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A Causality Analysis on the Empirical Nexus between Capital Formation and Economic Growth: Evidence from India

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Abstract

The study investigates the causal relationship between gross capital formation (GCF) and gross domestic product (GDP) over the period 1970-2013 using annual data. The study has employed econometric tools to analyse the behaviour of both the series. Johansen's co-integration test has been applied to explore the long-run equilibrium relationship between GCF and GDP. The analysis reveals that GCF and GDP are cointegrated and, hence, a long-run equilibrium relationship exists between them. The vector error correction model (VECM) has shown that the lagged terms of gross capital formation influence the gross domestic product of India. The Granger causality test exhibits the presence of short-run relationship between GCF and GDP and the relationship appears to be bidirectional. It is therefore concluded that high capital formation drives economic growth and, in turn, high economic growth contributes to the accumulation of more capital assets in India.

Keywords: Gross capital formation, Gross domestic product, Investment, Economic growth, Cointegration.

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1. Introduction

Capital formation or accumulation refers to the process of amassing or stocking of assets of value, the increase in wealth or the creation of further wealth. Capital formation can be differentiated from savings because accumulation deals with the increase in stock of needed real investments and not all savings are necessarily invested. Savings are essentially the first and the foremost requirement for capital formation to take place. Only when the banking institutions channelize such mobilized savings of households and business firms for investment, capital accumulation takes place. An empirical examination of the savings and investment behaviour in the Indian economy over the period from 1950-51 to 2005-06 made by Joshi (2007) reveals that while a one per cent increase in the household financial savings rate increases the capital formation rate in the long term by 0.25 per cent.

Economic theories have shown that capital formation plays a crucial role in the models of economic growth. Keynes (1936) was the first to call attention to the existence of an independent investment decision in the economy. He observed that investment depends on the prospective marginal efficiency of capital relative to some interest rate that reflects the opportunity cost of the invested funds. After Keynes, the evolution of investment theory was linked to simple growth models. These models gave rise to the accelerator theory, which makes investment a linear function of changes in output.

Other investment theories include the neoclassical model developed by Jorgenson and Hall (1967) and the "Q" theory associated with Tobin (1969). In the Q theory of capital formation the ratio of the market value of the existing capital stock to its replacement cost is the main force driving investment and growth. Another approach dubbed as neoliberal propounded by Galbis (1979) emphasizes the importance of financial deepening and high interest rates in stimulating growth. The core argument rests on the claim that developing countries suffer from financial repression and that if these countries were liberated from their repressive conditions, this would induce savings, investment and growth.

The Harrod-Domar model describes the economic mechanism by which more investment leads to more growth. For a country to develop and grow, it must divert part of its resources from current consumption needs and invest them in capital formation. Diversion of resources from current consumption is called saving. While saving is not the only determinants of growth, the Harrod-Domar model suggests that it is an important ingredient for growth.

Its argument is that every economy must save a certain proportion of its national income if only to replace the worn-out capital goods. The model shows that growth is directly related to the saving-income ratio and inversely related capital-output ratio. Hence, considering the Harrod-Domar model as a theoretical framework, the present study aims to investigate the relationship between capital formation and economic growth of India.

2. Review of Literature

Capital formation is a key to economic growth. Some past empirical studies (Hernandez-Cata, 2000; Ndikumana, 2000; Ben-David, 1998; Collier & Gunning, 1999; Ghura & Hadji, 1996; and Khan & Reinhart, 1990) conducted in Africa, Asia and Latin America have established the critical linkage between capital formation and the rate of growth. This analogy has been supported by a number of very recent studies. The study by Athukorala and Sen (2002) is a comprehensive Indian case study of saving, investment and growth. The empirical analysis found strong support for the view that the levels of investment as well as its efficiency are the proximate causes of growth.

Calderón and Liu (2003) examine the direction of causality between financial development and economic growth of 109 developing and industrial countries from 1960 to 1994. The paper finds the following: (1) financial development generally leads to economic growth; (2) the Granger causality from financial development to economic growth and the Granger causality from economic growth to financial development coexist; (3) financial deepening contributes more to the causal relationships in the developing countries than in the industrial countries; (4) the longer the sampling duration, the larger the effect of financial development on economic growth; (5) financial deepening propels economic growth through both a more rapid capital accumulation and productivity growth, with the latter channel being the strongest.

