Effect of Financial Development on Agricultural Growth in Pakistan: New Extensions from Bounds Test to Level Relationships and Granger Causality Tests

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Abstract:

This study investigates the relationship between financial development and agriculture growth employing Cobb-Douglas function which incorporates financial development as an important factor of production for the period 1971-2011. The ARDL bounds testing approach to cointegration is applied to examine long run relationship between the variables. The direction of causality is detected by VACM Granger causality test and robustness of causality results is tested through innovative accounting approach (IAA).

Our findings confirm that the variables are cointegrated for equilibrium long run relationship between agriculture growth, financial development, capital and labor. The results indicate that financial development has a positive effect on agricultural growth. This implies that financial development plays its significant role in stemming agricultural production and hence agricultural growth. The capital use in the agriculture sector also contributes to the agricultural growth. The Granger causality analysis reveals bidirectional causality between agricultural growth and financial development. The robustness of these results is confirmed by innovative accounting approach (IAA). This study has important policy implications for policy making authorities to stimulate agricultural growth by improving the efficiency of financial sector.

Keywords: Agriculture Growth, Financial Development, Cointegration

Introduction

Pakistan has an abundant resource of water and arable land. About 25 per cent of its land is under cultivated which receives its required amount of water through one of the finest irrigation systems of the world. Pakistan's irrigation system covers three times the region irrigated in Russia. Agriculture sector is considered as the backbone of Pakistan's economy. It provides employment to 45 per cent of the population and raw material for agro-based industries. The demand for industrial products increased with an increase in investment in the agriculture sector. The contribution of agriculture to GDP was about 23 per cent in 2009-2010 (GoP, 2010). More than 60 per cent population is living in rural areas and out of which 90 per cent of the rural population is directly and indirectly involved in agricultural economic activity. The agriculture sector produces a number of major and minor crops, livestock, fishing and forestry. The financial sector of Pakistan also contributes to the agricultural production by providing financial resources to farmers. The government of Pakistan has established Zarai Taraqiati Bank Limited (which is the largest financial institution) to provide technical know-how and financial services in the country. Availability and access to financial resources is one of the key elements for agricultural growth, which is why Pakistan's government has to undertake financial reforms to make it easy for the investors of the rural areas to access funds for agricultural output.

Both formal and informal credits are acquired for the agricultural growth in Pakistan. This credit is further classified into long, medium and short terms. Farmers obtain short term loans from a Mahajan (a person appointed to give loans to individuals in the beginning of the season and receives his money back once the crop is harvested or buys their crops at a cheaper rate). Mostly, farmers go to Mahajan for short term loans to avoid the hectic procedures followed in the banks and to save their time. Short term loans are used to purchase new varieties of seeds, water, fertilizers and power, livestock and poultry feed, and to fulfill veterinary expenses. Furthermore, a short term credit is also needed to develop fishery sector, and to make payments of storage facilities. A major chunk of short term loans is also used on curing expenditures for livestock and poultry. Agriculture credit is also required for transportation hiring expenditures, packing of the material and marketing of agriculture product in national and international markets.

Farmers go to banks for medium and long term loans to improve their land, clear forests for cultivation, leveling and terracing the land, and improve the soil. The long term loans are also needed to format land, improve watercourse alignment, construct modules and culverts, purchase heavy machinery including tube wells, lift pumps, turbines, bullocks, tractors, trailers, thrashers, arboriculture and plantation and barriers around the fields to save crop from harmful animals. Banks also provide loans to farmers to use advanced technology in cultivation such as construction of godowns, bins and silos, purchase of trucks, bullock-carts, transport machinery, country-boats and fork lifts, and provides guidance to use the processing machinery on their farms (GoP, 2010). The expenditures on construction of godowns, bins and silos, purchase of trucks, bullock-carts, transport machinery, country-boats, fork lifts are possible through long term loans from banks as well as credit is needed to purchase of seedlings, labour charges, apiculture and sericulture (SBP, 2010).

The above description on credit requirements shows that Pakistan needs a sound and well-developed financial system to promote not only agriculture sector but also its economic system. For the first four decades since Pakistan's independence in 1947, the main concern of government was to establish necessary infrastructure for the effective implementation of its macroeconomic policies. The financial sector of Pakistan could not work autonomously based on free market forces of demand and supply during those decades. Due to underdeveloped cash, bond and equity markets, monetary policy was implemented through direct credit allocation. The real interest rate usually remained negative due to a controlled interest rate mechanism by the government. Macroeconomic difficulties in 1970s and early 1980s further deteriorated the performance of the financial sector in the country. The government of Pakistan implemented financial reforms as part of structural adjustment program to improve the efficiency of financial sector of the country. These reforms were aimed at promoting competition, adopting market based monetary system, improved governance and credit management for optimal allocation of financial resources. The performance of financial sector improved after the implementation of financial reforms initiated in 1990s in Pakistan. Financial reforms can be launched successfully if transition period and cost of the process are reduced. This leads to a rise in the net value of non-financial firms and financial reforms removed the interest rate subsidies that enabled the firms to sustain their financing cost. The government of Pakistan is implementing new policies in financial sector to improve its efficiency and diverting her attention to launch new incentives for farmers to enhance the productivity of agriculture sector. This not only increases the exports potential but also provides raw materials for agro-based industries in the country as well as enhances its contribution to gross domestic product (GDP).

This paper considers the relationship between financial development and agriculture growth. The study has four contributions to economic literature: (i) ARDL bounds testing approach to cointegration is applied to test the existence of long run between financial development and agriculture growth. (ii) To test the stationarity, Clemente et al. (1998) structural break unit root test is applied which is ignored in economic literature over said issue and, (iii) the direction of causality is detected between financial development and agriculture growth by using VECM (vector error correction method) and (ii) robustness of causality is tested by innovative accounting approach (IAA) is combination of variance decomposition method (VDM) and impulse response function (IRF).

The rest of study is organized as following: section-II details the review of literature, section-III explains modeling, methodology and data collection, section-IV describes results and their discussions and, conclusion and policy implications are drawn in final section.

