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The Virtuous Economic Growth Cycle: An Empirical Evidence based on Developing - 8 Countries

Kawser Ahmed Shiblu[1] Nowrin Ahmed[2]

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Abstract

Purpose: *The study aims to explore the factors shaping the pace of economic growth in countries, particularly in the context of Developing-8 (D-8) countries. The study seeks to address the ongoing discussion about the direction of causality between savings and economic growth, drawing parallels with the classic "egg or chicken first" question.*

Methodology: *Analyzing established growth models like Harrold-Domar and Solow, the research examines the intricate relationships among savings, labor, and growth in D-8 nations. Employing techniques such as Unit Root Test, Optimal Lag Length Selection criteria, Multicollinearity Test, Cointegration Test, Granger Causality Test, Impulse Response Function, and Variance Decomposition, the study uncovers the hidden patterns of interaction.*

Findings: *Contrary to the unidirectional causality proposed by earlier growth models, the study finds a more complex relationship among savings, labor, and economic growth in D-8 countries. Instead of a straightforward causal link, the study observes the presence of a "positive feedback loop" referred to as the "virtuous cycle." This implies that in these economies, both economic growth (GDP) can drive savings and increased savings can foster economic growth.*

Implications: *The findings overturn conventional wisdom, emphasizing a more intricate, interdependent relationship. This revelation carries vital implications for comprehensive economic strategies within D-8 countries, underlining the necessity of a holistic approach that integrates both saving and growth factors for sustainable economic advancement.*

Value/Originality: *The study's uniqueness stems from its exploration of the savings-growth interplay in the context of D-8 countries. By introducing the novel concept of a positive feedback loop, it adds a fresh dimension to ongoing debates and significantly enriches the comprehension of economic dynamics. This perspective offers an exclusive standpoint for policy makers, researchers, and economists to consider when formulating effective developmental strategies.*

Keywords: Economic Growth, Savings, Labor, Developing-8, Virtuous Cycle

[1] *Assistant Professor, Department of Finance, Jagannath University, Dhaka-1100, Bangladesh, Email: kshiblu@gmail.com*
[2] *Joint Director, Head Office, Bangladesh Bank, Dhaka-1000, Bangladesh, Email: nowrin.fin@gmail.com*

Introduction

The importance of savings in the economy is never challenged by any economist in the world. The only disagreement among the economists is the level of impact and the direction of the impact. For example, the economists (Harrod, 1939) and (Domar, 1946) emphasized only on the savings for a sustainable economic growth, whereas (Solow, 1956) stressed the importance of savings as well as the labor force for a nation's economic growth. Some economists think savings promote growth whereas others believe growth increases savings. Yet, another group of economists consider the virtuous cycle of these two in which either savings stimulate growth and then growth boosts savings, or growth enhances savings and savings accelerates growth. This cycle creates a positive feedback loop. As the close relationship between savings and economic growth does not imply anything about the direction of causality, so the question remains open: whether it is savings or growth that comes first. Recent empirical evidence is also showing mixed outcomes. Studies done by (Alguacil, et al., 2004), (Oladipo, 2010), (Saltz, 1999), (Elryah & Qian, 2015) etc. claimed an unidirectional causality from savings to economic growth, whereas the reverse causality is stated by (Sinha & Sinha, 1998), (Anoruo & Ahmad, 2001) etc. On the other hand, (Bhat, et al., 2021), (Agrawal & Sahoo, 2009) etc. found a bidirectional causality between economic growth and savings. Even some findings by (Romm, 2005), (Patra, et al., 2017) etc. emphasized the indirect causality between growth and savings through a channel like investment.

Nevertheless, capital formation and employment creation stand out as the two other crucial channels fostering economic growth. Capital formation involves gathering physical capital assets like machinery, equipment, transportation infrastructure, and technology, contributing to enhanced productivity (Barro, 1991). By investing in these capital goods, in other words increasing capital formation, nations can augment the productive capability of their economies (Solow, 1956); (De Long & Summers, 1991); (Levine, 1992); (Odedokun, 1996); (Rousseau & Wachtel, 2000). Simultaneously, employment generation is indispensable, as increased employment results in incomes that spur additional spending and investment, initiating a positive cycle of economic expansion (Okun, 1963), (Freeman, 2000), (Rowthorn, 1995), (Verdoorn, 2002)

More specifically, Solow (1956) pioneered a seminal growth model demonstrating how increases in capital investment, technology, and labor raise an economy's output per capita over the long run. Further empirical research by De Long and Summers (1991) highlighted that machinery and equipment investment has a particularly strong link with economic growth. Regarding employment, Verdoorn's (2002) cross-country analysis demonstrated a robust relationship between job creation in industrial sectors and overall productivity growth. Taken together, these highly cited studies and models lend strong support for capital deepening and workforce additions as two interrelated mechanisms leading to sustained economic growth.

However, the policymakers, including domestic and international like IMF, prescribe a policy of high savings to promote growth of a country. Despite wide acceptance of this policy, the question may arise – is this policy equally applicable for all countries or group of countries like D-8 countries or G-8 countries? (Aghion, et al., 2016) tried to answer a question using theoretical

framework and empirical evidence - are savings equally be important for poor and rich countries. They argued that domestic savings promote growth in a poor country which allows technological diffusion and foreign investment leading innovation. But savings do not facilitate growth in rich countries as there is nothing to attract foreign investment. Moreover, the empirical evidence during the Asian financial crisis in 1997 cast a doubt on this policy prescription as East Asian countries with impressive savings rate had experiences a slow growth. So, higher savings may not necessarily instigate higher growth and maybe it is slow growth which cannot utilize the higher savings. Given the unclear causal link between savings and growth in different empirical evidences, this study aims to shed light on the true nature of this linkage within the context of the D-8 countries..

The paper consists of the following sections. Introduction is followed by section one: the rationale of the research. Section two and three respectively highlight the objectives of the research and review of prior researches. Data are described in section four. Section five and six deals with the growth model and data robustness check. The empirical results and analysis are presented in section seven, followed by the conclusion and final remarks in section eight.

