



Economic Complexity Dynamics: Do Financial Development, Industrialization and Remittances Matter in Bangladesh?

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ABSTRACT

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The article looks statistically at how financial development (FDP), industrialization (IND), remittance (PRI), and GDP shape economic complexity (ECC) in Bangladesh. Unlike prior work, this attempt relies on a dynamic model to quantify ECC using yearly data from 1995 to 2024. Employing the Autoregressive Distributed Lag (ARDL) method, we uncover that FDP has a positive and statistically noteworthy impact on ECC in the long run. It is worth reporting that the development of financial institutions is vital to elevating ECC in Bangladesh. In a similar vein, PRI and GDP disclose a positive and statistically strong link with ECC in the long run. In contrast, IND negatively affects ECC in the long run. Focusing on the short-run dynamics, this article finds negative effects of FDP, PRI, and GDP on ECC, while IND has a positive and significant influence on ECC in the short run. The accounted insights are validated by carrying out credibility assessments using Fully Modified Ordinary Least Squares (FMOLS) and Canonical Cointegration Regression (CCR). Overall, this attempt suggests that the Bangladeshi government should prioritize long-term FDP and PRI to enhance economic complexity.

1. INTRODUCTION

The economic complexity (ECC) of an economy is defined by how information flows through it and how its production is set up. This, in turn, has an effect on its link with economic growth [1, 2]. Lapatinas [3] stated that a country's ECC is an indicator of how advanced it is, since it reveals how advanced its output and exports are. The complexity of production directly impacts a nation's GDP; countries skilled in manufacturing intricate goods generally see rapid economic advancement. Since Hidalgo and Hausmann [4] initially talked about the idea of ECC, more and more scholars have been trying to figure out what it entails. Notwithstanding, Bangladesh's economy has been growing at a rate of about 6% per year [5], making it one of the fastest-growing leading economies in the world. In 2023, industrial sector accounted for 22.3% of GDP, and the industrial sector's contribution to GDP increased to about 34.6%. The manufacturing production in 2023 was approximately US\$97.7 billion, an increase from around \$100 billion in 2022. This upward trend indicates that Bangladesh's productive complexity is on the rise.

A nation's understanding of productivity and the complexity of its production are reflected in the variety and quality of its exports. A combination of specialization, creativity, and tacit knowledge is necessary to make a complex product. A

country's structural transformation can be shaped by financial development (FDP), which is crucial for ensuring sustained as well as equitable economic growth (EG). By highlighting the role of the financial sector in spurring economic growth, Schumpeter [6] solidified its place in the economic paradigm. In order to mobilize savings, allocate capital effectively, encourage innovation, and eventually promote economic sophistication, FDP is vital to strengthen the financial institutions and markets in depth, access, efficiency, and stability [7]. The banking sector is crucial in this regard, as it speeds up economic growth by ensuring a steady flow of funds via essential operations. Accordingly, the first linkage between FDP and EG was proposed by archaic scholars Goldsmith et al. [8] and McKinnon [9]. While FDP speeds up industrial diversification and economic progress in developing economies like Bangladesh, it also upsurges consumption and energy-intensive industry which ultimately rise environmental damage. A growing body of recent research highlights the ways in which FDP impacts ECC [10, 11].

On the FDP front, compared to the world average of 0.331 in 2020 and a slight improvement from 0.187 in 1980–2021, Bangladesh's FDP index score in 2021 was 0.243. Although the banking system is now more efficient, the report states that both loan availability and financial access are still in their early stages of development. Taken as a whole, these metrics point

to an encouraging but not entirely linear relationship: increasing industrial output and diversification indicate a more sophisticated economy, but for Bangladesh to continue and accelerate its shift into higher-value sectors, it is crucial to further enhance its financial depth and access. The linkage between FDP and ECC is brought to mind by this need. By bolstering innovation, allowing firm entrance and expansion, and supporting the reallocation of resources towards high-value sectors, FDP—through more accessible credit, more efficient financial institutions, and deeper capital markets—is crucial in easing this complexity [7]. In order to maintain profitable investments in diverse and complex industries, it is vital for financial systems to work smoothly since this lowers transaction and information costs [12]. In this way, FDP facilitates both economic development and the emergence of complex economic systems, particularly through the effective allocation of financial resources to areas that rely heavily on technology.

