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Income Risks, Gender, and Human Capital Investment in a Developing Country

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Abstract

This paper investigates the role of permanent and transitory incomes in educational investments using household panel data from Pakistan. The empirical results indicate that transient poverty is a serious obstacle to human capital investment. Our analysis also points out that schooling response to an income shock is consistently larger for daughters than sons and that there may exist resource competition among siblings. Human capital investment and intrahousehold schooling allocation decisions seem to be affected by a need for self-insurance devices under binding credit constraints. As a by-product, our empirical results are in favor of the investment model of education against the consumption model.

Keywords: Education in Pakistan; Permanent and Transitory Income; Risk-coping Strategies

JEL Classification Numbers: D91; I21; J24; 015; 053

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1. Introduction

A number of cross-country studies suggest that Pakistani aggregate human capital investments measured in terms of schooling outcomes are low relative to other countries of similar per capita income levels [Behrman and Schneider (1993); Birdsall, Ross and Sabot (1993); Summers (1992); Sawada (1997)]. These international comparisons also indicate that the low education level of Pakistan had serious adverse effects on its long-term economic growth [Birdsall, Ross and Sabot (1993)]. Yet, in order to answer operational questions about the tools and timings of appropriate education policies, micro-level household response toward various environmental changes needs to be investigated. This paper is such an attempt, examining particularly the role of permanent and transitory income changes in educational investments using household panel data from Pakistan.

In this regard, it is now well known that the availability of formal and/or informal risk mitigating or coping mechanisms is essential to welfare and poverty reduction of households in developing countries.[1] The lack of self or mutual insurance devices against income shocks generates disincentive of various household-level investments. Particularly, the negative role of the transient nature of poverty in reducing educational investment is thought to be serious, since the lack of insurance against a short-lived poverty might decrease a household's income permanently by reducing the household's human capital. As a result, transient poverty might cause chronic poverty.[2] As we will see in this paper, borrowing constraints of households, which are imposed by financial market imperfections, will intensify the negative education effects of transient poverty.[3]

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1 For example, see Alderman and Paxson (1992); Besley (1995); Deaton (1997; Chapter 6); Fafchamps (1992); Morduch (1995); Rosenzweig (1988); Rosenzweig and Stark (1989); Rosenzweig and Wolpin (1993); Townsend (1994); Udry (1994).

2 Empirical evidence suggest the importance of transient poverty, with households moving in and out of poverty over time [Walker and Ryan (1990; 93-97); Jalan and Ravallion (1998)]. For policy design, it is extremely important to distinguish the transitory poor from the chronically poor [Lipton and Ravallion (1995, section 5)]. When short-lived transient poverty is dominant, the appropriate policy response should be the provisions of insurance programs such as micro-credit program, crop insurance program, employment guarantee schemes and price stabilization policies. On the other hand, the reduction of chronic poverty requires costly continuous interventions to increase the productivity of the poor in the long-run.

3 In spite of the fact that educational investments are profitable due to high rate of return to education, especially in the non-farm sector [Fafchamps and Quisumbing (1999)] and/or complementarity between education and adoption of new technology [Foster and Rosenzeig (1996)], poor households in

However, almost no studies except Jacoby and Skoufious (1997) for India and Jensen (2000) for Côte d'Ivoire focused on such inter-linkage between financial market imperfections and human capital investments in developing countries. This paper tries to fill this hole in the literature, investigating the role income shocks play in school investments by using household panel data from rural Pakistan. Particularly, we extend the Jacoby and Skoufious (1997)'s investment model of education to a multi-child setting, which allows us to investigate a broad range of issues such as gender and intrahousehold resource allocation.

This paper is divided into two parts: theoretical and empirical parts. First, the theoretical results can be summarized as follows: poor households, especially landless farm households, frequently cannot borrow against future income. As such, when crop income falls temporally, they are likely to have a relatively high marginal utility of current consumption. Since the opportunity costs of child education are quite high in terms of a loss of marginal utility, the poor may choose optimally not to educate their children despite high rates of return on education.[4] In other words, parents can obtain an informal income insurance or a risk-coping device by letting children work inside or outside the household.[5]

An important departure of our theoretical framework from the Jacoby and Skoufias (1997) model is the explicit analysis of gender and intrahousehold aspects of human capital investments, which are considered as important real issues not only in Pakistan but also in other South Asian countries [Strauss and Thomas (1995, pp.1982-1988)]. Theoretically, when a household is under borrowing constraints, there may exist educational resource competition among siblings. On the other hand, with perfect access to the credit market, resource competition among siblings does not affect

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developing countries might shy away from them. A possible explanation for this phenomenon is the existence of borrowing constraints due to credit market imperfections, which is first pointed by Schultz (1961) and Becker (1964).

4 Human capital investments involve sunk costs and irreversibility. Borrowing constraints can limit investments with such characteristics [Fafchamps and Pender (1997)]. Even without explicit borrowing constraints, a household will have a precautionary saving motive in the presence of large fluctuations in income, acting as if under a self-inflicted borrowing constraint [Carroll (1992)].

5 Interestingly, studies on ICRISAT villages found that labor market participation acts as an informal but strong insurance device against crop income fluctuations [Walker and Ryan (1990, pp. 87-88); Kochar (1999a)].

child schooling pattern. A difference in credit availability, therefore, gives completely different implications of intrahousehold allocation of educational resources.

By using standard multi-purpose household panel data from rural Pakistan, the second half of this paper presents an empirical framework and results to examine the sensitivity of educational investments to the changes in permanent and transitory components of household income. Unlike Jacoby and Skoufious (1997), which focuses on seasonal pattern of education in India, this paper investigates the empirically important school entry and exit decisions separately.[6] With such an empirical framework, empirical results of this paper support the above theoretical implications of credit-constrained households. Transitory income affects children's school entry and dropout behaviors significantly, implying that credit and insurance market imperfections exist. Hence, transient poverty as well as chronic poverty may be a serious obstacle to human capital investment. Our analysis also points out that Pakistani parents apparently favor sons in terms of education. Schooling response to a negative income shock is consistently larger for daughters than sons, which suggests important dynamics of gender gap in education. Moreover, there may exist resource competition among siblings, and having out-of-school brothers and sisters increases the degree of education of a child. Human capital investment decision and intrahousehold schooling allocation seem to be affected by a need for self-insurance devices under binding credit constraints. As a by-product of these empirical results, we may conclude that the investment model of education can explain the schooling patterns in rural Pakistan better than the consumption model.

This paper is organized as follows. In Section 2, the above informal discussions are formalized in an intertemporal model of households' consumption and schooling decisions. The model distinguishes the effect of transient poverty from that of chronic poverty by decomposing income into permanent and transitory components. Section 3 presents an econometric model to examine the theoretical implications. We then estimate the conditional probabilities of schooling decisions by using logit model with household fixed effects. In Section 4, we present the data set and

[6] The field survey data reported in Sawada and Lokshin (2001) indicate the importance of school entry and exit decisions in Pakistan, rather than the variability of school attendance which is analyzed by Jacoby and Skoufious (1997).

the estimation results. Section 5 compares the investment model of education with the consumption model; our results support the former. The final section concludes the findings of our analysis.

