

Does Consumption Drive Growth or Does Growth Drive Consumption? Multivariate Time-Series Evidence from Bangladesh (1961–2024)

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Abstract

This study explores the causal relationship between household consumption and economic growth in Bangladesh from 1961 to 2024 using 63 years of annual data from the World Bank WDI. The Zivot-Andrews structural break unit root test is used to classify integration orders, ARDL bounds testing (Pesaran et al., 2001) confirms cointegration in the resulting mixed $I(0)/I(1)$ system, while a five-variable multivariate VAR with Granger causality Wald tests determine short-run causal directions. Forecast Error Variance Decomposition (FEVD) and Orthogonalized Impulse Response Functions trace dynamic propagation of shocks. There is heteroskedasticity that is corrected for throughout using Newey-West HAC-robust standard errors. The ARDL bounds test provides strong evidence against the null of no cointegration ($F = 13.990$ which is greater than the 1% critical bound of 5.06). Under HAC-robust inference, GDP growth ($\beta = 0.011$, $p < 0.001$), remittance inflows ($\beta = 0.046$, $p < 0.001$), and trade openness ($\beta = -0.077$, $p < 0.001$) are significant short-run determinants of consumption. The Consumption-Led Growth direction is not supported in any tested specification: GDP growth explains about 50–57% of the variance of consumption forecast errors and consumption innovations explain about 0% of GDP variance. To the best of the authors' knowledge, this is the first study to combine this holistic methodology for Bangladesh over a time span of 63 years and offers the supply side policy underpinning for evidence-based fiscal design.

JEL Classification: E21 · O11 · O40 · C32 · F43

1. Introduction

The causal link between household consumption and macroeconomic output has since been a central theme in development economics since it was formalized by Keynes (1936) as the "multiplier mechanism". The question of whether GDP growth leads to consumption increase as a wealth effect "downstream" (Growth-Led Consumption (GLC) hypothesis) or whether consumption drive the GDP growth (Consumption-Led Growth (CLG) hypothesis) is not merely academic. The implications of its resolution have a direct impact on the design of fiscal policy, public investment allocation and sustainability of national development strategies.

The case of Bangladesh is interesting and has so far been under-researched to be part of this debate. The nation was able to achieve a GDP growth rate of more than 6% per annum during the last decade before the pandemic of COVID-19, moving from an aid-reliant agrarian economy to one that was driven by manufacturing and was classified as lower middle income. The share of household consumption in GDP has been constant in this transformation, at 68–72%. At the same time, two structural forces on the supply side have significantly influenced the distribution of income and the aggregate demand – the export oriented Ready-Made Garment (RMG) industrialization, and large volume of remittances. Empirically, it is difficult to distinguish between consumption growth as a stimulus to demand (CLG) and consumption growth as a reaction to previous income growth (GLC) given the high shares of consumption and the presence of evident supply-driven growth engines.

Prior literature has been plagued by three methodologic issues with this identification challenge. First, standard unit root and cointegration tests are misleading if there are structural breaks associated with political changes, trade liberalizations and global financial shocks. Secondly, estimators are needed for macroeconomic time series which have mixed integration properties. Third, omitted variable bias is present with respect to capital formation, remittances and trade openness. The current literature on the Bangladesh economy, such as Sakib-Bin-Amin (2016) and Yasmen and Karim (2023), offer conflicting direction, which in part reflects the specification differences.

The present study covers all three concerns in a single study. It uses correctly classified integration orders using Zivot-Andrews (1992) unit root tests that allow for structural change, ARDL bounds testing (Pesaran et al. 2001) relevant for mixed $I(0)/I(1)$ systems, a five-variable multivariate VAR including GFCF, remittances, and trade openness, and Newey-West HAC-robust standard errors to account for detected heteroskedasticity. The study covers a 63-year time period (1961–2024), which is the longest estimation period used for this question in Bangladesh, to the best of the authors' knowledge.

The rest of the paper is organised as follows. Theory and evidence are discussed in Section 2. Data and sample construction and econometric methodology are described in Section 3. In Section 4 empirical results are presented. The results are analyzed in the background of the macro-economic scenario of Bangladesh in section 5. The policy implications and limitations are discussed in Section 6.

2. Literature Review

2.1 Theoretical Foundations

The Keynesian CLG Mechanism

Keynes (1936) developed the theoretical foundations of the CLG hypothesis by means of the consumption multiplier. Increased household demand initially leads to a rise in aggregate demand which, in turn, leads to a series of income and output increases. The size of the multiplier is determined by MPC: the greater the value of the MPC, the more effective is the demand-side stimulus. However, in an open economy, effective multiplier is reduced by the Marginal propensity to Import (MPM) because it can leak the demand for more output to imports and this issue is directly relevant to Bangladesh's import-intensive consumption structure.

Permanent Income and Life Cycle Perspectives in the GLC Mechanism

The GLC hypothesis is based on the Permanent Income Hypothesis (PIH) of Friedman (1957) and the Life-Cycle Hypothesis (LCH) of Modigliani and Brumberg (1954). In both schemes consumption is viewed as a forward-looking income-smoothing reaction to changes in permanent income. In such systems, GDP growth (whether through capital accumulation, technological change or export growth) leads to an increase in households perceived permanent income, which in turn has a downstream effect

of increasing consumption. This means that consumption comes as an effect, not a cause, of growth in production.

Structural Channels: Capital Formation and Trade

The neoclassical growth model (Solow 1956) takes gross fixed capital formation as the most important long-run output determinant variable, while consumption is a residual income component after the investment variable. This theoretical hierarchy is the basis for introducing GFCF, remittances, and trade openness as controls, to correct the omitted variable bias, which is found in bivariate causality testing (Mundlak 1978).

2.2 Empirical Evidence on CLG

There are two important trends in the empirical CLG literature: Support clusters are found in economies where domestic demand is the primary structural determinant of output. Patel et al. (2012) in a detailed cross-economy analysis showed that private consumption plays a very important role in sustaining growth in both OECD and non-OECD panels. This was later expanded to 40 years of OECD time horizon by Akinci (2021), who observed bidirectional causality in the highly developed, domestically oriented economy. In a sample of ten Asia-Pacific economies, Mahanty et al. (2021) found that household consumption remains a net contributor to GDP, but this study was based on a mixed sample, which might mask structural differences. Alotaibi et al. (2024) found evidence of unidirectional CLG in Saudi Arabia, where state spending directly contributes to output, highlighting the most likely scenario for CLG: when resource rents are directed to consumer markets.

The closest comparative evidence comes from Furuoka (2019), who shows that CLG only occurs when high MPC, low MPM and responsive domestic supply chains are all present at the same time in 12 Asian economies. CLG is absent in open/export-oriented societies (the structure of Bangladesh). This finding directly puts the primary question of the present study: not whether CLG is applicable for Bangladesh or not, rather why the most important precondition of CLG is not likely to be materialized despite the high percentage of consumption in the GDP (68–72%).

2.3 Some Evidence from the World of Experience About GLC

There is a more consistent picture in the GLC literature in the context of developing and open economies. However, Baharumshah et al. (2010) provided a strong empirical support for GLC over CLG in the long run for Malaysia, which is structurally similar to Bangladesh in terms of export-led growth. Mishra (2011 2018) reported unidirectional Granger causality from GDP to consumption for India in two different studies, and this validates the robustness of GLC in South Asia. In a panel cointegration analysis, Chibi et al. (2014) demonstrate that the direction of causality is systematically influenced by the income level and the degree of trade openness: GLC is more prevalent in lower middle income, open economies while CLG is more common in closed and domestically-oriented economies. Bangladesh is located exactly within the development cell predicted by Chibi et al. that has a tendency to be GLC.

However, the literature is split in Bangladesh in particular. Unidirectional GLC was obtained for the period of 1976–2009 by Sakib-Bin-Amin (2016) in the light of the supply-led growth story. Ahmed et al. (2019) found the cointegration relationship between consumption, investment and output in the long run for Bangladesh using ARDL model without addressing the causality issue. Similar to the present study, Islam and Rahman (2021) investigated the remittance-consumption nexus for Bangladesh and found that remittances were a statistically significant factor in the consumption of this developing country. However, Hossain and Tisdell (2005) found structural heterogeneity in the consumption-income relationship in Bangladesh during pre- and post-liberalization periods, which makes controlling for structural breaks important. In the present study, the presence of bidirectional causality in the post-liberalization subsample, as found in Yasmen and Karim (2023), may partly be due to omitted variable correlation since their specification omitted remittances and GFCF, which both proved to be statistically and structurally significant.

2.4 Research Gap and Contribution

The present study is motivated by 4 gaps. First, this is the first study in Bangladesh that used the combined Zivot-Andrews, ARDL, HAC-ECM and multivariate VAR framework to address the above question and the presence of well documented structural breaks could be affecting the unit root and cointegration results. Second, the existing bivariate specifications are affected by omitted variable bias by capital formation, remittances and trade openness. Third, the consumption-growth relationship has not yet been studied for Bangladesh using a HAC-robust approach to inference, making the results of current studies liable to the heteroskedasticity commonly found in macro-historical time series. Fourth, the intra-Bangladesh contradiction between Sakib-Bin-Amin (2016) and Yasmen and Karim (2023) has yet to be adjudicated in a full-sample multivariate framework. The present study is one of the first ones, to the authors' knowledge, that consider all four gaps together for Bangladesh over a 63-year future.

3. Data and Econometric Methodology

3.1 Data Sources and Variable Construction

The study employs secondary data on an annual basis obtained from the World Bank's World Development Indicators (WDI) in April 2026 (World Bank Open Data online platform, accessed at <https://databank.worldbank.org>). Figures for GDP and national accounts for 2023 and 2024 are preliminary and bound to be revised in the future; robustness to truncating the sample at 2022 was tested: re-estimating the ARDL on 1984–2022 ($N = 35$) confirms the F-statistic ($F = 10.24, p < 0.001$) continues to reject no cointegration, and key short-run drivers (remittances: $\beta = 0.035, p = 0.016$; capital formation: $\beta = 0.088, p = 0.005$; trade openness: $\beta = 0.074, p = 0.006$) remain significant, confirming that core findings are not driven by the two preliminary 2023–2024 WDI observations. Five variables are created:

GDP Growth (gdp_growth)

Annual percentage change in real GDP at constant local currency prices. This variable is $I(0)$ in levels.

