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MACROECONOMIC MEASURES OF BANGLADESH AND TURKISH ECONOMY

Purpose. The purpose of this research is to examine the major factors that influence sustainable economic growth and offer evidence-based policy guidance for emerging economies.

Methodology. A timeseries analysis using data from the World Bank and IMF is conducted using Augmented DickeyFuller tests to ensure stationarity, Johansen cointegration to detect long-run relationships, and quantile regression to handle non-normality and multicollinearity.

Findings. Quantile regressions indicate that capital accumulation in Bangladesh has an elasticity of approximately 1.65–1.72 ($p < 0.01$), the labor force is negatively associated with GDP (coefficients –1.69 to –2.82, $p < 0.01$), exports exhibit an elasticity of ≈0.81 ($p < 0.01$), and naturalresource rents depress GDP by ≈ –0.25 to –0.29 ($p < 0.01$). For Turkey, exports (≈0.38–0.39, $p < 0.01$) and FDI inflows (≈0.13, $p < 0.05$) are positively and significantly associated with GDP, and capital accumulation is positive and significant in several specifications (up to ≈1.01, $p < 0.01$).

Originality. The study uses quantile regression to jointly evaluate multiple macroeconomic variables and contrasts two emerging economies with distinct economic structures - Bangladesh's labor-intensive, export-driven model versus Turkey's diversified industrial base, and highlights unique patterns such as labor inefficiency and resource dependency.

Practical values. Policy-makers are advised to prioritize capital investment, enhance labor-market efficiency, diversify exports, and try to attract sustainable foreign investment. Reducing dependence on natural-resource rents and labor-intensive sectors can help emerging economies like Bangladesh and Turkey achieve more resilient, broad-based growth.

Keywords: *GDP, capital stock, labor force, export, foreign investment*

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Introduction. GDP is a fundamental metric in macroeconomic analysis that reflects a country's economic capacity to enhance living standards and sustain economic progress. Rapid changes in emerging economies like Bangladesh and Turkey have reshaped growth and development opportunities, necessitating informed policy design to identify and leverage growth drivers.

This transformation is driven by steady macroeconomic policies, a thriving ready-made garment (RMG) industry, and a demographic dividend from its young, expanding workforce. The RMG sector contributes significantly to GDP, employing millions of workers in the labor force, and establishes Bangladesh as a diversified economy with strong performance in manufacturing (automotive, electronics, textiles) and services. Bilateral trade between Bangladesh and Turkey, valued at almost $1 billion annually, is predominantly textile-driven, with Bangladesh's jute exports supporting Turkey's carpet industry, highlighting their complementary economic ties [1]. These distinct economic profiles, Bangladesh's export-led, labor-intensive model versus Turkey's diversified industrial base, are the criteria for comparative analysis.

Capital stock, encompassing physical infrastructure and productive assets, is a cornerstone of a labor-intensive economy like Bangladesh and a diversified economy like Turkey. The labor force is a crucial factor for economic growth, with Bangladesh benefiting from a large population. However, Turkey's more skilled and mechanized labor market offers comparative advantages in productivity. Exports, including technological exports, integrate these economies into global markets and enhance their foreign earnings and national output. By examining these variables, the study identifies shared and divergent growth patterns across Bangladesh and Turkey, providing their trajectories as emerging economies in a globalized context.

Literature review. Prior studies provide a theoretical foundation for growth analysis. Bazaluk, et al. [2] found significant relationships among GDP growth and other variables such as investment, FDI, and population between Turkey and Bangladesh, with population growth exerting the strongest influence on growth. Chirwa and Odhiambo [3] identified human capital, FDI, and natural resources as key growth drivers in developing nations. Attar [4] highlighted Turkey's insufficiencies in technology and human capital. Biswas and Saha [5]

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noted that exports, FDI, and capital formation drive India's growth, while Upreti [6] emphasized exports and resources in developing countries. Samsuddin and Amar [7] discovered that direct foreign investment had an impact, inflation had a negative and wide-ranging effect, population exhibited a significant and negligible influence, and exchange rate showed an expansive impact on financial growth in developing nations within the G20. Uneze [8] examined the causal association that contributes to greater economic growth in African countries. Karras [9] investigated annual data from 1960 to 1997 for 71 resource-receiving developing economies. The study stated in the conclusion that Official Development Assistance (ODA) exerts a strongly positive, permanent, statistically significant, and substantial impact on growth. Markusen [10] uncovered a positive contextual link between multinational and domestic labor productivity. Tananaiko, et al. [11] and Jones [12] argued that long-term growth is influenced by government policies that influence savings and investment. These studies validate the focus on Bangladesh and Turkey's unique dynamics, bridging neoclassical and empirical insights.