2. The Investment Model of Schooling

In this section, we will construct a dynamic household model which is a multiple children version of Levhari and Weiss (1974) and Jacoby and Skoufias (1997)'s seminal works on human capital investment under uncertainty. Suppose that a household's generation with M children persists T periods. Consumption and schooling decision are assumed to be made by parents so as to maximize the household's aggregated expected life-cycle utility, which is represented by a time-separable utility function of the household's aggregated consumption allocation over T periods. The household problem is:

$$\underset{\{C_t, S_{it}\}}{Max}\ E_t\left[\sum_{k=0}^{T-t} \beta^k U(C_{t+k}) + \beta^{T+1} W(H_{T+1}, A_{T+1})\right], \tag{1}$$

$$s.t.\ A_{t+1} = \left[A_t + Y_P^P + Y_{Pt}^T + \sum_{i=1}^{M} Y_{Cit}(1 - S_{it}) - C_t\right](1 + r_t), \tag{2}$$

$$H_{t+1} - H_t = \sum_{i=1}^{M}\left[f(S_{it}, CH_{it}, FEM_i, q_i) + e_{it}\right] \tag{3}$$

$$A_t + Y_P^P + Y_{Pt}^T + \sum_{i=1}^{M}\ (1 - S_{it})Y_{Cit} + B \geq C_t \tag{4}$$

$$B \geq 0, \text{ and } A_T \geq 0, \text{ given } A_0 \text{ and } H_0.$$

In equation (1), $U(\bullet)$ is a concave utility function, and β represents subjective discount factor. A concave function $W(\bullet)$ denotes the value of the financial bequest, A_{T+1}, and the salvage value of the final stock of all children's human capital, H_{T+1}. In equation (2), this household's consumable resources in each period are composed of pre-determined assets, A_t, stochastic parental income which is composed of time-invariant permanent income, Y^P, and stochastic transitory incomes, Y^T, and child

i's income at t, Y_{Cit} $(1 - S_{it})$, where $0 < S_{it} < 1$ represents the time allocation to schooling of child i at t.[7] Under these settings, the flow intertemporal budget constraint of this household is represented by equation (2),[8] where r denotes a non-stochastic interest rate on savings. In the period t, this household makes a decision on the period-t consumption and schooling after transitory is realized.[9]

The right-hand side of human capital accumulation equation (3) is the child's human capital production function which is assumed to be a function of the years of schooling, S, child specific factors, CH, the gender specific indicator variable, FEM, such that FEM=1 if the child is female and FEM = 0 if the child is male, school accessibility and quality variable, q, and an additive i.i.d. mean-zero stochastic element, e.[10] We assume that $\partial f/\partial S > 0$ and $\partial^2 f/\partial S^2 < 0$.

Equation (4) is the potentially binding credit constraint where B represents a maximum amount of credit available to the household.[11] The households in developing countries, especially poor landless farm households, cannot frequently borrow against future income due to financial repression such as interest rate restrictions imposed by government or from asymmetric information between lenders and borrowers [e.g., McKinnon (1973); Stiglitz and Weiss (1981); Carter (1988); Pender (1996)].

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[7] Note that the total time endowment of children is normalized to one.

[8] We assume that human capital does not change child wage rate immediately and the final stock of human capital is reflected in the household utility. We also implicitly assume that the final stock of human capital determines the income process of the current child when he/she become an adult. These assumptions are plausible for approximating the labor market conditions in Pakistan since the rate of return to child education is almost zero in villages [Fafchamps and Quisumbing (1999)].

[9] In other words, an information set at the beginning of the period t, I_t, which the household uses for decision-making, includes permanent income and the period-t transitory income. We also assume that parents know the immediate income from child's labor participation inside or outside the household. On the other hand, when this household makes a decision on the period t consumption and schooling, transitory income at the period t+1 has not been resolved yet and thus is assumed to be stochastic. A household's behavior which minimizes the variation of transitory income, Y^T, is thought to represent *risk management* strategy, which is defined as a set of *ex ante* actions to smooth income. On the other hand, *risk coping* behavior can be regarded as an *ex post* behavioral response toward a transitory change in income Y^T [Alderman and Paxson (1992)]. In this paper, risk management strategies are assumed to be pre-determined and their outcomes are given, so that we can focus on risk-coping issues.

[10] The stochastic factor, e, incorporates possibilities such as the risk of job-mismatching after schooling.

[11] If B = 0, household is said to be completely borrowing-constrained. If B is sufficiently large and thus the borrowing-constraint equation (4) is never binding, the optimal solution of schooling becomes the one under perfect credit availability.

This stochastic programming model of a household, has two state variables, i.e., physical assets, A, and human capital, H. When income is stochastic, analytical solutions to this problem, even without human capital, cannot be derived in general [Zeldes (1989)]. However, we can derive a set of first-order conditions that is necessary for an optimum solution.[12]

2.1. The Case of Perfect Credit Availability

When a household can borrow and save money freely at an exogenously given interest rate, the borrowing constraint is not binding. Hence, the Lagrange multiplier associated with the borrowing constraint is zero. In this case, we obtain:

(5) $$\left[\frac{\partial f / \partial S_{it+1}}{\partial f / \partial S_{it}}\right]\left[\frac{Y_{Cit}}{Y_{Cit+1}}\right] = \frac{1}{(1+r_t)}, \forall\ i.$$

This equation corresponds to the equation (4) of Jacoby and Skoufias (1997) under complete financial markets. A household with perfect access to credit will determine the evolution of optimal schooling so as to equalize the marginal rate of transformation of education production in the left-hand side and the non-stochastic market interest rate in the right-hand side. Therefore, the optimal schooling decision rule at time t can be represented as a reduced form of equation (5):

(5') $$S_{it}^{*} = S^{NC}(CH_{it}, FEM_{i}, q_{i}, r_{t}, g_{it}; S_{it-1}^{*}),$$

where g_{it} represents the child's wage growth rate, i.e., $g_{it} \equiv (Y_{Cit+1}/Y_{Cit}) - 1$. This is a nonlinear difference equation for the optimal schooling decision. The optimal level of schooling is a function of child specific variables, gender specific elements, and school availability and quality as well. This equation (5') indicates that if borrowing constraint is not binding, parental income or schooling decisions of other children does not affect the schooling decision of a child. In other words, two separabilities, one for consumption and schooling decision and the other for intrahousehold schooling allocation, hold in this model.

2.2. The Case of Binding Borrowing Constraint

[12] The whole derivations of the first-order conditions are available from the author upon request.

When the borrowing constraint is binding, the Lagrange multiplier associated with the borrowing constraint becomes positive.[13] Under borrowing constraints, the cut-off rate for child educational investment becomes an endogenous shadow interest rate, given by the marginal rate of substitution. To see this, tedious calculations give us the following optimal condition:

$$\left[\frac{\partial f / \partial S_{it+1}}{\partial f / \partial S_{it}}\right]\left[\frac{Y_{Cit}}{Y_{Cit+1}}\right] = E_t\left[\frac{\beta U'(C_{t+1})}{U'(C_t)}\right], \forall\ i. \tag{6}$$

This corresponds to the equation (4) of Jacoby and Skoufias (1997) for intertemporally autarkic households. In equation (6), the separability between consumption and schooling investment decisions breaks down. Moreover, the separability among different children's schooling decisions does not hold. Equation (6) for *M* children in a household and equation (4), satisfied as equality, together constitute a complicated system of non-linear simultaneous equations. Under this non-separability, the reduced form of the schooling decision equation can be represented by the following nonlinear difference equation:

$$S^*_{it} = S^C\left(Y^P_P, Y^T_{Pt} + \sum_{j\neq i} Y_{Cjt}(1 - S^*_{jt}), CH_{it}, FEM_i, q_i, r_t, B, g_{it}; S^*_{it-1}\right). \tag{6'}$$

In equation (6'), note that parental income, Y^P and Y^T, and other children's schooling decisions, S^*_{jt}, $\forall\ j \neq i$, become relevant to the child *i*'s schooling. The signs of the derivatives of equation (6') and their implications are summarized as the following two propositions.

Proposition 1 (*Permanent versus transitory income effects*): Under binding borrowing constraint, the realized transitory income in the period *t* has a positive impact on the optimal level of schooling at time *t*. On the other hand, the effect of permanent income on the optimal schooling is ambiguous. The effect of an increase in transitory income is always greater than the effect of an increase in permanent income.

Proof: See Appendix 1.1.

This proposition suggests that for borrowing-constrained households, schooling behavior is expected to be more sensitive to transitory poverty than chronic poverty. The intuition behind this proposition should be clear: facing a bad realization of parental income in the current period and a decline in Y^T, a

[13] Pender (1996)'s empirical results, using household data set from South India, suggest that this

borrowing-constrained household will have a relatively high marginal utility in the current period, given the past consumption and schooling decision. Hence, the household will be motivated to expand consumable resources in the current period by decreasing current education. The effects of permanent income change, however, will be lower than the effects of transitory income since there are two opposing effects of permanent income increase. Lower permanent income decreases consumable resources in the current period, thus, hampering human capital investment. At the same time, lower permanent income has a negative income effect over time which decreases the relative importance of current child income and thus increases the incentive of the family to invest in human capital.

Unlike our model, Jacoby and Skoufious (1997) emphasized the distinction between the anticipated and unanticipated components of transitory income. The anticipated component is the projection of the current change in income net of an aggregate component on the information available to the household in the previous period. On the other hand, the unanticipated component is predicted from information unknown to the household in the previous period. However, in case of binding borrowing constraints, it does not matter whether a shock has been anticipated or not. If the household cannot borrow and has insufficient resources to cover consumption needs, it will use any means to meet these needs, whether the income shortfall has been anticipated or not.