1. Rationale of the Research

The Developing-8 (D-8) is an intergovernmental organization established to promote economic collaboration and development among its eight member countries: Bangladesh (BGD), Turkey (TUR), Malaysia (MYS), Indonesia (IDN), Egypt (EGY), Nigeria (NGA), Iran (IRN), and Pakistan (PAK). These nations have come together to foster cooperation and address common challenges faced by developing economies. All these countries have maintained steady economies for a prolonged period. However, during the recent deadly pandemic in 2020, nearly all of them experienced slow or no economic growth, leading to increased unemployment rates. Figure 1 illustrates the unemployment rates in 2017-2020 for the D-8 countries. It is evident that all countries saw a rise in unemployment in 2020 compared to previous years, with particularly significant spikes observed in Iran, Bangladesh, and Egypt.

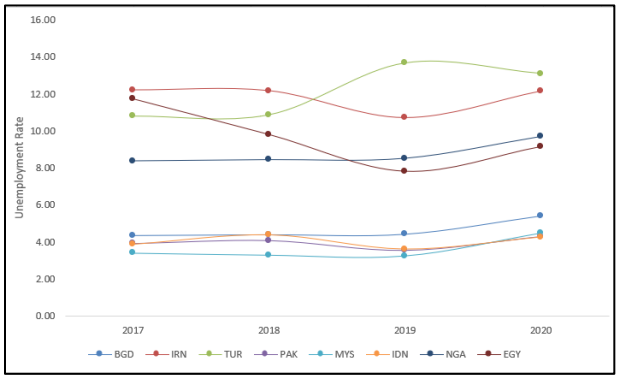
On the other hand, in Figure 2, we observe the Gross Domestic Product (GDP) growth rates and domestic savings as a percentage of GDP for the D-8 countries in 2020 and 2021. Economic growth resumed across the board in 2021, as indicated by the upper blue diamond above the black triangle for each country. However, domestic savings for some countries also declined from 2020 to 2021 (the blue diamond shifted left of the black triangle). One possible explanation is that these countries had to accelerate their economies by investing in business activities using their domestic savings to counter the increased unemployment and economic downturn.

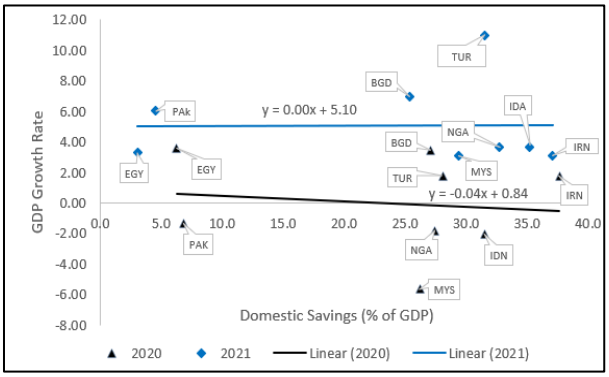
The trends and ambiguities we've observed in how domestic savings impact growth in D-8 countries after COVID-19 suggest we need to dig deeper into how savings and economic growth are linked in these developing nations. While previous studies have looked at how savings affect growth worldwide, to our best knowledge, the nuances of this link within the D-8 bloc remains unexamined, even though these countries were hit hard by the pandemic's economic downturn.

The sudden jumps in unemployment followed by recovery in output the next year, along with different paths in domestic savings, make us wonder if and how savings can help make this bloc economically stronger in the long term.

Because saving and investing are crucial for strong growth in developing countries, it's important to carefully study the connections, especially for the D-8 countries. Quantitative analysis can show us if low domestic savings are holding back growth and jobs in any of these countries, and if working together on fiscal policies could help them bounce back better. By studying these connections with specific models for the D-8, we can give policymakers solid information on other ways to boost productivity and create jobs after the pandemic, while also learning more about how these things work within this group of cooperating nations.

Figure – 1 & 2: 1. Unemployment rate trend, and 2. Growth-savings causality





2. Objective of the Research

The study is primarily conducted to examine the causal linkage between savings and the economic growth of D-8 countries. To achieve this general objective, the study has defined some specific objectives as follows.

- To identify the existence and the causal direction in D-8 countries.
- To assess any country-specific long-run causation.

The first specific objective is to figure out if and how savings and growth influence each other in the short and long term within the group. The idea is that when the economy grows, people might save more because they're earning more, and when people save more, it can lead to more investment and economic growth. By studying whether one leads to the other or if they both affect each other, we can learn things that will help policymakers make better decisions. On the other hand, the second objective is to find out the specific long-term balance between savings and income levels in each country. This will show us how savings and growth work together over time in each D-8 nation. Knowing if there's a stable connection between savings and income in each country will help us understand what policies might be needed. Some countries that aren't reliant on outside help might be able to take risks and invest their savings in new projects, while others might need help from outside to grow.

3. Review of Existing Researches

What does make a country grow faster or slower? – is a question studied over hundreds of years. The most basic growth model states that the accretion of additional capital and labor and enhancement of their efficiency and productivity increase the level of output which ultimately lead to the change the rate of output over time and thus the economic growth. A well-known early economic growth model was introduced independently by two economists, (Harrod, 1939) and (Domar, 1946), later which became known as Harrold-Domar (H-D) growth model. According to H-D model,

$$g_Y = \frac{s}{v} - d$$

Here, economic growth (g_y) is directly related to savings (s) in inverse proportional to the productivity of capital, v, with some adjustment for capital depreciation, d. This theory stipulates that savings is sufficient to lead sustainable economic growth, implying those countries with more savings and productive investment experience higher economic growth. On the other hand, renowned economist, (Solow, 1956) introduced a new model of economic growth by replacing the fixed-coefficient production function of Harrold-Domar with a more flexible production function which allows substitution between factors of production, labor, and capital. Unlike in H-D model, In Solow model, all variables are expressed on a per-worker basis, with output per worker denoted as *y* and capital per worker as *k*. According to Solow model, output per worker (y) is the function of capital per worker (k), i.e.,

$$y = A * k_0^{\propto}$$

Moreover, Solow model proposed capital-output and capital-labor ratios which are no longer fixed but vary with relation endowment of capital and labor. Thus, the iso-quants are curved shaped in Solow model which can exhibit either constant return to scale for both factors of production or diminishing returns to scale for each factor of production, based on the assumption made during the production process. The Solow model implies that countries out of steady state, poor countries, are supposed to grow fast compared to countries in steady state, the rich as an increase in income tends to slow the growth rate, and that the incomes of poor countries can begin to converge to those of the rich countries. But in the real world, no unconditional convergence is observed. Only when the differences in savings rates, population growth and the efficiency of production function are considered then the poor countries show convergence. Convergence depends on some conditions.

