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# POVERTY REDUCTION IN PAKISTAN: The Role of Agricultural and Industrial Subsector's Growth

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The purpose of this study is to estimate poverty reducing impacts of growth on agricultural and industrial subsectors of Pakistan. Autoregressive Distributed Lag (ARDL) approach, to co-integration and Error Correction model (ECM) are applied to estimate the long-and short-run impacts on poverty reduction. The study uses the time series data from 1950 to 2010. The findings indicate that growth in minor crops leads to poverty reduction, both in short-and long-run. However, growth in major crops and livestock subsectors does not reduce poverty in the long-run. In the industrial sector, Mining and Quarrying (MQ) and the manufacturing subsectors reduce poverty, both in short-run and long-run. It is recommended that anti-poverty interventions should be prioritized for subsectors where poverty can be reduced, both in short-and long–run, such as, minor-crops subsector.

## I. Introduction

One of the most cited method of poverty reduction is 'rise in economic growth rate of a country'. There are many studies which discuss relationship between the overall economic growth rate and the poverty reduction, e.g., Ravallion (1995), Johnson, et al. (2012), Bhagwati and Panagariya (2013), Ebong and Ogwumike (2013), Zaman and Khilji (2013). Although, majority of these studies support the idea that growth reduces poverty, it is of little value if one needs to know the relative contribution of various sectors of the economy in poverty reduction.

The work/research so far undertaken on sectoral contribution to poverty reduction lacks currently from the literature. Most recent research on this issue is undertaken by DeJanvry and Sadoulet (2010), Loayza and Raddatz (2010), and Rose et al. (2013). These studies quantify the poverty reducing impacts of three main sectors of the economy, which are agriculture, industry and services. Most studies concentrate on one sector at one time. For example, Agarwal (1986) focuses on agriculture sector, while Mitra and Schmid, (2008) takes into account the linkages between the services sector with poverty reduction. Moreover, results

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of these studies are not similar. For example, Hassan and Quibria, (2004) criticize the agricultural fundamentalism and find that poverty reduction is largely the result of growth in the industrial sector. In contrast, DeJanvry and Sadoulet (2010) suggest that agricultural sector growth reduces poverty more than growth in the industrial sector.

The above strands of literature contribute significantly to identify sectors which are more poverty reducing in specific country context. However, this literature generally ignores the relative contribution of various subsectors within three main sectors of the economy. Ignoring this role the subsectors conceal some very useful information for policy purpose. For example, if growth in minor crops subsector is found to be more effective in poverty reduction, an obvious policy implication will be to provide more support to this sector as compared to the major crops subsector. Keeping in view the dearth of research on the nexus between the subsector growth and poverty reduction, and also because of the contradictory findings of previous studies, it is important to identify the subsectors which are more effective for poverty reducing in specific context of each country.

The purpose of this research is to find whether subsectors growth matter in poverty reduction. To this end, poverty reducing impacts of growth in agricultural and industrial subsectors of Pakistan, are estimated. In particular, it is interested to examine those subsectors of agriculture and industry which are more poverty reducing? Further, it is investigated whether there is any difference in short-run and long-run impacts of subsectors growth on poverty reduction? Analysis of these questions in the present research is expected to contribute to the literature by providing fresh empirical evidence on linkages between (sub) sectoral growth and poverty reduction in Pakistan.

This study analyzes the agriculture region which is the largest employment generating sector of Pakistan. Although, share of agriculture decreased to 21.4 per cent of GDP, yet it continued to be the vital sector of the economy, GoP of the model used in this study, because of two reasons: (i) the relative contribution of both these subsectors in the overall growth of the sector is minor, (ii) the coefficients of these subsectors are found to be statistically non-significant. The study also analyzes the industrial sector of Pakistan as it plays a significant role in enhancing trade, creating competitive environment at the domestic and international market, generating employment opportunities and reducing poverty. This sector is segregated mainly into four subsectors which are manufacturing, construction, Mining & Quarrying (MQ), and electricity & gas contribution (EG). All these four subsectors are taken into consideration in order to investigate their contribution towards poverty reduction in the country. The rest of the paper is organized in a way that section II provides description of methods used to analyze data. Section III provides results and discussion, while section IV concludes the paper.