Our model also indicates resource competition among siblings, which is identified by Garg and Morduch (1998) and Morduch (2000). Under binding borrowing constraint, parents must decide how to ration available resources among their children:

Proposition 2 (*Resource competition effect*): Under binding borrowing constraint, additional education of a sibling has a negative impact on the optimal education level of a child. This resource competition effect is stronger when a sibling at school has a higher (potential) wage rate than other children within the household do.

Proof: See Appendix 1.2.

When borrowing constraint is binding, a child's opportunity cost of schooling should be financed by his/her siblings' low level of schooling and/or (shadow) wage income. On the other hand, if credit is perfectly available, resource competition among siblings will not affect children's schooling pattern,

Lagrange multiplier is positive.

as can be seen in equation (5).

3. The Econometric Framework

The existence of credit market imperfections and the issues of intrahousehold resource allocation can be investigated by testing whether the coefficients of permanent and transitory incomes, (Y_P^P, Y_{Pt}^T), and siblings' income, $\sum_{j\neq i} Y_{Cjt}(1-S_{jt}^*)$, are zero or not when we estimate equation (6').

Consider the five levels of education in Pakistan; none, primary, middle, secondary, and post-secondary. Educational outcomes are assumed to result from sequential decisions. The first decision is whether to enter into a primary school. For those who enter into a primary school, the second decision is whether to finish a primary school or dropout before graduation, etc.. However, household survey data, including the data set used in this paper, usually do not record the detailed history of schooling decisions of all children. This makes the estimation of a full sequential decision model impossible. All we know from our data set is that the schooling decision during the survey period. Our approach here is to construct a simple model of binary dependent variables of regenerative sequential decision making, controlling for differences in decision-making at different decision stages by adding child age and other variables.

To see our approach, note that sampled children can be classified into one of the following categories: (i) no schooling, (ii) entrant, (iii) continuing schooling and (iv) dropout. These are mutually exclusive and exhaustive categories. The first and second categories are used for entrants models, which are conditional on the sample of children without previous schooling, i.e., conditional on $S^*_{t-1} \leq 0$. The third and fourth categories, on the other hand, are used for binary dropouts qualitative models, which are conditional on the sample of children with some schooling, i.e., $S^*_{t-1} > 0$. We, therefore, can define two binary dependent variables as follows:

$$ENT_{it} \begin{cases} = 1 \text{ if child } i \text{ enter school at } t \\ = 0 \text{ if child } i \text{ does not enter school at } t, \end{cases}$$

$$DRP_{it} \begin{cases} = 1 \text{ if child } i \text{ finish education at } t \\ = 0 \text{ if child } i \text{ continue schooling at } t. \end{cases}$$

Although equation (6') is a non-linear equation, following the convention in the empirical literature, we utilize a linear specification of the augment of the cumulative distribution function [Amemiya (1981, p.1486)]. Then the relevant conditional probabilities can be written as [Amemiya (1981); Maddala (1983)]:[14]

(7) $\Pr(ENT_{it} = 0) = \Pr(S^*_{it} \leq 0 \mid S^*_{it-1} \leq 0) = 1 - F(\alpha_h + X_{it}\pi)$,

(8) $\Pr(ENT_{it} = 1) = \Pr(S^*_{it} > 0 \mid S^*_{it-1} \leq 0) = F(\alpha_h + X_{it}\pi)$,

(9) $\Pr(DRP_{it} = 0) = \Pr(S^*_{it} > 0 \mid S^*_{it-1} > 0) = F(\gamma_h + X_{it}\beta)$,

(10) $\Pr(DRP_{it} = 1) = \Pr(S^*_{it} \leq 0 \mid S^*_{it-1} > 0) = 1 - F(\gamma_h + X_{it}\beta)$,

where that i and h represent child and household subscripts, respectively, and X indicates a vector of explanatory variables. The parameters, α_h and γ_h, represent household specific fixed effects. Recall that the optimal schooling decision rule under imperfect credit market is given by equation (6'). If a household is borrowing constrained, X should include permanent and transient income variables, Y^P and Y^T, respectively. The child wage growth rate, g, and school availability, q, are assumed to be captured by time specific dummy variables, t_t, which include macroeconomic labor market conditions, child specific characteristics, CH, and household specific characteristic, α_h. A vector of sibling composition variables, SIB, substitutes the siblings' income $\sum_{j \neq i} Y_{Cjt}(1 - S^*_{jt})$, which represents the resource competition effect. Moreover, we assume that household fixed effects, α_h, also capture the upper-limit of credit, B, and the interest rate household face, r. Accordingly, we can define the matrix of independent variables, X as $X \equiv (Y^P, Y^T, CH, SIB, FEM, t)$.[15]

3.1 The First Step

We estimate the model by a two step procedure. In the first stage, we decompose income into permanent and transitory components. Then, we run the above mentioned binary variable regressions using the consistent estimates of permanent and transitory incomes in the right hand side. Conceptually, a household's income at time t can be decomposed into permanent income and

[14] These models are estimated separately, provided that we make the probability of choice at each stage independent of the choice at the previous stage. Alternatively, allowing dependence assumption requires data on sequential decision process, which is not available in the data set used here.

[15] Parental income is a function of assets as in the standard life cycle-permanent income framework of

transitory income as: $Y_t \equiv Y_t^P + Y_t^T$, where $E(Y^T) = 0$. We employ Paxson (1992), Alderman (1996) and Fafchamps, Czukas, and Udry (1998)'s regression approach to estimate permanent and transitory income by using the following regression equation:

$$Y_{ht} = \beta_h + X_{ht}^P \beta_1 + X_{ht}^T \beta_2 + \beta_t + u_{ht}.$$

The first term, i.e., household fixed effects β_h, and the second term, $X^P{}_{ht}\beta_1$, in the right-hand side denote the permanent components of income with X^P, being matrix of physical and human asset variables. The vector β_1, therefore, represents a vector of returns from these assets. Similarly, transitory variables matrix is denoted by X^T, and $X^T{}_{ht}\beta_2$ represents transitory income. The time specific fixed effects, β_t, are treated as another component of the transitory income, since these capture effects of aggregate shocks.

This model is estimated by household fixed effects panel regression separately for each district. The fitted values of the first two terms in the right-hand side together, i.e., the fitted values of $\beta_h + X^P{}_{ht}\beta_1$, are considered as the permanent components of the income. The prediction of the fourth and fifth terms, i.e., the fitted values of $X^T{}_{ht}\beta_2 + \beta_t$, are treated as the transitory components. The residual is thought to be the sum of permanent income, transitory income and measurement error.

3.2 The Second Step

In equations (7) and (8), Pr ($ENT = 1$) represents a probability of entrance to primary school given the child did not have schooling last year. The parameter vector, π, can be estimated from the subsample with $S^*_{it\text{-}1} \leq 0$ by dividing it into two groups: not enter primary school, enter primary school. Similarly, Pr (DRP=1), a probability of dropout given the child entered school can be estimated from the subsample with $S^*_{it\text{-}1} > 0$.

We can estimate the econometric model of (7) and (8) as a qualitative response model with household fixed effects, using the estimated permanent and transitory incomes in the right-hand side. Although it has been found that the probit model does not lend itself to the treatment of fixed effects [Greene (2000, pp.837-841)], Chamberlain (1980) showed that the conditional likelihood approach

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consumption, so that the value of family asset is omitted from the estimation.

could be applied directly to the fixed effect logit model. Hence, we estimate the model by maximizing the conditional likelihood function, assuming that $F(\bullet)$ is logistic distribution function, i.e., $F_{h\tau} = 1 / [1+\exp\{-(\alpha_h + X_{h\tau}\pi)\}]$.[16]

The case of school dropouts can also be formulated in a framework similar to the one used for entrants. In this regression, the conditional probabilities are given by equations (9) and (10). We will estimate this model by maximizing the conditional likelihood function with the assumption of logistic distribution, that is, $F_{h\tau} = 1 / [1+\exp\{-(\gamma_h + X_{h\tau}\beta)\}]$, as before.