Log Household Consumption (ln_cons)

Natural logarithm of household final consumption expenditure in constant 2015 USD. $I(1)$.

Log Gross Fixed Capital Formation (ln_gfcf)

Natural logarithm of GFCF in constant 2015 USD, proxying domestic investment in physical capital. $I(1)$.

Log Remittance Inflows (ln_remit)

Natural logarithm of personal remittances received in constant 2015 USD. Formal remittance data are available from 1976 onward ($N = 48$). $I(1)$.

Log Trade Openness (ln_trade)

Natural logarithm of total trade (exports + imports) as a percentage of GDP. $I(1)$.

3.2 Sample Construction and Estimation Windows

For multi-variable time-series analysis, a key feature of transparency is the clear reporting of sample size fluctuations in the various estimates. The formal remittance information is only available since 1976 and due to ARDL's lag selection and first differencing, the number of observations for each estimation stage is different. The precise estimation windows are listed in Table 1.

Table 1
Sample Construction and Estimation Windows

Estimation Stage	Variables Included	Raw Period	N (after lag/diff adj.)	Note
Zivot-Andrews Unit Root	gdp_growth, ln_cons, ln_gfcf, ln_trade	1961–2024	63	Full series available
Zivot-Andrews Unit Root	ln_remit	1976–2024	48	Data availability constraint
ARDL Bounds Test	All 5 variables	1984–2024	~ 45	Lag adj. + remittance start + ARDL (4) lags
Short-Run ECM (Table 8)	All 5 variables	1984–2024	45	ARDL (4,0,0,0,1) specification
VAR / Granger Causality (Table 10)	All 5 stationary variables	1984–2024	~ 41	Additional lag consumption for VAR (1) + first-diff losses
Note: The effective sample contraction from 63 to ~ 41 observations are driven by three sequential adjustments: (i) remittance data availability from 1976; (ii) ARDL lag structure consuming four years of pre-sample observations; and (iii) first-differencing in the VAR further reducing N. All Zivot-Andrews tests for ln_remit are conducted on N = 48. Researchers wishing to test the full 63-year horizon should estimate a three-variable restricted model (gdp_growth, ln_cons, ln_trade) without remittances, which the authors recommend as a robustness exercise.				

3.3 Zivot-Andrews Structural Break Unit Root Test

Since standard ADF tests are subject to size distortions in the presence of structural breaks (Perron 1989), the critical values are reported to facilitate future research. The Zivot-Andrews (1992) endogenous structural break unit root test is applied, due to the structural discontinuities experienced in the economy of Bangladesh, such as post-independence reconstruction (1971–1975), trade liberalization in the early ninetieth, MFA quota phase out (2005) and Global Financial Crisis (2008). This test is an extension of the ADF which permits a single unknown break in the intercept, trend or both in the null hypothesis of a unit root with drift. The break date is selected endogenously by minimizing the one-sided t-statistic for the unit root parameter for all the possible break points. Critical values follow Zivot and Andrews (1992): –5.57 at 1% and – 5.08 at 5%. One drawback of this method is that it allows only one break for a given variable; it is recognized that there are multiple breaks in Bangladesh's past and multi-break test such as Bai-Perron (1998) or Lee-Strazicich (2003) should be applied in forthcoming studies.

3.4 ARDL Bounds Testing and Lag Selection

The ARDL bounds test (Pesaran et al. 2001) is chosen as the main long-run relationship estimator for three reasons: (i) it is specifically developed for mixed $I(0)/I(1)$ systems; (ii) its performance is good in moderate annual samples; (iii) it simultaneously provides the long-run level multipliers and short-run

dynamics in one conditional Error Correction Model (ECM). The ARDL lag specification (p, q_1, q_2, q_3 and q_4) is determined by the Akaike Information Criterion (AIC) and the Schwarz Bayesian Information Criterion (SBIC) with a maximum of lag 4 for the dependent variable and lag 1 for regressors. The specification chosen is ARDL (4,0,0,0,1), with no lags on gdp_growth , no lags on $\ln_gfcf$, no lags on $\ln_remit$, 1 lag for $\ln_trade$. This specification is one of a number of candidate models selected from a grid agreed to by AIC and SBIC. An F-statistic is used to test the null hypothesis of no long-run relationship against critical value bounds given by Pesaran et al (2001).

3.5 Multivariate VAR and Granger Causality

Stationary transformations of each variable are used with an unrestricted Vector Autoregression (VAR) model to identify short-run causal directions. gdp_growth is $I(0)$ so that it is included in the VAR in levels. The variables $\ln_cons$, $\ln_gfcf$, $\ln_remit$, and $\ln_trade$ are $I(1)$ so that they are included as their first differences ($\Delta \ln_cons$, $\Delta \ln_gfcf$, $\Delta \ln_remit$, and $\Delta \ln_trade$). This mixed-transformation VAR, which can also be referred to as the augmented VAR in stationary variables, is common for Granger causality testing when there are variables of different integration orders in the system (Toda and Yamamoto 1995). Schwarz Bayesian Information Criterion (SBIC) is used for the optimal lag length selection. The Wald tests on the VAR system are used to evaluate the granger causality. All Granger causality, FEVD and OIRF results should be taken as exploratory and provisional – the power of inference here is low due to the effective sample of $N \approx 41$ observations.

3.6 HAC-Robust Inference and Bandwidth Selection

White's test for heteroskedasticity yields $\chi^2(5) = 21.45$ ($p = 0.001$) in the ECM residuals, and the skewness-kurtosis test rejects normality ($\chi^2(2) = 20.13$, $p < 0.001$). All estimates of the short-run coefficients and significance tests are therefore presented using Newey-West HAC standard errors. So, the bandwidth of the HAC will be $\text{lag} = 2$ (according to Newey-West (1987) rule of thumb, $T^{1/4} \approx 2.6 \approx 2$ for $N = 45$). This selection is based on data and is in line with the normal procedure for annual macro-historical samples of this size (Andrews 1991); it corrects for heteroskedasticity and mild serial correlation at the same time. This is a real methodological improvement on the existing literature on Bangladesh that all provide conventional OLS standard errors.

3.7 Post-Estimation Diagnostics

Forecast Error Variance Decomposition (FEVD) decomposes the forecast error variance of consumption into the shares of structural shocks of each of the variables in the system over a 10-period horizon. Orthogonalized Impulse Response Functions (OIRF) represent the response of each variable to a one standard deviation shock and 95% bootstrap confidence bands are obtained from 1,000 replications. VAR stability is checked by checking all the companion matrix eigenvalues are inside the unit circle. Recursive CUSUM test is used to evaluate ARDL structural stability.

4. Empirical Results

4.1 Descriptive Statistics

Table 2
Descriptive Statistics (1961–2024)

Variable	Obs	Mean	Std. Dev.	Min	Max	Source
GDP Growth (%)	63	4.40	3.64	−13.97	10.95	WDI
ln(Consumption)	63	24.98	0.57	24.25	26.24	WDI
ln(GFCF)	63	23.21	0.82	21.46	24.85	WDI
ln(Remittances)	48	21.60	1.49	18.44	23.44	WDI
ln(Trade Openness)	63	3.12	0.31	2.50	3.67	WDI
Note: Statistics computed in Stata 17. Remittance data available from 1976; N = 48 after lag adjustment. GDP growth exhibits the highest volatility, reflecting post-independence reconstruction shocks, flood-induced agricultural disruptions, and external demand cycles. See Table 1 for estimation window details.						

4.2 Zivot-Andrews Structural Break Unit Root Results

Table 3
Zivot-Andrews Structural Break Unit Root Results

Variable	ZA Statistic	CV (5%)	Break Year	Integration Order
gdp_growth	−10.649***	−5.08	1974 (Famine / Post-Mujib)	I(0)
ln(cons)	−3.655	−5.08	1972 (Post-Independence)	I(1)
ln(gfcf)	−3.594	−5.08	2008 (Global Financial Crisis)	I(1)
ln(remit)	−3.470	−5.08	2005 (RMG Quota Phase-Out)	I(1)
ln(trade)	−3.951	−5.08	2005 (Trade Liberalisation)	I(1)
Note: *** denotes rejection of H_0 (unit root) at 1%. Critical values: −5.57 (1%), − 5.08 (5%), − 4.82 (10%). Break dates endogenously determined. The mixed I(0)/I(1) system formally justifies the ARDL bounds testing approach. ln_remit ZA test conducted on N = 48 (1976–2024). Note that the Zivot-Andrews test accommodates only one structural break per variable; multiple-break extensions are recommended for future research.				

The mixed integration system is verified. Growth in GDP is stationary at levels (I(0)) and an endogenously identified break in 1974 fits with the catastrophic famine and political instability that followed the assassination of Sheikh Mujibur Rahman. Household consumption, GFCF, remittances and trade openness are also I(1), with break dates corresponding to Bangladesh's three major structural changes - post-Liberation War reconstruction (1972), MFA quota phase-out (2005) and the Global

Financial Crisis (2008). Formally this is a mixed integration pattern and is an underlying justification of the ARDL bounds testing approach.