## II. Material and Methods

### *1. Data and Variables*

The present study uses the time series data from 1950 to 2010 collected from the Handbook of Statistics on Pakistan's Economy. The dependent variable is the Gross Domestic Product per Capita (GDPPC). This serves as a proxy for poverty [Verena et al. (2009)] due to non-availability of the consistent time series data on headcount ratio. The independent variables are the three subsectors of agriculture and the four subsectors of industrial sectors. For agricultural sector, output of (i) major crops, (ii) minor crops and (iii) livestock is taken. The industrial sector includes: (i) mining and quarrying (MQ), (ii) manufacturing, (iii) construction, (iv) electricity and gas distribution (EG).

### *2. The Model Specification*

It is considerd that GDPPC is a function of output of agricultural and industrial subsectors in Pakistan. This is captured in the empirical model given below:

$$LGDPPC = \alpha_0 + \beta_1 LMajorCrops_t + \beta_2 LMinorCrops_t + \beta_3 LLS_t + \beta_4 LMQ + \beta_5 LMan_t + \beta_6 LCons_t + \beta_7 LEG_t + \mu_t \quad (1)$$

where, *LGDPPC* is log of GDP per capita for *t-th* year, while $\beta$s are parameters to be estimated and $\mu_t$ is usual error term with constant mean and zero variance. The independent variables are taken as log values of the share of each subsector in total GDP, of the country in million rupees. In Equation (1), $MajorCrops_t$ is the share of major crops, $MinorCrops_t$ is the share of minor crops, $LS_t$ is the share of livestock, $MQ_t$ represents mining and quarrying, $Man_t$ indicates manufacturing, $Cons_t$ is construction, and $EG_t$ indicates electricity and gas distribution in the *t-th* year. The rational for using share of each subsector in total GDP is to capture both the size of the subsectors as well as its growth, over time. The reasoning for using a double log model is to interpret ( s) as *(βs)* elasticities.

### *3. The Long-Run Impacts on Poverty Reduction*

To estimate long-run coefficients of agricultural and industrial subsectors variables, the Autoregressive Distributed lagged (ARDL) approach (Pesaran et al. (2001)] is used in this study. There are two reasons to use the ARDL approach. First, this approach can be used at any level of integration. More specifically, the ARDL gives consistent estimates, no matter the variables are I(0), I(1) or fractionally cointegrated. Second, it provides unbiased estimates, of the long-run model and the

valid t-statistics even if some of the study variables are endogenous [Harris and Sollis (2003)]. Following is the ARDL equation for variables used in the present research;

$$\begin{aligned}\Delta LGDPPCt = {} & \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta LMajCrops_{t-i} + \sum_{i=1}^{n} \beta_i \Delta LMinCrops_{t-i} + \\ & \sum_{i=1}^{n} \gamma_i \Delta LLS_{t-1} + \sum_{i=1}^{n} \Psi_i \Delta LMQ_{t-i} \sum_{i=1}^{n} \Omega_i \Delta LMan_{t-i} + \\ & \sum_{i=1}^{n} \pi_i \Delta LCons_{t-i} + \sum_{i=1}^{n} \omega_i \Delta LEG_{t-i} + \eta_1 LMajCrops_{t-1} + \\ & \eta_2 LMinCrops_{t-1} + \eta_3 LLS_{t-1} + \eta_4 LMQ_{t-1} + \eta_5 LMan_{t-1} + \\ & \eta_6 LCons_{t-1} + \eta_7 LEG_{t-1} + \eta_8 LGDPPC_{t-1} + \varepsilon_t \end{aligned} \quad (2)$$

The coefficients denoted by $\alpha_i$, $\beta_i$, $\gamma_i$, $\Psi_i$, $\Omega_i$, $\pi_i$ and $\omega_i$ capture the short-run impacts. The coefficients of the lagged variables $\eta_1$ to $\eta_8$ represent the long-run relationship. The white noise error term with zero mean and constant variance is denoted by $\varepsilon_t$, and $\alpha_0$ is the drift component.

