EDUCATION AND INCOME DISTRIBUTION NEXUS: A TIME SERIES ANALYSIS FOR PAKISTAN

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Abstract

The main objective of this study is to estimate long run relationship between investment in education and income inequality in Pakistan using annual time series data from 1973 to 2010. The study employs co-integration technique in order to avoid spurious results. The empirical results show that investment in education is one of the most important factors affecting the income inequality. Moreover, the study finds a non-linear relationship between investment in education and income inequality suggesting the existence of inverted U-shaped relationship between education expenditure and income inequality. There seems be two types of processes at work, namely *composition effect* and *compression effect* responsible for this type of relationship.

INTRODUCTION

Education is indeed an important factor which not only affects economic growth but also the distribution of income. Economic models, which view education as an investment in human capital, justify public spending on education on efficiency and equity grounds (Knight and Sabot, 1983; Park, 1996; Teulings and Rens, 2008 and others). That is, public spending on education is generally justified on the ground that it leads to less income inequality.

Policy makers often perceive improved access and enhancement in education as an equalizer of income distribution. However, empirically the relationship of education and income inequality is not yet fully clear. For example, some studies on income inequality highlight education as a contributing factor towards income inequality. That is, the gains from education are not equally distributed and increased educational attainment leads to increase in returns to ability and enhances income inequality between and within groups of high-skilled and unskilled

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workers (Galor and Moav, 2000). Findings of a number of studies do not support investment in education as a tool for reduction in income inequality. For example, Fields (1980) reported that an increased allocation of resources to education do not lessen income inequality in many developing countries. Jimenez (1986) argued that public education expenditures do not benefit the poor at all and do not lessen income inequality.

Considering conflicting evidence on the relationship between education and income inequality, this study looks for empirical evidence based on a country specific data. The study examines the long run relationship of investment in education and income inequality for the period 1973-2010 in Pakistan. Moreover, the objective of this analysis is to test the existence of inverted U-shaped relationship between investment in education and income inequality.

The study is organized as follows. Section two reviews some studies on nexus between education and income inequality. Section three outlines the specification of the model employed in this study. Section four discusses methodology for estimation of the model and data sources. Section five reports empirical results and finally section six concludes the study with some policy suggestion and recommendations.

2. LITERATURE REVIEW

In an early study, Becker and Chiswick (1966) found that there exist positive relationship between income inequality and inequality in schooling while income inequality was negatively related with average level of schooling. Chiswick (1971) reported that the relative dispersion of educational attainment in labor force was positively related to income inequality. Tinbergen (1972) found significant effect of inequality of education and the level of education on income distribution. Park (1996) examined the impact of educational variables on distribution of income. His empirical findings revealed that a higher level of educational attainment lessens the income

inequality, that is, the dispersion of educational attainment among labor force and income inequality are positively related.

Sylwester (2002) investigated whether devoting more resources to education can positively affect the distribution of income Public education expenditures in various LDC's were related to distribution of income in those countries. The results showed public education expenditures slowly lessen income inequality in LDC's. In another study, Sylwester (2003) empirically examined whether enrolment in higher education affect changes in subsequent income inequality. A negative relationship between enrolment in higher education and subsequent income inequality was found. Gylfason and Zoega (2003), examined the impact of education on income distribution across 87 countries by using three measures of education namely secondary-school enrolment, public expenditure on education and years of schooling for girls. Each of the measures of education was negatively related to income inequality.

In a recent study, Teulings and Rens (2008) argue that as skilled and unskilled are imperfect substitutes, an increase in the average education level makes unskilled worker scarce causing an increase in their earnings. At the same time, it raises supply of skilled worker which decreases their earnings. Consequently, an increase in average education level compresses the distribution of earnings, which leads to a more equal distribution of labor income. More recently, Keller (2010) examines impact of education on income distribution. The study utilizes different measures of education; enrollment rates, public expenditures on education and public expenditures per student. The findings of study reveal that expenditures per student in primary education significantly improve income distribution for LDC's. Enrollment rates at secondary education have significant equalizing effect for developed countries.

There is another strand of studies which examines the effect of income inequality on education. Perotti's (1996) found a negative effect of income inequality on education and countries with a more equal income distribution tend to make larger investments in education. Subsequent studies (De Gregorio and Kim, 2000; De Gregorio and Lee, 2002; Flug et al., 1998 and others) provide a supporting evidence for this negative effect. In addition to this inverse effect, Sylwester (2000) focuses specifically on public expenditure on education and reports that income inequality raises public expenditure on education. This result supports earlier findings of Easterly and Rebelo (1993) and James (1993).

In summary, this brief review indicates that education is among the main factors affecting distribution of income. Some studies provide evidence that education improves distribution of income while others reveal that education plays its role in enhancing income inequality.

3. THE MODEL

The study uses Gini coefficient taken from Jamal (2006) and various Economic Surveys of Pakistan (Government of Pakistan, various issues), to measure income inequality. An advantage of using Gini coefficient is its data availability and its common use as a measure of income inequality in other studies. We use public expenditure on education as a measure of investment in education. To test non-linearity of relationship between investment in education and income inequality, a square of public expenditure on education is used. Moreover, per capita GDP is used as a measure of economic development along with two educational variables.