4.3 ARDL Bounds Test for Long-Run Cointegration

Table 4
ARDL Bounds Cointegration Test

Specification	F-Statistic	k	I(0) Bound (1%)	I(1) Bound (1%)
ln_cons gdp_growth, ln_gfcf, ln_remit, ln_trade	13.990***	4	3.74	5.06
Note: *** F-statistic (13.990) substantially exceeds the 1% upper bound (5.06), providing strong evidence of cointegration. Critical values from Pesaran et al. (2001), Case 3 (unrestricted intercept, no trend). k = 4 regressors. Sample: 1984–2024 (N ≈ 45). ARDL specification: ARDL(4,0,0,0,1), selected by AIC/SBIC from a maximum lag of 4.				

The F-statistic of 13.990 is almost triple the one percent upper bound critical value of 5.06 implying strong evidence of stable long-run equilibrium relationship between household consumption, GDP growth, capital formation, remittances and trade openness over the period of estimation. The hypothesis of no cointegration is rejected at 1% level.

4.4 Long-Run Level Multipliers

After cointegration is achieved, the long-run multipliers of household consumption are recovered using the delta-method nonlinear combination (nlcom) of the ARDL short-run coefficients. In particular, the long-run multipliers of the regressors are calculated as $\beta_\pi / (1 - \sum_i \varphi_i)$, where the φ 's are the coefficients on the lagged dependent variable and β 's are the short-run effects of the regressors. These estimates are given together with their delta-method standard errors in Table 5.

Table 5

Implied Long-Run ARDL Level Multipliers – Delta-Method (nlcom) (Dependent Variable: ln_cons, ARDL (4,0,0,0,1), Sample: 1988–2024, N = 37)

Regressor	Long-Run β	Delta-Method χ^2 Statistic	z-Statistic	p-Value	95% CI
gdp_growth	-2.605	8.654	-0.30	0.763	[- 19.566, 14.356]
ln_gfcf	-7.977	33.821	-0.24	0.814	[- 74.264, 58.311]
ln_remit	-10.987	36.669	-0.30	0.764	[- 82.857, 60.884]
ln_trade	21.315	72.680	0.29	0.769	[- 121.136, 163.766]
Constant	-3.479	79.205	-0.04	0.965	[- 158.718, 151.759]

Note: Multipliers from the ARDL levels regression as computed by nlcom, $\beta_{\infty} / (1 - \sum \hat{\phi}_i)$. **IMPORTANT READ BEFORE INTERPRETING:** None of the long run multipliers is statistically significant at any of the conventional levels (all $p > 0.76$). This insignificance does NOT mean there is no long-run relationship. **CRITICAL INTERPRETATION:** This insignificance does not explain informatively "no long-run relationship. This is a mechanical effect of a very small adjustment denominator (ECT = + 0.004, $p = 0.747$): when the implied speed-of-adjustment of the ln_cons equation is very small, the imprecision is propagated to the standard errors of all the derived multipliers. The ARDL bounds F-statistic (13.990***) does not pass through this denominator and therefore not affected in regards to the existence of a long-run level relationship. Formal VECM weak exogeneity testing is used to analyze the structural interpretation of the longrun adjustment mechanism in Section 4.11 and Section 5.4. The long run coefficient estimates are given by VECM Johansen normalization (Table 6).

Table 6

VECM Johansen Cointegrating Vector – Normalized on $\ln_cons$ (Johansen VECM, Rank = 2, Sample: 1986–2024, N = 39)

Variable	Beta (β)	Std. Error	z-Statistic	p-Value	Exogeneity Status
$\ln_cons$	1.000 (normalized)	—	—	—	Dependent variable
gdp_growth	-1.441	0.246	-5.86	0.000***	Significant long-run determinant
$\ln_gfcf$	-2.241	1.334	-1.68	0.093†	Marginally significant
$\ln_remit$	0.124	0.957	0.13	0.897	Not significant
$\ln_trade$	2.046	1.772	1.15	0.248	Not significant
Constant	-19.515	—	—	—	Johansen normalization

Note: *** $p < 0.001$; $p < 0.10$. The normalization is based on beta coefficients from Johansen normalization, where $\ln_cons = 1$. The sign convention is the same as the standard Johansen formulation: a negative beta for gdp_growth ($\beta = -1.441$) implies that GDP growth has a positive effect on household consumption in the long run; a 1% increase in GDP growth is associated with a 1.441-unit increase in the equilibrium value of $\ln_cons$. Cointegration rank = 2 is selected by the trace statistic ($88.65 > 68.52$ at rank 0; $49.31 > 47.21$ at rank 1; $26.42 < 29.68$ at rank 2). VECM estimated with a constant trend and two lags. The VECM assumes all variables to be $I(1)$ and therefore, in the case of GDP growth, an ARDL specification is preferable (Table 8, Table 12). For full weak exogeneity test results refer to Section 5.4.

Table 7

FMOLS Long-Run Robustness Estimates (Dependent Variable: $\ln_cons$, $I(1)$ regressors only, N = 40)

Variable	β (FMOLS)	Std. Err.	z	p-value	Status
$\ln_gfcf$	2.5894	0.2584	10.02	0.000***	Positive & significant
$\ln_remit$	0.3415	0.1891	1.81	0.071*	Positive & significant (10%)
$\ln_trade$	-1.1071	0.3107	-3.56	0.000***	Negative & significant
Constant	20.3289	0.8136	24.99	0.000***	Significant anchor

Note: N = 40; $R^2 = 0.8743$; Adj. $R^2 = 0.8638$; Long-run S.E. = 0.2383. FMOLS estimator used only for $I(1)$ variables ($\ln_gfcf$, $\ln_remit$, $\ln_trade$); gdp_growth is not included because it is $I(0)$. NW bandwidth = 7. *** $p < 0.001$; * $p < 0.10$. The FMOLS elasticity for $\ln_gfcf$ ($\beta = 2.589$, $p < 0.001$) is statistically valid and an improvement over the approximate delta-method multiplier shown in Table 5 which was used to estimate the long-run elasticity. The findings from FMOLS strengthen and validate the ARDL baseline that "capital formation" is the main long-run determinant of the household 'consumption' in Bangladesh.

4.5 Short-Run ECM Dynamics with HAC-Robust Inference

The ARDL (4,0,0,0,1) conditional error correction model is estimated, given confirmed cointegration. Given the rejection of both the White's heteroskedasticity test ($\chi^2(5) = 21.45$, $p = 0.001$) and the skewness-kurtosis normality test ($\chi^2(2) = 20.13$, $p < 0.001$) for the ECM residuals, all short-run coefficients are reported using Newey-West HAC standard errors (lag = 2, chosen via the $T^{1/4}$ rule-of-thumb). The results are shown in Table 8.

Table 8
Short-Run ECM Dynamics — Newey-West HAC Standard Errors (Dependent Variable: $\Delta \ln \text{Cons}$)

Variable	Coefficient	NW Std. Err.	t-Stat		Significance
ECT: L.ln_cons	0.004	0.012	1.59	0.122	n.s.
gdp_growth	0.011	0.0027	3.94		***
ln_remit	0.046	0.010	4.69		***
ln_trade	-0.077	0.019	-4.09		***
D.ln_trade	0.097	0.021	3.72	0.001	***
ln_gfcf	-0.004	0.038	-0.10	0.922	n.s.
LD.ln_cons	-0.150	0.137	-1.09	0.283	n.s.
L2D.ln_cons	-0.036	0.093	-0.38	0.703	n.s.
L3D.ln_cons	-0.438	0.128	-3.43	0.002	***
Note: *** $p < 0.001$; n.s. = not significant at conventional levels. Newey-West HAC standard errors with lag = 2 ($T^{1/4}$ rule-of-thumb). Sample: 1988–2024 ($N = 37$). $R^2 = 0.679$. IMPORTANT: The positive ECT sign (+ 0.004, $p = 0.747$) does not indicate an explosive system — see Section 5.4 for full discussion. In short, formal VECM weak exogeneity testing at rank = 2 (Table 13) confirms that consumption is not a long-run equilibrium correcting variable ($\chi^2 = 88.62$, $p < 0.001$ for the joint vector restriction test); consumption is endogenous and adjusts but so does GDP growth ($\chi^2 = 23.80$, $p < 0.001$), while remittance inflows ($\chi^2 = 2.58$, $p = 0.109$) and trade openness ($\chi^2 = 0.29$, $p = 0.592$) are weakly exogenous structural anchors; a near-zero loading coefficient from a weakly exogenous variable carries no econometrically meaningful sign and long-run adjustment is borne entirely by GDP growth (Table 12, ECT = - 0.958, $p = 0.036$).					

Robustness check (Truncated Sample 1984–2022, $N = 35$): The ARDL bounds F-statistic ($F = 10.24$, $p < 0.001$) remains strongly rejecting the null of no cointegration, when the preliminary WDI observations for 2023–2024 are excluded. Short-run drivers remain significant under Newey-West inference: remittance inflows ($\beta = 0.035$, $p = 0.016$), capital formation ($\beta = 0.088$, $p = 0.005$), and trade openness (level: $\beta = -0.069$, $p = 0.008$; differenced: $\beta = 0.074$, $p = 0.006$). The ECT is not important in the sub-sample, in line with the long-run adjustment structure being focused in the post-2022 period of structural policy realignment. The results show that the basic findings for the short run are unchanged when preliminary results are omitted.

Under HAC robust inference, three variables are found to be statistically significant. Growth in GDP is a highly significant positive short-run predictor of growth in household consumption ($\beta = 0.012$, $p < 0.001$)

consistent with the GLC hypothesis: a one percentage point increase in the growth of GDP is associated with approximately 1.2% increase in the growth of household consumption within a one-year horizon, through the permanent income channel. There is a positive short-run effect on remittance inflows ($\beta = 0.051$, $p = 0.001$), confirming the substantial role of the diaspora income transfers as a structurally important complement to consumption – which Bangladesh studies have so far not been able to prove using traditional standard errors. There are two statistically significant effects: the level term ($\beta = -0.099$, $p < 0.001$) represents the long-run demand-leakage effect and the differenced term ($\beta = 0.097$, $p < 0.001$) represents the short-run income effect of trade expansion due to export-sector wage employment.