II. Literature Review

Relevant economic literature provides the theoretical and empirical significance of financial development in economic growth. For example, Schumpeter (1911, 1934) explored that a sound and well-developed financial system contributes to the economic growth by mobilizing funds, evaluating and selecting projects, managing risk, monitoring entrepreneurs and lowering transactional cost as well as fostering technical know how which helps to boost economic growth. Variety of methods has been applied to investigate the relationship between financial development and economic growth. Primarily cross-country growth regressions have been used by King and Levine (1993), Sala-i-Martin (1997), Rajan and Zingales (1998), Khan and Senhadji (2000), Dawson (2003) and Berger et al. (2004). Panel framework has also been utilized by some researchers like Calderon and Liu (2003), Edison et al. (2002) and Manning (2003). Furthermore, in the time series analysis causal relationship between financial development and economic growth is discussed in recent literature [Demetriades and Hussein (1996), Luintel and Khan (1999), Hsu and Lin (2000), Arestis et al. (2001), Chang (2002), Shan and Morris (2002), Bhattacharya and Sivasubramanian (2003), Ghirmany (2004), Khalid (2005), Darrat et al. (2005) and Shahbaz (2009)]. Our concern is to find out the impact of financial development on the sectoral level such as agriculture sector which is considered as mainstay of economic growth in in case of Pakistan.

For Chinese economy, Lihong and Qinggao (2007) explored the relationship between rural financial development and economic growth and concluded that rural financial development does not contribute to economic growth i.e. financial development does not seem to meet the demands of rural economic growth. It implies that rural financial development is ineffective to promote economic growth and invalidates the hypothesis of "supply leading" and confirms the "demand following" hypothesis. Apart from that, Sidhu et al. (2008) estimated the demand for institutional agriculture credit in Punjab (India) using simultaneous equations. Their results indicated that institutional agriculture credit is positively linked with agriculture productivity by encouraging farmers to use modern technology to increase domestic output by utilizing institutional agriculture credit efficiently.

Parivash and Torkamani (2008) assessed the effects of financial markets on growth of agriculture sector in case of Iran using VAR model and Granger causality tests. Their results showed that financial markets development has a positive impact on agriculture growth. Further, financial development Granger-caused agriculture growth validating supply-side hypothesis in Iranian economy. Similarly, Yazdani (2008) probed cointegration and causal relationship between financial development, capital stock, real interest rate, international trade and agriculture growth in case of Iranian economy. Their findings confirmed that variables are cointegrated for long run association. Causality analysis revealed that financial development Granger-caused agriculture growth. Moreover, results found that financial development, capital stock, international trade and real interest have significant effect on agricultural growth. Similarly, Sharif et al. (2009) depicted that Iranian financial markets play their role to stimulate agriculture growth but still financial reforms are needed to improve the performance of financial sector. A developed financial system boosts agriculture economic activity which contributes to economic growth.

Furthermore, Afangideh (2009) investigated the effect of financial development on agriculture investment and agriculture output using three stage least squares (3SLS) approach. The findings confirmed that gross national saving, bank lending to agriculture, agricultural investment and agricultural output are cointegrated for long run relationship. Moreover, results showed that an increase in bank lending improves the performance of agriculture sector by enhancing real gross national savings and real output. Empirical evidence suggested that a sound financial sector can alleviate growth financing constraints by enhancing savings, bank loans and improving investment activities in agriculture as well as agriculture sub-sectors which in resulting, increases domestic output and hence economic growth. Anthony (2010) explored the role of agriculture credit, interest rate and exchange rate for Nigerian economy. The results indicated that agriculture credit improves the efficiency of agriculture sector and agriculture sector promotes economic growth. The study suggests the governing bodies to pay attention to agriculture sector on priority basis and launch a comprehensive macroeconomic policy to stimulate agriculture sector.

In case of Pakistan, Ahmad and Qayyum (2008) considered the role of private investment in agriculture growth and reported that private investment contributes to economic growth by accelerating performance of agriculture sector. Their study suggests the government to pay attention on the implementation of appropriate macroeconomic policies which is the main determinant of private investment in Pakistan. Apart from that, Hye and Wizarat (2011) examined the effect of financial liberation on agriculture growth by employing Cobb-Douglas function in case of Pakistan using ARDL bounds testing approach to cointegration. Their results showed that financial liberalization has contributed to improve the performance of agriculture sector in long-and-short runs. A rise in interest rate declines growth of agriculture by increasing the cost of production. Capital and labor force also play their role to enhance the efficiency of agriculture sector. They suggested that GoP and SBP need to overhaul the financial reforms to improve the efficiency of agriculture sector after studying the structure of the economy not forcefully implemented by IMF or other international financial institutions. Lastly, Medyawati and Yunanto (2011) investigated the effect of agriculture, industry and banking sector on economic growth in Indonesian economy using VAR models. Their results depicted that agriculture, industry and banking sector contribute to the economic growth. The contribution of banking sector is relatively small as compared to agricultural and industrial sectors.

III. Modeling, Methodology and Data Collection

This study uses annual data of real GDP of agriculture sector (Y_t), financial development proxies by real loans disbursed to farmers (F_t), real capital (K_t) indicates by real gross fixed capital formation in agriculture sector and rural labor force (L_t). The study covers the sample period 1971- 2011. The data on real GDP of agriculture sector, real credit disbursed to farmers, real capital use in agriculture sector and rural labor force is collected from various publication Government of Pakistan (2010-11).

This paper investigates the effect of financial development on agriculture growth by incorporating capital and labor as important stimulants of agriculture productivity. We employ Cobb-Douglas function and the general equation is given below:

$$Y_t = \sigma K_A^{\beta} L_A^{\alpha} \tag{1}$$

Where Y_t is real GDP of agriculture sector, σ is residual showing the effect of financial development i.e. F_t , K_A indicates capital use in agriculture and L_A denotes rural labor force in agriculture sector. α and β show the marginal impacts of capital and labor on agriculture production. After decomposition of residual term, estimable equation is modeled as following:

$$\ln Y_t = \beta_1 + \beta \ln F_t + \beta_3 \ln K_t + \beta \ln L_t + \mu_t \tag{2}$$

Where $\ln Y_t$, $\ln F_t$, $\ln K_t$, $\ln L_t$ and μ_t are natural log of financial development proxies real loans disbursed to farmers, real capital use in agriculture sector, rural labor force and residual term assumed to be normally distributed. For reliable and consistent results, all series have been converted into natural logarithms. The log-linear specification provides efficient results as compared to simple specification (see Box and Cox, 1964; Bowers and Pierce, 1975; Ehrlich, 1977; Layson, 1983 and Shahbaz, 2010).