4 The Data Source and Empirical Results

We employ the rural Pakistan panel data collected from the International Food Policy Research Institute (IFPRI)'s Pakistan Food Security Management Project. The data set is based on multi-purpose surveys and contains rich information about the various aspects of economic environment as well as the decisions of poor farmers in the area [Alderman (1996); Alderman and Garcia (1993)].

The IFPRI panel data set was collected by 14 rounds of survey over six years from 1986 (*kharif*; monsoon wheat season) to 1991 (*Rabi*; winter season). Around one thousand households were included in the initial survey. The household surveys were conducted in the three less developed districts; Attock district of Punjab province, Badin district of Sind province, and North-West Frontier Province (NWFP)'s Dir district. A relatively well-developed and irrigated district, Faisalabad in Punjab province, was also included in the survey for comparison purposes [Alderman and Garcia (1993)].[17]

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[16] Note that the data is realigned so that the data of child i at time t can be represented by the τth data of household h.

[17] Based on this IFPRI Pakistan panel data set, several studies have been implemented in the various subjects of poverty and food security and their consequences for nutrition and health [Alderman and Garcia (1993)], saving and consumption smoothing behavior against income shocks [Alderman (1996)], dynamic calorie-income relationship [Behrman, Foster, and Rosenzweig (1997)], determinants of the large educational gender gap [Alderman, Behrman, Ross and Sabot (1996)], income distribution [Adams and He (1995)], human capital investments [Alderman and Gertlar (1997); Fafchamps and Quisumbing (1999)], risk-sharing among households [Ogaki and Zhang (2001)] and the intrahousehold allocation of expenditures [Kochar (1999b, 2000)].

4.1 Variables and Estimation Results of Income Regression

For income regressions, we utilize the five-year panel data of 765 households from 1986/87 until 1990/91 (Table 1). Aggregate household income variable is computed by summing the six sources of income; crop profits, livestock income, rent, agricultural wages, nonfarm income, and transfers. As the dependent variable for permanent income, X^P includes the values of total livestock, irrigated land holdings, rainfed land holdings, the number of male and female members aged sixteen or older, between the ages of six and sixteen, and number of children who are younger than six. Household fixed effects are also considered as parts of permanent income. Transitory income variable, X^T, includes the number of adults older than sixteen who died during the period, number of dead animals, and district-level deviation of annual rainfall from 20 years average. The time specific fixed effects are also treated as transitory income components. Table 1 provides the summary statistics of these variables for each district.

Table 2 reports the estimated coefficients of the income regression equation for each district. The estimation procedure for the fixed effect panel model is employed for each district's income and assets data. Coefficients of most of the variables are consistent with the theoretical prediction. The coefficients of physical asset variables are almost all positive with high degrees of statistical significance, indicating that holding physical assets gives positive returns. An exception is Attock where nonfarm income is significant. Positive and significant coefficients on elder male member variables except Dir indicate that returns from male human assets are highly positive in these villages. For transitory shock variables, it is notable that the deviation of annual rainfall from long-term average has a negative and statistically significant impact on income for all households except for households in irrigated Faisalabad district. This indicates that these households in Pakistani villages have limited income insurance devices and thus are vulnerable to exogenous weather shocks.

4.2 Variables and Estimation Results of Logit Models

For the logit estimations, we only used the first four years data of the six years data due to the unavailability of schooling data for the later years. The summary statistics of variables used in the conditional logit estimations are described in Table 3. From the original IFPRI data files, we construct a binary variable of school attendance, which takes one and zero for those who do and do not attend school, respectively. Making a transition matrix of this school attendance variable, the binary variable of school entrants, *ENT*, can be created for years one, two and three. Similarly, the binary variable of schooling continuation or dropout, *DRP*, is constructed from the school attendance variable.[18]

Rural Pakistani households in the data set typically employ a joint family system whereby the families of brothers live together and share household resources. In fact, household unit is defined as all offspring of a household head except married daughters who live separately. We therefore define sibling broadly as the all offspring of a household head such as children and grandchildren of the household head. In our estimation, the child specific characteristics, *CH*, include information about the child's relation to the household head, and the age of the child.

We select sibling variables, *SIB*, so as to capture the intrahousehold educational resource allocation effect, $\sum_{j \neq i} Y_{Cjt}(1 - S^*_{jt})$. Since our data set does not provide child wage rate, we assume that *SIB* is composed of the number of elder brothers and sisters at school and out of school, number of younger brothers and sisters at school and out of school.

The effects of gender specific variable, *FEM*, are captured simply by a female dummy variable and gender interaction terms. Although the household specific effects are incorporated in the logit model to control for household and village level unobserved characteristics, these fixed effects are not explicitly estimated in our conditional logit model.

4.2.1. The Entrant Model

For the entrant model, basic estimation results of the conditional logit regressions are in the specifications (1) and (2) of Table 4. First, coefficients of transitory income are consistently positive, implying that a positive shock to transitory income enhance the probability of entrance to school. On

[18] For the entrant and dropout models, we employ the initial three year panel data for children of ages between three and twenty three years old for entrants and between five and nineteen for dropouts, together with household background data. To check the potential sample bias of the IFPRI survey, we compared the school attendance rates calculated from these files with attendance rates from the Pakistan Integrated Household Survey (PIHS) that covers larger number of households. The age profiles of the school attendance rate from these data sets seem to be consistent with each other. The

the other hand, the effect of permanent income is found to be statistically insignificant. The hypothesis for the same coefficients of permanent and transitory incomes are rejected strongly by using Wald test and thus the results support the theoretical prediction of the asymmetric effects of permanent and transitory incomes on schooling behaviors under borrowing constraints (see Proposition 1).

The second finding from the specifications of (5) and (6) of Table 5 is that the coefficient of female interaction terms are all statistically significant, indicating that sensitivity or elasticity of schooling with respect to income shocks is large for females.[19] Facing negative income shocks under borrowing constraints, girl's shadow wage might be used as an income insurance device more intensively than boy's income. This is a new finding in the literature on educational investments. A possible theoretical interpretation is that marginal schooling productivity curve is flatter for females than for males. In this case, a negative income shock will increase the endogenous interest rate for investments, *R*, affecting female education more than male education (Figure 1).

Moreover, all of the gender dummy coefficients, *FEM*, are negative and significant for entrant regressions in Table 5 and 6, indicating that daughters have consistently lower probability of entrance of school than sons do. This implies that a daughter has a higher possibility of no-education than a son does. Pakistani parents apparently favor sons in terms of education.

Our estimation results also throw light on the other aspects of intrahousehold resource allocation [specifications of (1), (2), (5), and (6) in Table 4 and 5]. First, coefficients for variables of the number of siblings out of schools are all positive and most of them are statistically significant. Particularly, we found the positive and significant effects on schooling of having more elder sisters. These results indicate that existence of siblings out of school seems to enhance a child's school entry probability and thus sibling resource competition effects might exist. Second, statistically significant and positive coefficients on son/daughter and grandchild dummy variables imply that there is household head's apparent favor toward their own offspring.

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comparison tables are available upon request

[19] Using the IFPRI Pakistan panel data set, Alderman and Gertler (1997) found that income elasticities of demand for medical expenditure is uniformly larger for females than for males, the finding which is consistent with ours.

4.2.2. The Dropout Model

The dropout regression results are reported in the last two columns of Table 4 [specification (3), (4)] and Table 5 [specification (7) and (8)]. The preliminary findings are similar to the results of entrant models. First, coefficients of transitory income are consistently negative, which implies that higher transitory income reduce the probability of dropping out from school [specification (3) and (4) of Table 4]. Moreover, these estimated coefficients support the theoretical prediction of the asymmetric effects of permanent and transitory incomes on schooling behavior. As in the case of entrant regressions, these results are consistent with the theoretical predictions of Proposition 1, implying that households in rural Pakistan might face binding borrowing constraints.

Second, all of the female dummy coefficients, *FEM*, are positive and significant for dropout models, indicating that girls have higher probabilities of dropping out from school than boys do (Table 4 and 5). Moreover, transitory income coefficients are consistently positive and significant for female dummy interaction terms [Table 5, specification (7) and (8)]. These results regarding gender gap show that, after having entered a school, a daughter obtains systematically less education than a son, and that, facing negative income shocks, female children will be withdrawn from schools first. Hence, these Pakistani households might use daughters' labor as an income insurance device more intensively than sons' labor. Again, this finding implies a difference in the curvature of marginal schooling (Figure 1).