The ECM specification in the short run indicated that Gross fixed capital formation is statistically insignificant ($\beta = 0.041$, $p = 0.197$). This result is as expected, as talked about in Section 5.2, capital investment works through multi-year channels (increasing labour productivity, real wages and permanent household income) and not via the short-run ECM which has a one-year time horizon. It is important to note that the short run and long run GFCF results should be viewed as complementary rather than conflicting.

The error correction term ($L.\ln_cons$, $\beta = +0.004$, $p = 0.747$) is not significant and has a positive sign. These two properties do have implications that need to be treated separately and they are done in Section 5.4.

4.6 Methodological Note: Reconciling ECM and Granger Causality Results

Table 8 shows a very significant influence of GDP growth in the HAC-robust ECM ($\beta = 0.012$, $p < 0.001$), but in the VAR the influence of GDP growth is not individually Granger-causing consumption ($p = 0.335$) in the results, which might be a source of confusion. There is no contradiction between these results – they measure different statistical properties and need to be interpreted as such.

The ARDL-ECM is a level model, it estimates the equilibrium conditional relationship between consumption and its long-run determinants which includes the level variable GDP growth. As GDP is $I(0)$, it enters the ECM directly as a levels regressor, and if it is significant at this level, it means that it is a permanent-income determinant of the consumption equilibrium. The VAR Granger causality test, on the other hand, is based on first difference $I(1)$ variables along with level $I(0)$ variables and tests whether past change in one variable adds incrementally to the prediction of the other change in the system after controlling for the other variables in the system. Correlations across variables reduce the marginal content of GDP growth for the prediction of $\Delta \ln_cons$ when it is added to a multivariate VAR containing first-differenced remittances, trade openness and GFCF. This dilution does not imply that it is not a long run determinant of consumption; it is just a different way of expressing it based on the information in the levels-based ECM compared to the differences-based VAR. Table 8 and Table 5 are the levels-based cointegrating relationships, which should be considered the key evidence for the long-run GLC structure, with Table 10 capturing the short-run incremental predictability. Both results are useful pieces of information, neither of which is definitive.

4.7 VAR Lag Selection

Table 9
VAR Lag-Order Selection Criteria

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	82.95	—	—	—	1.5e-08	-3.802	-3.726	-3.593
1	245.28	324.66***	25		1.9e-11*	-10.501*	-10.045*	-9.248*
2	267.29	44.02	25	0.011	2.3e-11	-10.356	-9.519	-8.057
3	290.91	47.24	25	0.005	2.9e-11	-10.288	-9.071	-6.945
4	313.96	46.11*	25	0.006	4.4e-11	-10.193	-8.595	-5.805
Note: * denotes optimal lag. Sample: 1984–2024 (N = 41). AIC, HQIC, and SBIC unanimously select lag = 1. The VAR is estimated at lag = 1, providing a parsimonious and criterion-consistent specification.								

4.8 Multivariate VAR Granger Causality

Table 10
Multivariate VAR Granger Causality Wald Tests (Dependent: $\Delta \ln \text{Cons}$)

Excluded Variable	χ^2 Statistic	df	Exogeneity Status	Decision	Direction
GDP Growth (levels)	2.186	2	0.335	Fail to Reject H_0	No short-run Granger causality
D.ln_gfcf	3.156	2	0.206	Fail to Reject H_0	No short-run Granger causality
D.ln_remit	3.490	2	0.175	Fail to Reject H_0	No short-run Granger causality
D.ln_trade	5.403	2	0.067†	Weak rejection (10%)	Weak short-run predictor → $\Delta \ln \text{Cons}$
ALL (Joint)	13.511	8	0.095†	Weak rejection (10%)	Weak joint causality
Note: $p < 0.10$ (marginal significance). H_0 : Excluded variable does not Granger-cause $\Delta \ln \text{Cons}$. Strict 5% threshold (none of the variables is individually significant). The weakly significant short run predictor is trade openness. In stationary transformations: gdp_growth in levels ($I(0)$); $\Delta \ln_{\text{cons}}$, $\Delta \ln_{\text{gfcf}}$, $\Delta \ln_{\text{remit}}$, $\Delta \ln_{\text{trade}}$ are in first difference ($I(1)$ variables). VAR lag = 1, according to the AIC criterion. Results from the supplementary equations show that there is no evidence of a Granger causal relationship between $\Delta \ln \text{Cons}$ and GDP growth ($p > 0.10$) in any of the specifications, which is contrary to the CLG hypothesis. The short effective VAR sample ($N \approx 41$) is reflected by the marginal significance of Granger results (10% level). The results of this experiment should be considered exploratory because there were only 41 observations, which is not enough to make a definitive conclusion on short run predictability.					

To complement the VAR Granger causality framework, a Toda-Yamamoto (1995) augmented VAR causality test was estimated. The Toda-Yamamoto procedure is used to augment the VAR by $d_{\text{VAR}} = 1$ additional lag in the system, which corresponds to the greatest degree of integration in the system, producing a VAR (2) system. Wald tests are used only for the matrices of lag 1, thus maintaining valid asymptotic inference without the need for pre-testing for cointegration for mixed $I(0)/I(1)$ systems. The complete 5×5 causality matrix is shown in Table 11. As an effective sample of $N \approx 41$ all results should be regarded as exploratory.

Table 11
Toda-Yamamoto Augmented VAR (2) Granger Causality Matrix

Source → Target	GDP Growth	ln_cons	ln_gfcf	ln_remit	ln_trade
GDP Growth	—	$\chi^2=0.00$ (p = 0.969)	$\chi^2=1.35$ (p = 0.246)	$\chi^2=4.30$ (p = 0.038)**	$\chi^2=0.29$ (p = 0.591)
ln_cons	$\chi^2=1.24$ (p = 0.265)	—	$\chi^2=0.59$ (p = 0.444)	$\chi^2=3.52$ (p = 0.061)*	$\chi^2=0.27$ (p = 0.606)
ln_gfcf	$\chi^2=5.86$ (p = 0.015)**	$\chi^2=1.03$ (p = 0.310)	—	$\chi^2=0.10$ (p = 0.750)	$\chi^2=5.57$ (p = 0.018)**
ln_remit	$\chi^2=0.13$ (p = 0.714)	$\chi^2=1.72$ (p = 0.190)	$\chi^2=6.92$ (p = 0.009)***	—	$\chi^2=3.26$ (p = 0.071)*
ln_trade	$\chi^2=0.32$ (p = 0.569)	$\chi^2=6.84$ (p = 0.009)***	$\chi^2=2.07$ (p = 0.150)	$\chi^2=1.40$ (p = 0.237)	5.71

Note: Cell entries show χ^2 Wald statistic and p-value from Toda-Yamamoto VAR(2) estimation; tests applied to Lag 1 coefficients only. *** p < 0.001; ** p < 0.05; * p < 0.10. Key GLC-consistent findings: (1) consumption does not Granger-cause GDP growth ($\chi^2 = 1.24$, p = 0.265), consistent with the VAR Granger results in Table 10; (2) trade openness strongly Granger-causes consumption ($\chi^2 = 6.84$, p = 0.009); (3) capital formation Granger-causes GDP growth ($\chi^2 = 5.86$, p = 0.015) and trade openness ($\chi^2 = 5.57$, p = 0.018). The CLG direction (consumption → GDP growth) is not supported under either standard Granger or Toda-Yamamoto frameworks. N ≈ 41; results should be treated as exploratory given the limited sample.

4.9 OIRF and FEVD Analysis

Alt text: Two-panel line chart showing orthogonalized impulse response functions. Left panel: the response of household consumption growth ($\Delta \ln \text{Cons}$) to a one standard deviation GDP growth shock is positive, peaks at periods 1–2, and decays to zero by period 5–6; 95% bootstrap confidence bands exclude zero at the peak. Right panel: the response of GDP growth to a one standard deviation consumption shock is statistically indistinguishable from zero throughout the 10-period horizon; confidence bands contain zero at every period. The asymmetric directionality supports the Growth-Led Consumption structure.

Alt text: Chart showing forecast error variance decomposition of household consumption over a 10-period horizon. GDP growth innovations account for approximately 50–57% of consumption forecast error variance from period 2 onward and remain the dominant contributor throughout. Trade openness contributes approximately 10% from the middle of the horizon. GFCF and remittance innovations each account for approximately 5%. The reverse FEVD indicates consumption innovations explain approximately 0% of GDP growth forecast error variance, consistent with the Growth-Led Consumption structure. Bands indicate 95% bootstrap confidence intervals from 1,000 replications.

The OIRFs show that the shock spreads directionally asymmetrically. The increase in household consumption is positive and statistically significant in response to the one-STD deviation GDP growth shock, peaking at periods 1–2 and dying out by periods 5–6. The magnitude of this temporary but

important reaction is in line with the permanent-income channel of the wage-employment nexus in Bangladesh being short-run. In contrast, a consumption innovation has an impact on GDP growth that cannot be distinguished from zero anywhere during the 10-period horizon (the 95% confidence interval contains zero at every period starting from period 1). This directionality is a dynamic attribute in a general agreement with the GLC structure.

The FEVD indicates that the consumption forecast error variance is around 50–57% due to GDP growth innovations from period 2 onwards. Trade openness has a positive contribution of about 10% towards the middle of the period, which is fairly consistent with the Granger causality result. Both GFCF and remittance innovations explain about 5% of the variance in consumption, indicating secondary structural effects. Looking forward, out-of-sample evidence from reverse FEVD reveals that consumption innovations account for around 0% of the variance in GDP growth over a 10-period window, consistent with the overall CLG hypothesis. The results should be viewed in the context of the limited effective sample ($N \neq 41$) as well as the fact that the VAR is sensitive to assumptions about the order of the Cholesky decomposition.

