Financing the SDGs: How Bangladesh May Reshape Its Strategies in the Post-COVID Era?

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Abstract

COVID-19 has acutely arrested the attainment of sustainable development goals (SDGs). Internal mobilization of resources got slimmed as the government’s expenditure on health and social safety nets have increased. External sources are also constricted owing to the uncertainties over the cross-border investment and economic recovery process of the countries. A government study in 2017 projected that Bangladesh, on average, would need an additional USD 68.83 billion from internal sources and USD 11.03 billion from external sources since 2021 to accomplish its SDGs by 2030. Using autoregressive distributed lag (ARDL) forecasting techniques, this paper re-estimated future flows of all SDGs funding sources, e.g., fiscal revenues, private sector investment, non-government organizations (NGOs), public–private partnerships, foreign direct investments, and foreign grant still 2030 under the purview of the COVID-19. Revised allocation estimated by this study reveals that private investment and NGOs would need to contribute higher than the 2017 estimation during 2021–2025 while only private investment needs to be higher during 2026–2030.

Keywords SDG financing · Post-COVID · ARDL model · Resource mobilization · Bangladesh

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Résumé
Le COVID-19 a gravement freiné la réalisation des objectifs de développement durable (ODD). La mobilisation interne des ressources s’est amoindrie à mesure que les dépenses du gouvernement en matière de santé et de sécurisation sociale ont augmenté. Les ressources externes sont également restreintes en raison des incertitudes liées aux investissements transfrontaliers et au processus de redressement économique des pays. Une étude menée par le gouvernement en 2017 prévoyait que le Bangladesh aurait besoin, en moyenne, de 68,83 milliards de dollars supplémentaires provenant de sources internes et de 11,03 milliards de dollars provenant de sources externes à partir de 2021 pour atteindre ses ODD d’ici 2030. À l’aide de modèles de prévision autorégressifs à retards échelonnés (ARDL), cette étude a réestimé les flux futurs de toutes les sources de financement des ODD, par exemple, les recettes fiscales, les investissements du secteur privé, les organisations non gouvernementales, les partenariats public-privé, les investissements directs étrangers et les subventions étrangères jusqu’à 2030, le tout dans le contexte de la COVID-19. Selon cette étude, qui a recalculé l’allocation nécessaire, le secteur privé et les organisations non gouvernementales devraient augmenter leur contribution par rapport à l’estimation de 2017 pour la période 2021-2025, tandis que seul l’investissement du secteur privé doit augmenter pendant la période 2026-2030.

JEL Classification  C13 · C22 · E61 · O20 · O23

Background of This Study
Sustainable development goals (SDGs) are the marks for aspiration in a global movement that has prompted each country to pledge and support the distinguished United Nations 2030 Agenda. At the center of the agenda, it accentuates the collectivity, indivisibility, and universality of the SDGs and commits to “leave no one behind.” The SDGs are distinctive in their implication and adaptation since it urges for action by every country—poor, middle-income, and developed. To fulfill the ever-ambitious targets of inclusive economic growth, social equity, and environmental upgradation by 2030, countries are obligated to adopt multidimensional and interconnected development strategies in their respective national policies (UN 2019; Okitasari et al. 2018). Against the urge of fast-track corresponding investment, financing, and spending, the taking-off phase of SDGs was slow and steady for most of the countries. An initial study by United Nations Conference on Trade and Development (UNCTAD) estimated that approximately USD 5 to 7 trillion additional investment would be required per annum globally to support the SDG financing (UNCTAD 2014). Gaspar et al. (2019) estimate that low-income developing countries (LIDCs) would need an additional USD 0.5 trillion of annual spending till 2030 for achieving the SDGs targets while the emerging market economies (EMEs) would require an annual additional amount of USD 2.1 trillion till 2030. It remains very much exigent for the countries to manage the additional funds from internal resource mobilizations alongside the external sources. On top of that, with less than ten years in hand, the world has
been experiencing the most devastating global health and economic crisis in form of COVID-19. It is, therefore, become a stern challenge to conquer the potential realization of SDGs within the prescribed timeline (Ranjbari et al. 2021; Mukarram 2020). The challenges are especially mounting for the least-developed, developing, and emerging economies as these countries usually face more resilience to mobilize additional financial and non-financial resources for shifting from their fast-growing conventional economic activities towards equitable and pro-environmental sustainable development activities (ADB–ADBI 2012; Barbier and Burgess 2020; Mukarram 2020). Bangladesh, one of the fastest-growing economies, is also facing its dilemma under this setting to adopt the apt and balanced strategies that would help the country not only to recover from the ongoing crisis but also to address the concerns of attaining SDGs within the stipulated timeframe (Sakamoto et al. 2020). Hence, a comprehensive and meticulous revisit of the financing strategies from the pre-COVID period is pivotal and would demand the immediate attention of policymakers.

In 2017, the General Economic Division (GED) of the Planning Commission of Bangladesh has prepared a policy paper titled *SDGs’ Financing Strategy: Bangladesh Perspective* to estimate the additional cost for the country’s SDG implementation, the probable financing gaps, and proposed the sources of financial resources to fill up those gaps. Based on a definite framework and calculations of goal as well as sector-wise additional costs, the estimation of that study indicates that an additional amount over the provision of cost relating to SDGs would be USD 928.48 billion for 2017–2030, revealing an annual average cost of USD 66.32 billion (GED 2017).

Table 1 presents the estimated costs of SDGs at three different phases as calculated in GED (2017). It reveals that accelerated financing would be required over the three phases of the fiscal year (FY) 2017–2020, FY 2021–2025, and FY 2026–2030. On average, the first phase would require an additional cost for SDGs financing amounts to USD 32.5 billion per year while the next phases would need USD 60.1 and 99.6 billion respectively. This study proposed 83% to 87% of total SDGs finance to be extracted from domestic resources mobilization while 13% to 17% from the external sources. Out of the domestic sources, the private sector is expected to contribute around half of the costs (48%) while public revenue is assumed to provide around 40%. Public–private partnerships (PPPs) and non-government organizations (NGOs) are expected to facilitate 7% and 5% of total domestic funding respectively over the entire period. Among the external sources, foreign direct investments (FDIs) are expected to share the higher part (i.e., 50% in the first phase to 80% in the final phase) while foreign grants are assumed to share the rest.

Figure 1 reveals that other than the external grant, all financing sources are expected to have increasing shares of SDGs’ financing over the period according to the GED (2017) study.

