Impact of Agriculture Growth on Poverty: A Co-integration Analysis for Pakistan

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Abstract

Poverty is out of control in the rural areas of the Pakistan, where people are in a state of deprivation with regards to incomes, clothing, housing, health care and education facilities. According to economics survey 2009-10, 60 percent of the population of Pakistan living in rural areas and is directly or indirectly depends on agriculture for their income. Agriculture sector of Pakistan contributes in GDP is approximately 22 percent while it provides employment at least 45 percent of the total population. The study analyzed the impact of agriculture growth on poverty reduction in Pakistan extracting 31 time series annually observations. The study employed Johansen co integration methodology to test for the existence of a long run relationship between variables. The study concluded that agriculture growth, Employment in Agriculture, GDP, and Trade Openness has negative and significant impact on poverty in long run. To alleviate poverty, it is suggested that Pakistan enhance the productivity of the agriculture sector through the provision of a series of inputs including provision of easy credit to the small farmer, availability of quality fertilizers, pesticides, and by farmer education.

Key words: Agriculture Growth, GDP, Trade Openness, Employment, Poverty, Pakistan, unit root, co-integration, Error Correction

Introduction

Agriculture sector plays an important role in economic development and poverty reduction in developing countries. Agriculture also contributes in the economic growth through the provision of food and employment. With the trade liberalization agricultural export is the important source of income in developing countries. Income of a large proportion of population depends on agriculture and agriculture growth can be a key to promote overall growth and poverty reduction. (World Bank, 2008). Globally, the poverty has been declined during the past thirty years, and credit for this achievement goes to Agriculture Growth (World Bank, 2008; Dewbre, *et al*, 2011).

Pakistan is an agrarian economy where 62% population is currently living in rural areas and directly depends on agriculture by 2010. It is also the largest sector of the economy and its share in GDP and employment is 21 percent and 45 percent respectively. Over the Past six years, In Pakistan agriculture has grown at average rate 3.7 percent per annum. During the FY 2009-10 the performance of agriculture sector has been weaker. Its target was 3.8 percent but it can grow by 2.0 percent on in FY 2009-10. (Economic Survey of Pakistan 2009-10)

Globally, about 90 percent of the developing world's poor people lived in Asia or Sub Saharan Africa. Less than 1 percent of the poor lived in the Middle East and North Africa and

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7 percent live in Latin America and the Caribbean. At the beginning of the twenty first century, over 1.2 billion people are living in extreme poverty, subsisting on less than 1$ a day. This proportion has fallen from 32 percent in 1987 to 25 percent in 1998 (World Bank 2000). Food and Agriculture Origination (FAO) confirms that the number of the people at world level reached 963 million, or approximately 15 percent of the estimated of the world population. This represents an increase of 142 million over the figure for 1990-92. Poverty is measured by three methods:

1) Head Count Ratio: it is proportion of population below the national or international poverty line.
2) Poverty gap ratio: it is measure of poverty obtained by multiplying head count by the average distance at which the poor are from the poverty line.
3) Severity of poverty measure: where the weight given to each poor person is relative to the square of the income loss of the poor from the poverty line.

Different studies explained different phenomenon with respect to Agriculture Growth, Trade openness and poverty reduction. Country Partnership Strategy (CPS) progress report for Pakistan by World Bank (2011) shows that, poverty in Pakistan experienced a decreasing trend as 34.5% since 2001 and 17.2% in 2008. It is the largest sector of Pakistan with respect to employment but due to lack of studies on this topic there is a need to explore this issue in further detail especially for Pakistan.

The purpose of this study is to examine the impact of Agriculture growth, trade openness, GDP and employment in agriculture on poverty reduction in Pakistan. The co-integration method is applied to estimate the model. Annual data from 1980-2010 is selected for analysis. Augmented Dicky Fuller test is used for stationarity check and then difference taken if necessary. These variables are not investigated in this way.

This paper will follow in the sequence. Section 2 sheds light on literature review which provides empirical evidence. Section 3 provides theoretical explanation about relationship between variables and modeling process. Section 4 contains on material and modeling. Section 5 contains on estimation results and interpretation of findings. Finally in section 6 conclusions is drawn on the basis of results.