The economic literature provides comprehensive information about the use of different unit root tests to test stationarity properties such as ADF by Dicky and Fuller (1981)**,** PP by Philip and Perron (1988), DF-GLS by Elliot et al. (1996) and Ng-Perron by Ng and Perron (2001). These unit root tests report inappropriate and biased results due to their shortcomings. For example, Dejong et al. (1992) pointed out that the results of these tests are unreliable due to their poor size and power properties. Moreover, unit root tests such as ADF, PP and DF-GLS may over-reject the true null hypothesis and accepts null hypothesis when it is false. Ng-Perron (2001) unit root test seems to solve this problem. The empirical results provided by Ng-Perron (2001) again faces problem of spuriousness because this is incompetent to identify the information about structural breaks in the series. This problem is solved by Clemente et al. (1998) structural break unit root test. This test is more powerful compared to Perron and Volgelsang (1992), Zivot-Andrews (1992), ADF, PP and Ng-Perron unit root tests. Perron and Volgelsang (1992) and Zivot-Andrews (1992) unit root tests are appropriate when series has one possible structural break. Clemente et al. (1998) augmented the statistics of Perron and Volgelsang (1992) by assuming that there are two structural breaks in the mean. The null hypothesis i.e. H_0 against alternative hypothesis i.e. H_a are as following:

$$H_0 : x_t = x_{t-1} + a_1 DTB_{1t} + a_2 DTB_{2t} + \mu_t \ldots (3)$$

$$H_a : x_t = u + b_1 DU_{1t} + b_2 DTB_{2t} + \mu_t \ldots (4)$$

In equation-3 and equation-4, DTB_{1t} is the pulse variable equalant to 1 if $t = TB_i + 1$ and zero if not. Moreover, $DU_{it} = 1$ if $TB_i < t(i = 1,2)$ and if this assumption violates then it is equal to zero. Modification of mean is represented by TB_1 and TB_2 time periods. Further, it is simplified with assumption that $TB_i = \delta_i T(i = 1,2)$ where $1 > \delta_i > 0$ while $\delta_1 < \delta_2$ (see Clemente et al. 1998). If two structural breaks are contained by innovative outlier then unit root hypothesis can be investigated by applying equation-5 is modeled as following:

$$x_t = u + \rho x_{t-1} + d_1 DTB_{1t} + a_2 DTB_{2t} + d_3 DU_{1t} + d_4 DU_{2t} + \sum_{i=1}^{k} c_j \Delta x_{t-1} + \mu_t \ldots (5)$$

This equation helps us to estimate minimum value of t-ratio through simulations and value of simulated t-ratio can be utilized for all break points if the value of autoregressive parameter is constrained to 1. For the derivation of the asymptotic distribution of said estimate, it is supposed that $\delta_2 > \delta_1 > 0, 1 > \delta_2 - 1 > \delta_0$. δ_1 and δ_2 obtain the values in interval i.e. $[(t+2)/T, (T-1)/T]$ by appointing largest window size. Further, this assumption i.e. $\delta_1 < \delta_2 + 1$ is used to show that cases where break points exist in repeated periods are purged (see Clemente et al. 1998). Two steps approach is used to test unit root hypothesis, if shifts are in better position to explain additive outliers. In 1st step, purge deterministic variable by following equation-6 for estimation as following:

$$x_t = u + d_5 DU_{1t} + d_6 DU_{2t} + \hat{x} \ldots (6)$$

The second step is related to search the minimum t-ratio by a test to test the hypothesis that $\rho = 1$, as following:

$$\hat{x}_t = \sum_{i=1}^{k} \phi_{1i} DTB_{1t-1} + \sum_{i=1}^{k} \phi_{2i} DTB_{2t-1} + \rho \hat{x}_{t-1} + \sum_{i=1}^{k} c_i \Delta \hat{x}_{t-1} + \mu_t \ldots (7)$$

To make sure that $\min t_{\rho\ t}^{IO}(\delta_1, \delta_2)$ congregates i.e. converges to distribution, we have included dummy variable in estimated equation for estimation:

$$\min t_{\rho\ t}^{IO}(\delta_1, \delta_2) \rightarrow \inf_{\gamma} = \wedge \frac{H}{[\delta_1(\delta_2 - \delta_1)]^{1/2} K^{1/2}} \ldots (8)$$

We employ the autoregressive distributed lag (ARDL) bounds testing approach to cointegration developed by Pesaran et al. (2001) to explore the existence of long run equilibrium relationship between agriculture growth, financial development, real capital and labor force. The bounds testing approach has several advantages. The approach is applied irrespective of whether the variables are I(0) or I(1), unlike other widely used cointegration techniques. Moreover, a dynamic unrestricted error correction model (UECM) can be derived from the ARDL bounds testing through a simple linear transformation. The UECM integrates the short run dynamics with the long run equilibrium without losing any long run information. The UECM is expressed as follows:

$$\begin{aligned}\Delta \ln Y_t &= \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta \ln Y_{t-i} + \sum_{j=0}^{q} \alpha_j \Delta \ln F_{t-j} \\ &+ \sum_{k=0}^{r} \alpha_k \Delta \ln K_{t-k} + \sum_{l=0}^{s} \alpha_l \Delta \ln L_{t-l} + \mu_t\end{aligned} \tag{9}$$

$$\begin{aligned}\Delta \ln F_t &= \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \beta_i \Delta \ln F_{t-i} + \sum_{j=0}^{q} \beta_j \Delta \ln Y_{t-j} \\ &+ \sum_{k=0}^{r} \beta_k \Delta \ln K_{t-k} + \sum_{l=0}^{s} \beta_l \Delta \ln L_{t-l} + \mu_t\end{aligned} \tag{10}$$

$$\begin{aligned}\Delta \ln K_t &= \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \vartheta_i \Delta \ln K_{t-i} + \sum_{j=0}^{q} \vartheta_j \Delta \ln Y_{t-j} \\ &+ \sum_{k=0}^{r} \vartheta_k \Delta \ln F_{t-k} + \sum_{l=0}^{s} \vartheta_l \Delta \ln L_{t-l} + \mu_t\end{aligned} \tag{11}$$

$$\begin{aligned}\Delta \ln L_t &= \alpha_1 + \alpha_T T + \alpha_Y \ln Y_{t-1} + \alpha_F \ln F_{t-1} + \alpha_K \ln K_{t-1} + \alpha_L \ln L_{t-1} + \sum_{i=1}^{p} \rho_i \Delta \ln L_{t-i} + \sum_{j=0}^{q} \rho_j \Delta \ln Y_{t-j} \\ &+ \sum_{k=0}^{r} \rho_k \Delta \ln F_{t-k} + \sum_{l=0}^{s} \rho_l \Delta \ln K_{t-l} + \mu_t\end{aligned} \tag{12}$$

Where Δ is the first difference operator and μ_t is error term assumed to be independently and identically distributed. The optimal lag structure of the first difference regression is selected by the Akaike Information criteria (AIC). The lags induce when noise property in the error term. Pesaran et al. (2001) suggested F-test for joint significance of the coefficients of the lagged level of the variables. For example, the null hypothesis of no long run relationship between the variables is $H_0: \alpha_Y = \alpha_F = \alpha_K = \alpha_L = 0$ against the alternative hypothesis of cointegration $H_1: \alpha_Y \neq \alpha_F \neq \alpha_K \neq \alpha_L \neq 0$.