However, industrialization (IND) enhances ECC in two ways: it improves things and promotes the development of useful information. Rodrik [13] defined that the manufacturing sector is very significant for structural change because it can assist individuals to learn from experience, use technology, and boost productivity. Moving to high-tech industries, like electronics and equipment, makes it easier to get into more complex product areas and activities that add value [14]. The ready-made garments (RMG) sector is one of the things that has evolved Bangladesh's economy quickly. This sector's heavy reliance on low to medium technology goods and services makes the global finance less complicated. To meet the goals of government programs like Vision 2041, Bangladesh needs to raise its ECC by encouraging diversity, technical innovation, and the growth of human capital [15].

Moreover, remittances (PRI) may add complexity to the economy by making it easier for new businesses, increasing the range of goods and services available. Due to the higher reliance of businesses in developing nations on foreign investment, PRI significantly impact these nations. In order to formulate successful policies, it is vital to understand how PRI might improve economic growth and diversification [16]. In Bangladesh, PRI contributes 6.11% of GDP in 2024, which indicates that PRI is a significant factor for the development of ECC. Besides, the recent economic performance of Bangladesh has evolved significantly in every segment. Statistically, the annual growth of GDP is 4.22% in 2024. As a result of significant progress, it can produce more efficiently and increase the variety of export-focused goods [17].

Thus, from a Bangladeshi point of view, this article intends to link FDP, IND, PRI, GDP, and ECC. This attempt uses ECC to identify the structural changes of the economy, focusing on the prior literature. This article analyzes the determinants of ECC in Bangladesh over 1995–2024. Unlike existing studies that rely on cross-country approaches, this paper offers country-specific evidence by jointly examining FDP, IND, PRI, and GDP within a dynamic framework. The aim of this evaluation is reported below:

- (a) To assess the intensity of FDP, IND, PRI, GDP on ECC in Bangladesh.
- (b) To evaluate the short and long run linkage between FDP, IND, PRI, GDP, and ECC.
- (c) To identify a significant policy standard for developing the ECC in Bangladesh.

The rest of the articles' structure is as follows: Section 2 incorporates the prior literature, while Section 3 discloses the

data and methodology. The results and discussion are presented in Section 4. Finally, Section 5 concludes the article with appropriate policy formations.

2. LITERATURE REVIEW

How can we discover from countries that uniformly stand higher than the other entities? In the setting of ECC, this article investigates how nations accumulate knowledge and diversify their domains. ECC is a constructive parameter of economic growth and development as it quantifies the breadth and complexity of the exported goods and services [18]. Theoretically, ECC is related to FDP, IND, PRI, and GDP. FDP aids individuals and companies to access various forms of financing. As noted by Arooj and Sajid [19], FDP is positively tied with ECC in Pakistan from 1990 to 2019. However, ECC was marginally impacted by FDP [10]. Nevertheless, the addition of the interaction term "institution" had a favorable influence. Financial openness and ECC are positively correlated [20]. The scholars found a positive nexus by Njangang et al. [11]. Using data collected from 86 nations, Nguyen and Su [21] looked into the aftereffect of FDP on ECC. Evidently, they concluded that ECC is positively related to the banking sector.

It was also discovered by Nguyen et al. [22] that there are positive interconnections between ECC and financial markets and institutions. Moreover, FDP and ECC found a favorable linkage by Chu [23] using a data set of 94 economies and a system-generalized approach of moments estimation. Also, efficiency in the financial sector is far more crucial than depth and accessibility in the financial sector. Later, Chu [24] analyzed 94 different nations. This research used the generalized method of moments (GMM) to conclude that financial institutions increase ECC. Maskus et al. [25] followed the trend of most prior empirical research by using private credit and stock market capitalization as surrogates for FDP. When studying the FDP of emerging economies, Nguyen et al. [26] relied on direct FDP.

However, PRI plays as a money generating factor to economic escalation through strengthening family earnings and local investments. In the aggregate sense, PRI evolves the economic structure positively. In the prior attempts, Piras [27] relied on 78 nations from 2006 to 2020 and verified a favorable integration between PRI and ECC. Also, Saadi [28] targeted unbalanced data from 2002 to 2024 and highlighted that PRI and ECC are interconnected positively. The scholar identified that PRI significantly reinforces local business investment and upholds the production of export-related products. Ajide [29] mentioned a favorable linkage between the quantity of new enterprises and ECC. Moreover, Ajide and Osinubi [30] significantly uncovered that FDI and PRI advance ECC in Africa. They highlighted that we should incorporate PRI and FDP as a veritable domain as it modernizes the manufacturing structure. It significantly boosts the product quality via funding in the R&D promoting to greater intensity of ECC.