This study, however, divulges several key challenges in formulating the forecasted financing and costing exercise of SDGs. One key limitation was the data gap analysis which refers that at the period of estimation, data for 70 indicators were readily available while 108 indicators’ data were partially available and 60
Table 1  Summary of SDGs financing options proposed by GED (2017), Planning Commission

|                              | FY 2017–2020 | FY 2021–2025 | FY 2026–2030 | Growth (phases 1 and 2) (%) | Growth (phases 2 and 3) (%) |
|------------------------------|--------------|--------------|--------------|-----------------------------|-----------------------------|
| Total additional synchronized cost* | 129.8        | 300.7        | 498.0        | 131.6                       | 65.7                        |
| Annual average synchronized cost | 32.5         | 60.1         | 99.6         | 85.3                        | 65.7                        |
| Domestic                     | 26.9         | 51.5         | 86.2         | 91.2                        | 67.3                        |
| External                     | 5.5          | 8.6          | 13.4         | 56.3                        | 55.6                        |
| Public revenue               | 10.8         | 20.6         | 34.5         | 91.2                        | 67.3                        |
| Private investment           | 13.0         | 24.8         | 41.6         | 91.2                        | 67.3                        |
| Public–private partnerships  | 1.9          | 3.6          | 6.1          | 91.2                        | 67.3                        |
| External (foreign direct investments) | 2.7         | 6.5          | 10.7         | 136.3                       | 65.9                        |
| External grants              | 2.8          | 2.2          | 2.7          | −22.2                       | 26.3                        |
| Non-government organizations (NGOs) | 1.3         | 2.4          | 4.1          | 91.2                        | 67.3                        |

Source: GED (2017)

*Since the goals of SDGs are interconnected and, in some instances, overlapped, synchronization is made in cost estimation as segregated for each separate goal. SDG 8 (promote sustained, inclusive, and sustainable economic growth, full and productive employment, and decent work for all) in this connection, has been considered as the centre of synchronization.
were unavailable. Targets of a few indicators were not clearly stated while 33 targets were not quantifiable. Alongside these shortcomings, there are two critical issues in this projection that need close attention:

(a) COVID-19 remains unexpected havoc that halted the usual attainment process of SDGs and its financing strategies. Internal mobilization of funds and resources has gotten slimmed as the government is compelled towards high expenditure in health and social-safety nets while the revenue earnings from the incomes dropped notably (Islam & Divakar 2020). Other domestic investments are also facing stern challenges due to uncertainties in the business environment. External sources are also constricted owing to the uncertainties over the investment and economic recovery process. Thus, the usual growth trajectories of different sources of SDG financing have been reshaped and therefore, need to be re-estimated under the COVID context.

(b) Proportionate growths estimation for internal resource mobilizations at three phases may need to rationalize. GED (2017) projects 91.2% growth in additional funding from phase 1 to phase 2 while 67.3% growth from phase 2 to phase 3. This also may need to revisit for two reasons. First, alongside the global economy, the economy of Bangladesh has been undergoing serious adversity owing to the COVID-19 which seems to prolong for a considerable period, and hence, presumably hamper the higher rate of economic growth in phase 2 (i.e., 2021–2025). Secondly, Bangladesh is scheduled to graduate from the least-developed country (LDC) to a developing country officially by 2026. The country also set its target to lift its economy as a middle-income country by 2031 and a high-income country by 2041 (GED 2020). Hence, the acceleration of the economy and all benefits from graduation are expected to intensify in the third phase (i.e., 2026–2030). Especially, the graduation would boost the confidence of international financiers towards Bangladesh which may lead to high inflows of FDIs and low-cost foreign debts. Besides, an up-gradation of the country’s credit rating following graduation would lead to an acceleration in investible
resources (Bhattacharya 2021). Structural changes and policy reforms may result in a significant increase in tax revenues. In sum, the accelerations of domestic as well as external resource mobilization are anticipated for Bangladesh over the period till 2030. Hence, the growth of spending between the phases, as calculated by GED (2017), maybe revisited and adjusted according to the probable growth of the economy.

Based on the potential contexts, this paper would attempt to answer the following research questions:

- What would be the likely movement of the different sources of funds (up to 2030) for SDG implementation within the context of COVID-19, revised economic growths, and Bangladesh’s graduation from the LDC?
- Whether the estimated allocation of sources needs to revisit based on the new scenario?
- How best the reallocation of sources can be matched?

The paper is organized into five sections. The background depicted in “Background of This Study” section comprises a glimpse of SDGs financing in Bangladesh and the potential literature gap which leads to formulating the research question. After formulating the research questions in this section, “Methodology, Data, and Model Specification” section explains the methodology, data, and models. “Results and Findings” section presents the results and findings, “Analysis” section elucidates the analysis, and “Conclusion and Policy Outcomes” section ends up with policy recommendations and a conclusion.

**Methodology, Data, and Model Specification**

**Methodology**

The key approach of this study is to project the short- to mid-term movements of different sources of SDG financing primarily through linking them with the economic growth of the country. In forecasting any economic variable, two types of techniques are usually used. Autoregressive integrated moving average (ARIMA), a univariate technique for forecasting, where the present value of a variable is explained or regressed by its past values and its error. It is one of the extensively used econometric tools to forecast as only one variable is required to estimate the forecasting. However, in reality, a multivariate forecasting modeling may be of more significance and a long-term dynamic relationship among the variables would fit the model better. To establish a long-term relationship between two economic variables, many researchers have preferred the auto-regressive distributed lag (ARDL) model. ARDL is a dynamic model in which the dependent variable is explained by the lagged value of itself along with the lagged values of other explanatory variables.
Pesaran et al. (2001) proposed an ARDL model with bounds testing approach to examine the presence of cointegration association among the variables. It also contains just a single equation setup, making it simple to construct and interpret.

There are several distinct advantages of this approach over other cointegration approaches:

1. It avoids the problem of the order of integration related to the Johansen likelihood approach (Johansen and Juselius 1990); i.e., it can be used with a blend of \( I(0) \) and \( I(1) \) series simultaneously.
2. Unlike other conventional multivariate cointegration approaches, the bound testing approach does not require a larger sample size;
3. Despite the presence of some endogenous regressors, this bound-testing approach provides unbiased estimates of the long-run model and valid \( t \)-statistics (Harris and Sollis 2003).
4. ARDL model can be converted into an error correction model (ECM) containing a sufficient number of lags through a simple linear transformation, which fits in short-run modifications with long-run equilibrium while protecting the long-run information.

Yet, there is a key challenge of this ARDL bound testing approach. If any variable is found integrated of order two, the values of \( F \) statistics provided by Pesaran et al. (2001) cannot be interpreted under this model (Belloumi 2014). Nevertheless, considering the advantages of this approach over the classical ARDL approaches, this study prefers using this ARDL bound testing approach. From a methodological perspective, this study attempts to test the long-run and short-run cointegration in selected variables for forecasting designated sources (i.e., funds for SDGs) using ARDL models with establishing long-run relationships from short-run dynamics with GDP.