Thus, the study proposes the following model to investigate the effect of investment in education on income inequality[2]:

$$GINI = f(LnEXP, LnEXPSQ, LnPCI)$$

[2] For detail on specification of the model, see Tsakloglou (1988), Park (1996) and Frazer (2006).

Where GINI denotes Gini coefficient and is used as a measure of income inequality[3], LnEXP is log of public expenditure on education, LnEXPSQ is square of log of public expenditure on education and LnPCI is log of per capita GDP.

Time series data for period 1973-2010 have been used for estimation of long run relationship among variables included in the above model. The main data sources are Handbook of Statistics on Pakistan Economy of State Bank of Pakistan (2010), World Development Indicators (2011) and various Economic Surveys of Pakistan.

4. METHODOLOGY

The long run relationship among variables is established under the framework of co-integration analysis. In time series econometric literature, there are many techniques to verify long run relationship using co-integration. Before applying any co-integration technique, it is necessary to check stationarity of data or order of integration of the series. In order to test stationarity of data, the study employs Augmented Dickey Fuller (1981) test and Phillips-Perron (1988) test.

The study employed Johansen and Juselius (1990) co-integration approach. This approach is based on maximum likelihood estimation and provides maximum eigenvalue and trace test statistics by which numbers of co-integrating vectors are found. This co- integration technique of is based on Vector Autoregressive process and is explained as follows:

$$x_t = A_0 + \sum_{i=1}^{k} A_i x_{t-i} + u_t$$

where A_0 is (n x 1) vector of constants, x_t is (n x 1) vector of non stationary variables I(1), k is number of lags, Ai is (n x n) vector of coefficient and u_t is error term. The above Vector

[3]GINI coefficient is multiplied by 100, as many users including World Bank uses it in this form (Haughton & Khandker, 2009).

Autoregressive (VAR) process can be written in the context of Vector Error Correction Model (VECM) as

$$\Delta x_t = A_0 + \sum_{i=1}^{k-1} \Gamma_i \Delta x_{t-i} + \Pi x_{t-k} + u_t$$

where, $\Gamma_i = I_n - \sum_{i=1}^{k-1} A_i$ and $\Pi = -I_n + (A_1 + A_2 + A_3 + \ldots\ldots + A_k)$

Π Is k x k matrix with rank r and it contains information related to long run relationship. Two tests; Trace test and Maximum Eigenvalue test are used to find out number of co-integrating vectors. Both the tests have different set of hypotheses. Maximum Eigenvalue test uses the following test statistic

$$\lambda_{\max}(r, r+1) = -T \ln(1 - \hat{\lambda}_{r+1})$$

and statistic for Trace test is

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{n} \ln(1 - \hat{\lambda}_{r+1})$$

These statistics involve estimation of matrix Π .

5. EMPIRICAL RESULTS

Stationarity Tests

Augmented Dickey-Fuller (ADF) test and Phillips-Perron (PP) test have been employed to test stationarity of the variables. The stationarity of the variables has been checked under the two models, with intercept and no trend and secondly with intercept and trend. The results of ADF and PP tests are reported in the Table 1 and Table 2, respectively. In the first model which considers no trend, all the variables are found to be stationary at first difference under ADF while the results of PP test indicates that all the variables are stationary at first difference except

GINI which is non-stationary at first difference. In the second model, which incorporates trend in the equation, all the variables are stationary at first difference under both ADF and PP test. Keeping in view the results of ADF and PP tests the study treats the variables stationary at first difference.

Table 1: ADF Test

	Level		**First Difference**	
Variables	Without Trend(k)	With Trend(k)	Without Trend(k)	With Trend(k)
GINI	-1.64(1)	-1.80(2)	-3.15*(2)	-6.54*(2)
LnPCI	-0.95(0)	-2.50(1)	-4.84*(0)	-4.58*(0)
LnEXP	-1.99(0)	-2.97(3)	-4.56*(0)	-4.67*(0)
LnEXPSQ	0.38(0)	-1.62(0)	-4.83*(0)	-4.93*(0)

Note: Numbers in parentheses show number of optimum lags (k) based on Schwarz Information Criterion (SIC). Critical values for models 'without Trend', and 'with Trend' at 5% are -2.88 and -3.41 respectively and Critical values for models 'without Trend', and 'with Trend' at 1% are -3.43 and -3.96 respectively.
*Significant at 1%

Table 2: PP Test

	Level		**First Difference**	
Variables	Without Trend(k)	With Trend(k)	Without Trend(k)	With Trend(k)
GINI	-1.23(2)	-1.96(1)	-1.63(2)	-4.67*(1)
LnPCI	-0.86(3)	-1.59(3)	-4.79*(2)	-4.47*(2)
LnEXP	-0.99(0)	-2.82(3)	-4.51*(1)	-4.64*(1)
LnEXPSQ	-0.38(0)	-1.88(0)	-4.83*(0)	-4.80*(1)

Note: Numbers in parentheses show Newey-West Bandwith determined by Bartlett-Kernel. Critical values for models 'without Trend', and 'with Trend' at 5% are -2.88 and -3.41 respectively and Critical values for models 'without Trend', and 'with Trend' at 1% are -3.43 and -3.96 respectively.
*Significant at 1%

Co-integration Analysis

To find out the long run relationship of variables in the model, econometric techniques suggest the use of cointegration analysis. Since all the variables are stationary at first difference

so, Johansen and Juselius (1990) approach for co-integration is the proper choice. This approach has been used to find out long run relationship between public expenditure on education and income inequality.

