Institutional credit and agricultural production nexus

Sial, Maqbool Hussain; Awan , Masood Sarwar and Waqas, Muhammad
Department of Economics, University of Sargodha, Pakistan

2011

INSTITUTIONAL CREDIT AND AGRICULTURAL PRODUCTION NEXUS

Maqbool Hussain Sial
Professor Department of Economics, University of Sargodha, Pakistan.

Email: maqsial@yahoo.com

Masood Sarwar Awan

Assistant Professor Department of Economics, University of Sargodha, Pakistan.
Email: awan811@hotmail.com

Muhammad Waqas

Graduate Student Department of Economics, University of Sargodha, Pakistan.
Email: econmomist 147 @hotmail.com

ABSTRACT
Credit plays an important role in the development of agriculture sector. It capitalizes farmers to adopt new technologies. It helps smooth consumption by providing Working capital and reduces poverty in the process. Both formal and informal lenders are active in rural credit market of Pakistan. There is a need to highlight the relationship between institutional agricultural credit and agricultural production. Time series data for the period of 1973-2009 was used. The study utilized Johansen and Juselius (JJ) cointegration approach and Granger causality test to explore the long-run equilibrium relationship and the possible direction of causality between availability of institutional agricultural credit, labor force availability, cropping intensity, water availability and agricultural production. Result shows the long run relationship among variables. Granger causality test shows the uni-directional causality among institutional agricultural credit and agricultural production and among water availability and agricultural production. The bi-directional causality was found among availability of labor force & cropping intensity and among water availability & cropping intensity.
Keyword: Institutional credit, Agricultural credit, Pakistan

INTRODUCTION

Agriculture sector continues to play an important role in Pakistan's economy. It is the second largest sector, contributes 21 percent of GDP and remains largest employer by absorbing 45 percent of the country's total labor force. Almost 62 % population resides in rural area and depends directly or indirectly on this sector for their livelihood. Despite its critical importance Pakistan's agriculture sector is confronting many challenges like water and inputs shortage, rising prices of inputs like seeds, fertilizers, pesticides, electricity and fuel. Without major investment in Agriculture sector, it is unclear how prepared Pakistan would be to tackle problem of low productivity along with ever increasing food requirement. These issues demand the introduction of latest technologies in Agriculture sector. Introduction of green revolution during 60's provided a great opportunity to tackle these issues, however the effect on employment and income distribution of the various technological innovations in Pakistani agriculture has varied with their diffusion among different classes of farmers, as the input of tube wells, fertilizers and new seeds require a considerable amount of investment on the part of

farmers. The ability to reap the benefit of new technological breakthroughs thus depends on the ability to mobilize enough funds either through saving or borrowing for undertaking such investments.

Availability of credit is the necessary condition for any investment and for the growth of any sector. Specially, the small farmers face serious capital constraints and seem to be unable to live with agriculture sector. They require credit for seeds, fertilizers, and for fuel that's why farmers barrow's money from formal and informal sectors. Formal lenders are Zarai Taraqiati Bank Ltd. (ZTBL), Commercial Banks and Punjab Provincial Cooperative Bank (PPCBL). Informal lenders are village shop keepers, commission agents, and relatives etc. Formal lenders require certain securities for loans, while informal sectors demands no collateral for loan.

