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An Investigation of the Effectiveness of Financial Development in Pakistan

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Abstract

This study attempts to discern the relationship between economic and financial development in Pakistan for the period 1973 - 2006. Vector error-correction modeling is used to identify the causality between economic and financial development and the exogeneity of the variable(s) in the model. These error correction terms have been derived from Johansen's multivariate cointegrating procedure. Results indicate that, in the long run, economic development causes financial development. Furthermore, the real output variable is found to be exogenous. Thus, financial development is seen to be ineffective in terms of economic development determination in Pakistan.

JEL Classification: C59, O16.

Keywords: Economic Development, Financial Development, Causality.

I. Introduction

This is study is concerned with the issue of financial development in Pakistan for the period 1973 – 2006. We examine on the one hand the long run and short run causality between financial and economic development and on the other hand establishes the exogeneity of financial development using the Vector Error-Correction model (VECM) for Pakistan. The exogeneity of financial development implies that the financial system is ineffective in terms of economic development for Pakistan. Vector Error Correction Terms (VECTs) have been derived from Johansen's multivariate co-integrating testing procedure.

The study is structured as follows: Section II reviews the literature. Section III estimates the relationship between financial and economic development. Section IV explains the results and compares with other studies. Finally, we summarize and conclude in Section IV.

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II. Review of Literature

Arestis and Demetriades (1997) examined the relationship between financial and economic development for South Korea for the period 1979:1 – 1991:4. They used the log of the ratio of bank deposits to nominal GDP as a proxy of financial depth/development, the log of real GDP per capita as a proxy of economic development, ex-ante real deposit rate of interest, the log of capital stock per head and a summary measure of financial repression. The principal components method was used to construct this measure. They assumed that inflation expectations were static. They used Johansen's co-integration analysis with VAR length of two. Results showed two cointegrating vectors. The income vector showed economic development and the real interest rate had a positive effect on financial development. They also modified the model for USA and Germany. They used the log of real GDP per capita as a proxy of economic development, the ratio of stock market capitalization to GDP, an index of stock market volatility[1], the log of the ratio of M2 to nominal GDP and the log of the ratio of domestic bank credit to nominal GDP as proxies of financial depth/development for Germany and USA, respectively. They used the lag length of 4. Results again showed two cointegrating vectors. In the case of Germany, vector-1 showed that economic development and financial development had a positive relationship and vector-2 indicated that financial development and the stock market development had a positive relationship. Thus financial and stock market development had a positive effect on economic development for Germany. In the case of USA, results also indicated two cointegrating vectors and similar conclusions.

Arestis, Demetriades, Fattouh and Mouratidis (2002) examined the relationship between financial development and economic growth for Greece, Thailand, Philippines, Korea, India and Egypt for the period 1955-1997. They used cointegration and the Error Correction Model (ECM) for causality and exogeneity purposes. They used the ratio of nominal liquidity[2] to nominal GDP and real per capita GDP as proxies of financial and economic development, respectively. Control dummies were used for the un-weighted average of deposit and lending rates. They also used the real interest rate (discount rate minus expected inflation using current GDP deflator) and the summary variable of reserve and liquidity requirements by using the principal component method (if both variables were available).

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[1] Sixteenth term moving standard deviation of the end-of-quarter change of stock market prices was used for volatility.

[2] Currency held outside the banking system plus demand and interest bearing liabilities of the banks and non-bank financial intermediaries.

They found a unique cointegrating vector except for India where two vectors were found. This vector was normalized with respect to economic development. Results showed that financial and economic development variables had positive significant signs in all cases and the real interest rate had negative signs except Korea where this coefficient was insignificant and Thailand where the data for this variable was not available. The deposit and lending rates variables were found to be insignificant in all cases except for the case of Philippines where it had a positive significant sign. The reserve and liquidity requirements variable was also found insignificant in all cases except for the cases of India and Egypt where it had significant negative and positive signs, respectively. In the ECM, economic development was found exogenous. Thus, overall, on the one hand the role of interest rate was limited and on the other hand economic growth caused financial development.