## 4. *The Short- Run Impacts on Poverty Reduction*

The short-run short run relationship of the specified variables is determined with the Error Correction Model (ECM). The ECM is derived from a simple linear transformation of the ARDL model. The ECM integrates the short-run short run adjustments with long- run equilibrium without losing long- run information. The error correction term indicates the speed of adjustment from disequilibrium to equilibrium. The model is written as:

$$\begin{aligned}\Delta LGDPPCt = {} & \alpha_0 + \sum_{i=1}^{n} \alpha_i \Delta LMajCrops_{t-i} + \sum_{i=1}^{n} \beta_i \Delta LMinCrops_{t-i} + \\ & \sum_{i=1}^{n} \gamma_i \Delta LLS_{t-1} + \sum_{i=1}^{n} \Psi_i \Delta LMQ_{t-i} \sum_{i=1}^{n} \Omega_i \Delta LMan_{t-i} + \\ & \sum_{i=1}^{n} \pi_i \Delta LCons_{t-i} + \sum_{i=1}^{n} \omega_i \Delta LEG_{t-i} \phi_t ECM_{t-1} + \varepsilon_t \end{aligned} \quad (3)$$

where, $\phi_t$ is the speed of adjustment to the long-run while $ECM_{t-1}$ is the error correction term. Other variables in the log-form are the same as discussed above earlier.

## 5. *Stability of the Model*

Before proceeding to estimate the long- run relationship, this study employs F-bound test [(Pesaran et al. (2001)], to ensure wheather ARDL approach is applicable to the data or not. In addition to this, the diagnostic tests used in this study estimated the serial correlation, functional form, normality and heteroscedasticity of the model. In order to test the stability of the model, this study used CUSUM (the cumulative sum of recursive residuals) and CUSUM-Q (the cumulative sum of

squares of recursive residuals) tests;. fFor these tests,which the following hypothesis was made; coefficients in the model are stable.

$H_o$ : All : coefficients in the model are stable,
$H_1$ : All : Unstable model.

The basic idea of this technique is to plot cumulative sum and the sum of squares of recursive residuals against break points. We accept the null hypothesis if the plot is in critical boundaries at 5 per cent level of significance.

Using GDP per capita as a substitute of poverty the analysis in this study is carried out. The choice of this dependent variable may raise criticism on two grounds. First, focusing on the GDP per capita, as a proxy for poverty is tantamount to ignoring income inequalities that are generally associated with increase in the overall growth rate. Second, since poverty is a multidimensional construct, reducing it to a uni-dimensional measure (income or consumption alone) will make it redundant for policy purposes. Increase in GDP per capita worsen income inequalities is agreeable, but however, the analysis merits a separate research which is beyond the scope of the present study. Regarding poverty measures to be taken, the literature is divided. Some studies use single consumption indicators of measuring poverty [Kurosaki (2007)], while others prefer to use multidimensional poverty [Khan et al. (2014)]. In the former case, there is a further debate on choice of 'appropriate' poverty line. Some studies use official poverty line [Günther and Harttgen (2009)] where as others rely on the international poverty line [Kamanou and Morduch (2002)]. There are some other studies that prefer to use a relative or a counterfactual poverty line. For example, Celidoni, (2012) considers a person to be poor if his income is below 60 per cent of the median income of the households. It is acknowledged that there has been a recent trend in estimating multidimensional poverty. However, this measure is not accepted unanimously because of a lot of subjectivity involved in the choice of indicators used (e.g., housing, sanitation, etc.), and the cut-off point (e.g., K= 1, 2, 3 or more) that determines households status of poverty. The choice of these indicators and the cut-off point vary among researchers, hence, different levels poverty calculations. Additionally, due to recent trend in estimating multidimensional poverty, there does not exist sufficient data in the case of Pakistan.