Literature Review

Lin & Piese (2003) tried to find the relation between Agriculture Growth and Poverty reduction in Africa, Asia and Latin America. Pooled data with 121 observations has been used. Causal chain model has also been used on this data. Findings of the study indicate that it has negatively related to each other.

Saboor (2004) tried to find the trend analysis of rural poverty inequality and Agriculture. Time series data from 1990-2001 has been used for this purpose. Axiomatic approach was applied. The finding of the study suggested that Agriculture growth and poverty is negatively related while income inequality and poverty are positively related to each other.

Akram, *et al* (2008) tried to explore the impact of Agriculture credit on Growth and Poverty in Pakistan. Time Series data from 1975-2005 and Error Correction Model has been used to analysis between them. Result of the study shows that the availability of irrigation of water, agriculture credit, fertilizer, seed and tractors significantly impacted in reducing poverty.

Shepher & Prowse (2009) tried to explore the impact of Agriculture Growth on income poverty. Panel data has been used from (1990-2005). Gravity model approach has been used. Findings of the study show that impact of Agriculture Growth on income Poverty transmitted via prices (higher producer prices, lower food prices, higher wage).

Khan & Sattar (2010) tried to explore the impact of trade on poverty in Pakistan. Secondary Time series data is from 1973-2007has been used. Error Correction Model was used and finds a two way relationship between trade and growth. Findings of study suggested that trade and Growth are co integrated with each other. Findings of study also show that Growth has significant impact on trade but not on poverty, Trade has significant impact on Growth and Growth decreases the Poverty.

Hassin, *et al* (2010) tried to explore the relation between Agriculture Trade Liberalization, Productivity Gain and Poverty Alleviation in Tunisia. The model was applied to Tunisian data using social accounting matrix of 2001 and the 2000 household expenditures surveys and CGE modeling was used. Findings of the study show that Poverty is found to decline under Agricultural and full trade liberalization.

Christiaensen, *et al* (2010) tried to find the relation between the Role of Agriculture in Poverty Reduction in sub-Saharan Africa. Cross country data and OLS technique was applied in this paper. Findings of the study suggested that both are negatively related to each other.

Cuong (2010) tried to explore the relationship in Agriculture, Poverty and Inequality Reduction in Vietnam. Data used in this paper are from Vietnam Household Living Standard Surveys 2002 and 2004.Fixed-effects regressions have been used. The results of the study show that the production of agriculture helps to households increase per capita expenditure and per capita income by around 4.7 percent and 7.3 percent.

Modeller, *et al* (2012) tried to find the Impact of Trade Liberalization on Growth and Poverty in Ethopia. Social Accounting Matrix (SAM) data of 1999/2000 has been used. CGE Model has been applied. Findings of the study indicate that the short run impact of liberalization on poverty level was positive and in the long run impacts of instantaneous liberalization on poverty indices are decreasing in the long run.

Literature reviewed above enables us to understand the impacts of agriculture growth. And according to different scholars who analyzed the empirics of different countries, it can be proved that agriculture growth causes to decrease in poverty. In Pakistan, past studies have been estimated for the period up to 2008 by using OLS, Multi-variant regression or by co integration but in this study we will use not only variable agriculture growth but also use trade openness, employment in agriculture and GDP and we not only estimate long run relationship of these variables but also we will find short run adjustment of the coefficients for these variables.

Theoretical Framework

As the study is, supposed to measure the impact of agricultural growth on poverty. So,different studies explain that there is a significant relationship between agricultural growth and poverty. [Saboor, A. (2004), Bakhshoodeh and Zibaei (2007), Hassine, Robichaud and Decaluwe (2010), Christiaensen, Demery and Kuhl (2010)]. Channels are import to highlight the significance of the relationship of the variables. The way through which the agriculture growth affects the poverty, is explained as following:

Variables Justification

i.   Agriculture Growth

 As Agriculture Growth increases leads an increase in the number of labors yet this lead in their employment level which in turn leads a decrease in poverty. In literature Lin, Thirtle and Wiggins (2001).

Agri Growth ↑	Employment level ↑	→	Poverty ↓
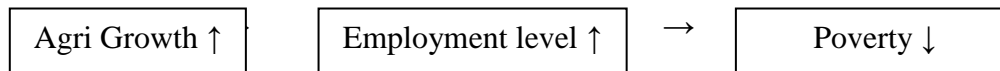
ii.   Trade Openness.