On the other hand, Ferraz et al. [15] inspected the nexus between IND policy and ECC. They claimed that IND policies expectedly diversified the social and economic durability. Also, Nepomuceno Lima et al. [31] statistically figured out a significant linkage between manufacturing and ECC. They exerted that individuals who shared in processing with elevated level of R&D favorably influence ECC. In the meantime, employing CS-ARDL method from 1990 to 2019,

Guo et al. [32] disclosed that ECC proficiently deals with resource allocation and balances the harmful behavior of trade. In the recent attempts, Emeka et al. [18] relied on 34 African economies from 2010 to 2021 and identified a positive integration between IND and ECC.

More importantly, due to the importance of GDP to formulate the economic structure, policymakers and scholars continuously look into the causality of GDP on ECC. Regarding this notability, the latest assessments claimed that a high GDP per capita in a nation incorporates more variations and complexity in the manufacturing structure that ultimately escalates the knowledge and skills of the individuals [33, 34]. It is completely evident how the authority may uphold the high intensity industries. World Intellectual Property Report [35] clarified that a more value of GDP in an economy may boost the degree of idea, technology, and information. Using these facilities, the individuals may lead to yield and trade more complex products.

Taken together, there is a dearth of articles to quantify the impact of FDP, IND, PRI, and GDP on ECC, particularly in the context of Bangladesh. This paper adds to the existing body of knowledge by taking a holistic view of Bangladesh and drawing conclusions on ECC. This article contributes to the current literature in more than one manner. To begin, as a growing nation, this study statistically finds out the contributed factor of ECC in Bangladesh. Unlike the prior attempts that mainly focused on the cross-country approaches, this article relies on country-specific assessment via jointly investigating FDP, IND, PRI, and GDP within a dynamic Autoregressive Distributed Lag (ARDL) model. This model is well-applicable for a small sample size with both first and second order integration [36]. Moreover, the ARDL method estimates both short and long run coefficients of the model and it also addresses the endogeneity and autocorrelation issues through changing the lag order. More precisely, this article expands the existing literature by adding financial, external, and structural dimensions to identify the degree of ECC in Bangladesh. For instance, FDP captures resource allocation efficiency, IND reflects structural transformation, PRI introduces an underexplored external channel influencing productive capacity, and GDP controls for overall economic scale. By aggregating, the paper provides a policy-relevant framework aligned with Vision 2041 of Bangladesh. Regarding the prior literature, this assessment formulates the following hypothesis:

- H_A:** FDP does not affect ECC in Bangladesh.
- H_B:** IND does not influence ECC in Bangladesh.
- H_C:** PRI does not evolve ECC in Bangladesh.
- H_D:** GDP does not promote ECC in Bangladesh.

3. DATA AND METHODOLOGY

3.1 Data

The aim is to investigate the multifaceted effects of FDP, IND, PRI and GDP on ECC in Bangladesh. Using the data from 1995 to 2024, the article uses economic complexity index for ECC, domestic credit to private sector (percentage of GDP) for FDP, industry including construction (annual percentage growth) for IND, PRI received (percentage of GDP) for PRI and gross domestic production (annual percentage growth) for GDP. We collect the data of ECC from Atlas Database and the remaining data is obtained from World Development Indicator

(WDI). Table 1 provides detailed information about the factors used in this investigation. Figure 1 reveals the flow of ECC in Bangladesh from 1995 to 2024.

Table 1. Variable details and sources

Variable(s)	Symbol	Measure	Source
Economic complexity	ECC	Economic complexity index	Atlas Database
Financial development	FDP	Domestic credit to private sector (% of GDP)	WDI
Industrialization	IND	Industry (including construction), value added (annual % growth)	WDI
Remittance	PRI	% of GDP annual %	WDI
Gross domestic production	GDP	growth	WDI

Note: WDI = World Development Indicators.