**Steps of ARDL Cointegration Approach**

Three basic steps are followed to estimate the ARDL cointegration models.

**Step 1: Examining the Existence of Long-Run Relationships Between the Variables** ARDL model uses a combination of endogenous and exogenous variables, unlike the VAR model which only uses endogenous variables. ARDL model can be specified

- if the variables are integrated of different orders, i.e., the model having a combination of \( I(0) \) and \( I(1) \) order of integration. In this case, the test of unit root (stationarity) is essential to ensure that no variable is integrated of order 2, i.e., \( I(2) \) as explained by Nkoro and Uko (2016).
- If the variables are integrated of order 1, i.e., \( I(1) \).
At first, the existence of the long-run relationship between the variables is examined by using bound F-statistic, i.e., bound test for cointegration. The null hypothesis for bound testing refers to that there will be no cointegration among the variables tested.

Using the bound test result, if the variables are cointegrated, both short-run (ARDL), as well as long-run (ECM) models, are to be specified. While, if the variables are not cointegrated, only the short-run (ARDL) model needs to be specified.

Step 2: Estimating the Appropriate Lags for the ARDL Model  
Akaike Information Criteria (AIC) is examined in this paper to select the appropriate lags of the variables in the ARDL model. STATA software is used to estimate a different number of lags that would be the best fit for the stated models.

Step 3: Reparameterization of ARDL Model into Error Correction Model  
Finally, in case of the existence of cointegration, the ARDL model needs to be reparameterization for converting it into ECM. Accordingly, the estimations are made for long-term relationships between the variables.

Model Specification

The generalized ARDL \((p, q)\) model is stated as

\[
Y_t = \gamma_0 + \sum_{i=1}^{p} \delta_i Y_{t-i} + \sum_{i=1}^{q} \beta_i' X_{t-i} + \epsilon_{it},
\]

where \(Y'_{t}\) are a vector and the variables \((X'_{t})'\) are allowed to be purely \(I(0)\), \(I(1)\), or cointegrated. \(\beta\) and \(\delta\) are coefficients while \(\gamma\) is the constant. \(i = 1, 2, \ldots, k; p, q\) are optimal lag orders. \(\epsilon_{it}\) is a vector of error terms assumed to be serially uncorrelated and independent. The lag lengths \(p, q\) are used for the dependent and exogenous variables and not necessarily be of the same value.

Hypothesis Testing  
The hypothesis is tested to determine if the coefficients of the lag level variables are zero. The null refers to the non-existence of the long-run relationship and is defined by:

\[
H_0 : b_{1i} = b_{2i} = 0 \quad \text{(where } i = 1, 2),
\]

\[
H_1 : b_{1i} \neq b_{2i} \neq 0.
\]

The following ARDL model will be estimated to test the cointegration relationship between the variables: sources of SDGs finance, economic growth, and human resource development. There are six sources of SDGs finance namely, tax revenues, private sectors investment, PPP, NGOs, FDI, and foreign grants.

The following model would be tested for public (i.e., tax) revenue:
\[ \Delta \text{lnPUBREV}_t = a_0 + b_{11} \text{lnPUBREV}_{t-i} + b_{21} \text{lnGDP}_{t-i} \]
\[ + \sum_{i=1}^{p} a_{1i} \Delta \text{lnPUBREV}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \epsilon_{1t}. \]

If there is no cointegration, the ARDL \((p, q)\) model is specified as
\[ \Delta \text{lnPUBREV}_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta \text{lnPUBREV}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \epsilon_{1t}. \]

However, if there is cointegration, the ECM is presented as
\[ \Delta \text{lnPUBREV}_t = a_0 + \sum_{i=1}^{p} a_{1i} \Delta \text{lnPUBREV}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \lambda \text{ECT}_{t-1} + \epsilon_{1t} \]

here, ECT is error correction term referring to the long-run relationship in the model.

The outcome of the bound test indicates whether to specify ECM or ARDL model. The short-run causal effect is represented by the \(t\)-statistics on the explanatory variables while the long-run relationship between the variables indicates that there is Granger-causality in at least one direction which is determined by \(t\)-statistics on the coefficients of the lagged error correction term.

Similarly, the other sources of SDG financing are also examined with the following models:

For private investment
\[ \Delta \text{lnPVTINV}_t = a_0 + b_{11} \text{lnPVTINV}_{t-i} + b_{21} \text{lnGDP}_{t-i} \]
\[ + \sum_{i=1}^{p} a_{1i} \Delta \text{lnPVTINV}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \epsilon_{1t}. \]

For NGOs investment,
\[ \Delta \text{lnNGO}_t = a_0 + b_{11} \text{lnNGO}_{t-i} + b_{21} \text{lnGDP}_{t-i} + \sum_{i=1}^{p} a_{1i} \Delta \text{lnNGO}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \epsilon_{1t}. \]

For FDIs,
\[ \Delta \text{lnFDI}_t = a_0 + b_{11} \text{lnFDI}_{t-i} + b_{21} \text{lnGDP}_{t-i} + \sum_{i=1}^{p} a_{1i} \Delta \text{lnFDI}_{t-i} + \sum_{i=1}^{q} a_{2i} \text{lnGDP}_{t-i} + \epsilon_{1t}. \]

For foreign grants,
\[ \Delta \ln \text{GRANTS}_t = a_0 + b_{11} \ln \text{GRANTS}_{t-i} + b_{21} \ln \text{GDP}_{t-i} \\
+ \sum_{i=1}^{p} a_{1i} \Delta \ln \text{GRANTS}_{t-i} + \sum_{i=1}^{q} a_{2i} \ln \text{GDP}_{t-i} + \epsilon_{1t}. \]

**Description of Data and Sources**

To examine the relationship between the variables, this study employs the annual time series data of GDP, and sources of SDG finance in the following fashion as shown in Table 2. The data for PPPs is not extractable in long time series. All the stated variables have over 20 observations except the microcredit loan amount which has 15 observations.

**Results and Findings**

In this study, GDP has been considered as the only explanatory variable for each ARDL model.

**Findings from the ARDL Models**

The following section explains the step-by-step analysis and respective findings of the ARDL–ECM models used to estimate and project the five mentioned sources of SDG financing. Due to the unavailability of PPP data, it has not been projected.

**Determination of Optimal Lag Lengths**

According to the AIC criteria, the optimal lag lengths for the models are estimated and results are presented in Table 3.