Third, for specifications (3) and (4) of Table 4 and specifications of (7) and (8) of Table 5, coefficients on the number of elder brothers at school are all positive and most of them are statistically significant, and those on the number of elder brothers out of school are negative and statistically significant. These results indicate that having elder brothers at school increases dropout probability, while existence of out-of-school elder brothers seems to decrease a child's school dropout probability. This demonstrates the importance of resource competition among siblings. Additional income to the household from elder sons might extend the total household resources and thus support the education of younger children. Together with the results of female specific effects, estimated coefficients suggest that younger brothers have a lower probability of dropping out from school.

4.3. Sibling Variables and Endogeneity Issues

So far, in order to capture the intrahousehold educational resource allocation effect, we employ the number of siblings at school and out of school (Tables 4 and 5). To investigate the robustness of the results, we employ alternative measures of *SIB* variables (Table 6). The first set of variables includes a new sibling variable measured as

$$\frac{\textit{Number of elder brothers at school} - \textit{Number of elder brothers out of school}}{\textit{Total number of elder brothers} \; + \; 1},$$

where one is added to the denominator in order to avoid division by zero. This is a measure of the relative number of elder brothers studying at school. As shown in the specifications (9) and (10) column of Table 6, we include similar variables for elder sisters, younger brothers, and younger sisters. Empirical results seem to be remarkable. We observe that these coefficients are all negative and statistically significant for the entrant model [specification (9) in Table 6]. The results indicate that a higher proportion of brothers and sisters at school decreases school entrance probability, implying the existence of resource competition effects among siblings. The results of dropout model also indicate that coefficients for the sibling variables are positive and significant especially for elder brothers and sisters [specification (10) in Table 6]. A higher proportion of siblings at school increases dropout probability.

If, however, there is a common household shock to all children's schooling decisions, the sibling variables in Table 4 and 5 and specifications (9) and (10) of Table 6 generate an endogeneity problem. The simultaneity of educational decisions may result in biased estimation of coefficients. To eliminate the endogeneity bias, we utilize the second alternative set of sibling variables, the total number of elder brothers and that of sisters, where these variables can be regarded as exogenous variables, given the household’s past fertility decision,. The estimation results are represented in the specifications (11) and (12) of Table 6. The coefficient of the number of elder sisters in the entrant model is the only coefficient that is statistically significant [specification (11)]. This positive coefficient indicates that having many elder sisters increase school entry probability for both younger brothers and sisters, which is similar to the findings of Parish and Willis (1993) in the case of Taiwan.

This might be because elder sisters reduce the resource constraints of the family, either by providing domestic labor or by marrying early. When resource constraints are binding, elder daughters may bear a good part of that burden [Strauss and Thomas (1995, p.1990)].

4.4. Permanent versus Transitory Income

Empirical results of the above regressions suggest that the role of permanent income play in school attendance is limited. While this finding is consistent with the theoretical implication, a possible alternative explanation for this result is based on the use of household fixed effects. Permanent income is obtained by regressing income on household fixed effects plus human and physical asset variables such as age composition of household members, land and livestock. Since these asset variables may not vary much over time, the large portion of permanent income might be captured by the household fixed effect. When we regress schooling variable on permanent income including household fixed effects, we might obtain high correlation between the permanent income variable and the household fixed effects. Although the estimated coefficients of transitory income remain valid, the double use of fixed effects may wipe away most of the permanent income effects in entrant and dropout models. In order to examine this conjecture, entrant and dropout models of schooling are estimated by incorporating village fixed effect, instead of household fixed effect. The estimation results are represented in Table 7. With the village fixed effects, the coefficients of permanent income become statistically significant in most specifications. The results suggest that our conjecture about household fixed effects might be true. Higher permanent income may also increase school entrance probability and decrease school dropout probability. The magnitude of permanent income effects, however, is always smaller than that of transitory income effects, as our theoretical framework suggests.

5. An Alternative Model?

So far, we used the Levhari and Weiss (1974) and Jacoby and Skoufias (1997)'s investment model of education to interpret the empirical results. However, there may be alternative ways to explain the empirical findings. First, we can employ a household model which includes children's education as a consumption good. Under market imperfection, this model can explain that child schooling becomes sensitive towards permanent and transitory income. Second, if the labor market is imperfect and thus the separability between labor supply and consumption decisions breaks down, parental income will affect child educational investments through changing shadow return rate of education. Based on MaCurdy (1981) and Kochar (2000)'s approach, the model in the Appendix 2 integrates these two alternative aspects of education. The school demand function framework is derived under the assumption of child education as consumption goods and endogenous labor supply.

Under credit market, the two separabilities, one for consumption and schooling decision and the other for intrahousehold schooling allocation, hold in this model, as in the case of the investment model. On the other hand, when the borrowing constraint is binding, both permanent and transitory components of income affect schooling demand. However, in the consumption model, income affects education decisions only by changing instantaneous income, education cannot reallocate resource intertemporally. As a result, the consumption model shows the symmetric effects of permanent and transitory income, while the investment model shows us the asymmetric effects. Therefore, we can test whether actual data prefers the consumption model or the investment model by testing the symmetric restriction of income coefficients. If coefficients of permanent and transitory income are symmetric, then the result is consistent with the consumption model. On the other hand, if coefficients are asymmetric, we may conclude that the investment model is supported.[20]

The empirical results indicate the existence of borrowing constraints, since the coefficients of parental income variables are statistically significant. Moreover, the coefficients of permanent and transitory incomes are asymmetric. The null hypothesis of symmetric effects of permanent and transitory income is H_0: $\pi^P = \pi^T$, where π^P and π^T are coefficients on permanent and transitory incomes, respectively, in the entrant or dropout models. The alternative hypothesis is represented by H_A: $\pi^P \neq \pi^T$. The Wald statistics for the empirical model of specifications (1), (2), (3), and (4) in Table 4 are 8.81, 5.79, 3.68, and 2.99, respectively. These results all reject the symmetry hypothesis. Hence, the

[20] However, we should note that these are two extreme models of schooling. In order to derive tractable analytical solutions, we cannot avoid imposing assumptions, which might not be empirically

empirical results suggest that the investment model has better performance than the consumption-labor supply model in explaining the actual observations.

6. Conclusions

This paper investigates the sensitivity of schooling to changes in permanent and transitory income using panel data from rural Pakistan. The logit model with fixed effects is employed to estimate regenerative sequential schooling decision process, i.e., models for entrants to and dropouts from school. The results of entrants models demonstrate that positive shocks to transitory income enhance probabilities of entrance to school. Similarly, results from dropout regressions indicate that higher transitory income will decrease probability of dropout from school significantly. Our analysis also points out that schooling response to transitory income is consistently larger for daughters than sons, which suggests important dynamics of gender gap in education. Village fixed effects estimation results show that permanent income also affects schooling pattern, although the magnitude of permanent income effects are always smaller than that of transitory income effects. Our estimation results for households in these Pakistani villages are consistent with the theoretical prediction of borrowing-constrained households. Schooling behavior seems to be more sensitive to transitory poverty than chronic poverty, especially for the poor. In regard to actual policy-making, poverty reduction program that provides poor parents with emergency coping aids such as workfare programs and low-quality food subsidies may be more cost-effective in keeping poor children in school than programs aiming either at reducing poverty itself or at reducing school costs for the poor as a whole.

While our empirical results are in favor of the investment model of education against the consumption model, we should also note that it is not the only way to explain some of our results. For example, the paper considers the sibling resource constraint results to be driven from capital market imperfections. However, alternate explanations, such as intrahousehold cost-sharing, other forms of externalities, or optimal portfolio choice, may generate similar results. Specifically, we impose an additive separability assumption for each child's human capital. In future, it would be interesting to

supported.

examine the predictions of alternative functional forms that range from complementarities to complete specialization of child education.

Appendix 1.1: Proof of the proposition 1

By differentiating equation (6), we have

$$\frac{dS_{it}^*}{dY_{Pt}^T} = \left[\frac{f_{Sit+1} f_{SitSit}}{f_{Sit}^2}\frac{Y_{Cit}}{Y_{Cit+1}} + E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t)Y_{Cit}\right]^{-1} \bullet E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t) > 0,$$

$$\frac{dS_{it}^*}{dY_P^P} = \left[\frac{f_{Sit+1} f_{SitSit}}{f_{Sit}^2}\frac{Y_{Cit}}{Y_{Cit+1}} + E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t)Y_{Cit}\right]^{-1}$$

$$\bullet\left[E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t) - E_t\left(\frac{\beta U''(C_{t+1})}{U'(C_t)}\right)\right] \gtrless 0,$$

verifying that $\frac{dS_{it}^*}{dY_{Pt}^T} > \frac{dS_{it}^*}{dY_P^P}$. Q.E.D.