Calderon and Liu (2003) examined the causality between financial development and economic growth for 109 industrial and developing countries including Pakistan for the period 1960-1994. They used Geweke's (1982) decomposition method. The ratio of the difference in broad money (M2) (deflated by CPI) to real GDP and the difference in deflated credit (provided by financial intermediaries to the private sector) to real GDP were used as proxies of financial development. The real GDP per capita growth rate was used as a proxy of economic growth. They also included a basic set of control variables[3] and regional dummies for Latin America, East Asia, and Africa. They considered a panel of seven non-overlapping 5-year periods of observation and three non-overlapping 10-year periods of observation over the sample period. These panels (5 and 10-year) were further divided into two sub samples: 87 developing and 22 industrial countries. Results showed that bi-directional causality existed between financial and economic development for both developing and industrial countries.

Christopoulos and Tsionas (2004) investigated the causality between financial development and economic growth for 10 developing countries for the period 1970-2000. They used the ratio of total bank deposit liabilities to nominal GDP and real GDP as proxies of financial and economic development, respectively. They also used the ratio of fixed capital formation to nominal GDP and the inflation rate (which was measured by using CPI) in the model. They found one cointegrating vector, which was normalized with reference to output. This vector showed that financial depth had a

[3]Control variables: human capital – the percentage of secondary school attained over age 15 years in total population, government consumption as a percent of GDP and black market exchange rate premium.

positive significant sign for all countries, and the inflation rate was insignificant in all cases except Peru where it had negative significant sign. The fixed investment ratio had a positive significant sign in five countries. Results also indicated, in the panel data error correction model, that the error correction term was significant and thus there was evidence of causality from financial to economic development. However, in the country to country case, the error correction terms were insignificant so no causality between finance and output was found except for Dominican Republic.

Ghirmay (2004) empirically explored the causal links between the level of financial development and economic growth for 13 Sub-Saharan African countries for the period 1965-2000. He analyzed each country separately by employing cointegration and error correction models. He used the log of real GDP as a proxy of economic development. The log of credit to the private sector by financial intermediaries was used as a proxy of financial development. For lag determination he used a general to specific approach with at most 10 percent level of statistical significance. Results showed that financial development and economic development were cointegrated, and had a positive sign except Zambia. VEC models showed unidirectional causality from financial development to economic development in two countries namely Benin and Ghana. On the other hand, in four countries namely Cameroon, Mauritius, Nigeria and Togo unidirectional causality was found from economic growth to financial development and bi-directional casualty was found in six countries namely Ethiopia, Kenya, Malawi, Rwanda, South Africa and Tanzania. Thus overall they found that economic development led to financial development.

Thangavelu, Jiunn and James (2004) examined the causal relationship between financial development and economic growth for Australia for the period 1960-1999. They used real GDP per capita as a proxy of economic development. The ratio of bank claims on private sectors to nominal GDP, the ratio of domestic bank deposit liabilities to nominal GDP and the ratio of equities turnover to nominal GDP were used as proxies of the level of financial development. Money market and reserve bank discount interest rate variables were also used in models. All variables were in log form except the interest rate variables. They applied the Akaike Information Criterion (AIC) to choose the quarterly lag length of each variable in a vector autoregressive (VAR) model and Granger causality test. They constructed six models each containing three variables: an economic growth variable, one of the three financial development variables and one of two interest rate variables. They found that variables were cointegrated in these models. Results showed that the ratio of equities turnover to nominal GDP Granger-caused real GDP per capita. On the other hand, real GDP per capita

Granger-caused the ratio of bank claims on private sectors to nominal GDP and the ratio of domestic bank deposit liabilities to nominal GDP. Thus, overall the results showed unidirectional causality from economic development to financial development.