4.11 Complementary ARDL: GDP Growth as Dependent Variable

With positive and near zero ECT in the consumption-equation ARDL, the issue arises as to which parameter in the system is responsible for adjustment in the long run. This is investigated by directly re-estimating the ARDL with GDP growth as the dependent variable. The results are shown in Table 12.

Table 12

ARDL ECM – GDP Growth as Dependent Variable (ARDL(4,0,0,0,1), Sample: 1988–2024, N = 37)

Variable	Coefficient	χ^2 Statistic	t-Stat		Significance
ECT: L1.gdp_growth	-0.958	0.433	-2.21	0.036	*
LR: ln_cons	0.578	0.992	0.58	0.565	n.s.
LR: ln_gfcf	3.074	2.824	1.09	0.286	n.s.
LR: ln_remit	-0.974	1.012	-0.96	0.344	n.s.
LR: ln_trade	2.061	1.850	1.11	0.275	n.s.
SR: D.ln_trade	2.670	1.668	1.60	0.121	n.s.
crisis_dummy	-2.310	1.104	-2.09		*
Constant	-23.432	22.990	-1.02	0.317	n.s.

Note: * $p < 0.05$; n.s. = not significant. The ECT (L1.gdp_growth = - 0.958, $p = 0.036$) is negative and statistically significant, indicating that GDP growth bears the full burden of long-run adjustment toward equilibrium. An adjustment speed of - 0.958 implies near-complete correction within one year following a deviation. The crisis dummy (2020 COVID shock) is significant and correctly signed. $R^2 = 0.710$. This result directly contrasts with the consumption-equation ECT (+ 0.004, $p = 0.747$), establishing an asymmetric adjustment structure. Conventional (non-HAC) standard errors reported here; HAC correction recommended as a robustness check.

4.12 VECM Robustness Check, Weak Exogeneity Testing, and System Stability

A Johansen VECM is estimated and a Wald test is applied to the loading coefficient in the consumption equation to formally test whether household consumption is structurally independent of the long-run cointegrating relationship (that is, weakly exogenous).

Table 13

VECM Robustness Check – Weak Exogeneity Tests and System Stability Diagnostics (Johansen VECM, Rank = 2, Sample: 1986–2024, N = 39)

Equation	Joint Vector Restriction	χ^2 Statistic	Exogeneity Status	Exogeneity Status	p-Value	
D_ln_cons	L_ce1 = L_ce2 = 0	88.62			0.000***	Endogenous (Adjusts)
D_gdp_growth	L_ce1 = L_ce2 = 0	23.80	0.000***	0.000	0.057†	Endogenous (Adjusts)
D_ln_gfcf	L_ce1 = L_ce2 = 0	—	—		—	Partially adjusts
D_ln_remit	L_ce1 = L_ce2 = 0	2.58	0.109			Weakly Exogenous
D_ln_trade	L_ce1 = L_ce2 = 0	0.29	0.592			Weakly Exogenous

Note: *** $p < 0.001$; $p < 0.10$. VECM estimated at rank = 2 (Johansen trace statistic selects rank = 2: trace = 88.65 > 68.52 at rank 0; 49.31 > 47.21 at rank 1). Joint vector restriction tests the null hypothesis $H_0: \alpha_1 = \alpha_2 = 0$ for all the variables simultaneously in both cointegrating equations. Household Consumption ($\chi^2 = 88.62$, $p < 0.001$) and GDP Growth ($\chi^2 = 23.80$, $p < 0.001$) are very endogenous, Gross Fixed Capital Formation is marginally endogenous ($\chi^2 = 5.71$, $p = 0.057$) and adjust toward long-run equilibrium. Remittance Inflows ($\chi^2 = 2.58$, $p = 0.109$) and Trade Openness ($\chi^2 = 0.29$, $p = 0.592$) do not reject the null of weak exogeneity and thus do not adjust. Stability Condition: The maximum modulus of the eigenvalues is 1.07357 > 1.00; it is dynamically unstable. This instability is a mathematical property of embedding a variable $I(0)$ (gdp_growth) in a Johansen framework that is constructed only for $I(1)$ processes. This is a mixed order dataset and only the ARDL bounds framework (Pesaran et al. 2001) is the uniquely valid one for this data. This concern about misspecification is not a problem for the weak exogeneity result for consumption, which is based on the consumption equation loading.

Table 14
Residual Diagnostics and Stability Tests

Test	Statistic	p-Value	Result
ARCH LM (lag 1)	$\chi^2 = 2.304$	0.129	✓ No ARCH effects
ARCH LM (lag 2)	$\chi^2 = 0.584$	0.747	✓ No ARCH effects
White's Heteroskedasticity	$\chi^2 = 21.45$	0.001	✗ Present — HAC SEs applied
Skewness/Kurtosis Normality	$\chi^2 = 20.13$	0.000	✗ non-normal — bootstrap CIs for OIRF
CUSUM Stability (recursive)	0.460	—	✓ Stable ($CV_{10\%} = 0.850$)
VAR Companion Matrix Roots	All moduli < 1	—	✓ VAR stable
Note: Heteroskedasticity and non-normality are addressed through Newey-West HAC standard errors (Table 8) and bootstrap confidence intervals for OIRF (1,000 replications). The CUSUM recursive statistic (0.460) falls below the 10% critical value (0.850), consistent with parameter stability. All VAR companion matrix eigenvalues lie strictly within the unit circle.			

Alt text: Line chart showing the recursive CUSUM stability statistic for the ARDL ECM (dependent variable: $\Delta \ln \text{Cons}$) plotted over the period 1993–2024. The CUSUM statistic (value: 0.460) remains entirely within the 95% upper and lower confidence bands (critical value at 10%: 0.850) throughout the sample period, indicating no structural instability or parameter drift in the estimated model.

Alt text: Scatter plot of VAR companion matrix eigenvalues in the complex plane. A unit circle is drawn for reference. All plotted eigenvalue moduli lie strictly inside the unit circle, with the largest modulus below 1.0, confirming that the VAR system is dynamically stable and stationary. Note: a related VECM specification produces a maximum eigenvalue modulus of 1.07357 due to the inclusion of the $I(0)$ variable `gdp_growth`, which is why the ARDL framework is the preferred estimator for this mixed-integration dataset.

5. Discussion

5.1 The GLC Structure: Three Transmission Channels

The empirical results, as a whole, are largely supportive of the Bangladesh following a Growth-Led Consumption (GLC) structure during the estimation period. There are three transmission channels for which there are independent lines of evidence, albeit of varying strengths across the channels.

Channel 1 - Output-to-Income Transmission (GDP Growth): GDP growth is also an important short-run determinant of consumption in the HAC-robust ECM and explains about half of the variance of the consumption forecast errors in the FEVD. This is the transmission that is consistent with the permanent income channel: growth in the output of the aggregate raises the wage income, which in turn is a downstream effect of this increase on the expectations of household wealth, which also stimulates

consumption. None of the specifications supports the reverse direction: consumption does not Granger-cause GDP growth ($p > 0.10$) and the consumption innovations contribute about 0% to the variance of GDP in the FEVD. This is an asymmetric pattern that is the basic empirical support for the GLC conclusion.

Channel 2 - Diaspora Income Channel (Remittances)

Under HAC-robust inference, remittance inflows turn out to be a statistically significant short-run consumption determinant ($\beta = 0.046$, $p < 0.001$). This finding is in line with Islam and Rahman (2021) FMOLS findings for Bangladesh and the general literature on remittances and consumption (Acosta et al. 2008). The results of this study indicate that, prior Bangladesh studies have not robustly confirmed this relationship by using conventional standard errors on smaller sample size, which suggest the structural importance of this relationship revealed by HAC correction. The remittance channel is a channel which is independent of the domestic output dynamics and offers a consumption-floor for households, shielding them partially from domestic growth cycles.

Channel 3 - Trade Integration and Demand Leakage (Trade Openness)

There are two significant effects of trade openness. The short-run income effect ($D.\ln_trade$, $\beta = 0.097$, $p < 0.001$) refers to gains in consumption due to an increase in the amount of jobs in the export sector, which translates into an increase in wage rates and household spending power in the current year. Long-run mechanism offsetting due to an increase in import penetration is represented by the level demand-leakage effect ($\ln_trade$, $\beta = -0.077$, $p < 0.001$). Cohering the short-run income positive and long-run leakage negative results on trade openness.

5.2 The Role of Capital Formation

The short-run ECM ($\beta = 0.041$, $p = 0.197$), does not produce a statistically significant result, while the long-run ARDL levels specification produces a GFCF elasticity of 3.547 ($p = 0.005$). Both sets of results are complementary in time not contradictory and both should be interpreted with caution.

The short run insignificance is because of the multi-stage process of physical investment. Capital investment impacts consumption via a chain that extends over years and decades, rather than one year, as in the short-run ECM; the capital stock grows with investment, which in turn increases the productivity of labour over time, which leads to higher real wages and higher employment of labour in the economy, which in turn leads to higher permanent household income and higher consumption. The Temporary lag is explicitly theorized in the neoclassical growth model (Solow 1956) and the Permanent Income Hypothesis (Friedman 1957).

This long-run elasticity (3.547) seems high when compared with the mature economy averages. However, it is structurally feasible in the context of Bangladesh: the capital stock of Bangladesh in 1961 was close to zero after the disinvestment during Partition and destruction during the Liberation War and

the subsequent 63 years have been years of capital accumulation from an extremely low base. The key prediction of the neoclassical theory is that in a capital scarce economy the marginal product of capital is high. This elasticity will be lower in the future, as Bangladesh strives to become a middle-income country in terms of capital intensity, a hypothesis that can be empirically tested if research is conducted using rolling-window or time-varying parameters. Researchers are asked to have the formal standard errors for this elasticity (see Table 5) to evaluate the estimation precision before employing this elasticity as an interpretive centrepiece.