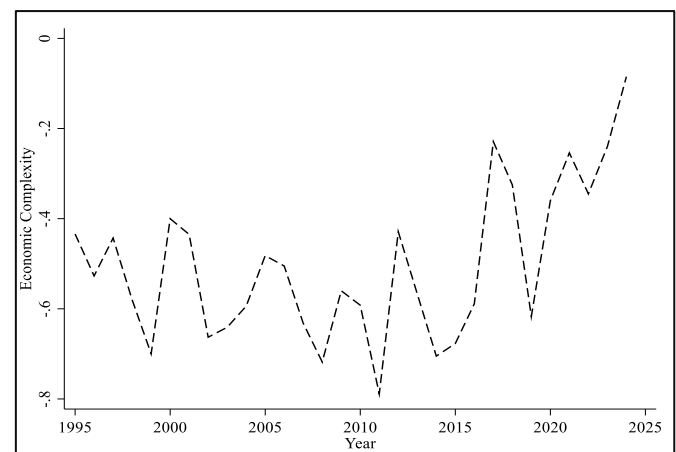


Figure 1. Annual trend of economic complexity (ECC) in Bangladesh

3.2 Methodology

3.2.1 Autoregressive Distributed Lag method

For the aim of conducting a short-term and long-term investigation of the cointegration linkage as well as the nexus across factors, this article utilizes the ARDL and the combined cointegration test. This can be attributed to the dynamic nature of the variables being studied. In addition, difficulties such as serial correlation and heteroscedasticity are well tackled by this approach which yields trustworthy estimations and clear explanations of coefficients. In addition to addressing specific econometric concerns, the ARDL technique captures dynamic integration, reduces omitted variable bias as well as assists in reducing endogeneity by integrating lags of both the independent and dependent variables. It partially accounts for multicollinearity by letting variables enter the model at different lags which might mitigate the effect of explanatory variables with strong correlation. To figure out the cointegration outcomes, we utilized the ARDL-bound testing by Pesaran et al. [37]. When dealing with time series data that has mixed orders of integration such as I (0) and I (1), the

ARDL model is highly beneficial for this kind of case. However, while carrying out the bound test, the integration order should not be I (2).

The first attempt to do when applying the ARDL method is to check the unit root. The Augmented Dickey-Fuller test [38] and Phillips-Perron test [39] are used to find a unit autoregressive root in this study. The unrestricted error correction model is established in Eq. (1) in order to move to the next level:

$$\begin{aligned} \Delta ECC_t = & \alpha_0 + \sum_{i=1}^a \alpha_{1i} \Delta ECC_{t-i} + \sum_{i=1}^b \alpha_{2i} \Delta FDP_{t-i} \\ & + \sum_{i=1}^c \alpha_{3i} \Delta IND_{t-i} + \sum_{i=1}^d \alpha_{4i} \Delta PRI_{t-i} \\ & + \sum_{i=1}^e \alpha_{5i} \Delta GDP_{t-i} + \gamma_1 ECC_{t-1} + \gamma_2 FDP_{t-1} \\ & + \gamma_3 IND_{t-1} + \gamma_4 PRI_{t-1} \\ & + \gamma_5 GDP_{t-1} + \varepsilon_t \end{aligned} \quad (1)$$

In Eq. (1), the intercept term is denoted by α_0 . However, the short-run coefficients are represented by $\alpha_1 - \alpha_5$ while the long-run coefficients are denoted by $\gamma_1 - \gamma_5$. Also, a, b, c, d and e illustrate the optimal lag lengths. The regular error correction term (ECT) allows for the projection of short-run parameters according to Eq. (2):

$$\begin{aligned} \Delta ECC_t = & \alpha_0 + \sum_{i=1}^a \alpha_{1i} \Delta ECC_{t-i} + \sum_{i=1}^b \alpha_{2i} \Delta FDP_{t-i} \\ & + \sum_{i=1}^c \alpha_{3i} \Delta IND_{t-i} + \sum_{i=1}^d \alpha_{4i} \Delta PRI_{t-i} \\ & + \sum_{i=1}^e \alpha_{5i} \Delta GDP_{t-i} + \rho ECT_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

Results from ECT show when an unusual shock happens and how long it takes for the system as a whole to get back to full equilibrium. The long-term causal linkage is exhibited by the statistically significant negative error correction coefficient, while the short-term causal link is reported by the other coefficients [40, 41].

3.2.2 Robustness check

To check the robustness and credibility, the paper employs Fully-Modified Ordinary Least Squares (FMOLS) by Phillips and Hansen [42] and Canonical Cointegration Regressions (CCR) by Park [43]. An efficient method for dealing with cointegrated variables is the FMOLS regression model, a non-parametric test that relies on residuals. Estimating inter-variable correlations over the long term is a strong suit of the two approaches. In cointegration analysis, these methods provide trustworthy inference tools since they excel in situations where there is a limited sample size or where the assumptions of conventional OLS methods might not be valid. Compared to basic ordinary least squares (OLS), FMOLS has the ability to eliminate serial correlation and endogeneity bias [44, 45].