However, there is a large amount of empirical research already done on the causal relationship between savings and economic growth. Based on the causality, these researches can be divided into four groups: 1. savings promote growth, 2. growth boosts savings, 3. causation runs bidirectionally, and 4. causation via another economic activity.

A large school of researchers concluded that a causal association runs from savings to economic growth. In 1999, (Saltz, 1999) observed unidirectional causal association from savings to GDP growth based on an analysis of 17 third world countries. A few years later, (Alguacil, et al., 2004)

concluded a similar causality in Mexico using Granger non-causality test procedure developed by (Toda & Yamamoto, 1995) and (Dolado & Lütkepohl, 1996), indicating that higher savings contributed to increased economic growth in Mexico. In contrast, (Irandoust & Ericsson, 2005) explored the relationship between foreign aid, savings, and economic growth in African countries from 1965 to 2000 using panel unit root and cointegration techniques. Their findings revealed that both foreign aid and savings had a direct positive impact on economic growth across all the countries included in their sample. In China, (Lean & Song, 2009) investigated the relationship between the domestic savings growth and economic growth using province specific and whole country data from 1955 to 2004. The study's findings indicated the presence of bidirectional causality between variables in short-run and a unidirectional causality from savings to growth in long-run. But province specific result revealed a different statistical relationship between growth and savings. The same result was observed in a small open economy, Nigeria. Using the same Granger non-causality test procedure in Nigeria, (Oladipo, 2010) found long-run equilibrium association between savings and economic growth and unidirectional causality from savings to economic growth. In the same year, a panel data analysis using Classical Pooled Regression model for a sample of Central and East European countries revealed a significant positive correlation effect of domestic savings rate on the economic growth (Ciftcioglu & Begovic, 2010). Later, (Jagadeesh, 2015) applied the Harrold-Domar growth model to the Diamond-rich country Botswana economy to test whether savings was one of the key determinants of economic growth using Auto Regressive Distributed Lagged (ARDL) and Dynamic Ordinary Least Square (DOLS) model. The findings supported the H-M model that higher savings accelerated the Botswana's economic growth.

In contrast to the previous findings, another set of researchers discovered evidence supporting the opposite causal relationship between savings and economic growth. (Sinha & Sinha, 1998) studied the relationship between savings (private and public) and economic growth in Mexico and indicated long run relationship between private saving and GDP. Moreover, the causality runs unidirectionally from the GDP growth to savings. So, the generally accepted wisdom that savings causes growth seemed to be wrong in at least in Mexico. In six African countries, (Anoruo & Ahmad, 2001) also found long-run link between economic growth and savings growth, and unidirectional causality from economic growth to savings growth. Another study on African countries also revealed the similar kind of conclusion. The causality between growth to savings (unidirectional), growth to domestic investment (bi-directional), and domestic investment to savings (bi-directional) were found in 16 sub-Saharan African countries employing VAR estimation and granger causality test on data over the period of 1981-2011. Furthermore, (Abu & Karim, 2016) described the percentage of variance of one variable explainable by others and the effect of shocks of one variable on others by Variance Decomposition analysis and Impulse Response Function.

A third group of researchers noted bidirectional causality which is widely known as virtuous cycle. (Romm, 2005) claimed a virtuous cycle between saving and economic growth using Johansen

Vector Error Correction Model (VECM) on sample data over the period 1946-1992 in South Africa. The author stated that growth encouraged savings which later promote growth, but the effect of saving on economic growth might be direct or indirect vis private investment. Later, the effect of total and private savings on economic growth of Bangladesh was studied by (Agrawal & Sahoo, 2009). The authors found that the public saving rate affects private savings, GDP growth rate, dependency ratio, interest rate, and bank density, which collectively determine total savings. Moreover, bi-directional connection is observed between economic growth and savings which is further validated by the Forecast Error Variance Decomposition analysis. In the very recent year, (Bhat, et al., 2021) examined the impact of savings on India's economic growth using data spanning from 1960 to 2019 and econometrics tools – unit root, co-integration and granger causality test. The authors concluded a bi-directional connection between saving and economic growth in India implying that higher economic growth promote higher savings tendencies among people and higher savings later results in higher economic growth.

The last group of researchers didn't observe any direct causation between savings and growth, rather the causation existed via another economic activity. (Li, et al., 2012) stated that the Chain's demographic structure i.e., the aging population China motivated to save and invest more which ultimately fostered the economic growth of China. Here, the savings rate became an endogenous variable rather an exogenous variable to determine the growth. Similarly, change in real income in Turkish economy was led by domestic savings and foreign direct investments in the long run, but causation only established from FDI to domestic savings in short run, according to (Taspinar, 2014). Likewise, a long run causality between savings and growth but, no short run causality between those, observed in India during 1950- 2012 by (Patra, et al., 2017). They claimed that domestic investment financed by the domestic savings promoted income which ultimately increased the economic growth.

While the previous paragraph summarize four main groups of findings in the extensive literature examining nexus between savings and growth—including evidence on uni-directional causality from both directions, bi-directional causality, and indirect effects via channels like investment—a research gap is obvious regarding dedicated analyses focused on developing economies that are members of the D-8 cooperation forum. Even though there's evidence from other countries and groups, like Mexico, Nigeria, and sub-Saharan African states, there hasn't been much focus on understanding how savings and growth work together in countries like Bangladesh, Egypt, Indonesia, and others in the D-8 group. Since these countries are all emerging economies and vulnerable to exogenous shocks, it's important to study how savings and growth interact in them to help create policies that make their economies stronger. Existing research lacks detailed statistical tests and models to understand the direction of causality and the specific connections between domestic savings and GDP growth rates in these countries. This gap is why this study aims to explore how savings can help these developing economies grow steadily, even during times of stability or crisis.

4. Data

This paper examines the savings-growth nexus specifically in the context of the Developing-8 group of countries. It employs a quantitative, empirical analysis utilizing longitudinal secondary data on economic indicators like GDP, gross domestic savings (GDS), gross capital formation (GCF) and labor force (Lab) etc. spanning 1993-2020 and covering the D-8 members.