Since independence Pakistan adopted a multi-dimensional approach of agricultural credit that progressed in a steady manner. Taccavi loans were the source of formal credit whereas; cooperative societies disbursed cooperative loans, since independence in 1947. In response to natural epidemics like flood, government advanced taccavi loans. Due to minor rate of disbursements, taccavi loans have not a significant impact in achieving the agricultural growth targets. On the other side cooperatives credit has a long and a somewhat chequered history (Qureshi and Shah 1992). These loans are designed to meet the needs of farmers' consumptions expenditures. They have no link with the purchase of farm inputs and farm development. Agricultural Development Finance Corporation and Agriculture Bank were formed in 1952 and 1957 respectively. In 1961, these institutions were merged into Agricultural Development Bank, which is now known as ZTBL. During 1976, with the establishment of Federal Bank for Cooperatives the aims of cooperatives loans have changed. After the establishment of this institution (disbursed the loans with the help of State Bank of Pakistan) cooperatives loans significantly help the farmers in purchasing inputs. Prior to 1972, commercial banks are unwilling to lend for agricultural sector. After the 1972 banking reforms commercial banks started to play their role in agricultural credit. This reform allocated a target to commercial banks to widen their portfolio for agricultural loans. Along with commercial banks this reform also gives a target to SPB to disburse the credit to small farmers and remove the constraints that small farmers face in the process of loan. In order to estimate the actual requirement of agricultural credit Agricultural Credit Advisory Committee was established.

SBP adopt certain measures to make credit financing more beneficial. State Bank assembles the district wise agricultural credit data, which helps the policy makers to put into practice such policy that is beneficial in reality. SBP advises banks to open 20% of their branches in rural areas. SBP is trying to increase the agricultural finance up to 3.3 million people. Due to the introduction of new 14 domestic banks for agricultural credit, the share of credit disbursement of private banks has increased. Total credit disbursement was at its highest position during 2007-08 that was 211,560.66 million rupees and distributed the lowest credit during 2000-01 that was 44,790.40 million rupees. ZTBL was at the top in the credit disbursement during 2008-09 distributed 45,399.87 million rupees, while domestic private banks and PPCBL distributed 18,557.24 and 3,538.89 million rupees respectively. With the passage of time, share of ZTBL, domestic banks, PPCBL and commercial bank's share increased but in 2008-09 all banks reduced their agricultural credit disbursement.

Table 1.1: Total Disbursement of Credit by Institutions from 1990-2009.

(Million rupees)

Years	Total credit disbursement	ZTBL	Domestic private banks	PPCBL	Commercial banks
1990-91	14,915.29	8,323.95	-	3,017.45	3,517.59
1991-92	14,479.31	6,996.44	-	3,247.01	4,179.56
1992-93	16,198.11	8,643.40	-	2,978.00	4,525.91
1993-94	15,674.05	8,989.26	-	2,621.49	4,063.30
1994-95	22,373.27	14,575.74	-	3,756.74	4,040.79
1995-96	19,187.31	10,339.27	-	3,803.38	5,044.66
1996-97	19,547.67	11,687.11	-	4,928.93	4,429.43
1997-98	33,392.30	22,353.60	-	5,439.93	6,109.70
1998-99	42,852.00	30,175.96	-	5,951.23	7,236.00
1999-00	39,687.60	24,423.89	-	5,124.20	9,312.50
2000-01	44,790.40	27,610.20	-	5,124.20	12,056.00
2001-02	52,314.49	29,108.01	592.82	5,127.54	17,486.12
2002-03	58,915.27	29,270.17	1,421.11	5,485.39	22,738.60
2003-04	73,445.86	29,933.07	2,701.80	7,563.54	33,247.45
2004-05	108,732.91	37,408.84	12,406.82	7,607.47	51,309.78
2005-06	137,474.31	47,594.14	16,023.38	5,889.40	67,967.40
2006-07	168,830.46	56,473.05	23,976.16	7,988.06	80,393.19
2007-08	211,560.66	66,938.99	43,940.92	5,931.45	94,749.29
2008-09	151,860.60	45,399.87	18,557.24	3,538.89	74,364.60

Source: Pakistan Economic Survey 2008-09

There is a need to explore the thing that whether the efforts done by SBP, Government of Pakistan and other institutions regarding the mobility of agricultural credit have impacts on agricultural credit or not? To highlight this thing this study use time series data of Pakistan for the period of 1973-2009. JJ approach of cointegration and Granger causality test are applied to find out the long run relationship among variables and possible direction of causality.