The study uses Akaike information criterion (AIC) and Schwartz Bayesian Criterion (SBC) for the selection of the appropriate lag length. The results are reported in the Table 3. As shown AIC and SBC propose lag lengths of 4 and 1 respectively. The study chooses lag length of one as appropriate lag length by following Johansen and Juselius (1992).

Table 3: Lag Length Selection Criteria for Order of VAR Model

Lag Order	AIC	SBC
0	4.544943	4.726338
1	-10.98137	**-10.07440***
2	-11.59888	-9.966323
3	-11.11981	-8.761675
4	**-12.48388***	-9.400170

* indicates lag order selected by the criterion
AIC: Akaike Information Criterion
SBC: Schwarz Bayesian Criterion

To find out the number of co-integrating vectors, Trace Statistic and Maximum Eigenvalue tests are used. The model 'unrestricted intercept and no trend' has been selected as the appropriate model among the five models of co-integration by using *Pantula* principle. These models consider different specification of intercept and trend term. In case of 'unrestricted intercept and no trend' model, it is assumed that intercept in co-integrating equation is cancelled out by intercept in Vector Autoregressive (VAR) model (Asteriou & Hall, 2007). Therefore, the constant term (or intercept) is not reported in the estimated model.

The results of Trace Statistic and Maximum Eigenvalue test are presented in Table 4 and Table 5 respectively. The Trace Statistic reports only one co-integrating vector and Maximum

Eigenvalue Statistic indicates no co-integrating vector at the 5% level of significance. There is conflict between results of two tests.

Table 4: Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.513384	51.45340	47.85613	0.0221
At most 1	0.410217	26.96387	29.79707	0.1025
At most 2	0.196487	9.011835	15.49471	0.3643
At most 3	0.045237	1.573934	3.841466	0.2096

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table 5: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.*
None	0.513384	24.48953	27.58434	0.1185
At most 1	0.410217	17.95203	21.13162	0.1317
At most 2	0.196487	7.437902	14.26460	0.4387
At most 3	0.045237	1.573934	3.841466	0.2096

Max-eigenvalue test indicates no co-integration at the 0.05 level
*MacKinnon-Haug-Michelis (1999) p-values

In case of conflict, Trace value test is preferred because Trace statistic takes into account all of the smallest Eigenvalue and it has more power as compared to Maximum Eigenvalue statistic (Johanson & Juselius, 1990; Asteriou & Hall, 2007). Therefore, the study considered one co-integrating relationship in the variables of the model.

The estimated long run relationship by normalizing the co-integrating vector is as under:

$$\underset{\text{t-stat}}{\mathbf{GINI} =} \underset{(3.4)}{\mathbf{3.2LnEXP}} \underset{(-5.65)}{\mathbf{- 0.23LnEXPSQ}} \underset{(3.5)}{\mathbf{+ 4.3LnPCI}}$$

The coefficients of expenditure on education and its squared term are statistically significant. The positive relationship between expenditure on education and income inequality and the negative sign of square term indicates a nonlinear relationship of expenditure between education and income inequality. It reflects the presence of inverted-U shape relationship between investment in education and income inequality. That is, as investment in education increases, income inequality increases first, reaches its maximum and then it declines. The empirical findings of this study support the hypothesis initially entertained but not tested by Knight and Sabot (1983); Teulings and Rens (2008).

The possible reason for these findings seems to be that investment in education leads to expansion of education which changes the educational composition of population. At the initial stage, income of more educated workers increases as compared to less educated because of skill biased technological change, which shifts demand for labor from unskilled workers to skilled workers. It is the most likely cause of increasing income inequality at the initial stage. At the later stage, an increase in average education makes unskilled workers scarcer which subsequently increases their income. At the same time, it raises supply of skilled workers and compresses their income. This leads to a more equal distribution of labor income hence income inequality starts declining at the later stage.

6. CONCLUSION

The present study investigates relationship between investment in education and income inequality. The analysis reveals that there is a non-linear relationship between investment in education and income inequality. That is, income inequality increases first with an increase in investment in education, reaches its maximum and then it declines. This indicates the existence

of inverted U-shaped relationship between investment in education and income inequality. This relationship is due to composition and compression effect.

Based on the econometric evidence of the present study, it may be suggested that the government of Pakistan should increase its investment in education since devoting more resources to education will equalize distribution of income in the long run. Investment in education can improve income distribution by promoting the educational expansion through fair distribution of education among the population. Moreover, investment in education should be complemented by deliberate government policies to ensure that distribution of education is equitable so that the fruit of enhanced returns to improved education are equally distributed among masses.

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