In addition to removing endogeneity and the serial correlation problem, CCR also addresses these problems by modifying the initial data, which streamlines the estimating

procedure while keeping the estimators' asymptotic characteristics. By ignoring short-run dynamics in favor of long-run interactions, these approaches are able to effectively manage multicollinearity in cointegrated systems. To analyze long-term equilibrium linkage in the econometric model, FMOLS and CCR are very useful estimators since they overcome these obstacles.

3.2.3 Post-estimation technique

Regarding the post estimation strategy, we therefore use the Breusch-Godfrey LM test [46] for serial correlation since it avoids the pitfalls of the Durbin-Watson test. Also, the article checks heteroscedasticity established by Breusch and Pagan [47] and Cook and Weisberg [48]. Furthermore, White test is applied to see the heteroscedasticity [49]. The data set is then checked for normal distribution using the Skewness and Kurtosis tests. The experiment further employs the VIF test approach to verify the presence of multicollinearity. Finally, by utilizing CUSUMSQ assessments, the model's stability is verified [50].

4. RESULTS AND DISCUSSION

To begin exploring the variables and getting a general notion about them, descriptive analysis is utilized. Table 2 displays statistical information such as the mean, number of observations, and standard deviation in addition to the minimum and maximum values. According to the data, ECC has the lowest mean value, whereas FDP has the greatest. Moreover, FDP captures the highest standard deviation and maximum value in the model, where the ECC has the lowest degree of standard deviation and minimum value.

Table 2. Descriptive statistics of the model

Variable(s)	Obs.	Mean	Std. Dev.	Min	Max
ECC	30	-0.5039	0.16990 84	-0.789	-0.085
FDP	30	33.1499	8.40293 9	18.91 2	44.40 697
IND	30	7.98988	2.07555 9	3.506 8	11.63 332
PRI	30	6.11765	2.37206 7	2.895 575	10.59 151
GDP	30	5.76881	1.12530 1	3.448 018	7.881 915

Note: ECC = Economic complexity; FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production.

Table 3. Unit root tests

Variable(s)	ADF		PP	
	Level	1st Diff.	Level	1st Diff.
ECC	0.135	-4.435***	-2.421	8.036***
FDP	-1.928	-4.914***	-1.453	4.976***
IND	-	-	-	-
PRI	4.536***	-2.840*	4.643***	-3.535**
GDP	-1.771	-2.840*	-1.585	-3.535**
	-3.518**	-	-3.476**	-

Note: ECC = Economic complexity; FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production; ADF = Augmented Dickey-Fuller test; PP = Phillips-Perron test. Significant behaviors are reported by *, **, and *** at 10%, 5%, and 1%, respectively.

Before implementing the ARDL method, it is important to perform a unit root test to verify that the variables are integrated in I (0) or I (1) or mixed order and none of them are into order 2 [51]. The results of the Phillips-Perron test and the Augmented Dickey-Fuller (ADF) test are shown in Table 3. According to the stationarity test, the outcomes are mixed. Therefore, the ARDL approach is utilized in this study to accomplish the objectives. This means that there is no universally applicable order of integration. In this case, the ARDL model outperforms the alternatives.

However, Table 4 displays the outcomes of the ARDL bound test, which is performed to determine the cointegration of the model. The estimated F-statistic value is higher than the critical upper bounds at every level of significance. By rejecting the null hypothesis that there is no cointegration connection between the variables, it is demonstrated that there exists a long run linkage. Following the confirmation of the long-term nexus, this establishes the adaptation of the ARDL short and long term estimations.

Table 4. Autoregressive Distributed Lag (ARDL) bounds cointegration test

Pesaran et al.'s [37] Bounds Test [Null Hypothesis: No Levels Relationship]				
Test statistic	value	significance	I (0)	I (1)
F-statistic	220.403***	At 10%	2.45	3.52
		At 5%	2.86	4.01
		At 1%	3.74	5.06

Note: Significant behaviors are reported by *, **, and *** at 10%, 5%, and 1%, respectively.

Following the demonstration of cointegration, Table 5 figures out the long run symmetric dynamics of FDP, IND, PRI and GDP on ECC in Bangladesh. In Table 5, we see that the long run intensity of FDP on ECC is significant and positive at 1% level of significance. Statistically, a one percentage upsurge in FDP promotes 0.038 percentage improvement in ECC in Bangladesh. These findings demonstrate the in-depth significance of financial systems that may facilitate the intricate economic processes. In order to achieve cutting-edge technology in the long run, the policy makers and monetary authority in Bangladesh need to invest plenty of money on the R&D which is ultimately essential to produce complicated and sophisticated commodities. The development of sophisticated and technology-intensive goods is facilitated by developed financial systems, which provide appropriate access to capital through a well-functioning banking system and capital markets. Previous attempts from Chu [23], Nguyen and Su [21], and Njangang et al. [11] found the identical outcome.