The methodology follows a panel data analytical approach, with the panel comprising the 8 countries over the time-series available. The panel data comprise of a sample of 224 country-year data. GDP usually measures the economic activities in an economy. A high GDP conventionally is used as a primary indicator to gauge its economic growth. On the other hand, GDS are here used as proxy of change in capital in the country. A country with higher savings generally is assumed to have higher capital invested in productive sectors. But empirically it is observed that this is not true for all the countries. So, the paper uses GCF as well. GCF implies how much capital is invested in the capital. It is also known as gross domestic investment. Finally, labor force indicates the supply of labor in the economy and includes those who are between 15 to 64 years old. All of these data collected from the World Bank DataBank (https://databank.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG/1ff4a498/Popular-Indicators#). After assembling this panel dataset, the study applies econometric analytical techniques like unit root tests, cointegration tests, vector error correction models, variance decomposition etc. to model and infer causality.

Therefore, this study can be categorized as empirical quantitative research making use of longitudinal panel data and modern time-series econometrics to analyze causal linkages between domestic savings and economic growth in the developing economies constituting the D-8 bloc. The use of nationally aggregative secondary data over 28 years classifies it as a longitudinal macro-quantitative econometric study elucidating savings-growth mechanisms for a specific country grouping.

5. Growth Model

While Harrold-Domar uses savings as the determining factor of economic growth, the Solow growth model uses capital as well as the labor to determine the economic growth of a country. The Solow model assumes the way to change capital is the change in savings adjusted for any depreciation. Additionally, this model uses all the variable on a per worker basis. This paper grabs the concept of Solow growth model but uses both savings and capital formation as a proxy for capital. Moreover, labor forces are used to observe the impact of labor on economic growth. As a result, the following model is used to discover the determinant of economic growth of D-8 countries:

$$GDP = \int (GDS, GCF, Lab)$$

Here, GDP = Gross Domestic Product, GDS = Gross Domestic Savings, GCF = Gross Capital Formation, and Lab = Labor Force. But to make the data more fit for the analysis by normalizing the data, the paper utilizes the logarithmic form. So, the model becomes:

$$LGDP = \alpha + \beta * LGDS + \delta * LGCF + \gamma * LLAB + \varepsilon$$

But before moving for causal analysis, the paper uses various robustness checks to eliminate any chance of model misspecification. This paper employs a normality test to reject any non-linearity in the dataset. The Augmented Dickey-Fuller Panel Unit Root Test checks the stationarity of the dataset and determines the order of the integration. As the panel time series data are highly sensitive to the lag length, optimum lag length is determined by observing multiple criteria discussed later. Finally, correlation matrix is used to check the multicollinearity problem in the data set.

After passing the all the robustness checks, the panel cointegration test (Kao Cointegration Test and Johansen Fisher-Cointegration Test) is performed to investigate any long-run relationship among GDP, GDS, GCF and Lab. Later, Cointegrating regression, namely Fully Modified OLS and Dynamic OLS, the cointegrating vectors or coefficients were estimated. Furthermore, Vector Error Correction Model (VECM)- based granger causality is utilized to determine the direction of the causality between the variables of interest. Later, the shock reaction of dependent variable is observed by Impulse Response functions. Finally, variance decomposition explains the reasons for any variability in dependent variable.

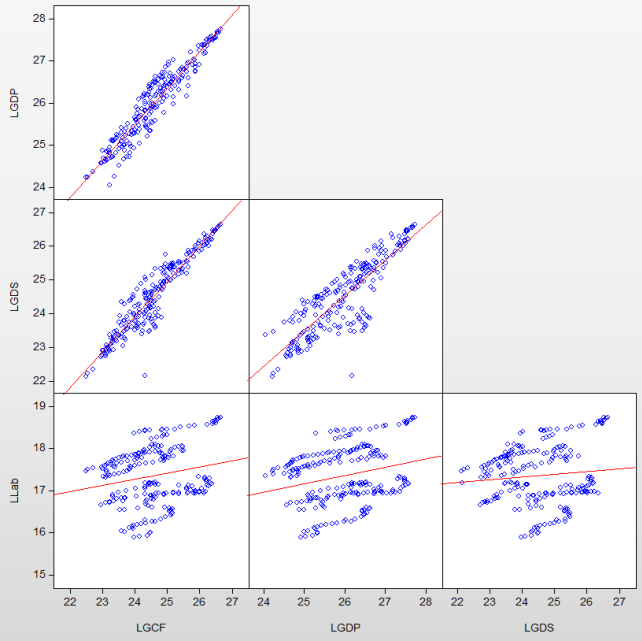
The econometric techniques employed for modeling the link between domestic savings and economic growth in D-8 countries are backed by solid research. Methods like panel unit root tests, cointegration analysis, Granger causality, and impulse response functions have been proven effective in previous studies. For example, (Kao, 1999) and (Pedroni, 2004)have shown that panel cointegration tests can reveal long-term relationships. Granger causality testing, which helps determine predictive relationships, has both theoretical and empirical support in time-series research (Granger, 1969). Impulse response analysis, commonly used in macroeconomics, is formally based on the vector auto-regression framework outlined by (Sims, 1980). By building our models on well-established methods from the literature, we ensure the credibility of our research framework.

6. Data Robustness Check

The robustness checks in this section we perform to ensure the accuracy of our statistical methods, like visual inspections for normality, Augmented Dickey-Fuller panel unit root tests to assess the order of integration, choosing the best lag length based on information criteria, and screening for multicollinearity using correlation matrices, are all supported by previous research (Anscombe, 1973), (Maddala, 1999) etc. These tests help us make sure that the assumptions we're making in our time series models are correct and that we're using the right parameters. This ensures that our models are reliable and that the results we find about the relationship between savings and growth in the D-8 countries are credible. The tests we run validate our econometric approach, following statistical standards and mathematical principles outlined in well-known references. Therefore, by conducting thorough diagnostic tests, we ensure that our research methods are robust and suitable for our study objectives.