Purpose. Academically, the study enriches the understanding of growth dynamics in developing economies by directly comparing two understudied nations. For policymakers, it offers actionable recommendations to enhance capital investment, improve labor market efficiency, promote export diversification, and attract sustainable FDI, fostering growth in Bangladesh, Turkey, and other similar economies. In a progressively interconnected global economy, these insights are vital for maintaining robust economic progress in emerging countries.

Methods. The research adopts a rigorous econometric approach, utilizes unit root tests (Augmented Dickey–Fuller) to ensure data stationarity, Johansen cointegration to assess long-run relationships, and quantile regression to address non-normal data distributions and multicollinearity. This methodology is well-suited to handle the complexities of macroeconomic data and offers robust insights compared to traditional OLS methods. The choice of Bangladesh and Turkey is strategic, as their non-geopolitically aligned status and contrasting economic structures – Bangladesh's RMG-driven export orientation versus Turkey's diversified industries – provide a unique lens for macroeconomic analysis diverging from regionally or geopolitically focused studies. This comparative approach addresses a gap in the existing body of literature, which often overlooks such pairings. This study investigates the long-run and causal associations between GDP (Y, denoted as GROWTH) and other crucial macroeconomic variables- total capital stock (L_TOT_CAP_STOCK), labor force (LABOR_FORCE), exports (LEX), technological exports (TECEXP), natural resource rents (RESC), FDI inflows (LFDINF), and FDI outflows (LFDOUT) in Bangladesh and Turkey from 1980 to 2025. WDI and IMF were selected as data sources for their comprehensive, reliable, and standardized macroeconomic indicators, ensuring consistency and comparability across the two countries. The following hypotheses are tested for the variables based on the literature evidences:

1. Higher capital stock increases GDP (positive elasticity).

2. A larger labor force increases GDP unless labor-market inefficiencies dominate (sign ambiguous).

3. Greater export volumes raise GDP (positive effect).

4. Technological exports raise GDP more strongly than aggregate exports (positive, larger elasticity).

5. Higher naturalresource rents reduce GDP (resourcecurse effect; negative effect).

6. FDI inflows increase GDP through capital and technology transfer; FDI outflows have an ambiguous net effect.

The research followed three sequential steps: data preparation, stationarity testing, and econometric modeling. Data preparation involved retrieving time series data (1980–2025) from WDI and IMF archives, including GDP, total capital stock (USD), labor force (numbers), exports and technological exports (USD), natural resource rents (% of GDP), and FDI inflows and outflows (USD) [3, 11]. Logarithmic transformations were applied to stabilize variance and interpret coefficients as elasticities, facilitating percentage-change analysis.

Stationarity was evaluated via the Augmented Dickey-Fuller (ADF) test, consistent with modern unitroot testing approaches [13], chosen for its robustness in identifying unit roots in time series data.

Long-run relationships were examined using Johansen cointegration [14], selected for its ability to handle multiple I(1) time series and estimate cointegrating relationships via maximum likelihood. A constant trend assumption, as in Equation (2), models deterministic trends. This method was ideal given the seven explanatory variables plus GDP.