Trade Openness is also a key factor to reduce poverty. So Trade Openness leads to increase our domestic technology and our production will more efficient and then our productivity is raised then production increase after that our Agriculture Growth increase and then our Poverty reduce and trade openness is measured by sum of import and export with ration of GDP(X+M/GDP). In literature Khan and Sattar (2010).

Trade Openness	Domestic Technology ↑	Production is more efficient	Productivity ↑	Agri Growth↑
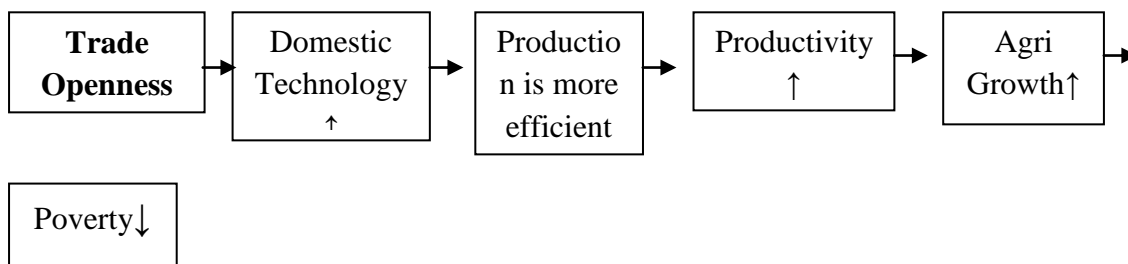
Poverty↓

iii.   Agricultural labor force

As Labor in Agriculture increase the employment level of people in Agriculture increases then their income level increases, their purchasing power increases and hence poverty decreases. In literature Brajesh, Jha (2003).

LA ↑	Employment ↑	Income ↑	Purchasing power ↑	Poverty↓
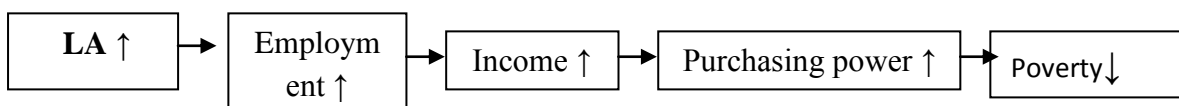
iv.   GDP:

GDP is also a key factor in reducing poverty. So as GDP increases employment opportunity for people increases hence income of the people increase and then poverty decreases. In literature Bhutto (2007).

GDP ↑	Employment Oppertunity ↑	Per capita income ↑	Poverty ↓
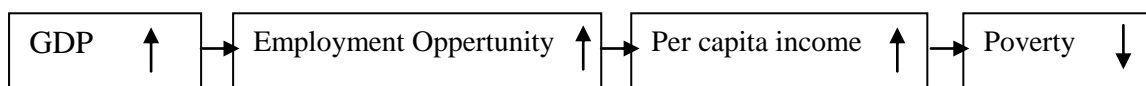
From the above discuss theoretical framework, we are able to understand the process through which agricultural growth affects the poverty. On the base of this theoretical framework and from literature we build a model and estimate it by applying co integration.

Material and Modeling

Model

Variables are selected on the base of selected studies given in literature review and time series data from 1980 to 2010 is obtained from Economic survey of Pakistan, World Development indicator, Food and Agriculture Organization and Handbook of Statistics State Bank of Pakistan. But due to unavailability of Poverty data in Pakistan we use same growth rates of some different years. For regression analysis we develop a model in which we took poverty as dependent variable and all other mentioned variables as independent

The functional form of proposed Model is:

Poverty = f (Agriculture Growth, Trade Openenss, GDP, Labour in Agriculture)

The model is:

Poverty = α + β1agrigrowth + β2tradeopenness + β3GDP + βlabourinagri + μ

Methodology

Unit Root Test

When we deal with a time series the first and primary step is to check whether the original time series is stationary or not. If we want to apply the suitable technique on the original time series then we must be conscious of the order of integration of original time series. Stationarity is also important in the context that if we apply OLS to a non-stationary time series it may results in the spurious regression as well. Unit root test was used to check stationary of time series data. To ensure the unit root in the data Augmented Dickey-Fuller (ADF) Test is used. ADF is an comprehensive form of Dickey-Fuller test. In DF test we suppose that error terms are uncorrelated but if error terms are correlated then ADF is best because it also allows for Serial Correlation to be checked. In Eviews we be able to run ADF in three different condition

i.   ADF with Intercept
ii.   ADF with trend & intercept
iii.   ADF without trend & Intercept (none)

A suitable ADF test specification should be applied according to the character of the data. The results are given below in the Table. They are computed by applying ADF test statistic on data I(0). The test confirms that all variables have a unit root problem and they are non stationary at level but stationary at their first difference, therefore, the order of integration of all variables are I(1).

Variables	Intercept only		Intercept and trend only	
	Level	First difference	Level	First difference
	Prob: value	Prob: value	Prob: value	Prob: value
Poverty	0.4602(0)	0.0010(0)***	0.6205(0)	0.0046(0) ***
AG	0.8153(0)	0.0002(0)***	0.4985(0)	0.0017(0) ***
ALF	1.000(0)	0.0057(0)***	0.9927(0)	0.0197(3)**
GDP	0.5432(0)	0.0021(0)***	0.3724(0)	0.0013(2) ***
X	0.4848(0)	0.0002(0)***	0.8616(0)	0.0012(0) ***

[*** indicates that variable are significant at 1 percent. ** indicates that variables are significant at level 5 percent.]

The results in the table reveal that the hypothesis of a unit root can't be rejected in all variables in levels. However, the hypothesis of unit root is rejected in first differences at 0.05 level of significant which indicates that all the variables are integrated of order one I(1), which means all the variables achieve stationarity only after first difference.

Lag Length Criteria:

Lag	LogL	AIC	SC
0	-538.248	37.4654	37.7011
1	-410.662	30.3905	31.8049*
2	-379.825	29.9879*	32.5811

In above table Lag selection criteria have shown. In this table AIC criteria reported that we use two lag but at the same time SC criteria reported that choose just one lag, and we choose SC criteria because Asghar, *et al*(2007), Gutierrez, *et al*(2007) and Hofman (2007) has empirically proved that SC criteria is best criteria in choosing Lag length so that's why we choose lag length 1.

Cointegration Approach

If we regress two non-stationary time series' on each other it may result in a spurious regression. If original time series is non-stationary then OLS is not a good choice for estimations. OLS is an suitable technique if all the variables are I (0) i.e. stationary at level if not one should check for the possible co-integration relationship between the original non-stationary series 'OLS is for short run relationship while co-integration suggests a long run association between the series'. If the linear combination of two time series having unit root is stationary then we can say that the two time series are co-integrated." (Gujarati: 2004).

If all the variables turn out to be stationary at their first difference i.e. I (1) then Johansen Co-integration test can also be used But if some variables are stationary at their level i.e. I (0) and some at first difference i.e. I (1) then Johansen is also not an suitable method. In such cases where variables are both I (0) and I (1) Autoregressive Distributed Lag model is an suitable technique. It uses two likelihood tests for determining the co integration relations. (Brooks (2002): Haleem *et al,* (2005): Saunders *et. al,* (2001)).

    i.   The Trace test
    ii.   The Maximum Eigen value test

Results of co integration: Unrestricted co integrating Rank test (Trace)

Null Hypothesis	Eigen value	Trace Statistics	5 percent critical value	Prob**
None*	0.849	104.437	69.818	0.000
At most 1*	0.504	49.436	47.856	0.035
At most 2*	0.443	29.095	29.797	0.060
At most 3*	0.301	12.117	15.494	0.151
At most 4	0.057	1.717	3.814	0.190

Unrestricted co-integration Rank test (Maximum Eigen value)

Null Hypothesis	Eigen value	Max-Eigen value	5 percent critical value	Prob**
None*	0.849	50.001	53.876	0.000
At most 1	0.504	20.341	27.584	0.318
At most 2	0.443	16.977	21.131	0.173
At most 3	0.301	10.399	14.264	0.187
At most 4	0.057	1.717	3.841	0.190