The rest balance of paper is designed as: part two explains the data and methodology; part three investigates and interprets the empirical results. Finally, part four presents the conclusions and also provides some policy implications.

DATA AND METHDOLOGY

The study used the secondary time series data for the period of 1973-2009, collected from various publications of government of Pakistan and from ZTBL and other credit

institution records. Dependant variable is agricultural gross domestic product, a proxy variable for agricultural production (AGRI_PRO). Availability of water (WTR_AVL), agricultural credit (CRDT), agricultural labor force (LBR_FRC) and cropped area (CRP_INT) are independent variables. All the variables are treated in real terms. Augmented Dicky Fuller and Phillips Perron unit root tests are employed in order to check the stationarity of the variables.

Engle and Granger (1987) argued that, financial and economic series is not stationary. When all the variables are stationary in their 1st difference, this permits the use of Johansen and Juselius (JJ) cointegration procedure to find out the long run relationship among variables. In Economical language, two variables are co-integrated if they have a long-term association among them. The present study uses JJ cointegration method because all the variables are of same order. The JJ method of cointegration is can also applied to a set of variables containing possibly a mixture of I(0) and I(1) [Pesaran and Smith (1998) and Pesaran *et al.* **(2001)**]. The common form of the vector error correction model is as follows:

$$Z_t = \sum_{i=1}^{p-1} \psi Z_{t-1} + \alpha_\circ + \eta_t$$

This can also be expressed as:

$$\Delta Z_t = \sum_{i=1}^{p-1} \Pi_i \Delta Z_{t-k} - \partial Z_{t-k} + \alpha_1 + \varepsilon_t$$

Where

$$\prod_i = -I + \partial_1 + \partial_2 + ... + \partial_t$$

$$i = 1,2,3,... k-1 \text{ and } \partial = I - \partial_1 - \partial_2 - .... \partial_k$$

Where p is symbolizes total number of variables used. The matrix $\prod$ confines the long run connection among the p-variables. For JJ cointegration method we utilize the Trace test, which is based on the appraisal of $H_\circ(r-1)$ against the null hypothesis of $H_\circ(r)$, where r shows number of cointegrating vectors. The cointegration test offers a systematic statistical structure for examining the long run association among variables.

RESULTS AND DISCUSSION

The key concept underlying time series processes is that of stationarity. To keep at bay the spurious results the series must be stationary (Asterio, 2006). A stationary series has the following three characteristics:-

- Exhibits mean reversion in that it fluctuates around a constant long run mean.
- Has a finite variance that is time invariant
- Has a theoretical correlogram that diminishes as the lag length increases.

In stationary time series shocks will be transitory and overtime their effects will be eliminated as the series revert to their long run mean values, on the other hand non stationary time series will necessarily contain permanent components.

The study use ADF and PP unit root tests. All the variables are stationary at first difference in ADF test, except credit variable while, in PP all the variables are stationary at first difference.

Table 3.1: Results of Unit root tests.

	ADF				PP			
Variables	Level	P*	Difference	P*	Level	Q*	Difference	Q*
With trend								
AGRI_PRO	-0.858	3	-4.515***	2	-0.584	2	-5.147***	2
CRDT	-1.342	1	-2.784	1	-2.304	1	-8.870***	5
LBR_FRC	-2.747	4	-4.522***	1	-3.218*	4	-7.297***	4
WTR_AVL	-1.271	5	-3.659**	2	-1.561	6	-6.420***	6
CRP_INT	-2.683	2	-4.230***	1	-2.983	5	-7.198***	5
Without trend								
AGRI_PRO	1.180	1	-4.594***	2	1.276	2	-4.216***	5
CRDT	-1.627	2	-2.446**	1	-2.406	5	-8.713***	1
LBR_FRC	-1.910	1	-4.542***	1	-2.655	6	-7.981***	2
WTR_AVL	-1.912	3	-3.824***	2	-2.515	4	-6.356***	4
CRP_INT	-2.775	1	-4.949***	3	-3.394	2	-7.209***	6

Notes:.P* shows the maximum lag length, as determined by using AIC. Under PP test Q* shows Newey-West Bandwith, as determined by Bartlett-Kernel.
*** shows 1% significance level; ** shows 5% significance level.