The preceding discussion shows that choice of poverty measure is subjective and depends on issue under investigation. This study uses the GDP per capita as a substitute of poverty, primarily because of non-availability of the time series estimates on multidimensional poverty or head-count ratio in the context of Pakistan. Additionally, the nexus between increasing economic growth and declining poverty, is widely supported by many researchers [Contreras (2001), Bigsten et al. (2003) and Richard and Adams (2004)]. On this basis, it is assumed that changes in average income can be a credible measure of change in poverty.

## III. Results and Discussion

### *1. Augmented Dickey Fuller (ADF) Test*

This study apply the Augmented Dickey Fuller (ADF) unit root test in order to determine the order of integration among the variables (results are given in Table 1). At level, the statistical values of all variables tends to be less negative than the critical value at 95 per cent level of significance. This indicates the presence of unit root at level. After taking the first difference of variables, the test statistics is more negative as compared to the critical value at 95 per cent level of significance. Hence, it is observed that the data is stationary at first difference. The results show that order of integration of all variables in the present study is the same.

**TABLE 1**

Results of ADF unit Root Test

| Variables | ADF results at level | | ADF results at 1st difference | |
|---|---|---|---|---|
| | Test Statistics | Conclusion | Test Statistics | Conclusion |
| GDPPC | 0.24 | I(1) | -3.44 | I(0) |
| MajCrop | -0.09 | I(1) | -3.40 | I(0) |
| MinCrop | 0.07 | I(1) | -3.43 | I(0) |
| LS | 0.53 | I(1) | -3.34 | I(0) |
| MQ | 0.28 | I(1) | -3.60 | I(0) |
| Man | 0.19 | I(1) | -3.49 | I(0) |
| Cons | -0.20 | I(1) | -4.15 | I(0) |
| EG | -1.02 | I(1) | -3.50 | I(0) |

*Notes:*Critical value at 95 per cent confidence interval (at level) is -2.9137. Critical value at 95 per cent confidence interval (at 1st difference) is -2.9l47. The values of all the variables are taken as log of the share of each subsector in the total GDP of the country. The abbreviations represent the following: GDPPC = GDP per capita, Maj Crop = Share of Major Crops, Min Crop = Share of Minor Crops, LS = Share of Livestock, MQ = Share of Mining and Quarrying, Man = Share of Manufacturing, Cons = Share of Construction, EG = Share of Electricity and Gas Distribution.

### *2. F-bound and Diagnostic Tests*

Before applying the ARDL approach to estimate the long-run coefficients, F-bound test was used to determine the presence of long-run relationship. Table 2 shows results of the F bound and diagnostic tests. F-statistics in the bound test is greater than the upper bound at 95 per cent level of significance, indicating that there exists long-run relationship among the variables.

**TABLE 2**

Tests of the ARDL analysis

| Tests | Statistics | |
|---|---|---|
| Optimal lag structure | (1, 1, 0, 1, 0, 1, 0, 0) | |
| F bound test | Lower bound I(0) | 2.27 |
| | Upper bound I(1) | 3.45 |
| | F-statistics | 4.03* |
| Diagnostic tests | A: Serial Correlation | 7.63 |
| | | (0.06) |
| | B: Functional Form | 1.45 |
| | | (0.23) |
| | C: Normality | 6.24 |
| | | (0.05) |
| | D: Heteroscedasticity | 0.00 |
| | | (0.96) |

*Notes:* 'A' is the Lagrange multiplier test of residual serial correlation, 'B' is the Ramsey's RESET test using the square of the fitted values, 'C' is based on a test of skewness and kurtosis of residuals, and 'D' is based on the regression of squared residuals on squared fitted values. Figures in parentheses are probability values.
*indicates 5 per cent level of significance.