Two asymptotic critical bounds are used to test for cointegration, lower bound is applied if the regressors are I(0) and the upper bound is used for I(1). If the F-statistic exceeds the upper critical value, we conclude the favor of a long run relationship. If the F-statistic falls below the lower critical values, we cannot reject the null hypothesis of no cointegration. However, if the F-statistic lies between the two bounds, inference would be inconclusive. When the order of integration for all the series is known to be I(1), the decision is made based on the upper bound. Similarly, if all the series are I(0), then the decision is made based on the lower bound. The robustness of the ARDL model has been checked through some diagnostic tests. The diagnostics tests are checking for serial correlation, functional form, normality of error term and heteroskedasticity.

After investigating the long run relationship between the variables, we employ the Granger causality test to determine the causality between the variables. If there is cointegration, an error correction model can be developed as follows:

$$(1-L)\begin{bmatrix} Y_t \\ F_t \\ K_t \\ L_t \end{bmatrix} = \begin{bmatrix} \phi_1 \\ \phi_2 \\ \phi_3 \\ \phi_4 \end{bmatrix} + \sum_{i=1}^{p}(1-L)\begin{bmatrix} a_{11i}a_{12i}a_{13i}a_{14i} \\ b_{21i}b_{22i}b_{23i}b_{24i} \\ c_{31i}c_{32i}c_{33i}c_{34i} \\ d_{41i}d_{42i}d_{43i}d_{44i} \end{bmatrix} + \begin{bmatrix} \xi_1 \\ \xi_2 \\ \xi_3 \\ \zeta_4 \end{bmatrix}\begin{bmatrix} Y_{t-1} \\ F_{t-1} \\ K_{t-1} \\ L_{t-1} \end{bmatrix} \times [ECM_{t-1}] + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{bmatrix} \quad (13)$$

where difference operator is $(1-L)$ and ECM_{t-1} is the lagged error correction term, generated from the long run association. The long run causality is found by significance of coefficient of lagged error correction term using t-test statistic. The existence of a significant relationship in first differences of the variables provides evidence on the direction of the short run causality. The joint χ^2 statistic for the first difference lagged independent variables is used to test the direction of short-run causality between the variables. For example, $a_{12,i} \neq 0\forall_i$ shows that financial development Granger cause agriculture growth and causality is from agriculture growth to financial development if $a_{11,i} \neq 0\forall_i$. Same inferences can be hypothesized for other variables in the model.

IV. Empirical Results and their Discussions

Descriptive statistics and correlation matrices are reported in Table-1 showing that all the series are normally distributed with constant variance and zero covariance as indicated by Jarque-Bera statistics. The correlation matrix explains that financial development, capital and labor are positively correlated with agricultural growth. There is also a positive correlation found between capital and labour with financial development and, positive and association exists between labour and capital.

Table-1: Descriptive Statistics and Correlation Matrix

Variables	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
Mean	13.3419	4.7712	11.8067	2.7269
Median	13.3535	4.7275	11.7755	2.7047
Maximum	14.0529	5.1877	12.8814	3.2960
Minimum	12.6463	4.4893	10.3676	2.3589
Std. Dev.	0.4537	0.1807	0.6799	0.2400
Skewness	-0.0177	0.5704	-0.1622	0.4893
Kurtosis	1.6916	2.3117	2.1461	2.7026
Jarque-Bera	2.9264	3.0332	1.4252	1.7871
Probability	0.2314	0.2194	0.4903	0.4091
$\ln Y_t$	1.0000			
$\ln F_t$	0.5057	1.0000		
$\ln K_t$	0.9229	0.4725	1.0000	
$\ln L_t$	0.9553	0.3788	0.8502	1.0000

There are many unit root tests i.e. ADF by Dickey and Fuller (1979), PP by Philip and Perron (1988), DF-GLS by Elliot et al. (1996), KKPS by Kwiatkowski et al. (1992) and Ng-Perron by Ng-Perron (2001) are used to test the stationarity properties of the series. The results by these tests are biased and unreliable once a series has structural break (Baum, 2004). To overcome such problem, we apply two structural break tests such as Zivot-Andrews (1992) contain information about one structural break and Clemente et al. (1998) has information about two structural breaks in the series. We prefer to take decision about integrating order of the variables based on Clemente et al. (1998) results. The series under estimation are agriculture growth ($\ln Y_t$), financial development ($\ln F_t$), real capital ($\ln K_t$) and labour force ($\ln L_t$).

The results of Zivot-Andrews unit root test are reported in Table-2 show that agriculture growth and financial development have unit root problem at their level form while capital and labor force are integrated at I(0). This indicates that variables have mixed order of integration. To test the robustness of stationarity properties, we have also applied Clemente et al. (1998) unit root test which provides more consistent and reliable results as compared to Zivot-Andrews (1992) unit root test[1]. The results of Clemente et al. (1998) are detailed in Table-3 reveal that all the series are not found to be integrated at I(0). This implies that series are stationary at I(1). We applied unit root tests two ensure that no variables is integrated at (2) or beyond. The computation of ARDL F-statistic for cointegration becomes inacceptable if any series is stationary at 2nd differenced form (Ouattara, 2004). The assumption of ARDL bound testing to cointegration is that integrating order of the variables should be I(1), or I(0) or I(1)/ I(0). Our results indicated that all the series are integrated at I(1) with intercept and trend.

Table-2: Zivot-Andrews Structural Break Trended Unit Root Test

Variable	**At Level**		**At 1st Difference**	
	T-statistic	Time Break	T-statistic	Time Break
$\ln Y_t$	-4.511 (0)	2000	-8.197(0)*	2005
$\ln F_t$	-4.452(0)	1998	-5.452 (0)**	2004
$\ln K_t$	-5.615(0)*	1982	-9.766(1)*	1982
$\ln L_t$	-5.166 (0)**	2002	-8.522 (1)*	2004

Note: * and *** represent significant at 1 and 10 per cent level of significance. Lag order is shown in parenthesis.