Verma and Pahlavani (2007) estimate the interdependencies between capital formation, saving and output for Iran for the period 1960 to 2003. The analysis uses Lee and Strazicich procedure to endogenously determine that structural breaks occurred in 1979 for real output, 1983 for saving and 1977 for investment. The relationships were estimated using Johansen's full information maximum likelihood (FIML) procedure which is appropriate for estimating the effects of non-stationary variables in a simultaneous setting. The estimates indicate a Solow-style relationship where a one per cent increase in saving will be associated with a 0.55 per cent increase in the long-run equilibrium level of output. The short-run estimates show that saving has a short-run equilibrating effect on output with elasticity -0.13, which further supports the Solow model whereby changes to saving have only transitory effects on the growth in output. The other important result found that investment dynamically Granger causes output growth with a short-run elasticity of 0.17, consistent with the endogenous growth explanation. The structural change parameter estimates that the effect on the growth in output fell by around 10 per cent after 1979.

Bakare (2010), in his study, focuses on capital formation and economic growth of Nigeria by applying the Harrod-Domar model. The ordinary least square multiple regression analytical method was used to examine the relationship between capital formation and economic growth. The study tested the stationarity and cointegration of Nigeria's time series data and used an error-correction mechanism to determine the long-run relationship among the variables examined. The empirical study found that the data were stationary and cointegrated and showed that there is a significant relationship between capital formation and economic growth in Nigeria. The results supported the Harrod-Domar model which proved that the growth rate of national income will directly or positively be related to saving ratio and capital formation (i.e. the more an economy is able to save and invest out of a given GNP, the greater will be the growth of that GDP).

Mehta (2011), in his study, empirically tested the short-run and long-run relationship between capital formation and economic growth variables in India with the help of cointegration technique and vector error correction technique. The study reveals a long-run relationship between capital formation and economic growth. From the policy point of view it suggests that more thrust may be given for boosting the capital formation in the economy in order to achieve high economic growth in Indian economy.

Hussin and Saidin (2012) examine the impact of foreign direct investment (FDI), openness, and gross fixed capital formation on economic growth (GDP) over the period 1981-2008 in ASEAN-4 countries by using panel estimation models. The findings show that all variables are correlated with each other and also have a positive relationship to GDP. FDI appears to be the most efficient variable in assisting the economic growth followed by openness and gross fixed capital formation. However, the results from ordinary least squares (OLS) method shows that only gross fixed capital formation is significant to growth and contributes positively to GDP in each of the ASEAN-4 countries.

Nowbutsing (2012) discerns the short-run and long-run impacts of public, private, and foreign fixed capital formation on growth of the economy of

Mauritius using the bounds testing methodology for the period 1976-2010. In addition, a composite index is used to control for conditional factors. The index comprises measures of human capital, public infrastructure, financial development, and trade openness. As regards trade openness, difference is made between services trade and merchandise trade. Among the measures of capital formation, positive and significant effects are reported for FDI, whereby a percentage point increase in FDI contributes 0.17 per cent to long-run economic growth. Moreover, the impact of private capital formation on economic growth is positive but insignificant, and that of public capital formation is negatively insignificant. This study separately tests for accelerator, or simply, the growth effects on public, private, and foreign capital formation. And, significant accelerator effect is established only in the case of private capital formation. Finally, significant crowding-out is established from foreign to private capital formation. And, the crowding-out hypothesis also holds from foreign to public capital formation, and *vice-versa*. However, insignificant crowding-out is detected between private and public capital formation. Among the conditional factors, human capital stock, public infrastructure, financial development and trade are important contributors to economic growth.

Gangal and Gupta (2013) analyse the impact of public expenditure on economic growth of India from 1998 to 2012. This study includes annual data of total public expenditure (TPE) and gross domestic product (GDP) per capita as an indicator of economic growth. ADF unit root test, cointegration test and Granger causality test techniques have been applied. The study reveals that there is linear stationarity in both the variables that indicates the long-run equilibrium and there is a positive impact of total public expenditure on economic growth. There is a unidirectional relationship from TPE to GDP found by the Granger causality test.