Results reveal that the optimal lag length for Model 1 is \((1, 0)\). It is \((2, 0)\) for Model 2, \((4, 0)\) for Model 3, and also for Model 4, while it is \((2, 0)\) for Model 5.

| Variable               | Data series  | Source of data                                      |
|------------------------|--------------|-----------------------------------------------------|
| GDP                    | 1995–2020    | World Development Indicators                        |
| Tax revenues           | 1995–2020    | Ministry of Finance, Bangladesh                     |
| Private sector credit  | 1995–2020    | Bangladesh Bank                                     |
| Microcredit outstanding| 2006–2020    | Microfinance Regulatory Authority, Bangladesh       |
| FDI inflows            | 1998–2020    | Bangladesh Bank                                     |
| Foreign grants         | 1997–2020    | World Development Indicators                        |
To test the existence of cointegration, a bound test with $F$-statistics is performed. A higher value of $F$-statistics than $I(0)$ for any model would refer that the model has cointegration between the variables, and hence, both short-run (ARDL), as well as long-run (ECM) models, are to be specified for that variable. Results are presented in Table 4.

According to the results of the test, cointegrations exist for Model 1 (Public revenue), Model 2 (Private investment), and Model 3 (NGOs’ investment). On the other hand, there is no cointegration between the variables under investigation for Model 4 (FDI inflows) and Model 5 (Foreign grants); hence, only the short-run (ARDL) model is to be specified for these variables.

### Estimations of Coefficients and Projection of Variables

#### Model 1: Public Revenue

The estimation of the coefficients under this optimization for Model 1 is presented in Table 5.

Result states that on average, a 1% increase in GDP would result in a 2.1% increase in public revenue collection, *ceteris paribus*. It also shows that a 1%
increase in the previous year’s revenue collection would reduce the current year’s collection by 0.2%, on average.

Now, considering the projection on the future GDP growth of Bangladesh, the estimations from the ARDL–ECM model lead towards the forecasted values of public revenue collection of Bangladesh till 2030. Figure 2 portrays the growth path (actual and forecasted) of public revenue as estimated from the model. It shows that growth in public revenue may increase up to 13.9% in 2021 which is not unlikely after the slowing down in 2020 owing to the devastating COVID-19s initial impacts. However, the growth is projected to slip a little in 2022 to 11.7%; would get increasing since then to reach a moderate 12.7% by the end of 2025 and 14.1% by the end of 2030.

Taking the growth rates, the level of public revenue collection of Bangladesh would stand at USD 50.0 billion in 2025 (15.1% of GDP) from 27.6 billion in 2020 (12.3% of GDP). It may reach USD 94.3 billion by the end of 2030 (18.5% of GDP) as shown in Table 6.

Model 2: Private Investment

The estimation of the coefficients under this optimization is presented in Table 7. Result states that on average, a 1% increase in GDP would result in a 1.8% increase in private sector investment, *ceteris paribus*. It also shows that a 1% increase in the previous year’s private investment would reduce the current year’s investment by 0.4%, on average.

Now, the ARDL–ECM model forecasts the values of private investment in Bangladesh till 2030 considering the projection on the future GDP growth of Bangladesh as mentioned earlier. Figure 3 portrays the growth path (actual and forecasted) of private investment as estimated from the model. It shows that growth in private investment may go up from 9.4% in 2020 to 10.5% in 2021 which is not unlikely after the slowing down in 2020 owing to the devastating COVID-19s initial impacts.

### Table 5 Estimations of coefficients (Model 1)

| D.lnPUBREV | Coefficients | Std | t | p>|t| |
|---|---|---|---|---|
| D.lnPUBREV | | | | |
| L1 | −0.234 | 0.091 | −2.580 | 0.017 |
| Long run | | | | |
| lnGDP | 2.096 | 0.171 | 12.280 | 0.000 |
| Short run | | | | |
| _cons | −6.979 | 2.005 | −3.480 | 0.002 |

Goodness-of-fit measures

- $R^2$ 0.4753
- $Adj R^2$ 0.4726
- $F$-statistics 41.849

*p*-values shown in the right-most column of the Tables
Fig. 2 Actual and projected growth rates of Public revenue collection (1996–2030)

| Years | Public revenue (in USD bill) |
|-------|-------------------------------|
| 1995  | 3.73                         |
| 2000  | 3.99                         |
| 2005  | 6.38                         |
| 2010  | 11.49                        |
| 2015  | 21.03                        |
| 2020  | 27.56                        |
| 2025  | 49.98                        |
| 2030  | 94.35                        |

Table 6 Projection of public revenue collection

Table 7 Estimations of coefficients (Model 2)

| D.InPRVTINV | Coefficients | Std | t   | p>|t| |
|-------------|--------------|-----|-----|-----|
| D.InPRVTINV | -0.434       | 0.167 | -2.600 | 0.017 |
| L1          |              |      |      |     |
| Long run    | 1.829        | 0.057 | 32.190 | 0.000 |
| lnGDP       |              |      |      |     |
| Short run   | 0.258        | 0.198 | 1.310 | 0.207 |
| lnPRVTINV   |              |      |      |     |
| LD          | -9.811       | 3.456 | -2.840 | 0.010 |
| _cons       |              |      |      |     |
| Goodness-of-fit measures |             |      |      |     |
| $R^2$       | 0.3734       |      |      |     |
| Adj $R^2$   | 0.2794       |      |      |     |
| F-statistics| 47.629       |      |      |     |

$p$-values shown in the right-most column of the Tables
However, the growth is projected to get increasing afterward as the uncertainties of the business environment and adverse impacts of the pandemic fade away over time. Consequently, it is projected to reach a moderate 11.4% by the end of 2025 and 12.1% by the end of 2030.

Taking the growth rates, the level of the private sector’s investment of Bangladesh would stand at USD 131.7 billion in 2025 (39.7% of GDP) from 77.9 billion in 2020 (35.0% of GDP). It may reach USD 236.4 billion by the end of 2030 (45.7% of GDP) as presented in Table 8.

### Table 8: Projection of private investments

| Years | Private investment (in USD bill) |
|-------|---------------------------------|
| 1995  | 6.00                            |
| 2000  | 9.40                            |
| 2005  | 14.13                           |
| 2010  | 24.87                           |
| 2015  | 43.06                           |
| 2020  | 77.95                           |
| 2025  | 131.72                          |
| 2030  | 236.43                          |

Model 3: NGOs Investment

The estimation of the coefficients under this optimization is presented in Table 9. The estimation of coefficients of the model states that on average, a 1% increase in GDP would result in a 2.5% increase in NGOs credit outstanding, ceteris paribus. It also shows that a 1% increase in the previous year’s NGOs credit would reduce the current year’s credit or investment by 1.9%, on average. The first and second lag differences of the natural logarithm of NGO credit outstanding would
increase the current year’s credit outstanding by 0.9% and 0.7% respectively, on average.