Table-3: Clemente-Montanes-Reyes Detrended Structural Break Unit Root Test

Variable	Innovative Outliers				Additive Outlier			
	t-statistic	TB1	TB2	Decision	t-statistic	TB1	TB2	Decision
$\ln Y_t$	-1.943(1)	1982	2004	I(0)	-8.333(2)*	1994	2003	I(1)
$\ln F_t$	-2.102 (2)	1982	2003	I(0)	-5.704 (1)**	1996	2001	I(1)
$\ln K_t$	-3.872 (2)	1987	1995	I(0)	-12.533(1)*	1979	1996	I(1)
$\ln L_t$	-1.848 (2)	1996	2004	I(0)	-10.616(3)*	1990	2001	I(1)

Note: * and ** indicates significant at 1 and 5 per cent level of significance. Lag order is shown in parenthesis

[1] The main advantage of Clemente-Montanes-Reyes (1998) unit root test is that it has information about two possible structural break points in the series by offering two models i.e. an additive outliers (AO) model informs about a sudden change in the mean of a series and an innovational outliers (IO) model indicates about the gradual shift in the mean of the series. The additive outlier model is more suitable for the variables having sudden structural changes as compared to gradual shifts.

The unique integrating order of the variables tends to lead us to apply ARDL bounds testing approach to cointegration to test whether cointegration exists or not among the series such as agriculture growth ($\ln Y_t$), financial development ($\ln F_t$), capital stock ($\ln K_t$) and labor ($\ln L_t$) in case of Pakistan over the study period i.e. 1971-2011.

Once integrating order of the variables is confirmed, next step is to choose appropriate lag order of the variable to apply ARDL bounds testing approach to cointegration. It is necessary to find out lag order because F-statistic is very much sensitive with the lag order. We use sequential modified LR test statistic (LR), Final Prediction Error (FPE); Akaike Information Criterion (AIC); Schwarz Information Criterion (SIC) and Hannan-Quinn Information criterion (HQ) to choose appropriate lag order but we prefer to take decision about appropriate lag following AIC. The AIC provides reliable and consistent information about lag order as compared to other criterion. The empirical evidence in Table-4 revealed that 1 is optimal lag to be selected.

Table-4: Lag Length Selection

VAR Lag Order Selection Criteria						
Lag	LogL	LR	FPE	AIC	SC	HQ
0	49.17735	NA	1.09e-06	-2.3777	-2.2053	-2.3164
1	188.3787	241.7708*	1.68e-09*	-8.8620*	-8.0001*	-8.5553*
2	204.3333	24.3517	1.73e-09	-8.8596	-7.3082	-8.3076
3	214.6936	13.6320	2.52e-09	-8.5628	-6.3219	-7.7655

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

The results of ARDL bounds testing approach to cointegration are reported in Table-5 indicating that our calculated F-statistics i.e. 9.420, 5,756 and 6.276 exceed the upper critical bound (UCB) at 1 and 10 per cent level of significance when agriculture growth ($\ln Y_t$), financial development ($\ln F_t$) and real capital ($\ln K_t$) are used as dependent variables. It implies that there are three cointegration vectors and we may reject the hypothesis of no cointegration. This confirms long run relationship between agriculture growth ($\ln Y_t$), financial development ($\ln F_t$), real capital ($\ln K_t$) and labor ($\ln L_t$) in case of Pakistan.

Table-5: Results of ARDL Cointegration Test

Variable	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
F-statistics	9.420*	5.756***	6.2760***	4.7077
Critical values[#]	1 per cent level	5 per cent level	10 percent level	
Lower bounds	7.397	5.296	4.401	
Upper bounds	8.926	6.504	5.462	
Diagnostic tests				
R^2	0.7528	0.7208	0.8232	0.5608
$Adj-R^2$	0.5762	0.5214	0.6969	0.2094
F-statistics	4.2639*	3.6156*	6.5195*	1.5962
Note: *, ** and *** show the significance at 1%, 5% & 10% level respectively. Critical bounds are generated by Turner (2006).				

To test the robustness of long run relationship, we also applied Johansen and Juselius (1990) approach to cointegration. The results are reported in Table-6 validate that there is a long run relationship found between the variables. It implies that long run results are effective and robust.

Table-6: Results of Johansen Cointegration Test

Hypothesis	Trace Statistic	Maximum Eigen Value
$R = 0$	75.3821*	39.7317*
$R \leq 1$	35.6504	18.3555
$R \leq 2$	17.2949	14.4507
$R \leq 3$	2.8441	2.8441
Note: * shows the significant at 1 per cent level.		

The coefficients of long run results are reported in Table-4 which specify the positive and significant impact of financial development on agricultural growth. All else same, a 1 per cent increase in financial development will fuel agriculture growth by 0.27 percent significantly. The positive and significant effect is also found of capital and labor on agriculture growth. All else is same, a 0.22 percent agriculture growth is linked with a 1 per cent increase in capital while a 1 percent increase in labor force will enhance agriculture growth by 1.18 percent. It implies that labor force plays a significant role and cogitates as an important factor of production in agriculture sector.

Table-7: Long-Run and Short-Run Analysis

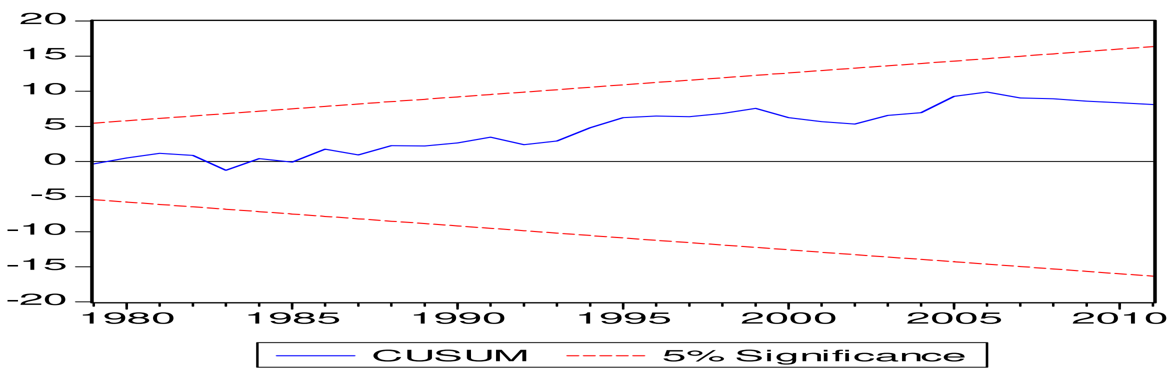
Dependent Variable = $\ln Y_t$		
Long-Run Results		
Variable	Coefficient	T-Statistic
Constant	6.1413*	16.2168
$\ln F_t$	0.2712*	3.1377
$\ln K_t$	0.2274*	5.6309
$\ln L_t$	1.1810*	10.8349
Short-Run Results		
Variable	Coefficient	T-Statistic
Constant	0.0374*	6.1563
$\ln F_t$	-0.0471	-0.6406
$\ln F_{t-1}$	0.1035**	2.3978
$\ln K_t$	0.0394**	2.0457
$\ln L_t$	-0.1608***	-1.8858
ECM_{t-1}	-0.1183**	-2.0185
Diagnostic Tests		
Test	F-statistic	Prob. Value
$\chi^2 NORMAL$	1.4137	0.4931
$\chi^2 SERIAL$	1.8966	0.1670
$\chi^2 ARCH$	0.0659	0.8110
$\chi^2 WHITE$	0.6507	0.8240
$\chi^2 REMSAY$	0.1352	0.7154
Note: *, ** and *** denote the significant at 1, 5 and 10 per cent level respectively.		