Quantile regression [15] was applied to examine associations, preferred over OLS due to its ability to handle non-normal data distributions and high multicollinearity, common in macroeconomic datasets. Equation (1) was estimated across six variants, each excluding one variable to mitigate multicollinearity

$$Y_t = \beta_0 + \beta_1 K_{1t} + \beta_2 LF_{2t} + \beta_3 EXP_{3t} + \beta_4 TECEXP_{4t} + \\ + \beta_5 RESC_{5t} + \beta_6 FDIN_{6t} + \beta_7 XFDOUT_{7t} + \varepsilon_t, \quad (1)$$

where Y_t is GDP per Capita; β_0 is constant or intercept term; K_1 is Total Capital stock; LF_2 is Labor force; EXP_3 is Total Export; $TECEXP$ is Technological export; $RESC_5$ is resource; $FDIN_6$ is Foreign direct inflow; $FDOUT_7$ is Foreign direct outflow; t is deterministic trend; ε_t is the stochastic error term.

The β_s are the coefficients that are to be estimated.

Lag length was selected by AIC, BIC, and HQIC for candidate lags up to four; AIC and HQIC favored ($p = 2$) while BIC weakly preferred ($p = 1$), and we adopt ($p = 2$) for the VAR (Johansen tests run with lag ($p - 1 = 1$), trace statistic, constant in the cointegrating relations). Quantile regressions were estimated at the 0.10, 0.25, 0.50, 0.75, and 0.90 conditional quantiles with standard errors obtained by 1,000 bootstrap replications.

Testing of normality and heteroscedasticity (Shapiro-Wilk and Breusch-Pagan tests) was also done to confirm the suitability of the data (Table 1) [16, 17].

Non-stationary data is non-deterministic because it displays stochastic or unpredictable tendencies [13].

Table 1

The variables' descriptions, units of measurement, sources, purpose, and intended sign

Variable sign	Variables	Name	Denomination	Source	Aim of using the variable	Expected Sign
Y	Growth (Dependent Variable)	GDP per capita	$	WB	Proxy for economic growth	
K	Total Capital Stock (Independent Variable)	(Total)	$	IMF	Economic growth	+
LF	Labor Force (Independent Variable)	(Total)	N	WB	A wide range of labor force promotes economies	+
EXP	Export (Independent Variable)	(Total)	$	WB	An increase in export volume contributes to the overall. Economic progress. Empirically, it is observed that demand for exported items promotes the output level of a country	+
TECEXP	Technological Export	(Total)	$	WB	Technological export of a country boosts economic growth more rapidly as it incurs opportunity costs	+
RESC	RESOURCE (Independent Variable)	Total amount of rents of natural resources (% of GDP)	$	WB	Development will be much easier in a nation with more resources than in one without any significant natural resources	–
FDIN	FDI (inflows) (Independent Variable)	FDI (Inflows)	$	WB	FDI contributes to lucrative growth by adding capital inflow, employment creation, export increase, and technology transfer	+
FDOUT	FDI (outflows) (Independent Variable)	FDI (outflows)	$	WB	Empirical discoveries show that the FDI outflow for developed countries has a greater impact on profitable growth	+

Secondly, the variables are examined for co-integration to ascertain the status of convergence. Cointegration theory [18, 19] tackles the issue of combining short-term dynamics with long-term equilibrium.

The hypothesis is stated as follows:

H0: no co-integrating equation.

HA: rejecting the null hypothesis (H0) as trace and max statistics > 5 % critical level.

Thirdly, 6 models were estimated with quantile regression [15], and this model (equation 2) has the ability to reveal links between variables that have nonlinear relationships with predictor variables.

$$y_t = \mu + A_1 y_{t-1} + \epsilon_t. \quad (2)$$

Results. It is observed that Turkey's export growth (about 30 % in 2020) is higher than that of Bangladesh. FDI inflow has augmented over the period for both countries, while its outflow has shown a steady-state pattern for Turkey, but it has increased over the years for Bangladesh. For both countries, labor force growth has exhibited a flat curve (since 1990). Total exports for Turkey have sharply increased since 2000 and oscillated between 2010 and 2020. However, it shows steady state export growth for Bangladesh. This situation is also aligned with technological export for both countries.

From Table 2, the variables GDP, capital stock, exports, and FDI inflow are not normally distributed (statistically significant) as the $Prob < 0.05$. The heteroscedasticity test indicates that no variable except resource rent has significant heteroscedasticity related to our independent variables. Thus, the variance of the remaining variables is constant over time, as there is $P < 0.05$.