Appendix 1.2: Proof of the proposition 2

By differentiating equation (6), we have

$$\frac{dS_{it}^*}{dS_{jt}^*} = -\left[\frac{f_{Sit+1} f_{SitSit}}{f_{Sit}^2}\frac{Y_{Cit}}{Y_{Cit+1}} + E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t)Y_{Cit}\right]^{-1} \bullet E_t\left(\frac{\beta U'(C_{t+1})}{U'(C_t)^2}\right)U''(C_t)Y_{Cjt} < 0,$$

verifying that $\frac{dS_{it}^*}{dS_{jt}^*} < \frac{dS_{it}^*}{dS_{kt}^*} < 0$, if $i\neq j$, $i\neq k$, and $Y_{Cjt}>Y_{Ckt}$. Q.E.D..

Appendix 2: A Consumption Model of Demand for Education

In order to address the consumption aspects of education and labor market supply decision issues, we can extend the framework of MaCurdy (1981) and Kochar (1999c). Assuming that there is a consumption value of child education, a household's problem can be written as

$$\underset{\{C_t,S_{it}\}}{Max}\; E_t\left[\sum_{k=0}^{T-t}\beta^k\{U(C_{t+k})+\sum_{i=1}^{M}\theta_i v(S_{it+k})\}+\beta^{T+1}W(A_{T+1})\right]$$

$$s.t. \qquad A_{t+1}=\left[A_t+Y_P^P+Y_{Pt}^T+\sum_{i=1}^{M}Y_{Cit}(1-S_{it})-C_t\right](1+r_t)$$

$$A_t+Y_P^P+Y_{Pt}^T+\sum_{i=1}^{M}(1-S_{it})Y_{Cit}+B\geq C_t$$

$$A_t\ given,\ A_T\geq 0\,.$$

The function $v(\bullet)$ is assumed to be concave. Note that the parameter θ_i is a welfare weight imposed on the household utility from the child *i*'s schooling.

A2.1. Case of perfect credit availability

When a household can borrow and save freely at an exogenously given interest rate, the borrowing constraint is not binding. Then from the first-order conditions, we have the Euler equation for the optimal consumption:

(A2-1) $$U'(C_t)=\beta E_t\left[U'(C_{t+1})(1+r_t)\right].$$

With respect to the optimal level of schooling, we have schooling function as:

(A2-2) $$E_t\left[\frac{\partial v/\partial S_{it+1}}{\partial v/\partial S_{it}}\right]\left[\frac{Y_{Cit}}{Y_{Cit+1}}\right]=\frac{1}{\beta(1+r_t)},\ \forall\ i.$$

Also, note that this condition potentially derives the optimal level of labor supply, 1-*S*. As in equation (5), the left-hand side is the marginal rate of transformation and the right-hand side represents a product of an exogenously given interest rate and a discount factor. The optimal schooling decision rule at time *t* can be represented as a reduced form of equation (11):

(A2-2') $$S_{it}^*=S_v^{NC}(\beta,r_t,g_{it})\,.$$

This equation (A2-2') indicates that if borrowing constraint is not binding, parental income or schooling decisions of other children does not affect the schooling decision of a child. As in equation (5), the two separabilities, one for consumption and schooling decision and the other for intrahousehold schooling allocation, hold in this model. However, unlike equation (5), the optimal level of schooling is not a function of child specific variables, gender specific elements, and school availability and quality. This is the difference between the investment model and consumption model under perfect credit availability. However, we should note that if households' preference toward a child's education is a function of child specific characteristics, the optimal schooling decision can be a function of child variables even under the consumption model, making the identification of the consumption model from the investment model difficult.

A2.2. Case of binding borrowing constraint

If borrowing constraint is binding, then the optimization problem can be reduced to period-by-period utility maximization:

$$\underset{\{C_t, S_{it}\}}{Max}\ U(C_t) + \sum_{i=1}^{M} \theta_i v(S_{it})$$

$$s.t. \qquad A_t + Y_P^P + Y_{Pt}^T + \sum_{i=1}^{M} Y_{Cit}(1 - S_{it}) + B = C_t\ .$$

Unlike the investment model, the borrowing constrained case can be expressed as a static optimization problem. This is simply because schooling gives consumption return instantaneously as a part of utility. There is no intertemporal dimension involved in schooling as consumption goods. From the first-order conditions, the Marshallian education demand function can be derived:

$$S_{it+k} = S_{it}^C (Y_t^*, Y_{C1t}, Y_{C2t}, \cdots, Y_{CMt})\ ,$$

where $Y_t^* = A_t + Y_P^P + Y_{Pt}^T + \sum_{j=1}^{M} Y_{Cjt} + B$ is the full income of this household. As in the case of the investment model, both permanent and transitory components of income affect schooling demand. However, permanent income and transitory income effects should be symmetric in this consumption model, unlike in the investment model whereby these effects should be asymmetric.

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Figure 1
Determination of the Optimal Schooling

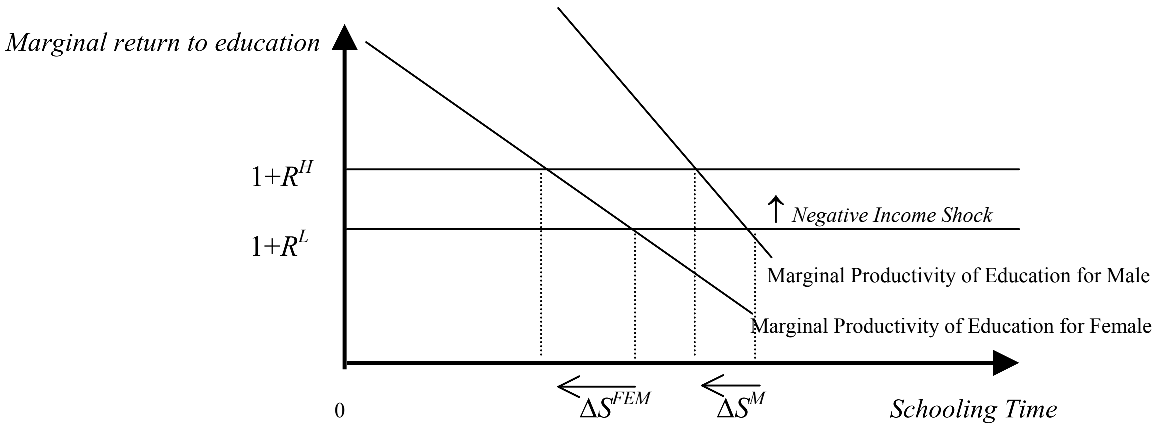

Table 1
Summary Statistics of Variable Used for Income Regressions

	District			
	Faisalabad	Attock	Badin	Dir
Variable	Mean (Std. Dev)	Mean (Std. Dev.)	Mean (Std. Dev.)	Mean (Std. Dev.)
Income				
Total annual household income (1,000 Rs)	44.87 (102.47)	23.52 (23.75)	32.99 (36.07)	45.12 (50.51)
Physical Assets				
Total value of livestock (1,000 Rs)	18.63 (16.64)	11.42 (12.02)	24.69 (22.73)	10.82 (9.15)
Total irrigated land (acres)	4.24 (7.92)	0.22 (0.74)	9.81 (18.07)	1.55 (5.92)
Total rainfed land (acres)	0.02 (0.26)	9.70 (20.75)	0.02 (0.52)	3.05 (8.04)
Total land (acres)	4.34 (7.96)	13.87 (30.77)	13.00 (23.09)	6.08 (24.22)
Human Assets				
Number of male member above 16	2.82 (1.51)	2.56 (1.32)	2.60 (1.66)	3.19 (1.86)
Number of male member between 6 and 16	1.27 (1.25)	0.85 (0.92)	1.43 (1.30)	1.95 (1.52)
Number of female member above 16	2.62 (1.37)	2.47 (1.19)	2.45 (1.47)	3.01 (1.75)
Number of female member between 6 and 16	1.03 (1.17)	0.81 (0.98)	1.30 (1.27)	1.84 (1.56)
Number of children below 6	1.30 (1.45)	0.98 (1.07)	1.91 (1.66)	2.40 (1.86)
Transitory Shock Variables				
Number of died member (elder than 16)	0.03 (0.16)	0.02 (0.15)	0.02 (0.14)	0.02 (0.13)
Number of dead animals	0.04 (0.38)	0.02 (0.16)	0.01 (0.13)	0.04 (0.34)
Deviation of annual rainfall from long term average (district level rainfall over 20 years)	31.28 (9.72)	-1.48 (8.81)	-10.33 (19.81)	-5.51 (5.79)
Year dummy for 86/87	0.19	0.20	0.20	0.20
Year dummy for 87/88	0.19	0.20	0.20	0.20
Year dummy for 88/89	0.19	0.20	0.20	0.20
Year dummy for 89/90	0.21	0.21	0.20	0.20
Year dummy for 91/92	0.21	0.20	0.19	0.20
Number of Observations	759	780	1168	951
Number of Households	159	162	239	205