In short run, empirical evidence shows that financial development has inverse and statistically insignificant effect on agriculture growth in the current period but current financial development stimulates agriculture development in future period. This implies that financial development takes time to benefit agriculture sector's development. The effect of capital and labor is positive and significant on agriculture growth in short span of time. The results pointed out that the estimate of lagged error correction term (ECM_{t-1}) is found to be statically significant with negative sign at 5 per cent level of significance. The significance of lagged error correction term i.e. ECM_{t-1} further confirms the established long run relationship between the series.

Furthermore, the significance of ECM_{t-1} with negative sign indicates the speed of adjustment from short run towards long span of time. The coefficient of ECM_{t-1} implies that deviations in short run towards long run is corrected by 11.86 per cent per year which is considered low. This low speed of adjustment in agriculture growth is due to high cost of production. The cost of production is affected by rising prices of inputs are used to enhance agriculture sector's production in Pakistan.

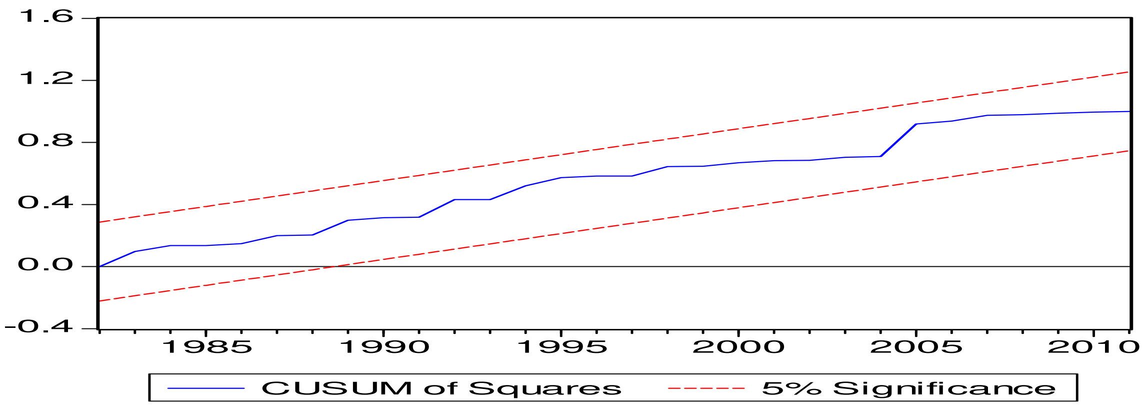
Hansen (1992) suggested in testing the stability of long run parameters to avoid potential biasedness and misspecification of the model to be estimated. In doing so, the stability of ARDL parameters is tested by applying CUSUM and CUSUMsq tests developed by Brown et al. (1975). Furthermore, Brown et al. (1975) indicated that recursive residuals are to be less affected by small or regular changes in parameters and these changes can be detected by using these residuals.

Figure 1: Plot of Cumulative Sum of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals



The straight lines represent critical bounds at 5% significance level.

The graphs of both tests are shown in figure 1 and 2 respectively. The results show that ARDL parameters are found to be stable because graphs of CUSUM and CUSUMsq (blue lines) are within critical bounds (red lines) at 5 per cent level of significance.

The VECM Granger Causality Analysis

The existence of long run relationship between financial development, agriculture growth, capital and labor forces us to detect the direction of causality between the variables of the variables by applying VECM (vector error correction method) Granger causality framework. The direction of causal relationship between financial development, agriculture growth, capital and labor has very important policy implications to develop agriculture sector by promoting access of farmers to financial resources and adopting necessary and advance technology in agriculture sector through capitalizing agriculture sectors. The Table-8 reports the results of VECM granger causality analysis. Once variables are found to be cointegrated for long run relationship then long run as well as short run causality can be investigated. Long run causality is found by significance of estimate of lagged error correction term i.e. ECM_{t-1} following t-test statistic while joint significance of the LR test shows the short run granger causality.

Table-8: VECM Granger Causality Analysis

Variables	$\ln Y_{t-1}$	$\ln F_{t-1}$	$\ln K_{t-1}$	$\ln L_{t-1}$	ECM_{t-1}	R^2	D. W	F-statistic
$\ln Y_t$	______	3.5471** [0.0414]	3.5051** [0.0429]	1.2287 [0.3070]	-0.1271*** [-1.8923]	0.3573	2.1774	2.0850***
$\ln F_t$	7.6611* [0.0021]	______	3.5311** [0.0420]	0.6792 [0.5146]	-0.4585* [-3.3076]	0.5954	2.2146	5.5187*
$\ln K_t$	3.3873**	3.6289**	______	2.7854***	-0.6866*	0.5878	1.8833	5.3491*

	[0.0472]	[0.0388]		[0.0777]	[-3.0609]			
$\ln L_t$	0.7518 [0.4802]	0.0611 [0.9804]	2.3621 [0.1115]	_____		0.2354	1.9806	1.1546
Note:								

The results reported in Table-8 reveal that the estimates of ECM_{t-1} are statistically significant with negative signs in all VECMs except labour equation. Moreover, statistical significance of ECM_{t-1} indicates shock exposed by system converging to long run equilibrium path at a slow speed for agriculture growth equation (-0.1271) and financial development equation (-0.4585) VECMs as compared to adjustment speed of capital equation (-0.6866).

This implies that in long run, there is bidirectional causality exists between agriculture growth and financial development, between financial development and capital and, between agriculture growth and capital. This suggests that government of Pakistan should develop financial development to enhance financial services in rural area on priority basis and direct the banks to provide loans to farmers at cheaper cost through loose monetary policy adopting by state bank of Pakistan (SBP). The access of farmers to financial resources at cheaper cost will enhance agriculture productivity by capitalizing agriculture sector that in resulting increases agriculture production which raises gross domestic product of the country. This rise in income of rural areas will increase the demand of financial services that in turn, increases financial development.

In short run, feedback hypothesis is found between agriculture growth and financial development and, between capital and agriculture growth. There is also bidirectional causality exists between financial development and capital. The unidirectional causal relationship is found running from labour to capital.