Pairwise correlation is illustrated in Table 3, which explores that capital stock, labor force, technological export, foreign direct inflow, and outflow are vastly correlated with GDP.

ADF test has been used to determine if the series is stationary (Table 4).

At 5 %, the likelihood ratio surpasses critical values, which explains the seven co-integration equations. This demonstrates that economic growth and all explanatory variables have a long-term link. (Table 5).

The results displayed separately for Bangladesh and Turkey. Each variable's logarithm was used to get its coefficient in percentage units. From the pairwise correla-

Table 2

Normality and Heteroscedasticity test (Shapiro-Wilk test)

Variable	Observation	Normality test ($Prob > z$)	Heteroscedasticity Test ($Prob > z$)
GDP	41	0.00026	0.3098
Total Capital stock	41	0.00295	0.2099
Labor force	41	0.00028	0.4590
Export	41	0.01223	0.2489
Technological export	41	0.00013	0.2058
Resource	41	0.37001	0.1954
FDI inflow	41	0.00053	0.3440
FDI outflow	37	0.00149	0.2722

Table 3

Pairwise Correlation Tables ($N = 41$)

	GDP	Total Capital stock	Labor force	Export	Technological export	Resource rent	FDI inflow	FDI outflow
GDP	1.000	–	–	–	–	–	–	–
Total Capital Stock	0.967	1.00	–	–	–	–	–	–
Labor force	–0.611	–0.25	1.00	–	–	–	–	–
Export	0.944	0.96	–0.08	1.00	–	–	–	–
Technological export	0.980	0.54	–0.69	0.50	1.00	–	–	–
Resource	–0.301	–0.20	0.22	–0.24	–0.55	1.00	–	–
FDI inflow	0.846	0.89	0.03	0.94	0.33	–0.12	1.00	–
FDI outflow	0.713	0.70	–0.02	0.82	0.41	–0.21	0.76	1.00

Table 4

BD and Turkey ADF tests

Bangladesh				
Variable	In Level calculated value of ADF	At 1st difference calculated value of ADF	5 % Critical McKinnon value	Integration order
GDP	–0.769	–5.614 ***	–3.54	1(1)
TECH_EXP	–2.018	–3.405***	–3.00	1(1)
EXP	–3.48	–8.55***	–3.54	1(1)
RESC	–1.152	–3.476***	–3.54	1(1)
FDINF	–3.146	–6.929***	–3.56	1(1)
FDOUT	–2.451	–6.141***	–3.58	1(1)
TOTAL_CAP_STOCK	–1.475	–3.405***	–3.54	1(1)
LF	–1.710	–3.476***	–3.58	1(1)
Turkey				
GDP	–1.504	–6.165 ***	–3.54	1(1)
TECH_EXP	–1.004	–6.23***	–3.54	1(1)
EXP	–1.563	–4.49***	–3.54	1(1)
RESC	–2.065	–7.20***	–3.54	1(1)
FDINF	–2.427	–7.54***	–3.54	1(1)
FDOUT	–3.11	–8.07***	–3.56	1(1)
TOTAL_CAP_STOCK	–5.021	–9.39***	–3.54	1(1)
LF	–2.218	–4.26***	–3.54	1(1)

Note ***, **, * indicate significance at 1, 5 and 10 % levels respectively

tion table, there are correlations between capital stock, labor force, technological exports, and foreign direct investments with the outcome variable GDP. Thus, 6 different models were deployed, omitting each variable from each model, and the regression was estimated (Table 6).

Table 6 shows that a rise in capital stock increases the GDP in 4 models and a decrease in labor force lowers the output in 3 models for Bangladesh. The export increase also widens economic growth for the 3 models.

The results also indicate information regarding what contributes to economic growth in these two developing economies.

Acemoglu [11] and Jones [12] highlighted the importance of capital accumulation in economic growth. This steady positive interest in capital stock in Bangladesh indicates that investments into the physical infrastructures and productive resources have played a very pivotal role in sectors such as ready-made garments (RMG).