Table 2
Panel Fixed Effects Estimation of Income Equation
Dependent Variable: Total Annual Household Income
(in 1,000 Rupees)

	District			
	Faisalabad	Attock	Badin	Dir
Variable	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)	Coef. (t-stat)
Physical Assets				
Total value of livestock (1,000 Rs)	1.33 (3.98)***	0.03 (0.27)	0.12 (2.42)**	0.23 (0.81)
Total irrigated land (acres)	9.20 (3.45)***	0.58 (0.31)	0.32 (1.81)*	1.91 (1.72)*
Total rainfed land (acres)	13.01 (0.75)	-0.19 (0.80)	-0.16 (0.12)	1.49 (2.28)**
Human Assets				
Number of male member above 16	60.08 (6.59)***	5.48 (2.35)**	8.16 (4.25)***	-1.90 (0.41)
Number of male member between 6 and 16	66.05 (8.16)***	0.72 (0.37)	2.14 (1.41)	0.23 (0.08)
Number of female member above 16	-7.28 (0.95)	3.64 (1.65)*	-0.30 (0.16)	2.37 (0.79)
Number of female member between 6 and 16	-2.44 (0.35)	2.17 (1.00)	2.79 (1.99)**	0.53 (0.21)
Number of children below 6	1.92 (0.40)	0.08 (0.05)	0.35 (0.33)	4.01 (2.14)**
Transitory Shock Variables				
Number of died member (elder than 16)	-14.48 (0.59)	-4.62 (0.51)	18.89 (2.08)**	7.71 (0.43)
Number of dead animals	-1.18 (0.15)	-1.84 (0.39)	-5.47 (1.04)	-1.46 (0.38)
Deviation of annual rainfall from long term average	-0.90 (2.14)**	-0.56 (3.36)***	-0.36 (2.37)**	1.91 (1.06)
Year dummy for 86/87	-4.64 (0.43)	-3.25 (1.42)	13.20 (2.06)**	-41.30 (1.56)
Year dummy for 87/88	-9.04 (0.94)	2.33 (0.62)	16.03 (3.41)***	-16.86 (2.05)**
Year dummy for 88/89	5.90 (0.71)	-7.92 (4.07)***	21.42 (3.30)***	-30.36 (2.02)**
Constant	-223.09 (4.24)***	0.47 (0.05)	-15.39 (1.76)*	51.36 (2.12)**
Number of Observations	759	780	1168	951
Number of Households	159	162	239	205
Overall R^2	0.186	0.076	0.418	0.119
F-statistics for a hypothesis that all coefficients are jointly zero	10.49	7.51	8.32	3.06

Note: Estimation includes household fixed effects. Dummy variable for the fourth year is omitted since rain deviation variable is district specific. Note that the fifth year is the default.
* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Table 3
Summary Statistics for Data Used for Entrants and Dropouts Model

	Entrants		Dropouts	
Variable	Mean	(Std. Dev.)	Mean	(Std. Dev.)
Dependent Variables				
Dummy =1 if enter school; =0 otherwise	0.11			
Dummy =1 if dropout of school; =0 otherwise			0.17	
Independent Variables				
Income Variables				
Total annual household income (1,000 Rs)	39.13	(43.76)	46.02	(58.80)
Permanent income (1,000 Rs)	49.37	(55.89)	67.52	(62.43)
Transitory income (1,000 Rs)	-10.30	(23.32)	-21.03	(19.43)
Residual income (1,000 Rs)	0.05	(33.64)	-0.47	(37.90)
Intrahousehold Variables				
Number of Siblings at School				
Number of elder brothers at school	0.50	(0.99)	0.84	(1.14)
Number of elder sisters at school	0.10	(0.43)	0.19	(0.52)
Number of younger brothers at school	0.68	(1.10)	0.90	(1.13)
Number of younger sisters at school	0.20	(0.55)	0.36	(0.75)
Number of Siblings out of School				
Number of elder brothers out of school	1.90	(1.74)	1.62	(1.58)
Number of older sisters out of school	1.95	(1.81)	2.12	(1.69)
Number of younger brothers out of school	1.59	(1.53)	1.32	(1.30)
Number of younger sisters out of school	1.97	(1.98)	1.85	(1.91)
Number of Siblings				
Number of elder brothers	2.39	(2.13)	2.46	(1.99)
Number of elder sisters	2.05	(1.92)	2.31	(1.78)
Number of younger brothers	2.26	(1.98)	2.22	(1.80)
Number of younger sisters	2.17	(2.09)	2.21	(2.08)
Ratio of Siblings at and out of School				
(Elder brothers at school – elder brothers out of school) / (total number of elder brothers +1)	-0.18	(0.28)	-0.11	(0.27)
(Younger brothers at school – younger brothers out of school) / (total number of younger brothers +1)	-0.29	(0.24)	-0.31	(0.24)
(Elder sisters at school – elder sisters out of school) / (total number of elder sisters +1)	-0.11	(0.25)	-0.04	(0.25)
(Younger sisters at school – younger sisters out of school) / (total number of younger sisters +1)	-0.25	(0.25)	-0.21	(0.28)
Gender Variable				
Dummy =1 if female; =0 otherwise	0.59		0.21	
Relation-to-head of household				
Dummy =1 if son/daughter of the household head	0.68		0.76	
Dummy =1 if grandchild of the household head	0.12		0.14	
(Default) Dummy =1 if sisnter / brother / nephew / niece / in-laws / other relative of the household head	0.20		0.10	

Table 3 (continued)
Summary Statistics for Data Used for Entrants and Dropouts Model

	Entrants		Dropouts	
Variable	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Age Dummy Variables				
age dummy (age of 3)	0.04			
age dummy (age of 4)	0.04			
age dummy (age of 5)	0.04		0.01	
age dummy (age of 6)	0.05		0.03	
age dummy (age of 7)	0.07		0.08	
age dummy (age of 8)	0.07		0.14	
age dummy (age of 9)	0.05		0.11	
age dummy (age of 10)	0.04		0.10	
age dummy (age of 11)	0.04		0.09	
age dummy (age of 12)	0.04		0.07	
age dummy (age of 13)	0.03		0.07	
age dummy (age of 14)	0.04		0.06	
age dummy (age of 15)	0.04		0.05	
age dummy (age of 16)	0.05		0.04	
age dummy (age of 17)	0.05		0.03	
age dummy (age of 18)	0.05		0.03	
age dummy (age of 19)	0.05		0.03	
age dummy (age of 20)	0.06		0.02	
age dummy (age of 21)	0.06		0.01	
age dummy (age of 22)	0.05		0.01	
age dummy (age of 23)	0.03		0.01	
Year Dummy Variables				
Year dummy (86/87)	0.15		0.20	
Year dummy (87/88)	0.45		0.39	
Year dummy (88/89)	0.40		0.41	
Number of observations for 86/87 (number of households)	767	(304)	423	(166)
Number of observations for 87/88 (number of households)	2218	(662)	866	(409)
Number of observations for 88/89 (number of households)	1974	(634)	910	(411)
Total Number of observations	4959		2199	

Table 4
Fixed Effects Logit Estimation of Entrants and Dropouts Model
Dependent Variable: ENT or DRP