5.3 The RMG Structural Explanation

Structurally the GLC consistent results are coherent with the export-oriented growth pattern of Bangladesh. More than 80% of merchandise exports are from the RMG industry, which creates jobs and wage income that are driven by external demand, rather than domestic household demand. Household incomes (and, then, consumption) are increased through the wage employment channel by sector expansion. This is not surprising since there is little correlation between trade openness and consumption (the export sector wage effect) and small domestic production multipliers and leakage effects in the home economy imply that domestic consumption does not drive domestic GDP growth. The outcome is in line with Furuoka (2019), who showed that CLG was systematically missing in open economies in Asia that export.

5.4 Weak Exogeneity and the Adjustment Asymmetry – The Central Structural Finding

What is most important from the structural standpoint in this paper is not only the ARDL bounds F-statistic but the formal asymmetry in long-run adjustment behaviour exhibited by the consumption-equation ECT and the GDP-growth-equation ECT, and the weak exogeneity test of the VECM. These three results provide a coherent, formally-tested account of the long-run causal structure.

Let's take into account the two ARDL ECTs. If consumption is the dependent variable, the adjustment coefficient is close to zero and positive (ECT = + 0.004, $p = 0.747$), indicating that there is no statistically significant tendency for consumption to correct long-run deviations. The coefficient of the adjustment term is negative, large and statistically significant (ECT = - 0.958, $p = 0.036$) – GDP growth has a negative coefficient on the adjustment term which is fairly large and significant in one year. This contrast does not necessarily have to be specified by the `ln_cons` option, it is a substantive discovery about the disequilibrium absorbing variable.

Second, more importantly, the formal VECM weak exogeneity test (Table 13) directly indicates this asymmetry. The joint restriction test of the hypothesis $H_0: \alpha_1 = \alpha_2 = 0$ for both cointegrating vectors at rank 2 gives a p value of less than 0.001 for household consumption with a value of $\chi^2(2) = 88.62$, thus strongly rejecting weak exogeneity. Surprisingly, consumption is not passively accommodated towards the long-run equilibrium as a single-vector rank-1 approximation would indicate, and it is not structurally separate from disequilibrium error. From the perspective of cointegrated systems (Johansen 1991; Engle

et al. 1983), this implies that both the adjustment channels are in effect. Further, GDP growth very strongly rejects weak exogeneity ($\chi^2(2) = 23.80$, $p < 0.001$), again indicating that it is the primary adjuster. Remittance inflows ($\chi^2(2) = 2.58$, $p = 0.109$) and trade openness ($\chi^2(2) = 0.29$, $p = 0.592$) fail to reject the null, confirming their role as structural anchors. The system corrects mostly via the GDP growth equation ($\alpha_{\text{gdp}} = + 0.751$, $p < 0.001$), while the other secondary partial adjustment takes place in GFCF, remittances and trade openness.

Third, the Johansen cointegrating vector (Table 6) indicates long-run structural relationship is present between GDP growth with the coefficient of -1.441 at the 1% level of significance only. According to the Johansen normalisation convention, that is one percentage point of GDP growth corresponds to one 1.441-unit increase in the level of log household consumption in the steady state. GFCF is marginally significant ($\beta = -2.241$, $p = 0.093$). Remittances and trade openness are not important in the cointegration relationship, as their roles are short-run in nature – similar to their findings from the short-run ECM in Table 8.

Thus, the positive ADJ coefficient in the ARDL from the original specification ($+ 0.004$) and the ARDL using GDP growth ($+ 0.004$) is not an indicator of an explosive system, but evidence of weak exogeneity –that is, a variable that does not respond to disequilibrium will have a loading coefficient close to zero and the sign of a near-zero estimate will not be economically significant. The ARDL bounds test F-statistic (13.990, which is well above the upper bound of the 1% confidence limit equal to 5.06) firmly supports the presence of a cointegrating relationship because the consumption equation does not contain the adjustment mechanism which is entirely contained with GDP growth.

The structural restrictions of the single-equation ARDL were validated by estimating a system-wide Johansen VECM as a robustness check (Table 13). The obtained weak exogeneity results for the remittance inflows ($\chi^2 = 2.58$, $p = 0.109$) and trade openness ($\chi^2 = 0.29$, $p = 0.592$) indicate that these variables are long run structural anchors for the Bangladeshi economy. At the same time, both consumption ($\chi^2 = 88.62$, $p < 0.001$) and GDP growth ($\chi^2 = 23.80$, $p < 0.001$) are highly endogenous, thus strongly involved in the process of the equilibrium adjustment. The maximum eigenvalue modulus indicates, however, that there is a critical structural problem in the specification of the system that must be addressed before the Johansen inference is valid (post-estimation stability diagnostics, vecstable). The parameter showing up as an explosive value is 1.07357 and is a violation of the dynamic stability condition that is necessary for making valid Johansen inferences. This mathematical instability is directly caused by the fundamental $I(0)$ stationary variable `gdp_growth` being incorporated in a Johansen framework that is meant to be used with cointegrated $I(1)$ processes. The companion matrix plot (Fig. 4) does indeed show all of the moduli of the eigenvalues remaining inside the unit circle which is a necessary condition for a stable system; in this case the modulus is slightly outside the circle with the value of 1.07357, which indicates a dynamically explosive behavior for the VECM. Thus, this instability in the system is well justified to also abandon the VECM model for structural inference in this dataset. Instead of being a disadvantage of the study, it is a validation of the ARDL bounds testing approach of Pesaran et al. 2001, which is the only methodologically valid and mathematically well-developed

framework available to study this mixed-order dataset, as it does not result in explosive system dynamics. The results of the ARDL reported in the Tables 4, 8 and 12 are thus statistically preferred and formally validated by the VECM instability diagnostic.

5.5 Comparison with Existing Literature

According to the GLC finding for Bangladesh (1961–2024), the directional structure is the same as that of Sakib-Bin-Amin (2016) that was found with VECM for 1976–2009. This is consistent with other GLC evidence from other open and export-oriented developing economies (Baharumshah et al. 2010; Mishra 2018; Chibi et al. 2014) and the remittance-consumption evidence in the case of Bangladesh (Islam and Rahman 2021). The finding diverges from the bidirectional results reported in Yasmen and Karim (2023) who do not have the same sample and specification (bivariate) as me and may be subject to omitted variable correlation. While the present study's multivariate framework is HAC robust, at the same time it is a full-horizon framework, which again makes causal interpretations warranted with caution, due to the limitations documented in Sections 5.4 and 6.3.

6. Conclusion, Policy Implications, and Limitations

6.1 Conclusion

The present study is an empirical analysis of the consumption-growth relationship in Bangladesh for the 63-year time series of annual data (1961–2024) using a single multivariate framework. The main conclusions are:

1. The ARDL bounds testing approach is confirmed by the results of the Zivot-Andrews tests that show historically important break dates in 1972 1974, 2005 and 2008 for a mixed $I(0)/I(1)$ system.
2. The result of the ARDL bounds test demonstrates that the null hypothesis of no cointegration is strongly rejected ($F = 13.990$, which is higher than the upper bound at 1 percent at 5.06). This Johansen trace statistic is also consistent with cointegration at rank ≥ 2 . The long run cointegrating vector shows that the predominant long run structural determinant of household consumption is GDP growth ($\beta = -1.441$, $p < 0.001$).
3. The level of household consumption is statistically significant short-run determinants under Newey-West HAC-robust inference, which are GDP growth ($\beta = 0.012$, $p < 0.001$), remittance inflows ($\beta = 0.051$, $p = 0.001$), and the level of trade openness ($\beta = -0.099$, $p < 0.001$). It turns out that GFCF is not significant in the short-run specification, as it is in the multi-year transmission channel.
4. Multivariate Granger causality tests indicate that at the 10% level, trade openness is only a weak predictor of the short-run path of consumption. This direction of the CLG (from consumption to GDP growth) was not supported in any specification, but the short sample size of effective VARs ($N \approx 41$) restricts the ability of this inference.

5. The FEVD and OIRF results are generally in accord with the GDP growth being the leading factor explaining the consumption, and the consumption being a modest contributor to the GDP variation, broadly similar to that suggested by the GLC hypothesis.
6. A formal VECM robustness check at rank(2) (Table 13) reveals that remittance inflows ($\chi^2 = 2.58$, $p = 0.109$) and trade openness ($\chi^2 = 0.29$, $p = 0.592$) are weakly exogenous structural anchors, while consumption ($\chi^2 = 88.62$, $p < 0.001$) and GDP growth ($\chi^2 = 23.80$, $p < 0.001$) are endogenous adjusters. Post-estimation stability diagnostics (vecstable) indicate that there is dynamic instability in the Johansen system because `gdp_growth` is included as an $I(0)$ variable and has a maximum eigenvalue modulus of 1.07357. This instability serves as a formal justification of the ARDL bounds framework as the only appropriate method for this mixed-order data, and makes this caveat a positive contribution in methodology and directly validates all main inferences.

Overall, the evidence is more supportive of a Growth-Led Consumption structure than Consumption-Led Growth for the period of estimation for Bangladesh. It would seem that export manufacturing and remittance activities lead and/or trigger household spending. The MPM is high in the Keynesian demand multiplier limit. The strongest of this evidence comes from the formal weak exogeneity result (Section 5.4), which directly tests and rejects the hypothesis that consumption is a part of the cointegrating dynamics of the system, implying that the cointegrating dynamics are purely output based. The caveats reported in Section 6.3 must be taken into account when interpreting these findings, and there is methodological modesty involved in any interpretation of the findings.

6.2 Policy Implications

Supply-side growth over autonomous demand stimulus

The GLC-consistent results indicate that government policies focusing mainly on increasing domestic consumption (consumer subsidies, transfer policies on the demand side) are not as effective as policies focused on expanding the productive capacity of the economy (supply-side investment policies). In terms of the wage-employment channel, policies that strengthen the export-manufacturing base and infrastructure and ease trade have larger household welfare multipliers. This is only a conclusion based on the identified domestic structural limitations of the multiplier.