The Lagrange multiplier (LM) version test statistics for serial correlation, functional form, normality and heteroscedasticity are used in diagnostic analysis. The $\rho$ value of LM test is greater than 0.05. It shows that functional form used in the analysis is correct. There is no problem of multicollinearity and the residuals are normally distributed.

### *3. Long-Run and Short-Run Coefficients*

After using the F-bound test and the diagnostic test statistics, the long-run coefficients are estimated. Results of the long-run elasticity, using the ARDL approach are given in Table 3, whereas Table 4 shows the short-run relationship of variables estimated by the error correction model.

**TABLE 3**

Estimated Long-Run Coefficients using the ARDL Approach

| Variable | Coefficient | Probability |
|---|---|---|
| Maj Crop | -0.02 | 0.77 |
| Min Crop | 0.56*** | 0.00 |
| LS | -0.15 | 0.28 |
| MQ | 0.27*** | 0.00 |
| Man | 0.40*** | 0.01 |
| Cons | -0.17*** | 0.01 |
| EG | -0.13*** | -0.00 |
| Constant | 0.79 | 0.16 |

*Notes:* The abbreviations are the same as given in Table 1. ***shows level of significance at 1 per cent.

**TABLE 4**

Results of error correction model

| Variable | Coefficient | Probability |
|---|---|---|
| ΔMaj Crop | 0.05** | 0.02 |
| ΔMin Crop | 0.13*** | 0.00 |
| ΔLS | 0.25*** | 0.00 |
| ΔMQ | 0.06*** | 0.01 |
| ΔMan | 0.54*** | 0.00 |
| ΔCons | -0.04*** | 0.01 |
| ΔEG | -0.03*** | 0.01 |
| Δconstant | 0.18 | 0.17 |
| ECM(-1) | -0.23*** | 0.00 |

*Notes:* The abbreviations are the same as given in table 1. ***and **shows level of significance at 1 per cent and 5 per cent respectively.

The coefficient of major crops is statistically significant in the short-run but it is insignificant in the long-run. It shows positive relationship with GDP per capita in short-run, meaning that with an increase in production of major crops by one per cent the GDP per capita rises by 0.05 per cent. However, its coefficient in the long-run is negative but statistically insignificant. The reason for insignificant coefficient in the long-run, may be that the share of major crops in the economy of Pakistan declined with the passage of time because of less production due to insufficient availability of the required level of water [GOP (2010). Moreover, increase in productivity of crops is much less than the cost of production [Zaidi (2005)]. The opposite relation of major crops in short-run and long-run may be due to the reason that it fulfills the nutritional and financial requirements of farmers in the short-run. Farmers may earn income by selling their crops in open market, during the season of crop harvesting but at lower-price, while in the long–run their per capita income may decrease because they do not have storage facility and are unable to sell them at high price during off-season. The coefficients of minor crops are statistically different from zero and are positively related to GDP per capita in both cases, i.e., short-run and long-run. Positive and significant coefficients imply that an increase in production of minor crops by one per cent results in 0.56 per cent increase in GDP per capita in the long-run and 0.13 per cent increase in the short-run. Minor crops give higher returns in short duration with little investment as compared to major crops. Therefore, growth in minor crops is expected to reduce poverty in both the short-run and long-run. Aravindakshan and Sherief (2010) suggest that organic farming also supports minor crop production at low cost, hence it results in alleviating poverty by enhancing income level of rural inhabitants in both the short-and long-run. As per Mari et al. (2007), production of minor crops is labor intensive which provides income to small farmers and landless labor. In Pakistan, as majority of the farmers are categorized as small farmers, the cultivation of minor crops may help such farmers to increase income in the short-and the long run [Nasir (2006)].