Atindehou, Gueyie and Amenounve (2005) examined causality between financial variables and economic development for 12 West African countries for the period 1960-1997. They used real GDP per capita as a proxy of economic development. On the other hand they used domestic credit - the ratio of total credit to all sectors (with the exception of credit to the central government) to GDP, liquidity liability – the ratio of liquidity commitments of the financial system to GDP, and the liquidity reserve – the ratio of bank liquid reserves to bank assets as proxies of financial development. All variables were in log form. They used Engle and Granger (1987) and Granger causality methodologies. The optimal lags were determined by using the Schwarz Criterion (SC). Result showed that domestic credit, and growth and liquidity reserve, and growth were not cointegrated in the cases of Gambia and Sierra Leone, respectively. ECMs results showed that domestic credit caused growth in the cases of Mauritius and Sierra Leone. Liquidity liability caused growth in the case of Ivory Coast, Mali (in the Granger causality model), Gambia, Mauritius and Sierra Leone (in the EC model). Liquidity reserves caused growth in the cases of Ivory Coast (in the Granger causality model), and Mauritius (in the EC model). Growth caused liquidity liability in the cases of Burkina Faso and Mauritius. Growth also caused liquidity reserves in the cases of Niger, Nigeria, Sierra Leone (in the Granger causality model), Mauritius and Togo (in the EC model). In the cases of Benin, Ghana and Senegal, no causality was found between growth and financial variables. These results were mixed in terms of the direction of causality between financial and economic development.

Ang and McKibbin (2007) examined the causality between financial and economic development variables for Malaysia for the period 1960-2001. They used the ratio of liquid liabilities (M3) to GDP, the ratio of commercial bank assets to commercial bank assets plus central bank assets, the ratio of domestic and private sector credit to nominal GDP as proxies of financial development. They also constructed a separate variable, a financial depth/development index, by using the principal components method on the above mentioned variables. They also constructed the financial repression index (the inverse of this index was interpreted as the extent of financial liberalization), which contained interest rate controls, direct credit programs, and statutory reserve requirements. For the interest rate control policy for the priority sectors they used dummy variables. The direct credit

programs, statutory reserve ratio and liquidity ratio were measured in percentages. All other variables were in natural log. They also included GDP per capita, real interest rate and five dummies: the oil crises in 1973 and 1979, the global economic recession in 1985, the Asian financial crises in 1997-98 and the world trade recession in 2001. They constructed 4-variable VAR models each containing one of the four financial development variables, a financial repression index, GDP per capita and real interest rate. Each model was estimated with the lag length of one or two for all variables with an EC term (which was obtained from co-integrated vector). Results showed that growth and financial variables had a positive relationship in the normalized equation. In the short-run, no Granger causality was found between financial variables and economic growth in all models. ECM based causality results showed unidirectional causality from economic growth to financial development.

Table-2.2.1 indicates, on the whole, that the relationship between financial and economic development is unclear in terms of the direction of causality from financial development to economic development. Thus, the effectiveness of financial development policies in terms of economic development is also unclear. On the other hand, there is also no separate study for Pakistan, which explores the issue of the relationship between financial and economic development in a time series framework (the study of Calderon and Liu (2003) is a panel data study of 109 countries which includes Pakistan).

II. Methodology and Model

Our aim is (1) to determine the direction of causality between financial development and economic development, and (2) to determine whether financial development is exogenous. Financial development will be considered effective if financial development is on the one hand exogenous and on the other hand it significantly causes economic development.

In our case, the model contains the following variables: economic development - real per capita GDP, financial development (the ratio of domestic credit to GDP), an investment variable (total capital formation to GDP), and a real interest rate variable (the weighted average savings interest rate minus current GDP deflator) *or* a price variable (the GDP deflator).

This model is consistent with the studies of Thangavelu, Jiunn and James (2004) Christopoulos and Tsionas (2004), and Ghirmay (2004). We also used credit to private sector ratio as a proxy of financial development but the signs were not consistent with economic theory (there was the

negative relationship between investment and GDP). So we did not use them to derive the Vector Error Correction terms (ECTs). These models are available in appendix-A.

Vector Error Correction modeling is used to identify the causality of financial and economic development and to establish the exogeneity of financial development. As Masih and Masih (1996) remark, co-integration cannot detect econometric exogeneity or endogeneity of variables. However, the VECM can help to discern the econometric exogeneity or endogeneity of a variable. Furthermore according to Masih and Masih (1996) and Choudhry and Lawler (1997) one can determine the direction of causality through VECM.