Such observation contradicts Chirwa and Odhiambo [3]. The negative coefficient could imply inefficiency of the labor market of Bangladesh, including underemployment or ineffectiveness of labor-intensive activity (agriculture or RMG). In Turkey, the coefficient of labor force is negative in other models, yet not significant, which implies that the consequence of labor on growth is weaker, perhaps because it is subjugated by the service sector.

This corroborates the export-based development hypothesis, as noticed in the studies such as Biswas and Saha [5] and Upreti [6], which state an evaluation of economic development to exports in the developing countries. The trade-oriented policies can be evidenced by the consistent export progression of Bangladesh, powered by RMG, and the steeper export developments of Turkey since 2000 [4].

The natural resource rents cause negative effects on the GDP in Bangladesh (–0.25 to –0.29), which concentrates on natural resources, may prevent diversified economic development [2]. The evidence presented by Mohammad and Ehikioya [20] on the foreign investment, influencing the growth process through capital, technology, and employment. Table 4 and Table 3 provide a very high pairwise correlation, which explains

Table 5

Co-integration Test

Johansen tests for co-integration for Bangladesh				
Trend: Constant				
Series: GDP, Total capital stock, labor force, resource, FDI inflow, FDI outflow, technological export				
Rank	Eigen Value	Likelihood Ratio	5 Percent Critical Value	Statistic
0	–	256.9629	156.00	325.8718
1	0.95803	302.94	124.24	233.9176
2	0.90748	337.4553	94.15	164.8871
3	0.86704	366.7123	68.52	106.373
4	0.75191	386.9249	47.21	65.9478
5	0.65716	402.4471	29.68	34.9034*
6	0.47989	411.9259	15.41	15.9459
7	0.29869	417.0705	3.76	5.6567
8	0.17721	419.8988	–	–
Johansen tests for co-integration for Turkey				
Trend: Constant				
Series: GDP, Total capital stock, labor force, resource, FDI inflow, FDI outflow, technological export				
Rank	Eigen Value	Likelihood Ratio	5 Percent Critical Value	Statistic
0	–	155.98679	156.00	201.8669
1	0.86666	191.24701	124.24	131.3464*
2	0.69507	212.03114	94.15	89.7782*
3	0.60592	228.32708	68.52	57.1863
4	0.51028	240.82061	47.21	32.1992
5	0.28185	246.61436	29.68	20.6117
6	0.25792	251.83451	15.41	10.1714
7	0.23527	256.52852	3.76	0.7834
8	0.02213	256.92023	168.36	–

Note***, **, * indicate significance at 1, 5 and 10 % levels respectively

why quantile regression is reported to combat the issue of multicollinearity. The specified methodological decisions add additional reliability to our results in contrast to OLS methods [21, 22]. Turkey must keep on utilizing FDI inflows by having investor-friendly policies. The two nations would be well served by increasing technological exports.

This research contributes to policymakers' workable knowledge towards maintaining the process of growth in these emerging economies by ruling out the positive contributions of capital stock, exports, and FDI, and detecting labor and resource issues affecting these economies [23, 24].

Conclusions. As was already indicated, the research precisely adds to the existing literature on the causal relation between production and growth. Other determinants like foreign direct investments, exports, and resource rent are found to be important covariates in regression analysis with GDP growth. However, technological export is not a significant predictor of GDP in any of these countries.

For industrialized countries, the literature supports the growth or feedback hypotheses. However, this research puts out a conservation hypothesis about the two emerging economies. For Bangladesh, capital stock is positively associated with GDP with an estimated elasticity of ≈1.65–1.72 ($p < 0.01$), exports exhibit a strong positive elasticity of ≈0.81 ($p < 0.01$), while naturalresource rents are negatively associated with GDP at ≈ −0.25 to −0.29 ($p < 0.01$). In case of Turkey, exports and FDI inflows are positively associated with GDP (export elasticity ≈0.38–0.39, $p < 0.01$; FDI inflow elasticity ≈0.13, $p < 0.05$), and capital accumulation is positive and significant in several specifications (up to ≈1.01, $p < 0.01$). An intensification in capital stock, exports, and foreign investment will improve Turkey's and Bangladesh's economic growth.