Now, the ARDL–ECM model forecasts the values of NGOs credit outstanding in Bangladesh till 2030 based on the projection on the future GDP growth of Bangladesh as mentioned earlier. Figure 4 illustrates the growth path (actual and forecasted) of NGOs credit outstanding as estimated from the model. It shows that growth in NGOs credit outstanding may slow down from 13.2% in 2020 to 11.6% in 2021 primarily due to persistent devastating COVID-19s impacts. However, the growth is projected to get increasing thereafter to reach a moderate 12.5% by the end of 2025 and 13.7% by the end of 2030.

### Table 9  Estimations of coefficients (Model 3)

| D.lnNGO | Coefficients | Std  | t    | p>|t| |
|----------|--------------|------|------|-----|
| Adjusted lnNGO |               |      |      |     |
|  L1       | -1.861       | 0.590| -3.160| 0.025 |
| Long run lnGDP | 2.501       | 0.050| 49.850| 0.000 |
| Short run lnNGO |            |      |      |     |
|  LD       | 0.931        | 0.427| 2.180| 0.081 |
|  LD2      | 0.741        | 0.340| 2.180| 0.081 |
|  LD3      | 0.326        | 0.297| 1.100| 0.322 |
|  _cons    | -70.066      | 24.043| -3.290| 0.022 |
| Goodness-of-fit measures |              |      |      |     |
|  $R^2$   | 0.7436      |      |      |     |
|  Adj $R^2$ | 0.4873      |      |      |     |
|  F-statistics | 21.341 |      |      |     |

*p*-values shown in the right-most column of the Tables

**Fig. 4** Actual and projected growth rates of NGOs credit outstanding (2007–2030)
Considering the projected growth rates, the level of NGO credit in Bangladesh would stand at USD 18.71 billion in 2025 (5.6% of GDP) from 10.58 billion in 2020 (4.8% of GDP) as shown in Table 10. It may reach USD 34.81 billion by the end of 2030 (6.7% of GDP).

**Table 10**  Projection of NGOs investment

| Years | NGOs investment (in USD bill) |
|-------|------------------------------|
| 2006  | 1.12                         |
| 2010  | 2.10                         |
| 2015  | 4.54                         |
| 2020  | 10.58                        |
| 2025  | 18.71                        |
| 2030  | 34.81                        |

**Table 11**  Estimation of coefficients (Model 4)

| lnFDI    | Coefficients | Std  | t    | p>|t| |
|----------|--------------|------|------|-----|
| Short run|              |      |      |     |
| lnFDI    | 0.166        | 0.393| 0.420| 0.681|
| lnGDP    |              |      |      |     |
| D1       | −3.019       | 13.740| −0.220| 0.830| |
| LD       | −19.501      | 20.248| −0.960| 0.356| |
| LD       | 36.793       | 20.005| 1.840| 0.093| |
| L2D      | −35.416      | 17.351| −2.040| 0.066| |
| L3D      | _cons        |      |      |     |
| _cons   | −19.637      | 13.672| −1.440| 0.179| |

Goodness-of-fit measures

R^2  | 0.6143
Adj R^2 | 0.3689
F-statistics  | 19.05

Model 4: FDI Inflows

The estimation of the coefficients under this optimization is presented in Table 11. The estimation of coefficients of the model states that on average, a 1% increase in second and third lag differences of the natural logarithm of GDP would result in a 36.8% increase and 35.4% decrease in FDI inflows, ceteris paribus. It also shows that a 1% increase lag difference of natural logarithm of FDI inflows would increase the current year’s inflow by 0.2%, on average; however, it is not found as statistically significant.
Now, the ARDL model forecasts the values of FDI inflows in Bangladesh till 2030 based on the projection on the future GDP growth of Bangladesh. Figure 5 illustrates the growth path (actual and forecasted) of FDI inflows as estimated from this ARDL model. Though the deviation of FDI inflows remains very high, the model has attempted to smooth out the projected growth rates. The estimation shows that growth in FDI inflows may slow down in the next couple of years primarily due to the uncertainty in global investment. However, after 2021, the growth would turn positive and would remain within the range of 38% to 40% till 2030, smoothing out the average.

According to the projected growth trend, FDI inflows during the 2021–2025 period may increase to USD 15.92 billion from 6.85 billion in the 2016–2020 periods. The FDI inflows may further increase to USD 82.09 billion during the 2026–2030 period as shown in Table 12.

**Model 5: Foreign Grants**

As there exists no cointegration between the variables under investigation, only the short-run (ARDL) model is to be specified. The estimation of the coefficients under this optimization is presented in Table 13. The result of estimation of coefficients implies that on average, a 1% increase in the current year’s natural logarithm of GDP and second lagged of the logarithm of GDP would increase the logarithm value of foreign grants by 182.6 and 123.1 percentage points while the second lag of

---

**Table 12** Projection of FDI inflows

| Period       | FDI inflows (in USD billion) |
|--------------|-----------------------------|
| 2001–2005    | 2.39                        |
| 2006–2010    | 4.06                        |
| 2011–2015    | 6.30                        |
| 2016–2020    | 6.85                        |
| 2021–2025    | 15.92                       |
| 2026–2030    | 82.09                       |

---

**Fig. 5** Actual and projected growth rates of FDI inflows (1999–2030)
the logarithm of GDP would decrease the logarithm value of foreign grants by 308.8 percentage points, on average.

ARDL model accordingly forecasts the values of foreign grants in Bangladesh till 2030 based on the projection on the future GDP growth of Bangladesh. Figure 6 illustrates the growth path (actual and forecasted) of foreign grants as estimated from this ARDL model. Though the deviation of historical foreign grants inflows remains very high, the model has attempted to smooth out the projected growth rates. From the estimation, it shows that growth in foreign grants may slow down gradually till 2030. It is not unlikely as Bangladesh is already qualified for LDC graduation which would lift the country’s status to a developing country and hence, the share of foreign grants would eventually get lowered. The growth rate was 13.6% in 2020, which is estimated to be down at 5.5% in 2025 and further slowed to 4.6% in 2030.

According to the projected growth trend, foreign grants during the 2021–2025 period may increase to USD 12.09 billion from 6.86 billion of the 2016–2020 period.

| Table 13 Estimation of coefficients (Model 5) |
| --- |
| lnGRANT | Coefficients | Std | t | p>|t| |
| Short run |
| lnGRANT | L1 | 1.297 | 1.968 | 0.660 | 0.518 |
| lnGDP | − | 182.602 | 63.149 | 2.890 | 0.010 |
| L1 | −308.788 | 111.192 | −2.780 | 0.012 |
| L2 | 123.142 | 70.981 | 1.730 | 0.100 |
| _cons | 67.147 | 43.835 | 1.530 | 0.143 |
| Goodness-of-fit measures |
| $R^2$ | 0.3773 |
| Adj $R^2$ | 0.2389 |
| $F$-statistics | 43.904 |

Fig. 6  Actual and projected growth rates of Foreign grants (1999–2030)
as shown in Table 14. The FDI inflows may further increase to USD 16.04 billion during the 2026–2030 period.