We use Johansen's multivariate co-integrating testing procedure to estimate Vector Error Correction terms. This procedure identifies multiple co-integration relationships (if possible). This procedure does not restrict one to a single cointegration vector as the Engle–Granger approach (1987) does.

This study adopts the two step sequential procedure as:

1. We perform the Johansen's multivariate cointegration test to identify the cointegration of variables.

2. We estimate the Vector Error – Correction model (VECM) to establish the direction of causality of variables on the on hand and exogeneity or endogeneity on the other.

We specify vector auto regression model using parameter notation from Johansen and Juslelius (1990) as

$$Y_t=\mu+\pi_1 y_{t-1}+.....+\pi_k\, y_{t-k}+\phi X_t+\varepsilon_t \quad t=1,2,.....T \qquad (2.3.1)$$

Where Y_t is a P dimensional vector of left hand side variables, X_t is a vector of the right hand side variables, ε_t is the usual error term that is distributed normally and independently with zero mean and covariance matrix Σ. The matrices π_1,. .... , π_k of the parameters contain the coefficients of left hand side variables, ϕ contains the coefficients of the right hand side variable and μ is a vector of constants. Due to non-stationarity of all variables under consideration at levels, we express the VAR in (2.3.1) in first-difference form. If cointegration exists, then we specify vector error correction models (VECMs) as:

$$\Delta y_t = r_1 \Delta y_{t-1} + \ldots \ldots \ldots + r_{k-1} \Delta y_{t-k+1} + \pi y_{t-k} + \phi X_t + \mu + \varepsilon_t \qquad (2.2)$$

Where

$r_1 = -(I - \pi_1 \ldots\ldots\ldots \pi_1)$, $\quad (i = 1, \ldots\ldots, k-1)$

$\pi = -(I - \pi_1 - \pi_2 \ldots\ldots \pi_k)$ (I is an identity matrix)

Johansen's methodology consists of testing the rank of π, which establishes the number of co-integrating vectors. Three possible cases may arise. These cases are defined as:

(i) Rank (π) = 0 - π is a null matrix. In this case, the traditional methods of first difference VAR are appropriate.

(ii) Rank (π) = P - π is a full rank matrix. In this case, a VAR in level form is suitable.

(iii) Rank (π) = r<P - π is not a full rank matrix. Thus, the coefficient matrix can be written as $\pi = \alpha\beta$, where α and β are each matrices of dimension P* r.

We compute the eigenvalues λ_i, (i=1, -----,P) of the matrix π. We use the λ trace statistic[4] to identify the number of co-integrating vector(s). This test statistic was developed by Johansen (1988) and is used to test the null hypothesis that at most r co-integrating vectors exist against the alternative that the number is more than r vectors.

We also use the test statistic λ max[5]. This statistic is used for testing the null hypothesis that at most r cointegrating vectors exist against the alternative that there are r+1 vectors. We use the critical values of Usterwald – Lenum (1992) for both tests.

In our case, the model contains four variables: an economic development variable, a financial development variable, investment variable and an interest rate variable or a price variable. All variables are log form except the interest rate variable.

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[4] λ trace (r) = $T\Sigma^{n}{}_{i=r+1}\, I_n(1-\lambda_i)$.

[5] λ max (r, r+1) = $-T \ln (1-\lambda_{r+1})$.

III. Results

The first step in the VEC analysis is to test the stationary properties of the variables under consideration. Table-2.4.1 presents the Augmented Dickey Fuller test. This indicates that all variables are stationary at first difference.

The next step is to find the order of vector auto regression. The Schwarz criterion and Akaike information criteria identify VAR (1) and VAR (2) for the model with respect to r and P, respectively. For testing the number of co-integrating vectors, Table-2.4.2 and 2.4.3 provide λ max and λ trace statistics at 95% critical values. With reference to r and P, both of these test statistics support the hypothesis of one cointegrating vector[6].