Livestock is another important sub-sector of agriculture. Results of the study indicate that coefficient of livestock is positive and highly significant in the short-run with an elasticity of 0.24 per cent. The long-run poverty reducing impacts does not hold. This may be because of the non-availability of logistic support to rural sectors in the long-run [Holmann et al. ( 2005)]. The results of this study are consistent with Idrees et al. (2007) who found that lack of awareness and use of conventional practices leads to a huge loss of income which makes the contribution of livestock insignificant in the long-run. The livestock sector is under rapid increasing demand but this opportunity cannot be cashed by poor if they are not augmented with proper livestock services awareness. The government needs to play an effective role in order to ensure participation of poor people in this opportunity [Ahuja and Redmond (2004)].

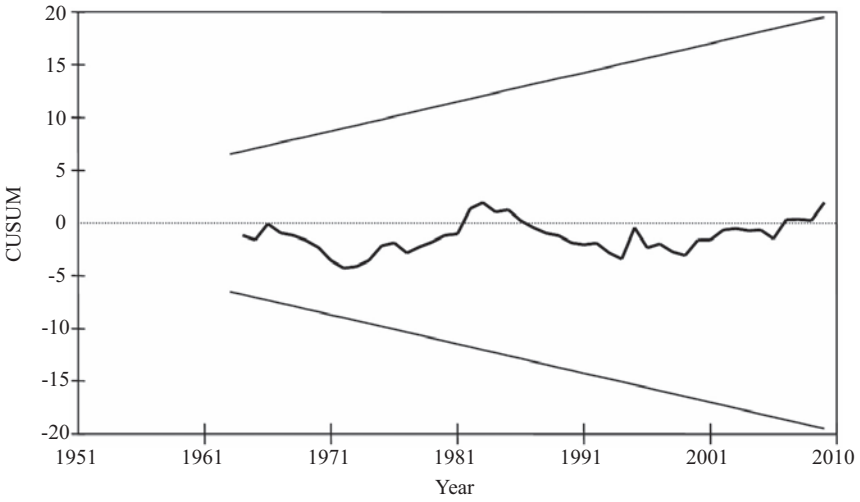
Overall results, regarding agriculture sector show that minor crops play an important role in increasing the GDP per capita in the short-run and long-run, whereas, other two variables (major crops and livestock) contribute to GDP per capita in the short-run only.

For estimating contribution of the industrial sector in reducing poverty through increasing GDP per capita, mining and quarrying, manufacturing, construction and electricity, and gas distribution needs to be considered. Results of this sector shows that coefficient of mining and quarrying has positive and significant coefficient in the short-run and long-run. One per cent increase in production of this industry would give higher GDP per capita by 0.061 per cent and 0.27 per cent in the short-run and long-run, respectively. A highly significant coefficient of manufacturing variable shows positive relationship with the GDP per capita in both the short-run and long-run, indicating that an increase of one per cent production of manufacturing industry would increase GDP per capita by 0.53 per cent in short-run and 0.4 per cent increase in long-run. The results of this study are consistent with the findings of Sokoloff et al. (1997) and, Khan and Wasif (2011). Similarly, while estimating the Kaldor's hypothesis for the economy of China, Hansen et al. (1996) finds that manufacturing sector has a positive relation with GDP growth of the country.

The coefficient of construction industry is significantly and negatively related to GDP per capita in the short-run and long-run. Similarly, a negative coefficient of electricity and gas distribution in short-run and long-run is found. With respect to construction, the possible explanation may be that the indecent jobs of this sector cannot ensure health, education, medical, social and food security of common man in the short-run and long-run [Budd (2004)]. Similarly, poor management of electricity and gas distribution in Pakistan might have eroded the poverty reduction impacts of growth in this subsector.