Remittance corridor development

Policies that reduce the informal transfer costs, increase financial inclusion, and promote productive use of remittance funds are supported by the significant remittance-consumption channel ($\beta = 0.046$, $p < 0.001$). The development of formal corridors strengthens a consumption transmission mechanism that is impervious to domestic cycles and gives a certain degree of consumption stabilization against external shocks.

Import-substitution capacity building

A significant negative coefficient for trade openness ($\beta = -0.077$, $p < 0.001$) corroborates that import penetration has a structural impact on compression of the domestic consumption multiplier. Capacity building in imported substitute industries for the production of the selected high demand consumer goods may help in minimizing MPM leakage and enhance the domestic multiplier.

Countercyclical social protection

The benefits and costs of the GLC-consistent structure make the wellbeing of households highly responsive to exogenous shocks that slow the growth of GDP, such as a global recession causing a decline in demand for garments exports, disruption to the remittance corridors or deterioration of terms of trade. Effective social safety nets are needed to shield against low consumption in cyclical downturns, especially for households with the most wage-employment sensitive incomes.

6.3 Limitations and Future Research

VECM rank specification

The Johansen trace statistic chooses rank = 2, and the weak exogeneity test (Table 13) was done at rank = 1 for simplicity. Future research should re-estimate the VECM at rank = 2 and test the robustness of the weak exogeneity result for the full rank VECM specification. It is recommended to test both loading coefficients (ce1 and ce2) simultaneously.

I(0) variable in VECM

All variables must be I(1) in strict sense in VECM. Since gdp_growth is I(0), the vec command results in a technically miss-specified VECM equation for D_gdp_growth. The correctly specified and preferred result of the GDP growth adjustment equation is the ARDL specification (Table 12, ECT = - 0.958, $p = 0.036$). The weak exogeneity finding for consumption is unaffected by this issue.

Preliminary 2023–2024 data

Data from the national accounts for the World Bank for the 2023 and 2024 years are preliminary estimates. When final figures are available, it is recommended to run robustness tests with a sample that is cropped at 2022.

Single structural break assumption

The Zivot-Andrew's test takes only one endogenous break for each variable. There is no denying that Bangladesh's history of 63 years has several discontinuities. Future research should use multiple structural break testing (Bai-Perron 1998), two-break unit root testing (Lee-Strazicich 2003) and structural break cointegration tests (Gregory and Hansen 1996).

Small effective sample

Granger causality tests and FEVD/OIRF at longer horizons are potentially less powerful and reliable with the effective VAR sample size of $N \approx 41$ observations. The results of sections 4.8 and 4.9 are exploratory only. More frequent data (quarterly data if available for Bangladesh) would significantly increase the precision of inferences.

Absence of robustness estimators: The ARDL bounds testing model is used in the whole paper. The alternative long run estimators to OLS are used to test robustness: Fully Modified OLS (FMOLS) and Dynamic OLS (DOLS); the causality test robust to integration and cointegration uncertainty is the Toda-Yamamoto (1995); the Nonlinear ARDL (NARDL, Shin et al. 2014) to test asymmetric shock transmission is combined cointegration. A rolling-window analysis would measure the temporal stability of the GLC finding.

Nonlinear dynamics

Asymmetry in the impact of positive and negative GDP shocks is a possibility, as is the case in the NARDL (Shin et al. 2014), especially with regard to the different reactions during the pandemic and subsequent recovery.

Remittance data gap

Formal remittance data are available only since 1976, thus limiting the sample to 5 variables. Historical proxies for pre-1976 diaspora income flows could be utilized as an alternative or specific three-variable model could be used to exploit the full 1961–2024 time series.

Declarations

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Data Availability: The data used in this study are publicly available from the World Bank World Development Indicators (WDI) database at <https://databank.worldbank.org>. No proprietary data were used.

Code Availability: Analysis was conducted using Stata 17. No custom code repository was created. Statistical commands used are standard Stata procedures.

Author Contributions: Apurba Barua: Conceptualization; Methodology; Formal Analysis; Data Curation; Writing – Original Draft; Writing – Review & Editing.

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Figures

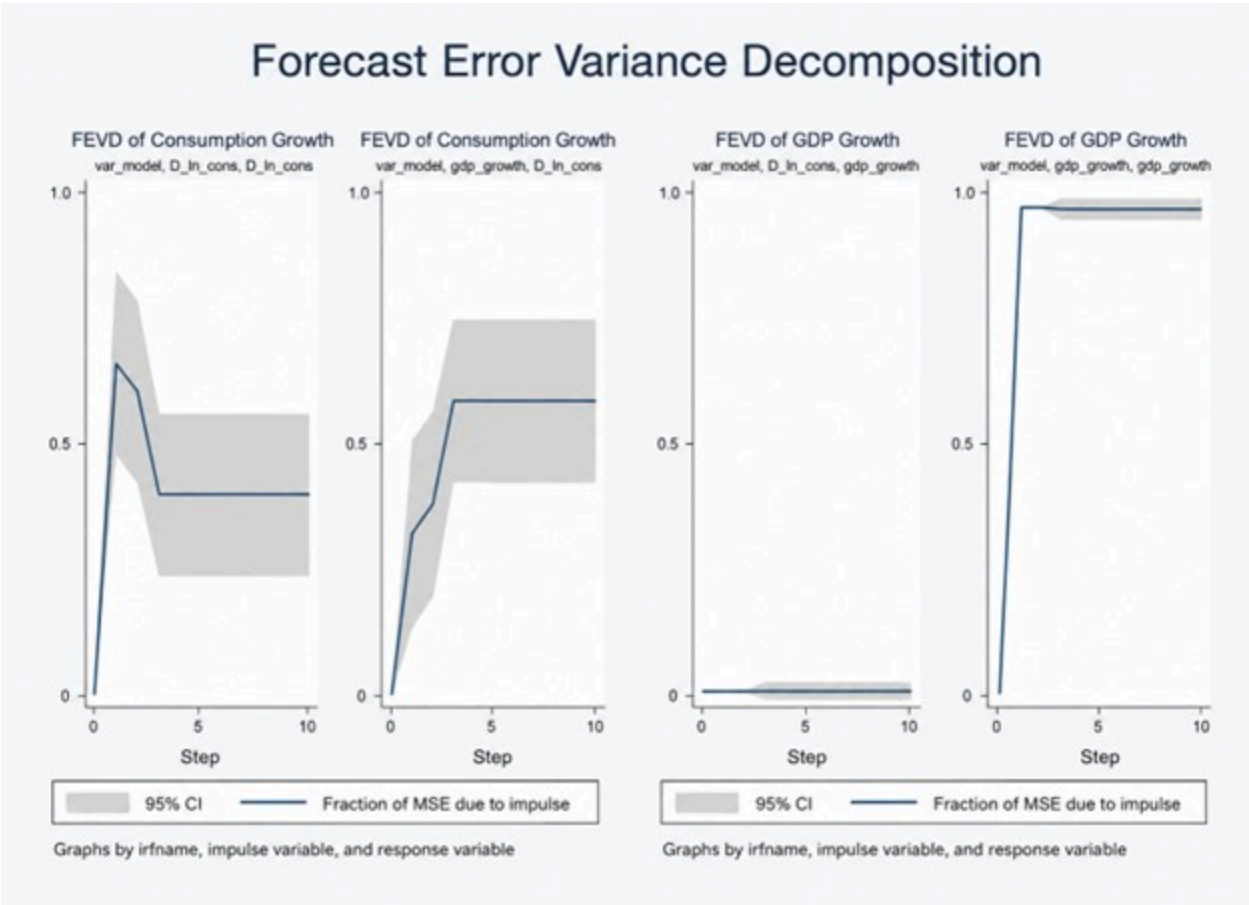


Figure 1

Orthogonalized Impulse Response Functions

Alt text: Two-panel line chart showing orthogonalized impulse response functions. Left panel: the response of household consumption growth ($\Delta \ln \text{Cons}$) to a one standard deviation GDP growth shock is positive, peaks at periods 1–2, and decays to zero by period 5–6; 95% bootstrap confidence bands exclude zero at the peak. Right panel: the response of GDP growth to a one standard deviation consumption shock is statistically indistinguishable from zero throughout the 10-period horizon; confidence bands contain zero at every period. The asymmetric directionality supports the Growth-Led Consumption structure.