Ugochukwu and Chinyere (2013) investigate the impact of capital formation on economic growth in Nigeria by employing ordinary least square (OLS) technique. To test for the properties of time series, Phillip-Perron test was used to determine the stationarity of the variables and it was discovered that gross fixed capital formation and economic growth are integrated of order zero (I(0)). Johansen cointegration test was employed to determine the order of integration while error correction model was employed to determine the speed of adjustment to equilibrium. The empirical findings suggest that capital formation has positive and significant impact on economic growth in Nigeria for the period under review.

Mehrara and Maysam (2013) investigate the causal relationship between gross domestic investment and GDP for the Middle East and North Africa

(MENA) region countries by using panel unit-root tests and panel cointegration analysis for the period 1970-2010. The results show a strong causality from economic growth to investment in these countries. Yet, investment does not have any significant effects on GDP in short- and long-run. It means that it is the GDP that drives investment in these countries, and not *vice versa*. So the findings of this paper support the point of view that it is higher economic growth that leads to higher investment.

Uneze (2013) examines the causal relationship between capital formation and economic growth in sub-Saharan African countries using panel cointegration and causality testing techniques. It is found that causality is bi-directional, suggesting that higher economic growth leads to higher capital formation and the increases in capital formation, in turn, results in higher economic growth.

Kanu and Ozurumba (2014) studied the impact of capital formation on the economic growth of Nigeria. It was ascertained that in the short run, gross fixed capital formation had no significant impact on economic growth; while in the long-run, the VAR model estimate indicates that gross fixed capital formation, total exports and the lagged values of GDP had positive long-run relationships with economic growth in Nigeria. It was also ascertained that there exists an inverse relationship between imports, total national savings and economic growth; while GDP was seen to have a unidirectional causal relationship with exports, gross fixed capital formation, imports and total national savings.

Shuaib and Dania (2015) examine the impact of capital formation on the economic development of Nigeria, using time series data from 1960 to 2013. The paper applied the Harrod-Domar model to Nigerian economic development model and tested if it has a significant relationship with the Nigerian economy. The paper explored various econometric and statistical methods to examine the relationship between capital formation and economic development. The paper tested for stationarity and conducted different diagnostic tests of Nigeria's time series data. From the empirical findings, it was discovered that there is a significant relationship between capital formation and economic development in Nigeria. The results corroborated the Harrod-Domar model which proved that the growth rate of national income will directly be related to saving ratio and capital formation, i.e., the more an economy is able to save and invest out of a given GNP, the greater will be the growth of that GDP.

Based on the review of the literature presented above, it can be concluded that empirical findings for different countries are in line with the theoretical predictions. These studies explain whether there exist a positive or negative relationship between capital formation and economic growth and also the strength of relationship, the direction of the cause-and-effect relationship etc., which have a lot of policy implications for national governments. It is pertinent to note that though a good number of research studies focused on investigating the impact of capital accumulation on economic growth in countries of Asia, Africa, America and Europe, hardly there are any significant research contributions empirically analyzing the causal relationship between capital formation and economic growth in India. Therefore, the present paper is an attempt in filling this vacuum.

3. Objectives

The main objective of this study is to explore the causal nexus between capital accumulation and economic growth in India. The specific objectives are:

- To examine the dynamics of short-term linkages between capital formation and economic growth.
- To explore the presence of long-term equilibrium relationship between capital formation and economic growth.
- To capture the linear interdependencies among the variables under study.

4. Methodology

4.1 Variables and Data

As the present study aims at exploring the causal relationship between capital accumulation and economic growth in the Indian context, capital formation and economic growth form the two main variables. Gross capital formation (GCF) and gross domestic product (GDP) are used as the proxies for capital formation and economic growth respectively. The study uses the annual data for the period from 1970 to 2013 which gives 44 annual observations. All the necessary data for the sample period are obtained from the secondary sources. Data are processed by applying econometric tools and techniques for facilitating further analysis through *EViews* econometric package.