Moreover, complex economies in Bangladesh may thrive when financial markets are viable and efficient, allowing capital to flow to areas that generate greater output and new ideas. With the targeted monetary policy, it is possible that more efficient institutions may raise economic sophistication. We can conclude that FDP positively influences ECC in Bangladesh via escalating resource allocation, introducing innovation and disclosing product diversification in the knowledge-focused segments. Indirectly, FDP may contribute to human capital formation through implementing budgets in education and skill advancement. Theoretically, well-skilled individuals in the labor force can easily deal with production

complexity, which strengthening the nation's financial structure. In a similar vein, Pugliese et al. [52] and Emeka et al. [18] also pointed out the positive intensity of FDP on ECC.

Table 5. Long run Autoregressive Distributed Lag (ARDL) dynamics

Var.	Coefficient	Std. Err.	T-Statistics	P-Value
ECM _{t-1}	-0.8062877	0.1189632	-6.78	0.021
FDP	0.0379325	0.0039471	9.61	0.011
IND	-1.356577	0.2152556	-6.30	0.024
PRI	0.0754711	0.0214947	3.51	0.072
GDP	1.296329	0.2072480	6.25	0.025

Note: FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production. Significant behaviors are reported by *, **, and *** at 10%, 5%, and 1%, respectively.

In the long run estimation, we see that IND and ECC are negatively related. Individuals are worried that the link may get worse over time because Bangladesh is modernizing so quickly. In the theory, IND leads to more diversity and productivity [53]. In reality, the RMG business has been the driving force behind Bangladesh's IND, even if other industries have raised well. Evidence clarifies that RMG exports serve as the principal catalyst for economic boost, constituting 80–85% of overall exports [54]. As Bangladesh's export industry has grown, so has its structural concentration [55, 56]. For instance, the country is good at making clothes and T-shirts, but not so good at making electronics and other things. Export diversification fails to faster GDP growth, thus neither skills nor structural changes have gotten better. In the existed attempts, Aydin et al. [57] found a similar inconsistent nexus between IND and ECC for China, India, and Indonesia. On the contrary, Emeka et al. [18] proved that IND upsurges the ECC in Brazil and Turkey.

However, PRI has a positive and significant role to evolve the ECC in Bangladesh. In the long run, one percent rise in PRI may escalate 0.075 percent ECC in Bangladesh. In the theoretical context, monthly PRI from overseas aid a family with their money problems and the fact that there are not many loans available in the area. Siddique et al. [58] found that families might later put more money into their children's education and other ways to improve their human capital. People who obtain money from family members who live in other countries may choose to invest some of it in new businesses, which can help the economy grow over time. PRI can greatly affect a country's savings rate, foreign currency reserves, and ability to buy advanced industrial capital goods [59]. PRI can assist raise ECC by giving people money they need to get training and find new jobs. This finding is supported by the attempts of Piras [27] and Ajide and Osinubi [30].

Moreover, the long run intensity of GDP on ECC is significant and favorable. Statistically, one percent progress of GDP in Bangladesh may lead to enhance 1.296 percentage ECC in the long run. Theoretically, this upward behavior is a sign of how the economy is evolving. If everything is perfect, countries may be able to invest in their people, their infrastructure and their technology as their income grows. This will make more goods and better exports. A lot of Bangladesh's economy depends on ready-made clothing and other basic commodities that are created there. The pharmaceutical, light engineering and IT service industries have all grown because of steady GDP growth. Hausmann et al. [60] assert that an increasing GDP is associated with more

sophisticated exports and more intricate economies. Besides, the negative and significant finding of ECT (ECM_{t-1}) confirms that any departures from the balance point are corrected by almost 81% per year.

Following the short run dynamics of ARDL model, Table 6 discloses that in the different lag assessment, FDP is negatively connected with ECC in Bangladesh. Unlike the long run linkage, IND has a positive and significant influence on ECC in the short run. However, the short run intensity of PRI on ECC is negative and significant for Bangladesh. Lastly, the linkage between GDP and ECC is negative and significant in the short run. Overall, we can conclude that IND is the only positive factor to boost the ECC in the short run.