Any non-linearity in the dataset may lead to a spurious conclusion. So, this paper uses a scatter plot to examine the data non-linearity (Figure - 3). Three out of six boxes perfectly confirm the data linearity. Although the remaining three at the bottom of the figure also do not present any clear linear relationship, the absence of any curvature pattern supports the linearity of the dataset.

Figure – 3: Data Linearity Check



To ascertain the order of integration, the ADF-Fisher unit root test using individual intercept is employed (Table -1). All D-8 combined variable is non-stationary at level but, those become stationary at first difference, implying the order of integration I (1). These outcomes provide the justification for using panel cointegration test to investigate the long-run association. However, the individual country unit root shows a mixed order of cointegration, but mostly in I (1). The author assumes that the reason for such mixed order of integration in country-level is due to the small sample size for each country.

Table -1: Unit Root Test

Variable		**D-8**	**BGD**	**EGY**	**IRN**	**NGA**	**MYS**	**IDN**	**PAK**	**TUR**
LGDP	*level*	9.24	0.12	4.96	0.00	0.01	0.46	3.09	0.47	0.13
	1st Diff.	57.68***	6.49**	3.45	5.48*	6.54**	9.21***	2.54***	5.55*	18.42***
LGDS	*level*	14.89	0.37	8.61**	0.01	1.54	0.18	0.24	3.62	0.32
	1st Diff.	69.34***	10.84***		8.79**	7.62**	12.15***	2.29***	23.24***	2.77*

LGCF	*level*	15.22	0.18	4.20	0.16	2.23	1.07	4.59*	1.61	1.17
	1st Diff.	79.71***	7.01**	7.0**	14.88***	6.43**	11.1***		9.77***	21.69***
LLAB	*level*	19.84	4.47	0.00	0.26	1.14	6.04**	7.02**	0.00	0.90
	1st Diff.	49.91**	0.01*	5.62*	3.33*	7.41**			10.67***	4.57*

As time (years) is inseparably involved in this research, so any suboptimal lag length used in integration test will lead to incorrect policy suggestions. So, here the lag length is observed under five models (LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, and HQ: Hannan-Quinn information criterion). But the lag which is observed the maximum times is chosen as the optimal lag length (Table – 2).

Table -2: Optimal Lag Length Selection

Criteria	**D-8**	**BGD**	**EGY**	**IRN**	**NGA**	**MYS**	**IDN**	**PAK**	**TUR**
LR	3	4	1	4	1	4	3	1	3
FPE	3	4	4	4	4	4	4	1	3
AIC	3	4	4	4	4	4	4	4	4
SC	2	4	2	4	4	4	1	2	1
HQ	2	4	4	4	4	4	4	4	4
Optimal	3	4	4	4	4	4	4	1	3

Finally, correlation matrix help find out any multicollinearity problem among the independent variables. But relatively reasonable and insignificant correlation among independent variables reject the problem of multicollinearity (Table -3).

Table – 3: Multicollinearity Check

	LGCF	LGDS	LLAB
LGCF	1	0.74068	0.20692
LGDS	0.74068	1	0.10248
LLAB	0.20692	0.10248	1

7. Empirical Results and Discussion

The summary statistics table - 4 presents descriptive statistics for the key variables examined in the study - log GDP, log domestic savings, log labor force and log capital formation for the Developing-8 countries over the period of analysis. As seen, the sample contains 224 annual observations for each variable. The mean GDP and capital formation are similar around 25, savings slightly lower at 24.5, while mean labor force is 17.3. Standard deviations range from 0.68 for

labor to 1.08 for savings. The median, minimum and maximum follow plausible ranges given the transforming of variables into natural logarithmic scale. The descriptive statistics indicate sufficient variation across countries and years, lending credibility for subsequent regression modeling to study interrelationships between these indicators of economic performance for the D-8 bloc. The statistics vet the integrity of the assembled panel data before employing estimations. With means and dispersions per expectations, the set provides a sound basis for testing savings-growth linkages controlling for capital investments and employment as conceptualized.

Table -4 : Descriptive Statistics

Stats	LGDP	LGDS	LLab	LGCF
N	224	224	224	224
Mean	25.99782	24.52724	17.35321	24.5966
SD	0.882244	1.079309	0.68316	0.966562
Median	26.0325	24.48977	17.31808	24.52391
Min	24.04658	22.12918	15.89007	22.50705
Max	27.74355	26.64276	18.73154	26.65825

However, Kao cointegration test and Johansen-Fisher cointegration test are employed to investigate the long-run association among the variables (Table- 5). The optimal lag length determined previously is used in both tests. In the combined D-8 country analysis, ADF t-statistics under the Kao cointegration test -3.02 and statistically significant at 1% level. So, we can undoubtedly reject the null hypothesis (H0: No cointegration among the variables) at 1% significance level and accept the alternative (H1 : There is cointegration among the variables). This confirms that GDP, GDS, GCF and Lab have a long-run relationship. On the other hand, country-specific cointegration analysis shows that only half of the countries (BGD, EGY, MYS, and TUR) have long-run association among the variables under the Kao test. Furthermore, the above conclusion regarding the combined D-8 country is validated by the significant Trace and Max-eigen statistics under the Johansen-Fisher (J-F) cointegration test. The significant Johansen-Fisher cointegration test failed to accept the null hypothesis of 'no cointegration'. So, the J-F test reinforces the long-run equilibrium relationship among the variables. But now IDN and PAK in addition to BGD, EGY, and TUR are also showing long-run association among the variables under Trace statistics. However, only BGD, EGY, and IDN hold the long-run association under Max-eigen statistics. Above all, it is observed that only combined D-8 country, BGD and EGY constantly reject the null hypothesis under all the statistics and remaining other countries show a flipping behavior in different models. So, the author reasonably concludes that the variables, GDP, GDS, GCF and Lab, are associated in long-run only in combined D-8 country, BGD and EGY. Thus, further analysis will be performed on these countries.

Table – 5: Cointegration Test Output

Kao Cointegration Test	Johansen Fisher Cointegration Test

	ADF t-Statistic	*Trace statistics*	*Max-eigen statistics*
D-8	-3.02***	283.7***	193.8***
BGD	-2.65***	49.04***	39.49***
EGY	-2.06**	17.18***	6.44**
IRN	-1.28	1.39	1.39
NGA	-0.85	1.39	1.39
MYS	-2.05**	1.39	1.39
IDN	-1.57	9.02**	9.45***
PAK	-1.69	15.3***	5.49
TUR	-1.9**	11.35***	4.05

The existence of long-run association tells neither the magnitude nor the direction of the association. But once the association is confirmed, the magnitude can be found by run cointegrating regressions (Table -6): Fully Modified Ordinary Least Square (FMOLS) model and Dynamic Ordinary Least Square (DOLS) model.