4.2 Econometric Specification

The study has employed certain econometric tools and techniques for analysing the relationship between the variables. The study consists of the following steps:

- Test the stationary of data
- Test the co-integration between the variables
- Fitting an error correction model if cointegration is established, and
- Test the causal relationship between the variables.

4.2.1 Test of Stationarity - Unit Root Test

Empirical work based on time series data assumes that the underlying time series is stationary. Broadly speaking a data series is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed (Gujarati & Sangeetha, 2007). The present study investigates whether GDP and GCF series are stationary by applying the unit root test.

An empirical way of checking the stationarity of the time series is by applying unit root test. It has become widely popular test of stationarity over the past several years. Stationarity condition has been tested using augmented Dickey-Fuller (ADF) method. ADF test is the modified version of Dickey-Fuller (DF) test. ADF makes a parametric correction in the original DF test for higher order correlation by adding lagged difference terms of the dependent variable to the right hand side of the regression. The ADF test, in the present study, consists of estimating the following regression.

$$Yt = bo + \beta Yt_{-1} + \sum_{i=1}^{m} \mu\text{i} \ \ Yt_{-\text{i}} + e_t \text{ ----------- } (1)$$

Yt represents the series to be tested, *bo* is the intercept term, β is the coefficient of the lagged value of *Yt*, μ_1 is the parameter of the augmented lagged first difference of the dependent variable, *Yt-i* represents the i^{th} order autoregressive process, e_t is the white noise error term. The number of lagged difference terms to include is determined empirically, the idea being to include enough terms so that the error term is serially uncorrelated (Gujarathi & Sangeetha, 2007).

The stationary condition under ADF test requires that the probability (p) value is less than 1 (IpI<1). Another way of stating the same is that the computed t-value should be more negative than the critical t-value (t-statistic < critical value). The computed t-statistic will have a negative sign and large negative t-value is generally an indication of stationarity (Gujarathi & Sangeetha, 2007).

4.2.2 Johansen's Cointegration Test

If ADF test results exhibit stationarity of the time series data and all the data sets are integrated at the same order, then we have to examine whether or not there exists a long run relationship between GCF and GDP. To investigate the cointegration between GCF and GDP, Johansen's cointegration test is administered. The Johansen method of cointegration applied in the study is as the follows:

$$Xt = a + \sum_{j=1}^{p} \beta j\, Yt - j + et \text{ -------------------------- } (2)$$

where, X_t is an n×1 vector of non-stationary I(1) variables, a is an n×1 vector of constants, p is the maximum lag length, β_j is an n×n matrix of coefficient of Y and e_t is a n×1 vector of white noise terms. The coefficient value (β) indicates the degree of cointegration or relationship, while the sign preceding to the coefficient indicates whether the long-run relationship between the variables is positive or negative.

4.2.3 Vector Error Correction Model (VECM)

Johansen's cointegration test reflects only the long-term balanced relationship between gross capital formation (GCF) and gross domestic product (GDP). Of course, in the short run, there may be disequilibrium. In order to cover the shortage, correcting mechanism of short-term deviation from long-term balance could be adopted. Therefore, under the circumstances of long-term causality, short-term causalities should be further tested (Ray, 2012). Hence, the vector error correction model (VECM) is used to analyse whether error correction mechanism takes place if some disturbance comes in the equilibrium relationship. In other words, it is to measure the speed of convergence to the long-run steady state of equilibrium. Thus the Johansen co-integration equation (2) has to be turned into a vector error correction equation as follows.

$$\Delta Xt = a + \sum_{j=1}^{p-1} \Gamma j\, \Delta Xt - j + \Pi\, Xt - p + et \text{ ---------------------- } (3)$$

where, Δ is the first difference operator, Γj is $-\sum_{j=1+1}^{p} \beta j$ and Π is equal to $-1 + \sum_{j=1+1}^{p} \beta j$.