This is to mention that, before fitting for the ARDL model, stationarity has been tested for each variable using the Dickey–Fuller Augmented Unit root tests. Alongside, other diagnostic tests and models’ stability tests are presented in “Annexure”.

### Analysis

The key question of this study attempts to diagnose the probable movements of different sources of SDG financing till 2030. Based on the projections (of sources’ funding) of this study, it shows the likely deviations of the funding amounts for each source from those specified in the GED (2017) study.

As Table 15 refers to, proposed shares of total SDG financing as per the GED (2017) study allocated around 35% from public revenue during 2021–2025 and 2026–2030 periods. Most of the shares are expected to be extracted from private investment sources which assumed just over 40% throughout the periods. NGOs and PPP sources are expected to contribute 4% and 6% of total funding respectively. Around 15% of funding is anticipated from external sources: 11% in form of FDIs, and around 4% from foreign grants.

| Period       | Grants inflow (in USD bill) |
|--------------|----------------------------|
| 2001–2005    | 3.08                       |
| 2006–2010    | 5.50                       |
| 2011–2015    | 5.68                       |
| 2016–2020    | 6.86                       |
| 2021–2025    | 12.09                      |
| 2026–2030    | 16.04                      |

| Sources                        | FY 2017–2020 (%) | FY 2021–2025 (%) | FY 2026–2030 (%) |
|--------------------------------|------------------|------------------|------------------|
| Public revenue                 | 33               | 34               | 35               |
| Private investment             | 40               | 41               | 42               |
| NGOs                           | 4                | 4                | 4                |
| PPP                            | 6                | 6                | 6                |
| External (FDI)                 | 8                | 11               | 11               |
| External grants                | 9                | 4                | 3                |
Table 16 shows the amounts from the six sources over three time phases. 2017–2020 depicts the realized data while the rest of the two time periods are projected data derived from the ARDL–ECM models as described earlier. Results reveal that public revenue may rise 3.6 times from USD 102.7 billion in 2017–2020 to reach USD 370.4 billion in 2026–2030. Private investment is also assumed to increase over 3.5 folds to reach USD 949.4 billion in the 2026–2030 period. NGOs seem to experience decent growth over the periods while PPP is expected to step up at a faster rate. FDI inflows are likely to be slimmer during 2021–2025 mainly due to the uncertainty and longer stay of the COVID-19 pandemic globally which may hold back the investors to decide on their investments. FDI inflows, however, are seemingly flooded in in the 2026–2030 period which is already evident as many advanced countries including Japan, Korea, India, and China are showing their interests to establish their large-scale investments in Bangladesh (Byron 2021). As the Government of Bangladesh is determined to develop 100 economic zones (EZs) to attract a significant volume of foreign investment by 2035. It promises to provide a series of incentives in the forms of exemptions on taxes and custom/excise duties, non-fiscal incentives such as no ceiling on FDIs, ease of work permits, and approval for resident or citizenship (BEZA 2021). This study also tries to capture those motives and reveals that FDI inflows in 2026–2030 may reach over USD 80 billion. Foreign grants, however, may not accelerate that much as the country graduates from LDC status which would reduce the volume of grants.

The annual amount from each source on an aggregated basis for each time phase is shown in Table 16 and on a per annum basis in Table 17.

According to the estimation, the shares of total source mobilizations are depicted in Table 18. Private investment grabs the highest of the shares with around 65% followed by public revenue collection with 25%. NGOs share would
reduce over the time while FDIs would increase sharply. PPP and foreign grants’ shares may be stable at 0.5% and over 1%, respectively.

The growth rates over the time phases are presented in Table 19. It reveals that in aggregate a 92% growth of all sources is predicted from 2017–2020 to the 2021–2025 period. The growth rate between 2021–2025 and 2026–2030 is projected as 81%. Higher growths are mostly expected for public revenue, private investments, PPP, and FDI inflows for both periods.

However, as the size of the sources varies by some margins, the contributions (of each component) on aggregated growth are calculated based on respective shares and growth rates of the components. The result shown in Table 20 states that the major contribution of growth comes from private investments, followed by public revenue and FDIs.

**Criteria for Revisiting the Shares**

Now, based on the revised composition, this study is to suggest a new allocation of SDG financing from different sources. To start with, it first checks whether there is any need to revise the requirement of the 2017–2020 financing amount. Since there
is no realized data on SDG financing during this period, this study deploys GDP normalization to test any aggregated deviation during the entire period. Normalized (at 2017) GDP using assumed growth rates based on the 7th five-year plan is calculated as 447.77 as presented in Table 21. It is assumed that the GED (2017) analysis considered these growth rates to determine the allocation of SDG funding from the components. The same GDP normalization technique is applied for actual GDP growth rates for 2017 to 2020 and the estimated normalized GDP over 2017–2020 is found as 447.27, very close to that calculated from the GED (2017) assumptions. Hence, this study adopts the proposition that no change is needed for the assumed data for the 2017–2020 period.

Therefore, it is evident that, despite the COVID-19s impact, the aggregated economic activities over the 2017–2020 period seem to have been very marginally affected, which could be ignored while revisiting any changes of SDG financing sources for this period.

Now, to calculate the revised allocations of sources, adequacy ratios are first calculated using the following equation:

\[
\text{Adequacy ratio} = \frac{\text{Models’ projection on total source component fund}}{\text{GED (2017) projection of fund mobilization by component}} \times 100\%.
\]

Table 22 shows that during the 2021–2025 period, other than FDI inflows and PPP, the rest of the sources would be adequate to supply the funding for SDGs. The adequacy ratio is the highest for private investment (434%), followed by NGOs (333%) and public revenue (194%). In aggregate, total SDG funding has an adequacy ratio of 270%, revealing that total supply from all sources is 2.7 times higher than it requires for SDGs financing during the 2021–2025 period.

Similarly, Table 23 shows that during the 2026–2030 period, all sources but PPP would be adequate to supply the funding for SDGs. The adequacy ratio is the highest for private investment (456%), followed by NGOs (219%) and public revenue (215%). In aggregate, total SDG funding has an adequacy ratio of 299%, revealing that total supply from all sources is 3 times higher than it requires for SDGs financing during the 2026–2030 period.

Now, to calculate the revised allocation of funding for each component, the aggregated adequacy ratio is taken as the benchmark for each period. The following equation is applied:

![Table 21](image-url)
For instance, for calculating the revised allocation of funding for SDGs from public revenue during 2021–2025, the total source component fund of USD 200.20 billion is divided by the aggregated adequacy ratio of 270%. Hence, the revised allocation of funding for SDGs from public revenue during 2021–2025 is calculated as USD 73.24 billion as against the GED (2017)’s estimated allocation of USD 103.00 billion. Similarly, the rest of the source components’ allocations are calculated for both the 2021–2025 and 2026–2030 periods.

