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RETURNS TO HUMAN CAPITAL IN PAKISTAN: A QUANTILE REGRESSION ANALYSIS

The quantile regression technique has been utilized to examine how the effect of education and experience varies across the earning distribution in Pakistan. The findings of the study are based on Pakistani social and living standards measurement survey (2007-2008). The effect of education and experience on earnings is positive and statistically significant at each of the quantiles. The estimated coefficients show that both the variables affect earnings of the individuals differently at different parts of earning distribution. Moreover, education has a higher effect at higher quantiles which shows complementarity between ability and education. The effect of experience on earning falls monotonically, as we move from lower to upper quantiles of the conditional earnings distribution.

Keywords: quantile regression; returns to human capital; earnings distribution.

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РЕНТАБЕЛЬНІСТЬ ЛЮДСЬКОГО КАПІТАЛУ В ПАКИСТАНІ: АНАЛІЗ КВАНТИЛЬНОЇ РЕГРЕСІЇ

У статті показно, що техніка квантильної регресії застосовується для дослідження того, як вплив освіти і досвіду варіюється для різних рівнів заробітку в Пакистані. Висновки дослідження зроблено на основі даних опитування щодо соціального рівня і рівня життя за 2007-2008 роки. Доведено, що вплив освіти і досвіду на заробіток є позитивним і статистично значущим у кожному випадку. Встановлені коефіцієнти показали, що обидві змінні впливають на заробітки по-різному в різних розподілах доходу. Освіта має більший ефект у вищих квантилях, що показує комплементарність між можливостями і освітою. Вплив досвіду на рівень заробітку рівномірно знижується від ніжчих до вищих квантилів умовного розподілу доходів.

Ключові слова: квантильна регресія; рентабельність людського капіталу; розподіл доходів.

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РЕНТАБЕЛЬНОСТЬ ЧЕЛОВЕЧЕСКОГО КАПИТАЛА В ПАКИСТАНЕ: АНАЛИЗ КВАНТИЛЬНОЙ РЕГРЕССИИ

В статье показано, что техника квантильной регрессии применяется для исследования того, как влияние образования и опыта варьируется для различных уровней заработка в Пакистане. Выводы исследования сделаны на основе данных опроса по измерению социального уровня и уровня жизни за 2007-2008 годы. Доказано, что влияние образования и опыта на заработок есть позитивным и статистически значимым в каждом случае. Установленные коэффициенты показывают, что обе переменные влияют на заработки по-разному в разных распределениях дохода. Образование имеет больший эффект в высших квантилях, что показывает комплементарность между возможностями и образованием. Влияние опыта на уровень заработка равномерно снижается от нижних к высшим квантилям условного распределения доходов.

Ключевые слова: квантильная регрессия; рентабельность человеческого капитала; распределение доходов.

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1. Introduction: The interplay between earnings and human capital is central to human capital theory. Schultz (1961) and Becker (1964) among others underlined the importance of investment in human capital. The theory suggests that human capital enhances lifetime earnings, lessens the possibility of being unemployed and provides higher standards of living. These are some of the major incentives for individuals to pursue and invest in human capital (Psacharopoulos and Patrinos, 2004). There is huge body of literature on the importance of human capital for earnings and its expected returns to individuals in both developed and developing countries. The analysis of relationship between human capital and earnings has a long tradition among researchers in Pakistan (e.g., Nasir, 1998; Nasir, 2002 and Nazli, 2004). However, these studies conventionally based on ordinary least squares. By focusing on just the conditional mean, researchers generally tend to ignore the underlying heterogeneity in earning. This approach has limitations: as it constitutes only a limited aspect of the earning distribution. This technique fails to answer how human capital affects earning distribution. For such purpose a distributional approach is required.