According to above tables both Trace test and Max Eigen values test eliminate the hypothesis of no co integration. For the elimination of null hypothesis calculated values of both trace test and max Eigen values test must go beyond their respective critical value smooth probability value must be equal to or less than 0.05. At most 1 has null hypothesis that there exists at least one co integration relation and substitute hypothesis that there are more than one co integration relations. Max Eigen values test is incapable to reject null hypothesis at most 1 which means according to max Eigen values test there is at least 1 co integration relation that exists between the variables. Trace test has rejected the null hypothesis at most 1 and at most 2 that there are at least 1 & 2 co integration relations in that order suggesting that there exist at least more than 2 co integration relations. Trace test is incapable to reject at most 2 null hypothesis thus suggests that there exists at least 2 co integration relations. Trace test is more consistent than maximum Eigen values test (Cheung and kai (1993), Liang (2006)). So according to trace test there are two co integration relationships among variables.
Normalized Equation: Normalized Co-integration Coefficient

$$\text{Poverty} = 561.34 - 9.1AG - 5.14\ GDP - 4.8TO - 0.011LA$$

The Normalized co-integration equation reveals that the Agriculture Growth and other variables have negative effect on Poverty. The Agriculture growth coefficient is 9.1and showing significant, implying in Pakistan, a one percent increase in Agriculture growth while other keep constant contributes 9.1% decrease in Poverty. Similarly, the GDP coefficient is 5.1, and showing significant, implying in Pakistan, one percent increase in GDP while other keep constant contributes 5.1% decrease in Poverty. Same as the case in Trade Openness, its coefficient is 4.8 and showing significant, implying in Pakistan that one percent increase in Trade Openness while other keep constant contributes 4.8% decrease in poverty. According to World Bank (2000), Openness helps in the eradication of poverty and in fourteen; one of

P	Constant	AG	GDP	X	LF
1.000000	-561.347	9.172	5.145	4.890	0.011
St. errors		(1.606)	(0.727)	(1.026)	(0.001)
t-ratio		5.73	7.06	4.76	7.42

the Millennium Development Goal (MDG) is that developing countries like Pakistan, must reduce poverty to its half till 2050. And same as the case of Employment in Agriculture, its coefficient value is 0.011 and showing a significant, implying in Pakistan that one unit increase in Employment in Agriculture while other keep constant contributes 0.011 unit decreases in Poverty and the values of R-square (0.63), and F-statistics (11.47) shows that the model is overall good fit and statistically significant.

Vector Error Correction Model (VECM):

Error correction	D(P)	D(AG)	D(X) (TO)	D(LF)	D(GDP)
Coint Eq1	0.049	-0.029	-0.016	9.446	-0.161
D(P(-1))	0.063	0.074	0.088	-19.949	0.080
D(AG(-1))	0.591	0.227	0.438	-63.142	0.076
D(GDP(-1))	0.067	0.045	0.131	-33.092	0.094
D(LF(-1))	-0.002	0.001	0.005	0.029	-0.000
D(X(-1))	0.135	-0.042	-0.995	50.423	-0.153
C	1.173	-0.975	-2.140	321-395	0.387

Vector Error Correction model is a restricted VAR model and it deals with those series which are non-stationary and found to be co integrated. If Co integration exists between series which suggests a long run relationship then VECM is used to check the short run properties of co integrated series. For VECM co integration must exist otherwise no need of VECM. It tells us about long run to short run adjustments of the model. In the Short run there is no adjustment from long run to short run as shown by the following co-integration. The estimated error correction model is enjoys a very low goodness of fit (R^2=0.155211). The empirical study is performed by using PC version of Eviews 6.0.

Conclusion and Policy Implications

Since all the variables have unit root at levels the study utilizes Johansen Co-integration analysis to test for the existence of a long run relationship between the variables. The co-integrating regression considers only long run property of the model and does not deal with the short run dynamics explicitly. Both the Trace test and Eigen value test indicates that there are two integrating vector. The study concluded that agriculture growth and other all variables have a negative effect on Poverty in the long run. All variables carry expected result.