The co-integration also implies dynamic error correction models (VECMs). Results from VECMs are presented in Tables-2.4.4 and 2.4.5. A general to specific approach using at most 10% level of significance determines the optimal lag structures in the VECMs. This approach is consistent with Ghirmay (2004). Diagnostic statistics of the VECMs are provided in the last two columns of Tables-2.4.4 and 2.4.5. These statistics indicate no serial auto-correlation and specification problems in the model. The significance of the lagged error correction term (ECT) implies causality from all right hand side variables to the left-hand side variable. Furthermore, the significance of the ECT also implies econometric endogeneity of left hand side variable in the given model (Masih and Masih 1996; Choudhry and Lawler 1997).

Results for the VECM with reference to r are presented in Table-2.4.4. The insignificance of the ECTs in the deposit ratio and per capita real GDP equations indicate that these variables are exogenous in the given model. These results also indicate that the deposit ratio and per capita GDP variables cause interest rate and capital formation significantly as a component of the long term cointegrating relationship embodied in the ECTs. The insignificance of the ECTs in the deposit ratio and per capita GDP equations also indicate that other variables in the model do not cause

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[6] Normalized cointegrating equations:

Yr = 1.389753D+1.765832I+0.044207r.
(12.54) (5.81) (6.66) Log likelihood ratio: 125.6198

Yr = 1.14817D+3.413841I-0.598748p.
(6.33) (6.33) (-5.36) Log likelihood ratio: 189.37

This study also estimated other models but these models were difficult to interpret since they were not consistent with economic theory in terms of the sings of variables. These normalized equations are presented in the appendix-A.

the deposit ratio and per capita GDP. Thus, on the one hand, financial development and economic development are found to be econometrically exogenous and no causality exists between financial development and economic development on the other. Furthermore, significant ECTs in the interest rate and investment equations indicate that the bi-directional causality exists between them. In the short run, the deposit ratio causes per capita real GDP (as evidenced by the significance of the 'F' statistics of the deposit ratio variables in the per capita GDP equation). Thus, in the short run, unidirectional causality exists from financial development to economic development.

Results for the VECM with reference to p are presented in Table-2.4.5. These results indicate that the lagged error correction terms are significant in the deposit ratio, price and capital formation equations. Thus, these three variables are found to be econometrically endogenous in this model. The significance of the ECTs in the deposit ratio, price and capital formation equations also indicate that per capita real GDP in the model does cause the deposit ratio, prices and capital formation. Thus, unidirectional causality exists from economic development to financial development. On the other hand, in the short run, the price level and deposit ratio do not cause per capita GDP. Price level and per capita GDP cause deposit ratios and capital formation (as evident in the significance of the 'F' statistics of the price and real per capita GDP variables in the deposit and capital formation equations). Thus, in the short run, unidirectional causality also exists from economic development to financial development

Comparison with Other Studies

The estimated results are consistent in terms of one-way causality from economic development to financial development with Cameroon, Togo, Mauritius, Nigeria (Ghirmay 2004) and Australia (Thangavelu, Jiunn and James 2004) and Burkina Faso, Mauritius, Niger, Mauritius, Togo (Atindehou, Gueyie and Amenounve 2005) and Malaysia (Ang and McKibbin 2007). These estimated results are also consistent with the panel data of Greece, Thailand, Philippines, Korea, India and Egypt (Arstis, Demetriades, Fattouh and Mouratidis 2002). The estimated results are consistent in terms of no causality between economic development and financial development with Benin, Ghana and Senegal (Atindehou, Gueyie and Amenounve 2005).

IV. Conclusion

This study attempted to discern the relationship between economic and financial development for Pakistan for the period 1973 - 2006. Vector error-correction modeling is used to identify the causality between economic and financial development and exogeneity of the variable(s) in the model. These error correction terms have been derived from Johansen's multivariate co-integrating procedure. Financial development could be considered effective if financial development is on the one hand exogenous and on the other hand it causes economic development – per capita real GDP.

VECM (with reference to real interest rate) indicates that no causality exists between economic development and financial development. However, only in short run financial development causes economic development (as evidenced in the significance of the 'F-statistics).