4.2.4 Granger Causality Test

Upon confirmation of variables being co-integrated, study will proceed towards testing the presence of casual relationship between GCF and GDP administering the Granger causality test. Causality is a kind of statistical feedback concept which is widely used in the building of forecasting models (Ray, 2012). The Granger causality test (1969, 1988) seeks to determine whether past values of a variable help to predict changes in another variable. The Granger causality technique measures the information given by one variable in explaining the latest value of another variable. In addition, it also says that the variable Y is Granger caused by variable X if variable X assists in predicting the value of variable Y. If this is the case, it means that the lagged values of variable X are statistically significant in explaining the variable Y (Ray, 2012).

GCF and GDP are interlinked and co-related. However, co-integration test provides no theoretical or empirical evidence that could conclusively indicate sequencing from either direction. For this reason, in the present study, Granger causality test was carried out on GCF and GDP. The causality test will see the reaction between GCF and GDP such as, if variable GCF has Granger cause to GDP and GDP also has Granger cause to GCF, it means that the value after GDP can help us to expect the value for the next period of GCF and also the value after GCF can help us to expect the value for the next period of GDP respectively. The Granger method involves the estimation of the regression equations. In this study of two-way variables (GCF and GDP), two equations are used for the Granger causality regression tests.

If the causality runs from GCF to GDP, then the Granger causality regression equation is:

$$GDPt = n + \sum_{a11} GDPt - 1 + \sum_{\beta 11} GCFt - 1 + \varepsilon_1 t \text{--------------------} \quad (4)$$

If the causality runs from GDP to GCF, then the Granger causality regression equation is:

$$GCFt = n + \sum_{a12} GCFt - 1 + \sum_{\beta 12} GDPt - 1 + \varepsilon_2 t \text{----------------------} \quad (5)$$

From the equation (4), GCF_{t-1} Granger causes GDP_t if the coefficient of the lagged values of GCF as a group β11 is significantly different from the zero based on F-test. Similarly, from equation (5), GDP_t Granger causes GCF_t if β12 is statistically significant.

5. Hypotheses

The following hypotheses are developed to meet the objectives of the present study.

H_1: GCF has a unit root
H_2: GDP has a unit root
H_3: There is no co-integration between GCF and GDP
H_4: GDP does not Granger cause GCF
H_5: GCF does not Granger cause GDP

6. Results and Discussion

In order to test whether there exists any cointegration and causality between gross domestic product (GDP) and gross capital formation (GCF), the pre-condition is that the time series data pertaining to both the variables are stationary and do not encounter unit root problem. For this purpose ADF unit root test is administered and the results are presented in Table 1.

Table 1: ADF Unit Root Test for GCF and GDP

Particulars	GCF				GDP			
	t-statistic	Critical Value		p-value	t-statistic	Critical Value		p-value
At level	-0.801132	1%	-3.605593	0.8079	-0.279363	1%	-3.605593	0.9743
		5%	-2.936942			5%	-2.936942	
		10%	-2.606857			10%	-2.606857	
At 1st difference	-3.603060	1%	-3.596616	0.0038	-4.235106	1%	-3.605593	0.0497
		5%	-2.933158			5%	-2.936942	
		10%	-2.604867			10%	-2.606857	

The results of ADF unit root test show that both variables under study, namely GDP and GCF, did not attain stationarity at level (I (0)). However, after first differencing (I (1)), both the variables become stationary. The results indicate that the null hypotheses H_1(GCF has a unit root) and H_2(GDP has a unit root) can be rejected as the t-statistic value is smaller than the ADF critical value at first difference (I (1)) at 1% level of significance. That is, in case of GCF the t-value is -3.603, which is lower than calculated ADF critical value (-3.596), at 1% level of significance. Even in respect of GDP the t-value (-4.235) is smaller to the computed ADF critical value (-3.605) at 1% level of significance. Hence, one can conclude that GDP and GCF time series are stationary at first difference (I(1)) in ADF test. In other words, GDP and GCF time series data do not have any unit root problem and hence, they can be taken up for testing the presence of cointegration.

After ensuring the stationarity of the time series data of GCF and GDP, a cointegration test is carried out by using Johansen method to identify whether there exists any long-run equilibrium relationship between the variables. The results of this test are presented in Table 2.