Table 6. Short run Autoregressive Distributed Lag (ARDL) dynamics

Var.	Coefficient	Std. Err.	T-Statistics	P-Value
$\Delta ECC (-1)$	-1.0288160	0.1286132	-8.00	0.015
$\Delta ECC (-2)$	-0.8127473	0.0659080	-12.33	0.007
ΔFDP	-0.0713550	0.0029085	-24.53	0.002
$\Delta FDP (-1)$	-0.1757725	0.0055993	-31.39	0.001
$\Delta FDP (-2)$	-0.2018044	0.0099727	-20.24	0.002
$\Delta FDP (-3)$	-0.0430857	0.0061193	-7.04	0.020
ΔIND	1.0306710	0.0393692	26.18	0.001
$\Delta IND (-1)$	0.7676667	0.0319880	24.00	0.002
$\Delta IND (-2)$	0.3436807	0.0173963	19.76	0.003
$\Delta IND (-3)$	0.0748368	0.0065351	11.45	0.008
ΔPRI	0.0005966	0.0076652	0.08	0.945
$\Delta PRI (-1)$	-0.0184116	0.0111852	-1.65	0.241
$\Delta PRI (-2)$	-0.0140710	0.0062346	-2.26	0.153
$\Delta PRI (-3)$	-0.1135203	0.0118787	-9.56	0.011
ΔGDP	-0.9137963	0.0351909	-25.97	0.001
$\Delta GDP (-1)$	-0.6713483	0.0300732	-22.32	0.002
$\Delta GDP (-2)$	-0.2689422	0.0181817	-14.79	0.005
$\Delta GDP (-3)$	-0.0461007	0.0094517	-4.88	0.040
Constant	1.2012690	0.1146606	10.48	0.009

Note: ECC = Economic complexity; FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production. Significant behaviors are reported by *, **, and *** at 10%, 5%, and 1%, respectively.

One probable effect of FDP on ECC is that in the short run, money flows from risky areas to safer ones. This makes the industrial infrastructure stronger instead of promoting new ideas and different ways of doing things. More money can evolve the business faster, but it does not mean that the workers are productive. But for now, IND is really good for ECC. In the short term, at least in the simplest manufacturing industries, industrial activity increases production capacity and assists people learn by doing by limiting diversification. Using PRI has a negative effect on ECC right away. PRI encourages consumers spend more money, but they fail to make businesses that will make more money. When they receive money, they particularly go for businesses that have more intricate processes and stuff that can be transferred. A brief examination at the short-term link between GDP and ECC confirms that simple industries are the ones that are making more goods. This means that better technology in factories does not always mean more goods are made. These short-term results, which are instead fueling economic development, demonstrate that industries fail to adjust demand.

Regarding the robustness check (see Table 7), we adopt FMOLS and CCR model for the long run estimations. The accounted outcomes validate the linkage between FDP, IND and PRI with ECC in the long run. However, we find an inconsistent association between GDP and ECC which is different from the long run dynamics. This article significantly concludes that FDP, IND and PRI are the most effective factors for the long run progress of ECC in Bangladesh.

Table 7. Robustness check

Fully Modified Least Squares (FMOLS) Model				
	Coefficient	Std. Error	T-Value	P-Value
FDP	.016154	.003651	4.424916	.0002
IND	.049630	.023252	-2.134463	.0432
PRI	.052652	.011195	-4.702953	.0001
GDP	.038463	.044485	.864614	.3958
Constant	-.539873	.113414	-4.760190	.0001
Canonical Cointegrating Regression (CCR) model				
FDP	.017433	.003986	4.3732216	.0002
IND	.067992	.030841	-2.204632	.0373
PRI	.053845	.011458	-4.699468	.0001
GDP	.042719	.052279	.8117135	.4219
Constant	-.445437	.124148	-3.587952	.0015

Note: FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production. Significant behaviors are reported by *, **, and *** at 10%, 5%, and 1%, respectively.

However, we also check the following post-estimation tests such as multicollinearity, heteroscedasticity and autocorrelation to ensure the legitimacy of the ARDL analysis. In Table 8, we find that the evaluated outcomes are free from ARCH effect, heteroscedasticity, and serial correlation. Moreover, the article accept the null hypothesis of constant variance and homoskedasticity. Besides, the VIF test confirms that the article is free from the multicollinearity issue. Table 9 displays that all the variables are less than 10 and the mean VIF is just 3.43. Therefore, the ARDL assessments are robust and accountable. Moreover, we also adopt CUSUMSQ to figure out the stability of the model. In Figure 2, the model is consistent and the coefficients do not undergo any discernible systematic shift during the inquiry (at the 5% significance level).

