & Wei, J. (2018). Financial Innovation, stock market Development, and Economic Growth: an application of ARDL model. *International Journal of Financial Studies*, *6*(3), 69. https://doi.org/10.3390/ijfs6030069

Quaicoe, A., Aboagye, A. Q., & Bokpin, G. A. (2017). Assessing the impact of export processing zones on economic growth in Ghana. *Research in International Business and Finance*, *42*, 1150–1163. https://doi.org/10.1016/j.ribaf.2017.07.052

Razzaque, M. A., & Rahman, J. (2019). Bangladesh's Apparel Exports to the EU: Adapting to Competitiveness Challenges Following Graduation from. *ResearchGate*. https://www.researchgate.net/publication/333092701_Bangladesh's_Apparel_Exports_to_the_EU_Adapting_to_Competitiveness_Challenges_Following_Graduation_from_Least_Developed_Country_Status

Rondinelli, D. A. (1987). Export Processing Zones and Economic Development in Asia: A review and reassessment of a means of promoting growth and jobs. *American Journal of Economics and Sociology*, *46*(1), 89–106. https://doi.org/10.1111/j.1536-7150.1987.tb01766.x

Sarkar, P. (2024). BEPZA's Economic impact: Fueling Bangladesh's GDP expansion through export processing zones. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.4974048

Sivalingam, G. (1994). The Economic and social impact of export processing zones: the case of Malaysia. Retrieved from https://econpapers.repec.org/paper/iloilowps/993049733402676. htm

Sumi, S. A., Akhter, R., Hasan, S. B., & Bhowmik, D. (2024). The Impact of Foreign & Domestic Investment on Export Processing Zones in Bangladesh: An Auto Regressive Distributed Lag (ARDL) Approach. *Saudi Journal of Economics and Finance*, *8*(09), 290–297. https://doi.org/10.36348/sjef.2024.v08i09.002

UNIDO Statistics Data Portal. (n.d.). https://stat.unido.org/content/publications/how-industrial-development-matters-to-the-well-being-of-the-population

Wang, X. (2013, October 18). The role of economic development zones in national development Strategies: the case of China. Retrieved from https://www.rand.org/pubs/ rgs_ dissertations/ RGSD320.html#:~:text=This%20dissertation%20finds%20that%20EDZs,substantially%20to%20China's%20economic%20growth

World Investment Report 2019 - Special Economic Zones | Publications | UNCTAD Investment Policy Hub. (n.d.). Retrieved from https://investmentpolicy.unctad.org/publications/1204/world-investment-report-2019---special-economic-zones

Wu, W., & Hong, C. (2022). How processing trade assists local industrial upgrading: input–output analysis of export processing zones in China. *Journal of Industrial and Business Economics*, *50*(2), 369–397. https://doi.org/10.1007/s40812-022-00246-w