After investigation the unit root of data the next step is to find out the long run relationship among variables. JJ cointegration approach is used because all the variables are *I(1)*. In JJ approach first step is to set the lag length. Based on the values of SBC and AIC this study set the lag length of order two because at order two both criterion has low values.

Table 3.2: Lag length selection criterion

Order	LL	AIC	SBC	LR test	Adjusted LR
0	-1150.7	-1155.7	-1159.7	389.6817[.000]	270.6123[.000]
1	-988.0259	-1018.0	-1051.8	64.2706[.000]	44.6324[.009]
2	-955.8906	-1010.9	-1041.4	----	----

* AIC = Akaike Information Criterion SBC = Schwarz Bayesian Criterion

The model with unrestricted intercept and no trend is selected, by using Pantula Principal. Both Eigen value and Trace statistic reject the null hypothesis of no Cointegration because the value of trace test (106.57) is grater then 5% and 10% critical values. Results reveled that there are two cointegrating vector, based on the Eigen values and Trace statistics.

Table 3.3: Johansen Maximum Likelihood Test for Cointegration

Hypotheses	Trace test	5% critical values	10% critical values	Hypotheses	Max-Eigen Statistic	5% critical value	10% critical values
$R = 0$	106.578	70.490	66.230	$R = 0$	40.558	33.640	31.020
$R \leq 1$	66.020	48.880	45.700	$R = 1$	32.764	27.420	24.990
$R \leq 2$	33.255	31.540	28.780	$R = 2$	16.829	21.120	19.020
$R \leq 3$	16.426	17.860	15.750	$R = 3$	10.917	14.880	12.980
$R \leq 4$	5.509	8.070	6.500	$R = 4$	5.509	8.070	6.500

Now we explore the thing that there is a long run relationship among said variables. The next step is to find the short run dynamics among the variables. Error correction mechanism is used for short run dynamics, in which error correction term shows the speed of convergence towards equilibrium. It is significant and negative in sign. The speed of correction towards equilibrium depends upon the value of error correction term. Big value shows the slow speed of adjustment towards equilibrium and vice versa. Most of the variables are statistically insignificant, except agricultural labor force and error correction term. Negative sign of agricultural labor force depicts that as the agricultural labor force increases the agricultural production decreases. Durbin-Watson statistic shows that the model has no autocorrelation while, F-statistic pointed the good fit of the model.

Table 3.4: ECM regression results

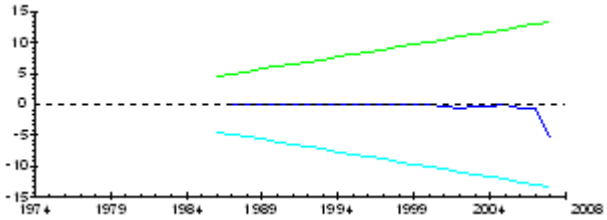
Variables	Coefficients	Std. Error	Prob-value
Constant	-0.171	0.284	0.552
ΔCRP_INT	0.133	0.650	0.839
ΔWTR_AVL	-0.261	0.560	1.000
ΔCRDT	0.042	0.065	0.525
ΔLBR_FRC	-0.486	0.342	0.167
ΔECM(-1)	-0.047	0.038	0.225
R-Squared	0.290	Adjusted R-Squared	0.113
S.E. of Regression	0.038	DW-statistic	1.995
Log-likelihood	70.952	F-stat	4.639 [0.000]

Note: Agricultural production is dependant variable.

Parameter consistency is check by using Cumulative Sum and Cumulative Sum of Square tests, proposed by Brown et al. (1975). Following graphs shows the stability of model for whole sample because the residuals are within 5% critical bonds.