Table -6: Cointegrating Regression Output

		FMOLS			**DOLS**		
		LGDS	LGCF	LLAB	LGDS	LGCF	LLAB
D-8	Coefficient	0.287	0.545	0.598	0.546	0.340	0.340
	P-Value	0.000	0.000	0.000	0.002	0.073	0.101
BGD	Coefficient	-0.489	1.288	0.340	-0.556	1.367	0.317
	P-Value	0.017	0.000	0.000	0.003	0.000	0.000
EGY	Coefficient	-0.164	0.990	0.765	0.105	1.021	-0.069
	P-Value	0.018	0.000	0.052	0.510	0.000	0.494

In the case of D-8 countries as whole, all the three independent variables, GDS, GCF, and LAB, show positive and statistically significant coefficients at different level of significance under both cointegrating regressions. Here, 1 percentage point (pp) increase in GDS, GCF and LAB respectively leads to approximate 0.29pp, 0.55pp and 0.60pp increase in GDP in long-run, estimated by FMOLS. Despite having changes in coefficient magnitude, DOLS model similarly estimates positive and significant long-run association. These results imply that savings, capital, and labor force contribute to the D-8 countries' GDP in long run.

Moving to the country-specific analysis, both regression models confirm the significant role of savings, capital, and labor force in BGD GDP. In Bangladesh, savings plays a negative role whereas capital and labor have positive role in GDP. There can be many possible explanations of such an outcome. First, in Bangladesh a major percentage of population is poor, and they do not have access to formal financial institutions due to lack of creditworthiness. As a result, the savings of these large groups remain in the form of cash or of precious metal like gold. So, any savings made by this group never goes to the productive sector/investment. Second, the life of Bangladeshi

people is highly unsecured and unstable due to natural calamities, political unrest, improper social safety benefit etc. So, sometimes people must use their savings to live their life. That is why many people keep their money idle instead of productive investment. However, BDG overcomes the negative effect of savings by efficiently employing the capital and labor force. The large effect of capital with a handsome effect of labor force renationalizes the surprising growth of BGD economy. Similarly, the capital plays a significant positive role in the Egypt economic growth. Under both models, on average 1pp capital increase led to 1pp GDP. However, as the savings and labor force coefficients do not show constant behavior under both models, their long-run effect on EGY GDP cannot be determined precisely.

While long-run co-integration remains the priority, short-run tests add richness regarding early signals, delays in transmission of impacts, and intertemporal mechanisms connecting savings and growth in D-8 countries. The additional techniques help characterize the relationship's evolution so policy makers can derive apt tools for targeted time horizons, notwithstanding the primacy accorded to long-term equilibrium associations quantifying enduring effects.

After establishing the long-run association and the magnitude of the association, yet couple of questions remain unanswered: Is there any short-run causality among the variables in D-8 countries? If yes, in which direction does the causality run? To answer these questions, a VECM-based Granger Causality test is performed.

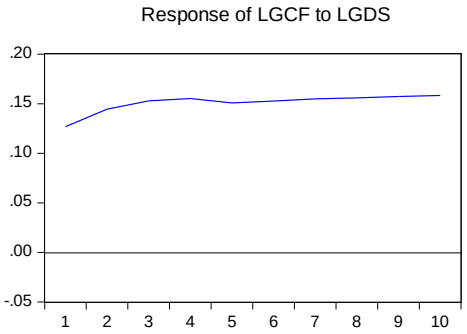
Table – 7: Causality Test

		Independent Variable			
		D(LGDP)	D(LGDS)	D(LGCF)	D(LLAB)
Dependent Variable	D(LGDP)		0.0467**	0.2218	0.5705
	D(LGDS)	0.0722*		0.4043	0.5956
	D(LGCF)	0.5005	0.7338		0.9399
	D(LLAB)	0.9196	0.9457	0.6452	

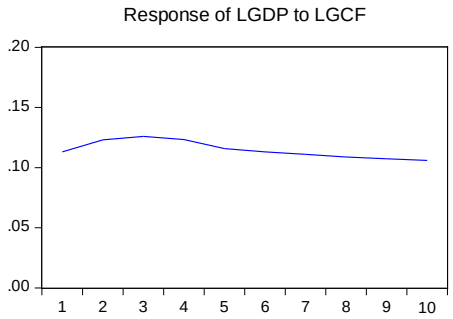
In Table -7, the short-run causality runs bidirectionally from savings to GDP, implying that in short-run, GDP boosts savings and savings promotes GDP in D-8 countries. However, no other short-run causal relationship is established. The possible explanation can be as follows: short-run savings takes time to accumulate and to be turned into capital. Thus, capital is formed over time, and in the long run, capital formation accelerated economic activities which subsequently employ more labor force. That is why capital and labor force exhibit only long-run causality in D-8 countries. However, to access the merit of the above possible explanation, Impulse Response (IR) function is used. IR function help determine the persistence of the effect.

Figure – 4 & 5: Impulse Response Functions

Response to Generalized One S.D. Innovations



Response to Generalized One S.D. Innovations



Here, the 'response of capital to savings' graph (Figure - 4) illustrates that as savings changes (shock) over time, it stimulates capital formation in long run. Similarly, as capital starts to form in the long-run, it causes economic activities, thus promotes economic growth, indicated by the 'responses of GDP to capital' graph (Figure - 5). These rationalize the underlining reason for the long-run association between capital, labor force and economic growth.

Now to have a forward look, the paper decomposes the variance of GDP and GCF to measure the explanatory power of GDS on future GDP, GDS on future GCF, GCF on future LAB, GCF on future GDP, and GDP on future GDS on annual basis for the next 10 years.