Basic purpose of this study was to check the impact of agricultural growth on poverty. According to empirical results agricultural growth variable has a significant impact on poverty. This study has also used economic growth which is also significant but as compared to economic growth agricultural growth has a stronger impact on poverty reduction. The reason behind this, in Pakistan mostly people belong to rural areas and more than 60% rural population is related to agriculture directly or indirectly. So agricultural growth directly affects the poor and poverty. Agriculture sector also provides employment to a large proportion of population and also the largest employer sector. So govt. needs to improve this sectors output and growth as it benefits the poor. Govt. should subsidize the farmers so that production could increase and growth as well. Policies should be made to improve the performance of Agriculture sector. To alleviate poverty, it is suggested that Pakistan enhance the productivity of the agriculture sector through the provision of a series of inputs including

provision of easy credit to the small farmer, availability of quality fertilizers and pesticides, tractor and harvester services, improvement in the effectiveness of the vast irrigation system and, finally, farmer education.

References

- Akram, W. Hussain, Z. Shabir, H. and Hussain, I. (2008) Impact of Agriculture Credit on Growth and Poverty in Pakistan,*European Journal of Scientific Research* ISSN 1450-216X Vol.23 No.2 (2008),

- Basic Econometrics by Damodar N. Gujarati (2004) and Dawn C.porter (4th Edition)

- Bakhshoodeh, M. &Zibaei, M. (2007) Agriculture Trade Openness and Poverty Reduction: A Cross-Country Analysis, *Iran Agricultural Research, Vol.* 25, No. 2 and Vol. 26, No. 1-2 Printed in the Islamic Republic of Iran, 2007 ©Shiraz University

- Christiaensen, L., Demery, L. &Kuhl, J. (2010) the (Evolving) Role of Agriculture in Poverty Reduction: An Empirical Perspective, *WIDER Working Paper* 2010/36 (Helsinki,UNU-WIDER)

- Cuong, N. (2010) Does Agriculture Help Poverty & Inequality Reduction? Evidence from Vietnam, Agricultural Economic Review.*JEL Classification*: I32, Q12, O13

- Dewbre, J., D. Cervantes-Godoy and S. Sorescu (2011), Agricultural Progress and Poverty Reduction: Synthesis Report, *OECD Food, Agriculture and Fisheries Working Papers*, No. 49, OECD Publishing.

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

- Dickey, D.A. and Fuller, W.A., (1979). "Distribution of the Estimators of Autoregressive Time Series with a Unit Root", Journal of the American Statistical Association, Vol.74, pp. 427-431.

- Imai, K., Gaiha, R. &Thapa, G. (2011) Role of Agriculture in Achieving MDG 1 in Asia and the Pacific Region, *Economics Discussion Paper Series Manchester*-1824 EDP-1104

- Jamal, H. (2004) Does Inequality Matter for Poverty Reduction? Evidence from Pakistan's Trend, *SPDC RESEARCH REPORT* NO. 58.

- Jha, B. (2003) Employment, Wages and Productivity in Indian Agriculture, Institute of Economic Growth University of Delhi Enclave.

- Johansen, S., &Juselius, K. (1990) Maximum Likelihood Estimation and Inference on Cointegration with Application to the Demand for Money. *Oxford Bulletin ofEconomics and Statistics* 52, 170–209.

- Soloaga, I. & Torres, M. (2003), Agricultural Growth and Poverty Reduction in Mexico, International Association of Agricultural Economists Conference Paper, Gold Coast, Australia, August 12-18, 2006

- Saunders, P., Biswas, B., &Mohapatra, S., (1999). A Co-integration Analysis of the Impact of Real Exchange Rate Variations on US Agricultural Exports, Volume 59 article. 2, *Agriculture Financial Review*

- Shepher, A. &Prowse, M. (2009), Agriculture Growth, poverty dynamics, Background Paper for the *Chronic Poverty Report* 2008-09

- Thirtle, C. Lin, L. &Piesse, J. (2003), The Impact of Research Led Agricultural Productivity Growth on Poverty Reduction in Africa, Asia and Latin America, University of Stellenbosch, RSA.*JEL Classification*: O11, O13, O15

- World Bank (2008) *World Development Report 2008: Agriculture for Development*, NewYork: Oxford University Press

- World Bank (2000), Dynamic Risk Management and poor, Developing a Social Protection for Africa, The World Bank, Washington D. C.