Table 8. Diagnostic tests

Tests	χ^2 (Prob.)	Null Hypothesis
ARCH LM test	0.032 (0.8586)	No ARCH effect
Breusch-Godfrey LM test	0.634 (0.4347)	No serial correlation
Breusch-Pagan/Cook-Weisberg test	0.28 (0.5936)	Constant variance
White's test	26 (0.4076)	Homoskedasticity
Skewness	25.56 (0.3219)	
Kurtosis	0.15 (0.687)	

Table 9. Multicollinearity test

Variable	VIF	1/VIF
GDP	5.14	0.194686
IND	4.26	0.234514
FDP	2.45	0.407592
PRI	1.87	0.535947
Mean VIF	3.43	

Note: FDP = Financial development; IND = Industrialization; PRI = Remittance; GDP = Gross domestic production; VIF = Variance Inflation Factor.

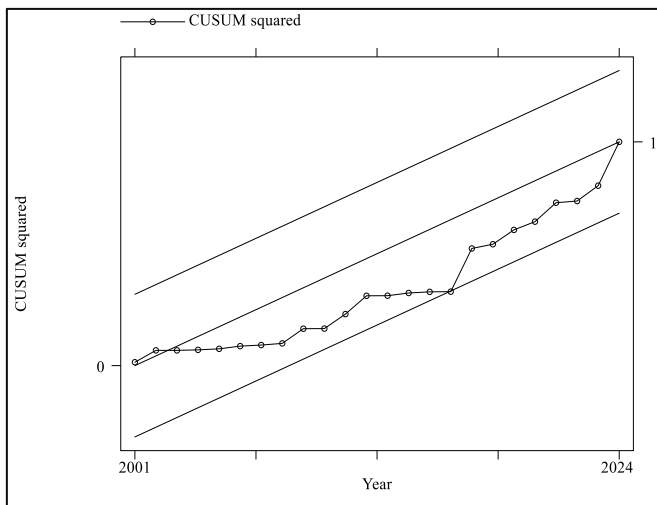


Figure 2. CUSUMSQU for economic complexity (ECC) model

5. CONCLUSION AND POLICY RECOMMENDATIONS

Using the ARDL dynamic approach, this article examines the effects of FDP, IND, PRI, and GDP on ECC in Bangladesh from 1995 to 2024. Before evaluating the ARDL model, we need to clarify the stationarity order of the variables. The article adopts the ADF and PP unit root tests where we evidently figure out that all the variables are stationary at both level and first order condition. More importantly, no variables are at second order condition. This quantification fulfills the precondition of the ARDL dynamic functions. After that, we confirm the long run cointegration between FDP, IND, PRI, GDP, and ECC in Bangladesh.

The ARDL model confirms that in Bangladesh, there is a clear linkage between FDP and ECC over the long run. The structural sophistication has evolved since the government modified how money works. The strong negative association suggests that the growth of IND does not contribute to the invention of new products. However, a positive sign of PRI implies that it may enhance the productive capability over time. Lastly, the strong link between GDP and ECC states how important it is for the economy to grow the complexity of production structure in Bangladesh. According to the short-run dynamics, FDP is negatively connected to ECC in Bangladesh. In the short term, IND has a positive and significant effect on ECC, which is different from the long run assessment. But for Bangladesh, the short-term effect of PRI on ECC is also negative and strong. Finally, the short-term nexus between GDP and ECC is negative and significant. In general, we identify that IND is the only factor that evolves the ECC in the short term. In order to make the results more reliable, the study conducts multiple robust methodologies, such as FMOLS and CCR model. The findings of this model statistically confirm the validity of the ARDL analysis.

With this new knowledge in hand, we can offer specific policy recommendations to the government of Bangladesh that will bring about the desired changes in ECC. Since productive financial markets are good for the economy of Bangladesh, policymakers should aim to make them deeper and broader. The economy may benefit from increased diversity and technological advancement if venture capital and equity funding are to be directed towards emerging industries that

demand extensive knowledge. However, in case of IND, our authority should incorporate modern technologies and wide-range manufacturing to enhance the IND structures. Moreover, the government should facilitate the PRI holders to expand the small and medium-sized businesses (SMEs) and imply new skill for them to evolve their productive capacity in Bangladesh.

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