Table 6

The quantile regression results for 6 models

Country Name	Log (GDP)	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Bangladesh	Log (Capital stock)	–	0.91***	**1.67*****	**1.72*****	**1.65*****	**1.70*****
	Log (Labor force)	0.72	–	0.093	**–1.69*****	**–2.03*****	–2.82***
	Log (Export)	**0.81*****	**0.277****	–2.04***	–	0.11	0.19
	Log (Technological export)	–0.016	0.021	–	0.04	0.02	0.08
	Log (Resource)	**–0.266*****	**–0.26*****	–0.31013***	**–0.29*****	–0.29***	**–0.25*****
	FDI inflow	**–0.105*****	**–0.069*****	–0.0009	0.00		0.02
	FDI outflow	–0.021	0.00308	–0.00263	0.00	–0.00	
	Constant	–22.5998	–4.72467	30.30809	25.14	29.51	39.87
Turkey	Log (Capital stock)	–	0.002533	0.270392	**1.013*****	0.104	0.484
	Log (Labor force)	–0.09594		0.32429	–0.866	–0.583	–0.968
	Log (Export)	**0.387*****	**0.383****	–0.24357	–	**0.683*****	**0.469*****
	Log (Technological _export)	0.042367	0.004026	–	0.078	0.010	0.133
	Log (Resource)	0.087577	0.084013	0.086178	**0.123****	0.086	0.106
	FDI inflow	0.1285**	**0.134*****	0.130705***	**0.167*****	–	0.085
	FDI outflow	0.026689	0.026408	0.028114	**0.047*****	0.023	–
	Constant	–3.62059	–4.47139	–0.68653	9.768	0.026	5.128

Note ***, **, * indicate significance at 1, 5 and 10 % levels respectively

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Макроекономічні показники економіки Бангладеш і Туреччини

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Мета. Аналіз основних чинників, що впливають на сталий економічний ріст, і надання обґрунтованих на фактичних даних рекомендацій щодо формування політики країн із перехідною економікою.

Методика. Проведено аналіз часових рядів із використанням даних Світового банку та МВФ. Застосовано розширений тест Дікі-Фуллера (Augmented Dickey–Fuller) для перевірки стійкості, тест Йохансена на коінтеграцію для виявлення довгострокових взаємозв'язків, а також квантильну регресію для врахування ненормальності розподілу й мультиколінеарності.

Результати. Результати квантильної регресії свідчать, що в Бангладеш нагромадження капіталу характеризується еластичністю приблизно 1,65–1,72 ($p < 0,01$), робоча сила має негативний зв'язок із валовим внутрішнім продуктом (коефіцієнти від –1,69 до –2,82, $p < 0,01$), експорт демонструє еластичність близько 0,81 ($p < 0,01$), а рентні доходи від природних ресурсів знижують ВВП приблизно на –0,25– –0,29 ($p < 0,01$). Для Туреччини встановлено, що експорт (≈0,38–0,39, $p < 0,01$) та притік прямих іноземних інвестицій (FDI inflows) (≈0,13, $p < 0,05$) мають позитивний і статистично значущий вплив на ВВП, тоді як нагромадження капіталу є позитивним і значущим у кількох специфікаціях (до ≈1,01, $p < 0,01$).

Наукова новизна. У дослідженні використовується квантильна регресія для комплексної оцінки впливу кількох макроекономічних змінних і порівнюються економічні показники двох країн, що розвиваються, із різними структурними характеристиками – трудомістка, експортно-орієнтована модель Бангладеш і диверсифікована промислова економіка Туреччини. Виявлені специфічні закономірності, зокрема неефективність

використання праці й залежність від природних ресурсів.

Практична значимість. Результати дослідження свідчать про доцільність для органів державної політики приділяти пріоритетну увагу інвестуванню в капітал, підвищенню ефективності ринку праці, диверсифікації експорту й залученню сталих іноземних інвестицій. Зменшення залежності від рентних доходів природних ресурсів і трудомістких секторів може сприяти досягненню більш стійкого та збалансованого економічного зростання в таких країнах як Бангладеш і Туреччина.

Ключові слова: *валовий внутрішній продукт, основний капітал, робоча сила, експорт, іноземні інвестиції*