Fig 3.1: Cumulative Sum of Recursive Residual

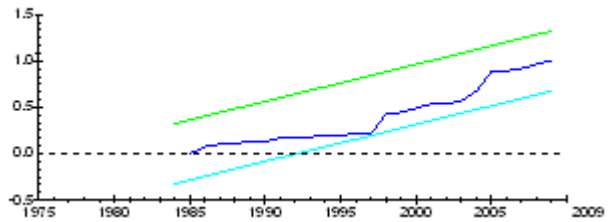
Plot of Cumulative Sum of Recursive Residual



The straight line represent critical bonds at 5% significance level

Fig 3.2: Cumulative Sum of Square Recursive Residual

Plot of Cumulative Sum of Square Recursive Residual



The straight line represent critical bonds at 5% significance level

In order to check the possible direction of causality, Granger Causality test is used. The results reveal that there is uni-directional causality between institutional agricultural credit and agricultural production, which means that availability of institutional agricultural credit cause the increase in agricultural production. There is also uni-directional causality among water availability and agricultural production, while there are bi-directional causalities among availability of labor force and cropping intensity and among water availability and cropping intensity.

Table 3.5: Results of Granger Causality test.

Pair wise Granger Causality Tests			
Null Hypothesis:	F-Statistic	Prob.	Conclusion
CRDT does not Granger Cause AGRI_PRO	15.3792	0.000	CRDT → AGRI_PRO
AGRI_PRO does not Granger Cause CRDT	2.85967	0.099	
CRP_INT does not Granger Cause AGRI_PRO	1.67056	0.204	CRP_INT…AGRI_PRO
AGRI_PRO does not Granger Cause CRP_INT	0.89457	0.350	
LBR_FRC does not Granger Cause AGRI_PRO	3.78783	0.059	LBR_FRC…AGRI_PRO
AGRI_PRO does not Granger Cause LBR_FRC	2.43575	0.127	
WTR_AVL does not Granger Cause AGRI_PRO	3.96647	0.005	WTR_AVL → AGRI_PRO
AGRI_PRO does not Granger Cause WTR_AVL	0.4342	0.836	
CRP_INT does not Granger Cause CRDT	0.00233	0.961	CRP_INT…CRDT
CRDT does not Granger Cause CRP_INT	0.81738	0.372	
LBR_FRC does not Granger Cause CRDT	0.24152	0.626	LBR_FRC…CRDT
CRDT does not Granger Cause LBR_FRC	0.67381	0.417	
WTR_AVL does not Granger Cause CRDT	0.00931	0.923	WTR_AVL…CRDT
CRDT does not Granger Cause WTR_AVL	0.08315	0.774	
LBR_FRC does not Granger Cause CRP_INT	4.53964	0.040	LBR_FRC ⇄ CRP_INT
CRP_INT does not Granger Cause LBR_FRC	6.52001	0.015	
WTR_AVL does not Granger Cause CRP_INT	15.3724	0.000	WTR_AVL ⇄ CRP_INT
CRP_INT does not Granger Cause WTR_AVL	3.9808	0.003	

CONCLUSION AND POLICY IMPLICATIONS

Credit plays an important role in the development of agriculture sector. It capitalizes farmers to adopt new technologies. It helps smooth consumption by providing Working capital and reduces poverty in the process. The purpose of this study is to check the long-run equilibrium relationship and the possible direction of causality between institutional agricultural credit, availability labor force, water availability, cropping intensity and agricultural production. Results show the long run relationship among variables. Granger causality test shows the uni-directional causality among institutional agricultural credit and agricultural production and among water availability and agricultural production. The bi-directional causality is found among availability of labor force and cropping intensity and among water availability and cropping intensity.

The study concludes that in order to improve agriculture sector it is necessary to relax stringent collateral requirements and extend the outreach so that formal lenders, such as ZTBL, PPCBL and DPBs, can reach the poor and the asset-less.