Using the aggregated adequacy ratio seems to be a plausible benchmark to ensure equitable allocation of the components based on the overall economic scenario.

Figures 7 and 8 show the comparative changes in the allocation of SDG funding by various sources based on the GED (2017) model and this study’s model. According to the revised allocation estimated by this study, private investment and NGOs need to be higher than the GED (2017) estimation during 2021–2025 while only private investment needs to be higher than the GED (2017) estimation during the 2026–2030 period.

\[
\text{Revised funding for each component} = \frac{\text{Model’s projection on total source component fund}}{\text{Aggregated adequacy ratio}}.
\]
The model of this study refers to the fact that the private sector needs to take the major responsibilities in SDG financing which is quite conceivable and realistic under the current context. The country has been accelerating faster and consistently making remarkable progress, especially, in terms of economic and social indicators. The growth of the country is driven primarily by the private sector, especially, the RMG has lion-share in exports of the economy while the remittance is the other driving force. Most of the industries, manufacturing, and agriculture are privately-owned. Other than a few basic services such as electricity, water, and gas, other service sectors are owned by the private sector. Therefore, a momentous growth of this private sector is expected in the coming years when the country will accelerate its economic activities in the post-COVID era by stepping up towards graduation from LDC (Kamruzzaman 2021). A better country credit rating after graduation may help to borrow commercial loans at a cheaper rate from the international market. The private sector may exploit this opening to a larger extent.
The public revenue collection was assumed to take more share as per the earlier GED (2017) study which might be a reasonable assumption at that stage. However, the dispersion of COVID has changed the entire landscape of the government’s income and expenditure. This unprecedented pandemic has obligated the governments to reorder their fiscal settings, primacies, and abilities by substantial extents (Alam et al. 2020). First, the governments have to arrange additional fiscal expenses to support different susceptible sectors of the economy alongside the low-income people to withstand the crisis period (Islam and Divakar 2020). The support from the public sector is thus channeled to the private sector in the form of various refinancing schemes, subsidizing interest rates, and tax breaks. In addition, COVID-19 exposed the vulnerability of the health and social security sectors of most of the countries. The governments now need to plan for additional spending on these sectors. Besides, lockdown, social distancing, and disruption of global supply chains have directed substantial slowdown in businesses and incomes of the people, series of job cuts in many sectors of the economy. The collective impact of these would manifestly put a momentous burden on fiscal taxation and other revenue generation. Hence, the government’s effort and capabilities towards SDGs are being largely challenged.

The worries in the global business and investments have restricted the limited flows of FDIs worldwide in the short run. However, as the pandemic is anticipated to fade away in near future, the FDI inflows are assumed to get a potential impetus. Pandemic has encouraged some of the courtiers to move their industries from China to other Asian countries. Many countries like Japan, Korea, and the US are now considering Bangladesh as a prospective terminus for investors primarily due to its big domestic market and low-priced labor costs. In addition, the Government’s various investment-conducive policies have encouraged to attract FDIs in the medium-term. It is thus assumed that FDI may grow faster in the coming years. The Government of Bangladesh is playing a significant part in this connection through establishing various authorities like the Bangladesh Economic Zones Authority (BEZA) and Bangladesh Hi-tech Park Authority. BEZA has targeted to establish 100 EZs to attract big FDIs and to create 10 million jobs by 2030. On the other hand, High Tech Park Authority is also contributing to job creation by establishing Hi-Tech Park, Software Technology Park, and IT Training and Incubation Centre through six running projects and three operational projects with substantial flows of FDIs are anticipated.

The growth of PPP in Bangladesh is still at its early stage of development. Some legislation and regulatory issues are shaping in this connection to make it more conducive to float more PPP projects. However, based on the current context, no rapid changes are expected, rather it is assumed to move along with the pace of public and private investments side-by-side.

NGOs play a pivotal role in the mass-scale socio-economic development of Bangladesh, especially, in the rural economies. In FY 2020, through 759 licensed micro-credit institutions, this sector provided various types of financial services to 33.3 million individuals whereas around 90% of the members were women (Bangladesh Bank 2020). However, the sector is still smaller as its loan outstanding equals only 8% of that of the banking sector’s loan. COVID-19 has slowed down the earnings of the low-income
members of NGOs which largely hamper the persistent growth of this sector. Therefore, a moderate level of growth is assumed for the NGOs in the short- and mid-terms.

The effectiveness of official development assistance (ODA) or foreign grants is a contested topic that Bangladesh should meticulously consider under the context of its transitional phase of development. Elayah (2016) states that aid effectiveness in a developing country is largely hurdled by its poor policy, institutional incapability, and diverged donor interests. Williamson (2010) argues that a lack of balance in incentives (to both donor and recipient) and information affect the optimal effectiveness of any foreign grant or ODA. Hence, too much reliance on such grants may not be a better choice. Foreign grants are mainly offered to Bangladesh in two forms: to support budgetary deficit, to support against climate change or natural disasters, and other rehabilitation programs. As the economy moves on faster, the portion of grants is expected to shrink and presumably convert into foreign loans. Therefore, no rapid rise in foreign grants seems plausible in the future.

**Conclusion and Policy Outcomes**

Fulfilling the targets of SDGs not only put some challenges in front of the nations, but they have also brought enormous opportunities to adopt innovative and transformative models of development that the world ever thought of in a most collective manner (Lundsgaarde & Keijzer 2019). Development has been recognized as a shared agenda and common enterprise. Environmental, social, political, and financial risks are now viewed as the collective cross-border schema of the countries’ development strategies (Steiner 2018).

This study highlights the case of Bangladesh, the fastest growing economy which set some earlier targets in 2017 regarding the allocation of SDGs financing from six sources. The study by GED (2017) seems to raise two downsides at present. First, the devastating impact of the COVID-19 global pandemic was out of the equation, quite understandably. Secondly, the proportionate growths of the funding sources between three time phases (i.e., 2017–2020, 2021–2025, and 2026–2030) presumably pressurized more on the 2021–2025 period which may not be plausible owing to the prolonged pandemic. Now, amid the COVID-19 situation, this study uses the ARDL–ECM model to analyze the likely movements of all those sources till 2030 and proposes a new allocation with some quantitative and qualitative rationales.

For empirical analysis, GDP has been considered the explanatory variable to estimate and forecast the short- and/or long-run relationships with the sources using the bound test cointegration approach under the ARDL–ECM model. Considering the projection on the future GDP growth of Bangladesh, the estimations from the ARDL–ECM model lead towards the forecasted values of public revenue collection, private investment, NGOs credit, PPPs, FDI inflows, and foreign grants to SDGs of Bangladesh till 2030.