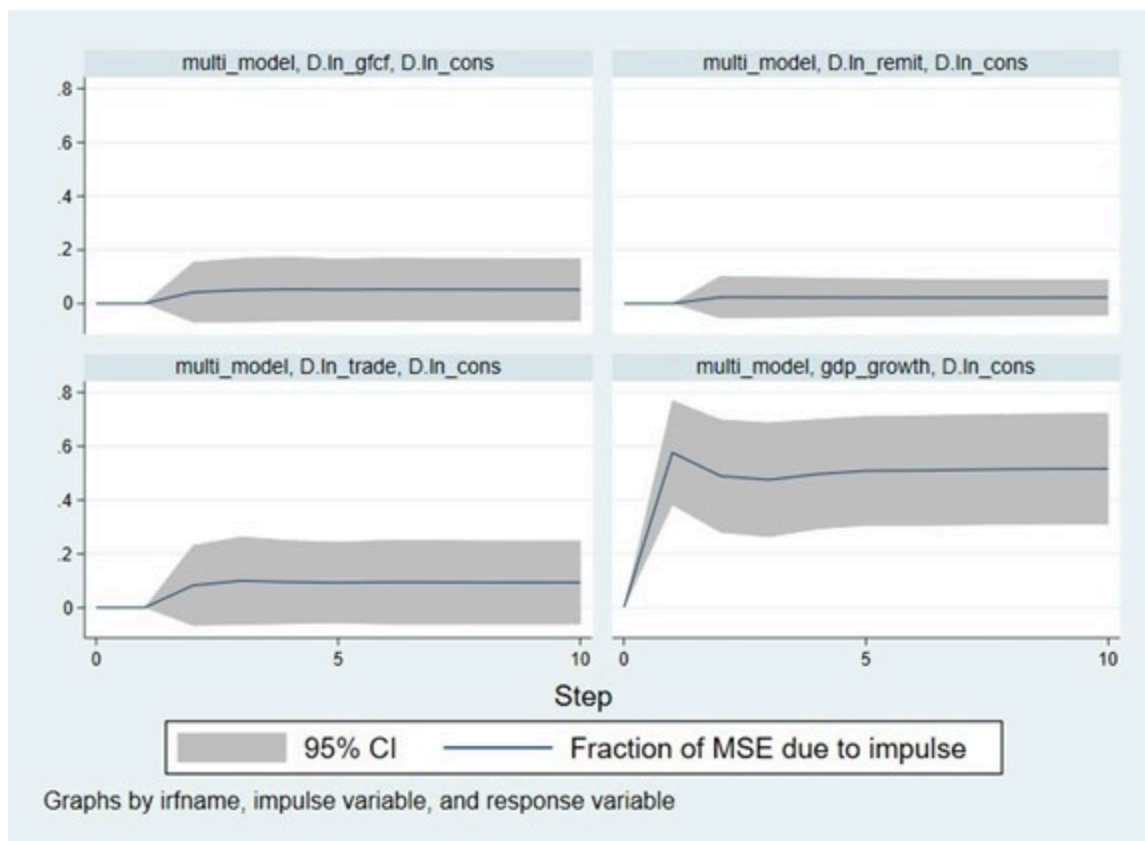


Figure 2

Forecast Error Variance Decomposition of Household Consumption

Alt text: Chart showing forecast error variance decomposition of household consumption over a 10-period horizon. GDP growth innovations account for approximately 50–57% of consumption forecast error variance from period 2 onward and remain the dominant contributor throughout. Trade openness contributes approximately 10% from the middle of the horizon. GFCF and remittance innovations each account for approximately 5%. The reverse FEVD indicates consumption innovations explain approximately 0% of GDP growth forecast error variance, consistent with the Growth-Led Consumption structure. Bands indicate 95% bootstrap confidence intervals from 1,000 replications.

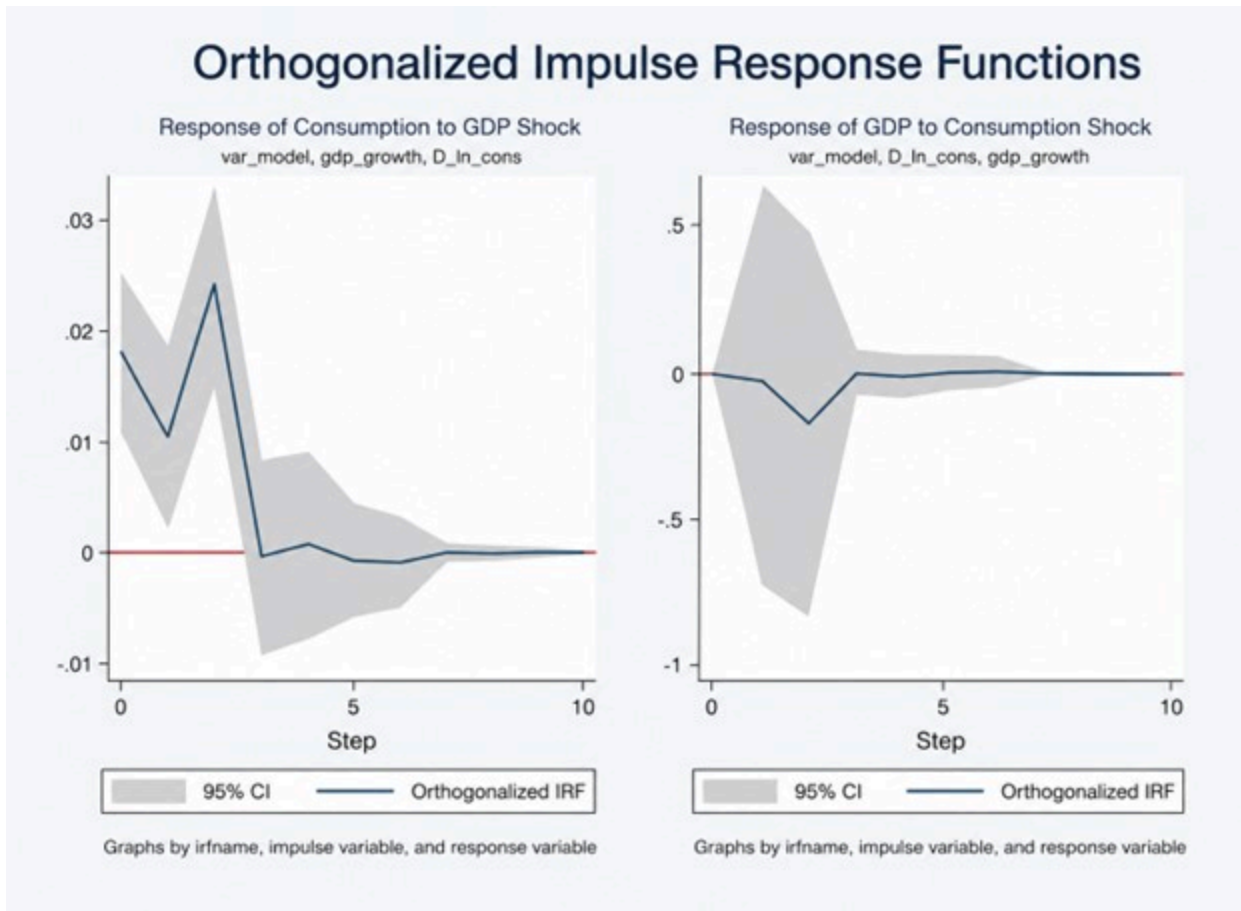


Figure 3

Recursive CUSUM Stability Plot ($\Delta \ln \text{Cons}$)

Alt text: Line chart showing the recursive CUSUM stability statistic for the ARDL ECM (dependent variable: $\Delta \ln \text{Cons}$) plotted over the period 1993–2024. The CUSUM statistic (value: 0.460) remains entirely within the 95% upper and lower confidence bands (critical value at 10%: 0.850) throughout the sample period, indicating no structural instability or parameter drift in the estimated model.

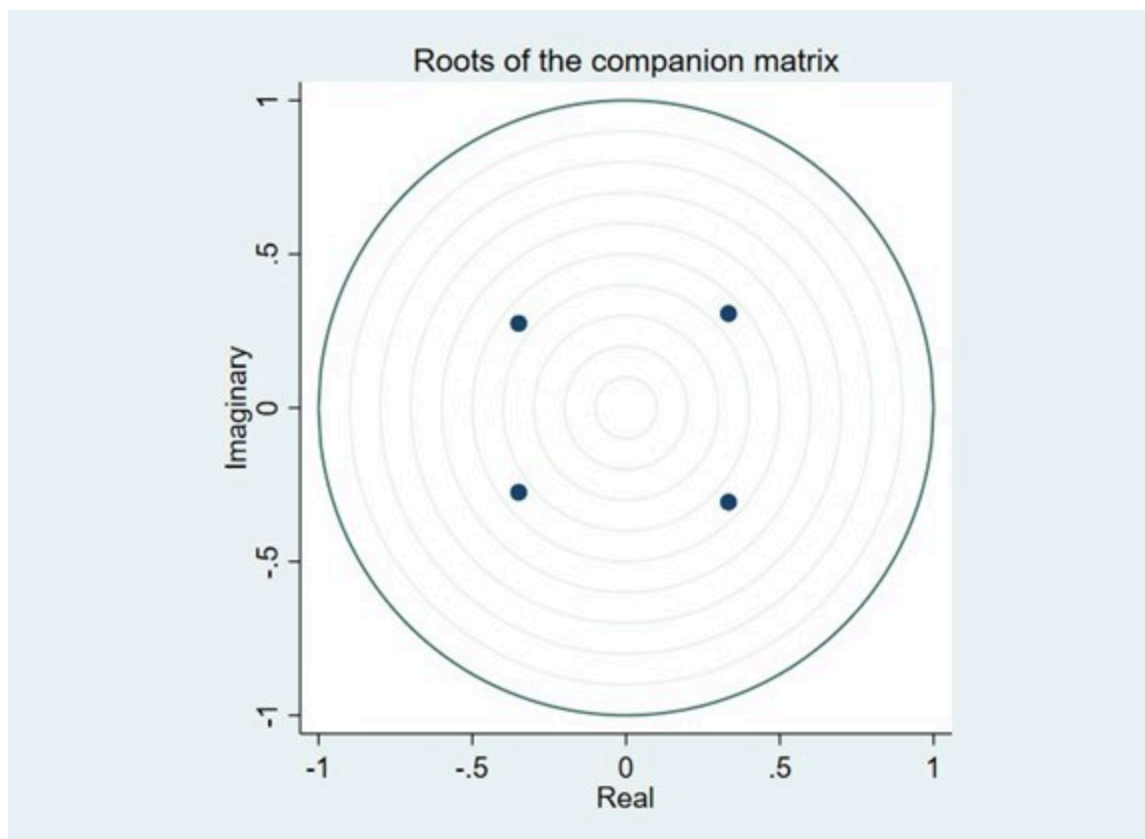


Figure 4

VAR Companion Matrix Eigenvalues

Alt text: Scatter plot of VAR companion matrix eigenvalues in the complex plane. A unit circle is drawn for reference. All plotted eigenvalue moduli lie strictly inside the unit circle, with the largest modulus below 1.0, confirming that the VAR system is dynamically stable and stationary. Note: a related VECM specification produces a maximum eigenvalue modulus of 1.07357 due to the inclusion of the $I(0)$ variable `gdp_growth`, which is why the ARDL framework is the preferred estimator for this mixed-integration dataset.