Government and private lending institutions should follow the practices of world's famous lending institutions. These institutions achieved their goals like outreach of poor clients, rural development, better recovery rates etc, successively. Bank for Agriculture and Agricultural Cooperatives Thailand (BAAC), Land Bank of the Philippines, Bank Rakyat Indonesia (BRI), Grameen Bank, Bangladesh, Banruaral S.A Guatemala, ACLEDA Bank Cambodia have achieved their targets due to effective implementation of their policies. Their recovery rates are very high, lending is almost collateral free. In order to avoid risk they have introduced "Built in insurance system".

REFERENCES

Agricultural Development Bank of Pakistan. Agricultural Credit Indicators, Islamabad: Central Information Department, MIS Division.

Agricultural Statistics of Pakistan 2004-05. Islamabad: Economic Wing, Ministry of Food, Agriculture and Livestock.

Dickey, D. and Fuller, V. (1979). Distribution of Estimators for Autoregressive Time Series with a Unit Root. Journal of the American Statistical Association, 84:427-431.

Dickey, D. and Fuller, V. (1981). Likelihood Ratio Statistics for Autoregressive Time Series with a Unit Root. Econometrica, 49:1057-1072.

Handbook on Best Practices in Agri/Rural Finance (2009). Agricultural Credit Department . State Bank of Pakistan

Iqbal, M., Ahamad, M. and Abbas, K. (2003). The Impact of Institutional Credit on Agricultural Production in Pakistan. The Pakistan Development Review 42(2), 469-485.

Johansen, S. (1988). Statistical Analysis of Cointegration Vectors. Journal of Economic Dynamics and Control, 12: 231-254.

Johansen, S. and Juselius, K. (1990). Maximum Likelihood Estimation and Inference on Cointegration - With Application to the Demand for Money. Oxford Bulletin of Economics and Statistics, 52:169-210.

Malik S.J. (1999), Poverty and Rural Credit: The Case of Pakistan, Pakistan Institute of Development Economics.

Malik, S.J. (1989). The Changing Source Structure and Utilization Patterns of Rural Credit in Pakistan, Washington, D.C.: International Food Policy Research Institute, July, Mimeographed).

Malik, S.J. (1990). Report on the Benchmark Credit Survey. Washington, D.C.: International Food Policy Research Institute. (Report).

Malik, S.J. (1991). Report On the Bench Mark Credit Survey. Washington D.C.: International Food Policy Research Institute.

Malik, S. J. (1999). Poverty and Rural Credit: The Case of Pakistan. Pakistan Institute of Development Economics, Islamabad.

Malik, S.J., Mohammad, M. and Manzoor, G. (1991). The Role of Institutional Credit in the Agricultural Development Bank of Pakistan. The Pakistan Development Review 30:4

Malik, S.J. (1992). Credit Constraints and Household Borrowing Behavior: Impact on Household Consumption and Fertilizer Use in Selected Areas of Rural Pakistan.

Malik, S.J. (2005). Agriculture Growth and Rural Poverty: A review of the evidence, Pakistan Resident Mission working paper No. 2. Islamabad: ADB.

Qureshi, S.K. and Akhtiar H.S. (1992). A Critical Review of Rural Credit Policy in Pakistan. The Pakistan Development Review 31(4), 781-801.

Sial, M.H. and Carter, M.R. (1996). Financial Market Efficiency in an Agrarian Economy: Microeconometric Analysis of the Pakistani Punjab. The Journal of Development Studied 32(5), 771-798.

Sial, M.H., Awan, M.S. & Waqas, M. (2011). Role of Institutional Credit on Agricultural Production: A Time Series Analysis of Pakistan. International Journal of Economics and Finance, 3:126-132.

Zuberi, H.A. (1989). Production Function, Institutional Credit and Agricultural Development in Pakistan. The Pakistan Development Review. 28(1), 43-56.