The Granger causality tests are inappropriate as they show the degree of feedback of one variable to another and also difficult to determine the relative strength of causality tests beyond the sample period. We applied innovative accounting approach (IAA) (variance decomposition method and impulse response function) to test the feedback and relative effectiveness of causality approaches (Shan, 2005; Shahbaz et al. 2008 and, Paul and Uddin, 2010). The combination of VDM and IRF is called innovative accounting approach (IAA)[2]. The VDM is applied to test the response of shock in the dependent variable due to occurring shocks in forcing variables in the model to be estimated. This approach is considered an alternate to IRF (graph of IRF is shown in figure-3). The impulse response function describes how much of the predicted error variance for any variable is accounted for by innovative shocks throughout each independent variable in a system over various time-horizons.

Table-9 reported that agriculture growth is dominantly described by its innovative shocks i.e. 84.02 per cent while the contribution of financial development, capital and labor to agriculture growth is 12.30, 1.76 and 1.98 per cent respectively. Agriculture growth contributes 30.88 per cent to financial development and role of capital and labour is minimal. A 30.77 per cent contribution in financial development is through its own innovative shocks.

Table-9: Variance Decomposition Approach

Variance Decomposition of $\ln Y_t$:					
Period	S.E.	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
1	0.0369	100.0000	0.0000	0.0000	0.0000
2	0.0498	95.7549	2.4029	0.1164	1.7256
3	0.0603	90.9526	5.3719	0.4481	3.2272
4	0.0697	87.5853	7.6721	0.8422	3.9002
5	0.0784	85.6083	9.2112	1.1763	4.0040
6	0.0865	84.5505	10.2005	1.4158	3.8330
7	0.0941	84.0244	10.8430	1.5722	3.5603
8	0.1014	83.7878	11.2757	1.6684	3.2679
9	0.1082	83.7048	11.5807	1.7247	2.9897
10	0.1147	83.7021	11.8052	1.7554	2.7371
11	0.1210	83.7410	11.9765	1.7699	2.5124
12	0.1270	83.8009	12.1105	1.7742	2.3142
13	0.1327	83.8707	12.2173	1.7721	2.1397
14	0.1382	83.9442	12.3037	1.7658	1.9861
15	0.1436	84.0180	12.3742	1.7570	1.8506
Variance Decomposition of $\ln F_t$:					
Period	S.E.	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
1	0.0981	0.63648	99.3635	0.0000	0.0000
2	0.1261	10.2664	80.5040	0.4453	8.7842
3	0.1496	19.02955	61.5439	0.4104	19.0160

[2] Shan (2005) provided details on innovative accounting approach

4	0.1687	24.2330	49.4351	0.3245	26.0072
5	0.1829	27.0536	42.3738	0.3299	30.2424
6	0.1931	28.6057	38.1984	0.3876	32.8081
7	0.2002	29.4977	35.6297	0.4538	34.4186
8	0.2052	30.0335	33.9816	0.5100	35.4747
9	0.2088	30.3664	32.8838	0.5525	36.1971
10	0.2114	30.5773	32.13002	0.5835	36.7090
11	0.2132	30.7111	31.6005	0.6061	37.0820
12	0.2146	30.7947	31.2228	0.6228	37.3595
13	0.2156	30.8448	30.9507	0.6355	37.5689
14	0.2163	30.8724	30.7537	0.6452	37.7285
15	0.2168	30.8852	30.6106	0.6528	37.8513
Variance Decomposition of $\ln K_t$:					
Period	S.E.	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
1	0.2454	13.8142	2.2326	83.9531	0.0000
2	0.2855	22.2811	2.8868	72.8524	1.9795
3	0.3003	26.4929	3.9099	67.0360	2.5610
4	0.3057	28.5862	4.1423	64.7763	2.4950
5	0.3084	29.7209	4.0795	63.6354	2.5640
6	0.3109	30.4314	4.0665	62.6547	2.8473
7	0.3135	31.0062	4.1637	61.6413	3.1886
8	0.3164	31.5973	4.3301	60.5956	3.4768
9	0.3194	32.2655	4.5237	59.5315	3.6790
10	0.3225	33.0194	4.7223	58.4556	3.8026
11	0.3257	33.8442	4.9170	57.3723	3.8663
12	0.3290	34.7196	5.1056	56.2873	3.8873
13	0.3324	35.6264	5.2881	55.2066	3.8787
14	0.3359	36.5492	5.4647	54.1361	3.8498
15	0.3393	37.4762	5.6354	53.0810	3.8072
Variance Decomposition of $\ln L_t$:					
Period	S.E.	$\ln Y_t$	$\ln F_t$	$\ln K_t$	$\ln L_t$
1	0.0431	12.9967	0.1248	3.5997	83.2786
2	0.0579	10.6105	1.6404	2.0789	85.6701
3	0.0662	8.5525	2.6565	2.3533	86.4376
4	0.0713	7.3910	3.2808	2.9562	86.3718
5	0.0748	7.1633	3.7187	3.4817	85.6360
6	0.0775	7.7255	4.0888	3.8604	84.3251
7	0.0799	8.9033	4.4469	4.1137	82.5359
8	0.0820	10.5452	4.8146	4.2752	80.3647
9	0.0841	12.5294	5.1949	4.3710	77.9045
10	0.0862	14.7563	5.5818	4.4189	75.2428
11	0.0883	17.1426	5.9666	4.4309	72.4597
12	0.0904	19.6177	6.3413	4.4155	69.6253
13	0.0926	22.1228	6.6999	4.3795	66.7976