VECM (with reference to price level) indicates economic development causes financial development variable. This result is also supported by short run analysis (as evidenced in the significance of the 'F-statistics).

Furthermore, real output is found exogenous in both models. Thus, overall, financial development is ineffective in influencing real output in Pakistan.

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Table-2.2.1. Summary: Empirical Studies of Financial and Economic Development

Study	Variables	Country	Causal relationship	Level form Impact
Arestis and Demetriades (1997)	the ratio of bank deposit to nominal GDP (FD), real GDP per capita (ED), real deposit rate (r), capital stock per head and a summary measure of financial repression (FR)	South Korea	-	FD and ED (+)
Arestis and Demetriades (1997)	real GDP per capita (ED), the ratio of stock market capitalization to GDP (SD), an index of stock market volatility (V), the ratio of domestic bank credit to nominal GDP(FD)	USA	-	FD and ED (+) FD and SD (+)
Arestis and Demetriades (1997)	real GDP per capita (ED), the ratio of stock market capitalization to GDP (SD), an index of stock market volatility, the ratio of M2 to nominal GDP(FD)	Germany	-	FD and ED (+) FD and SD (+)
Arestis, Demetriades, Fattouh and Mouratidis (2002)	the ratio of nominal liquidity to nominal GDP (FD), the ratio of real GDP to population (ED), real interest rate (r) and the summary variable of reserve and liquidity (FR).	Greece Thailand Philippines Korea India Egypt	ED→FD	FD and ED (+)
Calderon and Liu (2003)	The ratio of the difference in deflated broad money (M2) by CPI to real GDP (FD) and the difference in deflated credit by CPI to real GDP (FD), Real GDP per capita growth rate(ED)	22 industrial and 87 developing countries including Pakistan	FD↔ED	-
Christopoulos and Tsionas (2004)	the ratio of total bank deposits liabilities to nominal GDP (FD), GDP at constant price (ED), the	In the case of Dominican Republic and panel data of	FD→ED	FD and ED (+)

	share of fixed capital to nominal GDP and inflation rate	10 developing countries		
Ghirmay (2004)	Log of real GDP increment (ED). The level of credit to the private sector by (FD)	Cameroon, Togo Mauritius, Nigeria. Benin, Ghana Ethiopia, Kenya, Malawi, Rwanda, South Africa, Tanzania.	ED→FD (4cases) FD→ED (2cases) FD↔ED (6cases)	FD and ED (+)
Study	Variables	Country	Causal relationship	Level form Impact
Thangavelu, Jiunn and James (2004)	Real GDP per capita (ED), the ratio of bank claims on private sectors to nominal GDP, the ratio of domestic bank deposit liabilities to nominal GDP and the ratio of equities turnover to nominal GDP were used as proxies of the level of financial development (FD in alternative from). Money market, reserve bank discount interest rate variables (in alternative forms)	Australia	ED→FD (FD→ED, for only in the model of equity ratio)	-
Atindehou, Gueyie and Amenounve (2005)	real GDP per inhabitant as a (ED), domestic credit to GDP (FD), the ratio of liquidity commitments of financial system to GDP (FD1) and the ratio of bank liquid reserves to bank assets (FD2)	Ivory Coast, Mauritius, Mali, Sierra Leone, Gambia. Mauritius, Sierra Leone Ivory Coast, Mauritius. Burkina Faso, Mauritius. Niger,	FD1→ED (5cases) FD→ED (2cases) FD2→ED (2cases) ED→FD1 (2cases)	-

		Mauritius, Togo Nigeria, Sierra Leone.	ED→FD2 (5cases)	
		Benin, Ghana, Senegal.	No causality (3cases)	
Ang and McKibbin (2007)	the ratio of liquidity liability (M3) to GDP , the ratio of commercial bank asset to commercial bank assets plus central bank assets, the ratio of domestic credit to private sector to nominal GDP. They also estimated a separate variable, financial depth/ development index (FD in alternatives), financial repression index, GDP per capita (EG) and real interest rate	Malaysia	ED→FD	FD and ED (+)

Where, ED and FD are used for economics and financial development, respectively. → and ↔ show unidirectional and bi directional, respectively. (+) and (-) show positive and negative impact, respectively.