### *4. Stability of the Model*

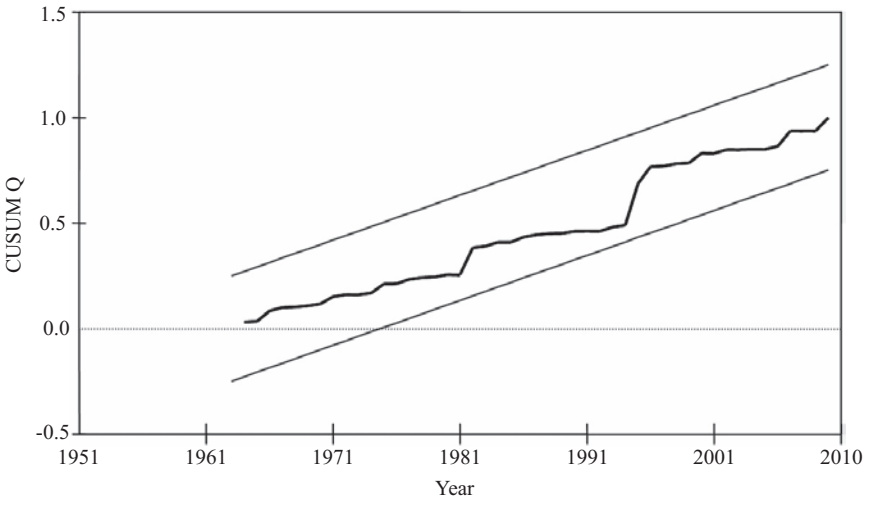
The stability of long-run coefficients together with the short-run coefficients by using CUSUM and CUSUMQ tests (Brown et al. 1975) were tested. The CUSUM test takes residuals along vertical axis while the time series along horizontal axis check the structural stability of the parameters. It is evident from Figures 1 and 2 that the critical boundaries at 5 per cent level of significance are not crossed by the graph. It ensures that parameters of the model are stable and null hypothesis about correct specification of model is accepted at 5 per cent level of significance.




*Note:* The straight line represents the critical bounds at 95 per cent significance level. CUSUM is cumulative sum of recursive residuals while CUSUM Q is the cumulative sum of square of recursive residuals.

**FIGURE 1**

Plot of Cumulative Sum of Recursive Residuals




*Note:* The straight line represents the critical bounds at 95 per cent significance level. CUSUM is cumulative sum of recursive residuals while CUSUM Q is the cumulative sum of square of recursive residuals.

**FIGURE 2**

Plot of Cumulative Sum of Squares of Recursive Residuals

## IV. Conclusion

The agriculture and industrial subsectors contribute significantly in poverty reduction. This hypothesis, using the ARDL approach was tested by taking the GDP per capita as a proxy variable for poverty reduction in Pakistan. The results show that both sectors have substantial contribution to improve the GDP per capita in the long-run and short-run. In the agriculture sector, major and minor crops and the livestock are found to reduce poverty in the short-run. However, minor crops reduce poverty, both in the short-and long-run. Regarding the industrial sector, manufacturing and mining, and quarrying (MQ) industries are found to reduce poverty in the short-run as well as in the long-run.

Based on the findings of this study, it is suggested that poverty reducing impacts of agricultural subsectors can be enhanced by research and development in the minor crops sector. Strengthening the agricultural extension services may help in realizing the growth potential of this subsector. Higher investment in tunnel farming technology for vegetables and fruit production (such as cucumber, cauliflower, strawberry, cabbage, melon and watermelon) can be a better opportunity to improve vegetables and fruit production. Moreover, since 1990s, breaking stagnation of major crops (such as wheat, rice, maize, seed cotton, sugarcane, chick pea and potato) has the potential to accelerate growth rate that can ultimately give benefits to the poor. Finally, ensuring availability of energy to industrial and other sectors can create employment and income generation opportunities for masses that will ultimately result in poverty reduction in the country.

This study is restricted to analyze the subsectors of agriculture and industry. It will be interesting further to undertake research to analyze each individual components of these subsectors by adding other layers of disaggregation. For example, minor-crops subsector may be disaggregated to analyze how poverty rates vary over time with the growth rate of each individual crop cultivated by the farmers.

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