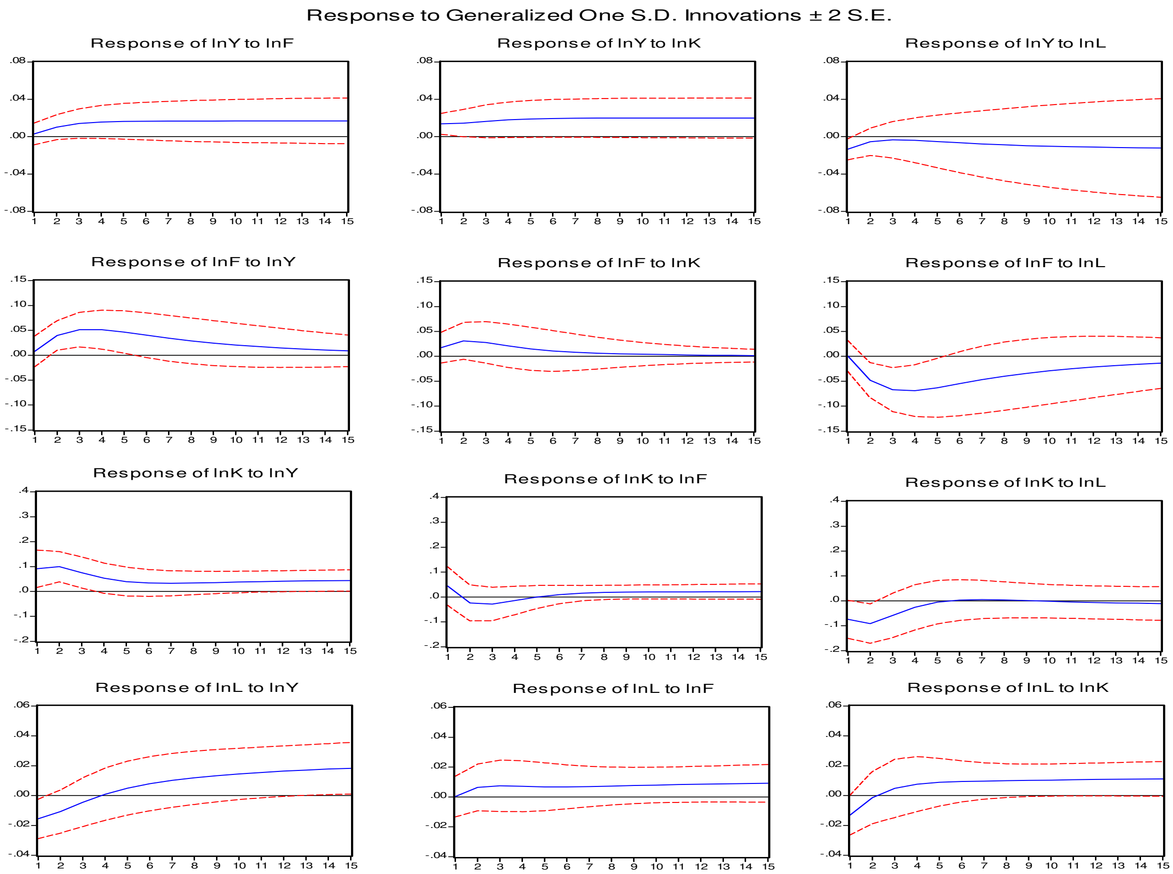
14	0.0948	24.6111	7.0384	4.3280	64.0223
15	0.0970	27.0465	7.3548	4.2654	61.3331

Agriculture growth explains capital by 37.47 per cent and a major portion of capital is explained through its innovative shocks i.e. 53.08 per cent while contribution of labour to capital is 3.80 per cent. Lastly, a 61.33 per cent portion of labour is explained by itself and agriculture growth explains labour by 27.04 per cent. The contribution of financial development and capital to labor is negligible i.e. 7.35 and 4.26 respectively.

The overall results pointed out bidirectional causal relationship between agriculture growth and financial development and findings are found to be consistent with VECM Granger causality analysis. It implies that causality results are reliable and robust. Furthermore, agriculture growth Granger-causes capital and labor significantly.

This is the VAR model that provides the basis of the impulse response functions and time horizons. These are used to test the response of the one variable to the other variables of interest. The impulse response function (IRF) traces out the effect of an innovative shock of an endogenous variable on the other variables that the VAR system accommodates. The relative importance of innovative shocks is informed through variance decomposition method (VDM). We applied the generalized forecast error variance decomposition approach proposed by Koop et al. (1996), and Pesaran and Shin (1999) and empirical results provided through this approach are not sensitive to the order of the variables included in a VAR model.

Figure-3: Impulse Response Function



The diagram of impulse response function shows that positive response exists in agriculture growth due to innovations in financial development started from 1st to 15th time horizon. A same inference can be drawn for capital and agriculture growth while response of agriculture growth from labour is negative. Growth in agriculture sector positively contributes to financial development. This implies bidirectional causality between agriculture growth and financial development. Financial development is affected positively by shocks in capital till 8th time horizon after this, effect has died out while impact of labour on financial in negative implies no contribution of labor through shocks to financial development. The positive response found from agriculture growth to capital and same inference can be drawn between agriculture growth and labor after 3rd time horizon. Lastly, response of labour is found to be positive due to innovations in financial development and capital after 2nd time horizon.

V. Conclusion and Policy Implications

The use of finance through informal as well as formal sources is a worldwide phenomenon in rural financial markets. According to the IFAD (2001) report on developing economies, farmers prefer informal financial markets over formal financial markets to obtain agri-loans. Easy access to financial resources facilitates agriculture growth by improving agricultural productivity. The rise in agricultural production promotes the overall economic growth by supporting the other sectors of country such as manufacturing, industrial and services sectors.

This study investigates the relationship between financial development and agriculture growth employing Cobb-Douglas function which incorporates financial development as an important factor of production using annual data for the period 1971-2011. The ARDL bounds testing approach to cointegration is applied to examine long run relationship between financial development and agricultural growth incorporating capital and labour. The direction of causality is detected by VACM Granger causality test and robustness of causality results is tested through innovative accounting approach (IAA).

Our findings confirm that the variables are cointegrated for equilibrium long run relationship between agriculture growth, financial development, capital and labor. The results indicate that financial development has a positive effect on agricultural growth. This implies that financial development plays its significant role in stemming agricultural production and hence agricultural growth. The capital use in the agriculture sector also contributes to the agricultural growth. The positive and dominant effect of labour on agricultural growth is found implying that the rural labor force is also an important factor in stimulating agriculture production. The Granger causality analysis reveals bidirectional causality between agricultural growth and financial development, financial development and capital, and agricultural growth capital in agriculture sector. The robustness of these results is confirmed by innovative accounting approach (IAA).

Our findings suggest that although financial development has a positive effect on agricultural growth, government must give due priority to agriculture sector to improve its productivity by enhancing the access of rural population to financial resources at a cheaper cost to capitalize agriculture sector and to improve the contribution of agriculture sector to overall economic growth. The agri-based business enterprises should be encouraged by launching new financial reforms especially for agriculture sector. The government must pay her attention to lower the prices of agri-based products i.e. seeds, fertilizers, electricity, oil or diesel and, research and development activities should be encouraged to promote agriculture production. This will not only enhance the agriculture's share in gross domestic product (GDP) but also the productivity of other sectors such as industry and services. The most important road infrastructure from rural areas to agri-markets should also be developed. This study has a potential to include other variables such as agriculture exports or imports, agri-inputs prices, inflation, formal and informal finance, foreign income and electricity prices to investigate causal relationship between financial development and agricultural growth. The true picture of causal relation between the variables has important policy implications for policy making authorities to stimulate agricultural growth.

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