Table-2.4.1. Augmented Dickey – Fuller Tests

Variable	ADF(0)	ADF(1)	Variable	ADF(0)	ADF(1)
Y_r	-1.19	-3.65**	P	-3.47	-7.82*
r.	-2.58	-7.16*	I	-2.59	-4.07**
D	-3.52	-4.98*			

*Indicates significant at 1%, **Indicates significant at 5%

Table-2.4.2. Testing the Rank of ∏ (with reference to r)

Eigenvalue	H_0	H_1	Trace Statistics	95%	H_0	H_1	Lamda Statistic	95%
0.754608	r=0	R=1	74.04312	68.52	r=0	r≥1	42.49307	33.32
0.454273	r≤1	R=2	31.55005	47.21	r≤1	r≥2	18.17472	27.14
0.275093	r≤2	R=3	12.77532	29.68	r≤2	r≥3	9.973004	21.07
0.986430	r≤3	R=4	2.802261	15.41	r≤3	r≥4	2.802261	14.9

Table-2.4.3. Testing the rank of ∏ (with reference to P)

Eigenvalue	H_0	H_1	Trace Statistics	95%	H_0	H_1	Lamda Statistic	95%
0.884411	r=0	R=1	97.7321	68.52	r=0	r≥1	56.1006	33.32
0.520978	r≤1	R=2	41.6314	47.21	r≤1	r≥2	19.1362	27.14
0.324732	r≤2	R=3	22.4952	29.68	r≤2	r≥3	10.2087	21.07
0.253133	r≤3	R=4	12.2864	15.41	r≤3	r≥4	7.5885	14.9
0.165304	r≤4	R=5	4.6978	3.76	r≤4	r≥5	4.6978	8.18

Table-2.4.4. VECMs with reference to r

	Lagged differences			Error Correction Terms			
	ΔYr	ΔD	ΔI	Δr	ECT	LM	RESET
ΔYr	1 (3.45)***	1 (3.45***)	-	-	0.01 (0.93)	128	1.01
ΔD	-	-	1 (7.07)**	-	-0.007 (-0.19)	1.03	0.90
ΔI	3 (3.76)**	-	-	1 (3.29)**	-0.17 (-4.25)*	2.01	6.75
Δr	-	-	-	1 (3.84)**	8.52 (2.80)*	1.58	2.52

Notes: The ECTs were derived by normalizing one or more co-integrating vectors on y_r. The VECMs are based on an optimally determined criteria (general to specific (Ghirmay 2004)) lag structure and a constant. F-Statistics are in parenthesis. ***, ** and * indicate significance at the 10%, 5% and 1% levels, respectively. LM is serial correlation test with 2 lag terms. RESET is Ramsey specification error test with 2 fitted terms.

Table-2.4.5. VECMs with Reference to Lagged differences Error Correction Terms

	ΔYr	ΔD	ΔI	Δp	ECT	LM	RESET
ΔYr	-	-	1 (3.80)***	-	0.004 (0.04)	4.95	0.89
ΔD	1 (3.88)***	-	2 (5.62)**	2 (3.44)**	0.17 (3.3)***	0.07	5.5
ΔI	3 (5.50)*	1 (3.9)***	-	1 (5.15)*	0.14 (4.26)*	0.70	2.79
Δp	-	1 (4.45)*	-	-	-1.01 (4.75)*	0.67	3.11

See footnote: Table-2.4.4

Appendix

The following cointegration models are inconsistent with economic theory in terms of negative significant sign of total capital formation:

Yr	I	C	r.
	1.047511	-1.06821	-0.86759
	-0.32678	-0.13939	-1.14024

(std.err. in 3rd row of the table)

Yr	I	C	P
1	1.441335	-1.31893	-0.37321
	-0.32223	-0.14995	-0.07355

(std.err. in 3rd row of the table)
Note: C is credit to private sector.