Empirical studies on relationship between human capital and earnings (e.g., Bushinsky (1994) for USA; Machado & Mata (2001) for Portugal; Fersterer & Winter-Ebmer (2003) for Australia; Stefani & Biderman (2006) for Brazil) have taken into account the heterogeneity in earning. The results of these studies expose the fact that impact of human capital is not same across the conditional earnings distribution or there is difference in returns to human capital for workers at different points of the earning distribution. However, rare research of this nature is available from developing countries[4] in general and for Pakistan specifically. This study is an attempt to fill this gap. The objective of this study is to examine how the effect of education and experience varies across the earning distribution in Pakistan. For this purpose, quantile regression method has been used to characterize the earning distribution. The study utilizes Pakistan social and living standards measurement (PSLM) survey 2007-08 data for the analysis.

The rest of the paper is structured along the following lines. Section 2 provides the details on the methodology adopted in the study and data source. In Section 3 estimated results are presented. Finally, concluding remarks of the study are given in Section 4.

2. Methodology and Data: The ordinary least squares regression is based on the mean of the conditional distribution of the dependent variable. The problem with this kind of single equation method is that it does not allow studying the effect of an explanatory variable on other parts of the earning distribution. To better represent the idea being addressed in the study, we have utilized quantile regression. The quantile regression method was introduced by Koenker and Basset (1978). Quantile regression (QR) specifies the relationship between explanatory variables and a particular quantiles (or percentiles) of the dependent variable. A complete picture of the effect of the explanatory variable on all the parts of the dependent variable can be obtained by using this method[5].

Following Bushinsky (1998), the quantile regression earnings function can be written as follows:

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[4] Only exception is Bargain et al. for India and China.
[5] For a survey of QR models and applications, see Koenker (2005).

$$Lnw_i = x_i\beta_\theta + u_{\theta i} \quad \text{with} \quad Quant_\theta(Lnw_i \mid x_i) = x_i\beta_\theta, \tag{1}$$

where *Lnw* is the natural log of earnings, *x* is the vector of explanatory variables and β is the vector of parameters and u_θ is the random error term. $Quant_q(Lnw_i \ x_i)$ denotes the θth conditional quantile of ln*w*, given x_i. Unlike in OLS, quantile regression parameters minimize the absolute sum of the errors from a particular quantile of the log earnings. The θth quantile regression, $0 < \theta < 1$, is defined as a solution to the problem:

$$\min\left[\sum_{i:Lnw_i \geq x_i\beta} \theta \mid Lnw_i - x_i\beta_\theta \mid + \sum_{i:Lnw_i \leq x_i\beta} (1-\theta) \mid Lnw_i - x_i\beta_\theta \mid \right]. \tag{2}$$

By variation of θ, any quantile of the conditional distribution can be obtained. We use β_θ instead of β to make clear that different values of θ give different values of β. For the minimization of problem, linear programming techniques are utilized to solve the problem by using complete sample. Robust standard errors for vector of coefficients are obtained by using bootstrapping procedure.

We employ widely used earnings function method proposed by Mincer (1974) in which, labor market experience is allowed to be nonlinear. The study estimates Mincerian earning functions of the following form which include both a linear and a quadratic term of experience:

$$Lnw_i = \alpha + \beta_{\theta 1}Edu + \beta_{\theta 2}Exp + \beta_{\theta 3}Expsq + \sum_i \delta_{\theta i}Z_i + u_{\theta i}, \tag{3}$$

where θ is the quantile being analyzed, *LnW* is the natural log of monthly earnings for the *i*th individual, *Edu* is years of schooling, *Exp* is labor market experience, *Expsq* is square of labor market experience, *Z* includes dummies for gender, marital status, region of residence, occupation and province of residence. The above earning function has been estimated using the quantile regression estimator at 9 deciles, which are denoted by $\theta=0.1$, $\theta=0.2$, $\theta=0.3$, $\theta=0.4$, $\theta=0.5$, $\theta=0.6$, $\theta=0.7$, $\theta=0.8$, $\theta=0.9$. The standard errors of estimates are obtained by bootstrapping with 100 repetitions. In addition to quantile estimations, we also perform OLS regression. The quantile regressions provide more detailed description of how explanatory variables affect the dependent variable. In the present application, quantile regressions describe how effect of education or experience varies across the quantiles of earning distribution.