Table – 8: Decomposition of variances

Variance of	LGDP	LGCF	LLAB	LGDP	LGDS
Explained by	LGDS	LGDS	LGCF	LGCF	LGDP
1	0.00	1.07	2.44	0.00	55.28410
2	0.00	0.97	3.20	1.02	65.92818
3	0.84	2.09	4.06	1.96	66.48953
4	1.24	3.13	5.11	2.70	66.14144
5	1.43	3.85	6.22	3.42	66.61615
6	1.65	4.60	7.36	4.12	66.68093
7	1.82	5.30	8.49	4.82	66.74138
8	1.97	5.95	9.58	5.49	66.85066
9	2.11	6.57	10.60	6.13	66.90511
10	2.24	7.15	11.56	6.73	66.95460

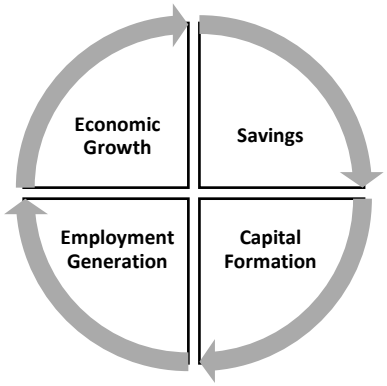
The variance decomposition table -8 reveals that savings have explanatory power over the future GDP at a very low rate starting from 0.00% to 2.24% in the 10th year. But it has a relatively higher explanatory power over capital formation (from 1.07% to 7.15%). This means that overtime savings will turn into capital. And this capital generates employment opportunities, indicated by its increasing explanatory power on labor force from 2.44% to 11.56%. These vibrant economies with large capital formation, as a result, start to bring D-8 countries economic wellbeing over long-run, displayed by the increasing explanatory power from 0.00% to 6.73%. Finally, economic

growth will allow people to save more thus savings is highly explained by the GDP. This creates a virtuous cycle among the variables in D-8 countries.

Overall, the finding that GDP, savings, capital formation and labor are cointegrated only for the D-8 bloc combined but not individually across most member states intuitively owes to the aggregation smoothing out country-specific variations. With idiosyncratic shocks offsetting each other only the common long-run equilibriums emerge at the aggregate level, consistent with economic integration principles. Savings and investment deficits in one economy are counterpoised by opposing surpluses elsewhere wash out. Secondly, the short-run bidirectional Granger causality specifically between savings and growth aligns with the Permanent Income Hypothesis whereby GDP expansions raise incomes permitting higher savings out of marginal propensity, while greater savings equally spur productive investments underpinning growth. This intuitive alternating sequence is consistent with emerging pro-cyclical mechanisms.

However, H-D economic growth model emphasizes only the role of savings in economic development of a country which seems partly applicable for D-8 countries as savings as well as capital formation and labor have a significant role in these countries. On the other side, Solow growth model highlights both the savings as well as labor for the economic growth which is consistent of this paper's findings. But there is also little difference in the interpretations of Solow growth model and the empirical findings in the D-8 countries. The Solow model stipulates the unidirectional causalities run from savings (or capital) to growth and labor to growth. But the paper concludes no clear-cut causality from the short-term period to the long-run period, rather suggest a 'positive feedback loop', widely known as 'The virtuous cycle'.

Figure – 6: The Virtuous Cycle in D-8 countries



This cycle presumes the beginning is from either economic growth or savings. It cannot be surely stated: GDP caused Savings or savings promoted economic growth. So, the debate remains open in D-8 countries: "Growth or Savings first?" like the question- "egg or chicken first?". However, the development story in D-8 countries can be explained this way: once savings starts to accumulate and result in capital investment, more labors are employed, and economic activities are boomed. As a result, the economic growth is escalated, and thus the savings get boosted. So,

although economic growth and savings are associated in the short-run, savings have also a long-run association with economic growth of D-8 countries through capital and labor force. On the other hand, country like BGD and EGY individually failed to show such cycle and most of their growth comes from the long-run contribution of capital and labor force. These findings are also consistent with these countries' high reliance on foreign debt and investment for economic growth.

Notably, the absence of uniform long-run cointegration between savings and growth across D-8 members contradicts (Lean & Song, 2009) who found unambiguous cointegration for Chinese provinces. However, the short-run bidirectional causality matches their provincial-level findings. Our results suggest a decoupling between long-term and short-term savings-growth linkages which previous studies assuming either unambiguous cointegration or lack thereof fail to capture. Additionally, the identified virtuous cycle where savings and growth perpetually stimulate each other resembles mechanisms reported for India (Bhat, et al., 2021), South Africa (Romm, 2005), East Asia (Agrawal, 2001) and Bangladesh (Agrawal & Sahoo, 2009). Our D-8 findings mirror these bidirectional feedback loops driving mutual expansion found in individual developing economies, contrasting unidirectional causality claims in earlier works.

8. Conclusion

This study set out to investigate the causal savings-growth nexus in Developing-8 countries - both at an aggregate level and individually - to inform appropriate policy interventions for these emerging economies. Employing cointegration tests and Granger causality analysis on GDP, savings, capital formation and employment data spanning 1993-2020, key conclusions are drawn: GDP, savings, capital and labor are cointegrated only for the D-8 bloc combined reflecting common long-run equilibriums absent at individual country levels; Short-run savings and growth reciprocally Granger cause each other - a virtuous cycle also explaining long-term linkage running through capital and employment; and Capital and labor augment production only over protracted periods as indicated by impulse responses.

These results underline suitability of coordinated D-8 stimulus initiatives leveraging savings and investments rather than narrowly country-specific measures that ignore externalities on neighbors. The findings militate against models and assumptions positing unambiguous unidirectional causalities between savings and growth, underscoring a nuanced interdependent relationship. As data emerges post-pandemic, reevaluating causal mechanisms and lead/lag effects between key variables can validate enduring efficacy of D-8 policy mixes for members to achieve resilient and equitable growth.

References

Abu, N. & Karim, M. Z. A., 2016. The Relationships Between Foreign Direct Investment, Domestic Savings, Domestic Investment, and Economic Growth: The Case of Sub-Saharan Africa. *Society and Economy,* 38(2), pp. 193-217.

Aghion, P., Comin, D., Howitt, P. & Tecu, I., 2016. When Does Domestic Savings Matter for Economic Growth?. *IMF Economic Review,* 64(3), pp. 381-407.

Agrawal, P., 2001. The relation between savings and growth: cointegration and causality evidence from Asia. *Applied Economics,* Volume 33, pp. 499-513.