Table 2: Results of Johansen Cointegration Test

Cointegration Test	Level	Max. Eigen- value	t-statistic	C.V. at 5%	Prob.
Trace Test	H_0: r=0 (none)*	0.394528	25.89007	15.49471	0.0010
	H_1: r≤1 (at most 1)	0.164370	6.823655	3.841466	0.0090
Max. Eigen	H_0: r=0 (none)*	0.394528	19.06642	14.26460	0.0081
	H_1: r≤1 (at most 1)	0.164370	6.823655	3.841466	0.0090

Note: Trace test and Max-Eigen test indicate 2 cointegrating equations at the 0.05 level.
* Denotes rejection of the hypothesis at the 0.05 level.

The results of Johansen co-integration test as presented in Table 2 exhibit that the trace statistic for the calculated maximum eigenvalue (25.89007) is more than its critical value (15.49471) indicating the presence of co-integration between variables. Even the Max-Eigen test confirms the existence of long run cointegration between the two variables, since Max-Eigen t-statistic value (19.06642) is greater than its critical value (14.26460) at 5 per cent level of significance.

The results of Johansen co-integration test denote that the null hypothesis H_0: there is no cointegration between the GCF and GDP is rejected at 5 per cent level of significance. This, in turn, leads to the acceptance of alternative hypothesis that there is cointegration between GCF and GDP.

After confirming the presence of co-integrating vectors based on Johansen cointegration test results, the short run and long run interaction of the underlying variables is examined by fitting them in vector error correction model (VECM) based on Johansen cointegration methodology. The results show that a long run equilibrium relationship exists between the GDP and GCF. The estimated cointegrating coefficient for the GDP based on the first normalized eigenvector, derived from the results presented in Table 3, is as follows:

$$\begin{aligned} LGDP = -306.2549 + &5.13665LGCF \\ &(20.6148) \end{aligned}$$

The variables are converted into log transformation and these values represent long-term elasticity measures. The t-statistic of the co-integrating coefficient of

GCF is given in brackets. The coefficient for GCF is positive, which implies that increase in the gross capital formation enhances the economic growth of India. And this positive impact of GCF appears to be statistically significant. Thus the result is in line with the theoretical predictions.

Table 3: Cointegrating Vector

Cointegration Equation		
GDP	**GCF**	**Constant**
1.0000	-5.136651 (0.24917) [-20.6148]	306.2549

Note: Standard errors in ( ) & t-statistics in [ ].

Table 4: Vector Error Correction Estimates (VECE)

Error Correction	D(GDP)	D(CF)
CointEq1	-0.224346 (0.05420) [-4.13942]	-0.059318 (0.03147) [-1.88514]
D(GDP(-1))	-1.344592 (0.58503) [-2.29833]	-0.527437 (0.33966) [-1.55285]
D(GDP(-2))	-0.901247 (0.60895) [-1.47999]	-0.356357 (0.35355) [-1.00795]
D(CF(-1))	2.610182 (1.10092) [2.37092]	1.177198 (0.63917) [1.84176]
D(CF(-2))	0.577779 (1.21665) [0.47489]	0.352242 (0.70636) [0.49867]
C	95.81553 (21.0422) [4.55350]	29.86293 (12.2167) [2.44444]

Note: Standard errors in ( ) & t-statistics in [ ].

The coefficient of error correction term (ECT), as shown in Table 4, is negative (-0.224346) and statistically significant at 5 per cent level of significance, indicated by greater t-statistic value (4.13942) than critical value (1.96) at 5 per cent level. This implies that GDP do respond significantly to re-establish the equilibrium relationship once deviation occurs. Thus the statistically significant negative ECT confirms the long-run equilibrium relation between GDP and GCF. The significant negative sign of relation between GDP and GCF reflects a healthy convergence rate to equilibrium point per period. From the results presented in the Table 4, it could be inferred that GDP will converge towards its long-run equilibrium after the change in GCF at lag 1. Thus, the value of next year's GDP is influenced to a higher degree by the current year's GCF and this prediction appears to be accurate by 95 per cent.