Taking the growth rates, the level of public revenue collection of Bangladesh would stand at USD 50.0 billion in 2025 (15.1% of GDP) from 27.6 billion in 2020 (12.3% of GDP). It may reach USD 94.3 billion by the end of 2030 (18.5% of GDP). The level of the private sector’s investment in Bangladesh would stand at USD 131.7 billion in 2025...
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(39.7% of GDP) from 77.9 billion in 2020 (35.0% of GDP). It may reach USD 236.4 billion by the end of 2030 (45.7% of GDP). NGOs credit outstanding may slow down from 13.2% in 2020 to 11.6% in 2021 primarily due to persistent COVID-19s impacts. However, the growth is projected to get increasing thereafter to reach a moderate 12.5% by the end of 2025 and 13.7% by 2030 to reach USD 34.81 billion. According to the projection, FDI inflows during the 2021–2025 period may increase to USD 15.92 billion from 6.85 billion in the 2016–2020 period. The FDI inflows may further increase to USD 82.09 billion during 2026–2030. The growth rate of foreign grants was 13.6% in 2020, estimated to be down at 5.5% in 2025, and further slowed to 4.6% in 2030 to stand at USD 16.04 billion.

Proposed shares of public revenue and private sector’s investment were around 35% and 40% according to GED (2017) study. However, based on the probable growths and amounts of six sources till 2030 conducted in this study, the revised shares of allocation is proposed. The adequacy ratio has been used as the criteria to allocate the funding accordingly. In aggregate, total SDG funding has an adequacy ratio of 270% during the 2021–2025 period revealing that total supply from all sources is 2.7 times higher than it requires for SDGs financing. The ratio is 299% for the 2026–2030 period. According to the revised allocation estimation, private investment and NGOs need to be higher than the GED (2017) estimation during 2021–2025 while only private investment needs to be higher than the GED (2017) estimation during the 2026–2030 period.

The main essence of SDG financing should warrant the conceivable and efficient blend of financial and non-financial resources which should target the appropriate economic sectors at the right time to facilitate the sustainable development of a country. To comprehend the practical challenges of an economy, it is pivotal to develop the appropriate strategies and proportionate spending in SDG financing. While miscellany and innovation should be espoused in public spending and financial approaches towards SDGs, more attention is needed to track the emerging pattern of other funding resources. The respective potentials, as well as challenges of such funding sources, should, therefore, be properly analyzed and revisited, especially, following the COVID-19 context. In addition, the non-financial instruments and policy support should also be aligned with the financial instruments to enhance the effectiveness of the entire process. A thorough mapping of the financial flows from each financing source would be critical and would lead to efficient decision-making.

Annexure: Unit Root Tests

Choice of Number of Lags for Stationarity

In the unit root test, the choice of the number of lags depends on two statistical indications:

1. Z statistics, which must be negative and large,
2. MacKinnon approximate p-value for Z(t) < 0.1 (statistically significant at 10% significance level).
To get the desired results for stationarity, the test is usually started with zero lag and at ‘level’. If both of the conditions are not fulfilled, the variable is non-stationary. Consequently, the number of lags is gradually increased and results are followed. Even if for a very high lag (say, 10), the expected results are not found, in the next phase, first differences are calculated and a test for stationarity is conducted using the same procedure (i.e., gradually with a higher number of lag).

Based on the test, the following outcomes are obtained for each model:

| Model                  | Value | Level (without lag) | Level (lag = 2) | Level (lag = 4) | Level (lag = 8) | Level (lag = 10) | First difference (without lag) | First difference (lag = 2) |
|------------------------|-------|---------------------|-----------------|-----------------|-----------------|-----------------|-------------------------------|-----------------------------|
| Public revenue         | Z-stat| 2.216               | 1.934           | 3.460           | 3.025           | 1.305           | −3.852                       |                             |
|                        | p-value| 1.000              | 1.000           | 1.000           | 1.000           | 1.000           | 0.014                        |                             |
| Private investment     | Z-stat| 3.025               | 0.941           | 3.265           | 1.870           | 2.600           | −3.164                       |                             |
|                        | p-value| 1.000              | 1.000           | 1.000           | 1.000           | 1.000           | 0.092                        |                             |
| NGO’s investment       | Z-stat| −0.089              | −0.787          | −0.835          | −2.479          | −2.968          |                               |                             |
|                        | p-value| 0.993              | 0.967           | 0.963           | 0.339           | 0.141           |                               |                             |
| Foreign direct investment | Z-stat | −4.229             |                 |                 |                 |                 | 0.004                        |                             |
| Foreign grants         | Z-stat| −3.422              |                 |                 |                 |                 | 0.048                        |                             |

The graphical representation of the unit root tests are presented in the following part:
Variable: Public Revenue

Decision: Level is non-stationary while the first difference is stationary.

Variable: Private Investment

Decision: Level is non-stationary while the first difference is stationary.

Variable: NGO’s Investment

Decision: Level is non-stationary while the first difference is stationary.
Variable: Foreign Direct Investment

Decision: Level is stationary.

Variable: Foreign Grants

Decision: Level is stationary.

**Diagnostic Test**

For testing the serial correlation, Durbin–Watson $d$-statistics and Breusch–Godfrey LM are examined while for testing heteroskedasticity, White’s test is conducted.
| Model                  | Presence of any correlation? | Any heteroskedasticity? |
|-----------------------|------------------------------|-------------------------|
|                       | D–W test| Breusch–Godfrey LM test | White’s test |
| Public revenue        | No      | No                      | No          |
| Private investment    | No      | No                      | No          |
| NGOs’ investment      | No      | No                      | No          |
| Foreign direct investment | No    | No                      | No          |
| Foreign grants        | No      | No                      | Yes         |

**The Skewness–Kurtosis (Jarque–Bera) Test**

| Model  | Adjusted $\chi^2(2)$ with probability |
|--------|---------------------------------------|
| PUBREV | 6.82**                                |
| PRVTINV| 5.47*                                 |
| NGO    | 2.85                                  |
| FDI    | 3.41                                  |
| GRANT  | 0.82                                  |

* and ** Refers to statistical significance at 10% and 5% level respectively

Results of the J–B test indicate that public revenue and private investment are not normally distributed and have the presence of skewness and kurtosis. For NGO, FDI, and Grant, we do not have enough evidence to view these variables as something other than normally distributed.

**Fitting and Stability of the Model Test**

To check the model’s fitting and stability, CUSUM (Cumulative Sum) sequential analysis has been tested. All of the models seem to be well-fitted and remain within the stable ranges.
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Declarations

Conflict of interest  There is no issue of conflict of interest for this paper.

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