Agrawal, P. & Sahoo, P., 2009. Savings and Growth in Bangladesh. *The Journal of Developing Areas,* 42(2), pp. 89-110.

Alguacil, M., Cuadros, A. & Orts, V., 2004. Does Saving Really Matter for Growth? Mexico (1970–2000). *Journal of International Development,* Volume 16, pp. 281-290.

Anoruo, E. & Ahmad, Y., 2001. *Causal Relationship between Domestic Savings and Economic Growth: Evidence from Seven African Countries,* s.l.: Blackwell Publishers.

Anscombe, F. J., 1973. Graphs in statistical analysis. *The American Statistician,* 27(1), p. 17–21.

Barro, R. J., 1991. Economic growth in a cross section of countries. *The Quarterly Journal of Economics,* 106(2), p. 407–443.

Bhat, T. A., Lone, T. A. & Dar, K. H., 2021. The co-integration and causal relationship between saving and economic growth in India. *Theoretical and Applied Economics,* XXVIII (1(626)), pp. 239-246.

Ciftcioglu, S. & Begovic, N., 2010. Are domestic savings and economic growth correlated? Evidence from a sample of Central and East European countries. *Problems and Perspectives in Management,* 8(3), pp. 30-35.

De Long, J. B. S. L. H., 1991. Equipment investment and economic growth. *The Quarterly Journal of Economics,* 106(2), p. 445–502.

Dolado, J. J. & Lütkepohl, H., 1996. Making wald tests work for cointegrated VAR systems. *Econometric,* Volume 15, pp. 369-386.

Domar, E. D., 1946. Expansion, Rate of Growth, and Employment. *Econometrica,* pp. 137-47.

Elryah, Y. & Qian, N. Q., 2015. On the causality relationship of economic growth and domestic savings in the ASEAN economies: A co-integration analysis. *i-manager's Journal on Management,* 9(4).

Farrar, D. E. G. R. R., 1967. Multicollinearity in regression analysis: the problem revisited. *The Review of Economic and Statistics,* p. 92–107.

Freeman, D. G., 2000. Regional tests of Okun's law. *International Advances in Economic Research,* 6(3), p. 557–570.

Granger, C. W. J., 1969. Investigating causal relations by econometric models and cross-spectral methods. *Econometrica: Journal of the Econometric Society,* p. 424–438.

Harrod, R. F., 1939. An Essay in Dynamic Theory. *The Economic Journal*, 49(193), pp. 14-33.

Irandoust, M. & Ericsson, J., 2005. Foreign aid, domestic savings, and growth in LDCs: An application of likelihood-based panel cointegration. *Economic Modelling*, Volume 22, pp. 616-627.

Jagadeesh, D., 2015. The Impact of Savings in Economic Growth: An Empirical Study Based on Botswana. *International Journal of Research in Business Studies and Management,* 2(9), pp. 10-21.

Kao, C., 1999. Spurious regression and residual-based tests for cointegration in panel data. *Journal of Econometrics,* 90(1), p. 1–44.

Lean, H. H. & Song, Y., 2009. The domestic savings and economic growth relationship in China. *Journal of Chinese Economic and Foreign Trade Studies,* 2(1), pp. 5-17.

Levine, R. R. D., 1992. A sensitivity analysis of cross-country growth regressions. *The American Economic Review,* p. 942–963.

Li, X., Li, Z. & Chan, M.-W. L., 2012. Demographic Change, Savings, Investment, and Economic Growth: A Case from China. *The Chinese Economy,* 45(2), pp. 5-20.

Maddala, G. S. W. S., 1999. A comparative study of unit root tests with panel data and a new simple test. *Oxford Bulletin of Economics and Statistics,* 61(S1), p. 631–652.

Odedokun, M. O., 1996. Alternative econometric approaches for analysing the role of the financial sector in economic growth: Time-series evidence from LDCs. *Journal of Development Economics,* 50(1), p. 119–146.

Okun, A. M., 1963. Potential GNP: its measurement and significance. *Cowles Foundation for Research in Economics at Yale University.*

Oladipo, O. S., 2010. Does Saving Really Matter for Growth in Developing Coiuntries? The Case of a Small Open Economy. *Internationa Business and Economics Research Journal,* 9(4), pp. 87-94.

Patra, S. K., Murthy, D. S., Kuruva, M. B. & Mohanty, A., 2017. Revisiting the causal nexus between savings and economic growth in India: An empirical analysis. *EconomiA,* Volume 18, pp. 380-391.

Pedroni, P., 2004. Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric Theory,* 20(3), p. 597–625.

Romm, A. T., 2005. The Relationship between Savings and Growth in South Africa: A Time Series Analysis. *South African Journal of Economics,* June.73(2).

Rousseau, P. L. & Wachtel, P., 2000. Equity markets and growth: Cross-country evidence on timing and outcomes, 1980–1995. *Journal of Banking & Finance,* 24(12), p. 1933–1957.

Rowthorn, R., 1995. Capital formation and unemployment. *Oxford Review of Economic Policy,* 11(1), p. 26–39.

Saltz, I. S., 1999. An examination of the causal relationship between savings and growth in the third world. *Journal of Economics and Finance,* 23(1), pp. 90-98.

Sims, C. A., 1980. Macroeconomics and reality. *Econometrica: Journal of the Econometric Society,* p. 1–48.

Sinha, D. & Sinha, T., 1998. Cart before the horse? The saving–growth nexus in Mexico. *Economics Letters,* Volume 61, pp. 43-47.

Solow, R. M., 1956. A Contribution to the Theory of Economic Growth. *The Quarterly Journal of Economics,* 70(1), pp. 65-94.

Taspinar, N., 2014. Foreign Direct Investment, Domestic Savings, and Economic Growth: The Case of Turkey. *International Journal of Economic Perspectives,* 8(1), pp. 12-21.

Toda, H. Y. & Yamamoto, T., 1995. Statistical inference in vector autoregressions with possibly integrated processes. *Journal of Econometrics,* Volume 66, pp. 225-250.

Verdoorn, P. J., 2002. Factors that determine the growth of labour productivity. In Productivity growth and economic performance: Essays on Verdoorn's Law (pp. 28–36). *Springer.*