The results also show that the change in the GCF is not influenced much by the lagged value of GDP. Therefore, VECM results confirm that GDP converges toward its long-run equilibrium after the change in GCF at lag 1. Thus, from this it is found that capital formation has significant positive impact on economic growth process of Indian economy.

As the Johansen cointegration test exhibits only the presence of long-run equilibrium relationship between GCF and GDP, pairwise Granger causality test is applied to capture the degree and direction of relationship between the two variables under study. The results of Granger causality test are presented in Table 5.

Table 5: Results of Granger Causality Test

Null Hypotheses	Observations	F-statistic	Probability	Decision
GDP does not Granger cause GCF	36	6.23944	0.0005	Reject
GCF does not Granger cause GDP	36	6.07513	0.0006	Reject

From the results it appears that there exists causality between GCF and GDP. The test explores bidirectional causality between the two variables. The causality runs from GCF to GDP and from GDP to GCF. It means that the value after GCF can help us to expect the value for the next period of GDP and also the value after GDP can help us to expect the value for the next period of GCF. Hence, GDP is Granger caused by GCF and GCF is Granger caused by GDP. Based on the results of Granger causality test, F-statistic values are significant and hence, null hypotheses (H_4: GDP does not Granger cause GCF and H_5: GCF does not Granger cause GDP) are rejected. This leads to the conclusion that capital formation Granger cause economic growth and economic growth also Granger cause capital formation. Therefore, capital formation and economic growth are mutually correlated in India.

7. Summary and Findings

The paper examines the relationship between capital formation and economic growth in India using annual data over the period 1970 to 2013. The unit root properties of the time series data were assessed using ADF test after which the cointegration and causality tests were conducted. The vector error correction model was also estimated in order to examine the short-run dynamics. The major findings of this study are the following:

- Based on the results of unit root test, the null hypotheses that there exist unit root problem in GCF and GDP time series data are rejected. The unit root test ensured that both GCF and GDP are stationary at first difference [I(1)] in case of augmented Dickey Fuller (ADF) test.

- The Johansen cointegration test confirmed that economic growth and capital formation are cointegrated, indicating an existence of long-run equilibrium relationship between the two. The trace test under Johansen cointegration method indicates two cointegrating equations at 5 per cent level of significance.

- The normalized cointegrating equation derived from the VECM indicates that capital formation has profound positive impact on GDP. This long-run positive relationship is tested statistically significant by a negative coefficient of the error correction term.

- The Granger causality test results revealed the presence of bidirectional causality. It suggests that GDP does Granger cause GCF and GCF does Granger cause GDP. Thus, the causality runs from GCF to GDP and from GDP to GCF indicating that, in Indian economy, high economic growth leads to high capital formation and, in turn, high capital formation drives economic growth.

8. Conclusion

The study reveals bidirectional causality between capital formation and economic growth in India and these results have significant policy implications. It is imperative for the national government to create pre-conditions for capital accumulation. Firstly, fiscal and monetary measures must encourage households and business community to save more. Secondly, banking services should be made available in every village so as to promote rural savings and mobilize their savings. Thirdly, a liberal and competitive investment climate should be created so that savings mobilized by the banks will channel towards investment in the creation of more capital assets such as physical capital, human capital and technology. This improves the potential for productivity growth. The onus of providing very conducive environment for capital formation is on the government. Agricultural sector, manufacturing sector and services sectors as well could gain from strongly-built capital assets. Therefore, it is imperative for the Government of India to frame a policy for encouraging public, private and foreign investment in such areas of the economy which would enhance sectoral capital formation, and, in turn, driving inclusive economic growth.

As the results of the VECM test reveal that economic growth of India is influenced by the capital formation of the previous year, key policy measures focusing on developing infrastructure, improving human resource quality through health, education and sanitation, mechanization of all spheres of economic activities should be drafted by the government. These steps would speed up the process of development and, in turn, would attract foreign direct investment and absorb more domestic savings into investment. Hence, the liberalized savings and investment policy on the one hand, and inclusive growth policy on the other, will have profound positive and complementarity effect on each other to augment the process of wellbeing in the country.

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