The data from the PSLM survey for the period 2007-08 has been used for the analysis. These data supply comprehensive information on individuals' characteristics. Keeping in the view the standard definition of labor force, only individuals ranging from age 15 to 65 are kept in the sample.

3. Results and Discussion. Table 1 presents the estimates of quantile regression for the selected values of θ along with OLS estimates. We have shown and discussed only the estimated coefficients of education, experience and it square[6]. Since dependent variable is log of earnings so coefficients can be interpreted as returns to educa-

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[6] To conserve the space only these coefficients are presented here as this is focus of the present study.

tion or experience. All the coefficients are statistically significant at all the quantiles. It is evident from OLS results that mean effect of education on earnings is 6.6% for an extra year of education. This is in line with Martins and Pereira (2004) for Denmark, Netherland and Greece. Quantile regression results show that education affects earnings of the individuals differently at different parts of earning distribution. It initiates from 5.2% at first decile and rises to 6.1% at median which finally reaches 7.2% at top decile. It shows that percentage increase in earnings resulted from an extra year of schooling is not the same for individuals. It is also evident that education has a higher effect at higher quantiles. This can be interpreted as complementarity between ability and education in labor market of Pakistan (Mwabu and Schultz, 1996).

Turning to coefficients of experience and its square, it can be observed that these are with expected signs and are consistent with human capital theory. That is, experience-earnings profile is concave. Moreover, both the linear and quadratic terms are significant at all quantiles. The results confirm that the impact of experience on earnings varies across the earning distribution. It demonstrates that the effect of experience on earning decreases as one move from lower to upper quantiles. It starts from 6% at the first decile and falls to 4.9% at top decile. This is consistent with the findings of Machado and Mata (2001) for Portugal. In summary, there are positive returns to human capital at every point of earning distribution in Pakistan. These results show that human capital gives access to a distribution of earnings rather than assuring a certain amount of earnings in Pakistan.

4. Concluding Remarks. This study is an attempt to examine how the effect of education and experience varies across the earning distribution in Pakistan, using quantile regression technique. The study employs quantile regression technique in order to characterize the earning structure in detail. The estimation of earning functions at different parts of the earning distribution reveals that education and experience has a positive effect on earnings over the whole distribution of earning in Pakistan. However, education affects earnings of individuals differently at different parts of earning distribution and education has a higher effect at higher quantiles. Similarly, effect of experience on earnings is different across the distribution and effect of experience on earning decreases as one move from lower to upper quantiles.

Keeping in view the findings of the study, we may conclude that returns to human capital are not equally distributed in Pakistan. That is, human capital enhances earning dispersion in Pakistan. Therefore, it is suggested that government should devise policies for investing in the poor as they usually have lower human capital because of their low power to invest in their children.

Table 1. **OLS and Quantile Regression Model Estimates for Pakistan**

Variables	OLS	θ=0,1	θ=0,2	θ=0,3	θ=0,4	θ=0,5	θ=0,6	θ=0,7	θ=0,8	θ=0,9
Education	0.0660***	0.0519***	0.0551***	0.0573***	0.0579***	0.0605***	0.0628***	0.0647***	0.0670***	0.0715***
	(56.77)	(40.03)	(45.61)	(39.38)	(39.47)	(47.29)	(48.04)	(57.03)	(55.66)	(40.40)
Exp	0.0517***	0.0599***	0.0543***	0.0522***	0.0492***	0.0487***	0.0474***	0.0476***	0.0461***	0.0458***
	(36.64)	(21.18)	(29.28)	(26.92)	(26.18)	(40.59)	(44.17)	(36.18)	(29.84)	(17.25)
Expsq	-0.0006***	-0.0008***	-0.0007***	-0.0007***	-0.0006***	-0.0006***	-0.0006***	-0.0006***	-0.0005***	-0.0005***
	(-29.04)	(-16.64)	(-22.19)	(-19.64)	(-19.23)	(-26.85)	(-26.87)	(-23.87)	(-19.46)	(-11.39)
N	23000	23000	23000	23000	23000	23000	23000	23000	23000	23000

t – statistics in parentheses
*p<0.05, **p<0.01, ***p<0.001

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