	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)
Independent variable	ENT	ENT	DRP	DRP
Specification	(1)	(2)	(3)	(4)
Income Variables				
Permanent income (1,000 Rs)	-0.008	-0.002	-0.005	-0.006
	(0.913)	(0.227)	(0.769)	(0.796)
Transitory Income (1,000 Rs)	0.102	0.087	-0.092	-0.083
	(2.802)***	(2.428)**	(2.050)**	(1.862)*
Residual Income (1,000 Rs)	0.002	0.001	-0.002	-0.002
	(1.374)	(0.692)	(0.495)	(0.646)
Number of Siblings at School				
Number of elder brothers at school	0.229	-0.174	0.382	0.266
	(1.080)	(1.595)	(1.232)	(1.744)*
Number of elder sisters at school	0.300	0.262	-0.494	-0.325
	(1.488)	(1.762)*	(1.757)*	(1.394)
Number of younger brothers at school	0.355		0.220	
	(1.713)*		(0.730)	
Number of younger sisters at school	-0.026		-0.166	
	(0.132)		(0.738)	
Number of Siblings out of School				
Number of elder brothers out of school	0.468	-0.083	-0.731	-0.808
	(1.929)*	(0.667)	(2.068)**	(3.568)***
Number of older sisters out of school	0.446	0.257	-0.068	0.130
	(2.463)**	(2.348)**	(0.308)	(0.794)
Number of younger brothers out of school	0.743		-0.175	
	(3.393)***		(0.595)	
Number of younger sisters out of school	0.295		-0.264	
	(1.760)*		(1.331)	
Gender Variable				
Dummy =1 if female; =0 otherwise	-1.751	-1.380	1.658	1.983
	(5.214)***	(8.016)***	(3.636)***	(7.829)***
Relation-to-head of household				
Dummy =1 if son/daughter of the household head	0.898	0.908	-0.094	-0.178
	(2.581)***	(2.641)***	(0.168)	-0.323
Dummy =1 if grandchild of the household head	0.989	0.903	0.534	0.501
	(2.020)**	(1.867)*	(0.754)	0.704
Total number of observations	2675	2675	1270	1270

Note: Estimation includes household fixed effects, age dummy variables, and year dummy variables. The conditional maximum likelihood method is employed. 370 household-year data (2284 observations) for entrant regressions and 283 household-year data (929 observations) for dropout regression are omitted due to all positive or negative outcomes.
* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Table 5
Fixed Effects Logit Estimation of Entrants and Dropouts Models with Gender Interaction Terms
Dependent Variable: ENT or DRP

	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)
Independent variable	ENT	ENT	DRP	DRP
Specification	(5)	(6)	(7)	(8)
Income Variables				
Permanent income (1,000 Rs)	-0.010	-0.004	-0.006	-0.006
	(1.056)	(0.398)	(0.744)	(0.796)
Interaction term with female dummy	-0.001	0.000	0.001	0.002
	(0.400)	(0.259)	(0.227)	(0.309)
Transitory Income (1,000 Rs)	0.090	0.073	-0.069	-0.062
	(2.371)**	(2.009)**	(1.521)	(1.375)
Interaction term with female dummy	0.026	0.028	-0.031	-0.029
	(3.872)***	(4.097)***	(2.527)**	(2.374)**
Residual Income (1,000 Rs)	0.003	0.001	0.000	0.000
	(1.385)	(0.767)	(0.049)	(0.030)
Interaction term with female dummy	-0.001	-0.001	-0.004	-0.005
	(0.244)	(0.255)	(0.635)	(0.709)
Number of Siblings at School				
Number of elder brothers at school	0.257	-0.130	0.425	0.263
	(1.193)	(1.166)	(1.360)	(1.710)*
Number of elder sisters at school	0.341	0.310	-0.542	-0.341
	(1.674)*	(2.078)**	(1.917)**	(1.450)
Number of younger brothers at school	0.335		0.273	
	(1.591)		(0.898)	
Number of younger sisters at school	-0.034		-0.217	
	(0.172)		(0.947)	
Number of Siblings out of School				
Number of elder brothers out of school	0.499	-0.033	-0.620	-0.749
	(2.025)**	(0.262)	(1.737)*	(3.299)***
Number of older sisters out of school	0.452	0.277	-0.080	0.141
	(2.460)**	(2.501)**	(0.365)	(0.851)
Number of younger brothers out of school	0.731		-0.144	
	(3.280)***		(0.482)	
Number of younger sisters out of school	0.279		-0.295	
	(1.640)*		(1.463)	
Gender Variable				
Dummy =1 if female; =0 otherwise	-1.594	-1.229	0.947	1.362
	(4.479)***	(6.203)***	(1.701)*	(3.364)***
Relation-to-head of household				
Dummy =1 if son/daughter of the household head	0.921	0.930	-0.167	-0.241
	(2.605)***	(2.655)***	(0.303)	(0.441)
Dummy =1 if grandchild of the household head	1.163	1.094	0.345	0.311
	(2.323)**	(2.207)**	(0.488)	(0.437)
Total number of observations	2675	2675	1270	1270

Note: Estimation includes household fixed effects, age dummy variables, and year dummy variables. The conditional maximum likelihood method is employed. 370 household-year data (2284 observations) for entrant regressions and 283 household-year data (929 observations) for dropout regression are omitted due to all positive or negative outcomes.
* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level

Table 6
Fixed Effects Logit Estimation of Entrants and Dropouts Model
Dependent Variable: ENT or DRP

	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)
Independent variable	ENT	DRP	ENT	DRP
Specification	(9)	(10)	(11)	(12)
Income Variables				
Permanent income (1,000 Rs)	-0.000	-0.005	-0.003	-0.006
	(0.030)	(0.704)	(0.354)	(0.809)
Interaction term with female dummy	-0.001	0.003	-0.001	0.002
	(0.491)	(0.543)	(0.304)	(0.376)
Transitory Income (1,000 Rs)	0.121	-0.064	0.072	-0.058
	(3.217)***	(1.428)	(1.989)**	(1.282)
Interaction term with female dummy	0.025	-0.030	0.027	-0.032
	(3.664)***	(2.438)**	(4.080)***	(2.734)***
Residual Income (1,000 Rs)	0.002	0.000	0.001	-0.001
	(1.245)	(0.069)	(0.750)	(0.125)
Interaction term with female dummy	-0.002	-0.004	-0.001	-0.003
	(0.580)	(0.573)	(0.256)	(0.501)
Ratio of Siblings at and out of School				
(Elder brothers at school – elder brothers out of school)	-1.412	3.283		
/ (total number of elder brothers +1)	(3.162)***	(5.036)***		
(Younger brothers at school – younger brothers out of school)	-2.337	-0.373		
/ (total number of younger brothers +1)	(4.346)***	(0.527)		
(Elder sisters at school – elder sisters out of school)	-2.486	1.287		
/ (total number of elder sisters +1)	(5.429)***	(2.189)**		
(Younger sisters at school – younger sisters out of school)	-1.818	0.919		
/ (total number of younger sisters +1)	(3.643)***	(1.777)**		
Number of Siblings				
Number of elder brothers			-0.092	0.023
			(0.942)	(0.159)
Number of elder sisters			0.276	0.023
			(2.807)***	(0.153)
Gender Variable				
Dummy =1 if female; =0 otherwise	-1.288	1.038	-1.215	1.378
	(6.704)***	(2.537)**	(6.171)***	(3.466)***
Relation-to-head of household				
Dummy =1 if son/daughter of the household head	0.944	-0.128	0.922	-0.286
	(2.685)**	(0.235)	(2.637)***	(0.534)
Dummy =1 if grandchild of the household head	1.303	0.602	1.087	0.299
	(2.612)**	(0.849)	(2.194)**	(0.426)
Total number of observations	2675	1270	2675	1270

Note: Estimation includes household fixed effects, age dummy variables, and year dummy variables. The conditional maximum likelihood method is employed. 283 household-year data (929 observations) are omitted due to all positive or negative outcomes.
* statistically significant at 10% level; ** statistically significant at 5% level; *** statistically significant at 1% level

Table 7
Village Fixed Effects Logit Estimation of Entrants and Dropouts Model
Dependent Variable: ENT or DRP

	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)	Coef. (z-stat.)
Independent variable	ENT	ENT	ENT	DRP	DRP	DRP
Specification	(13)	(14)	(15)	(16)	(17)	(18)
Income Variables						
Permanent income (1,000 Rs)	0.002	0.002	0.002	-0.004	-0.005	-0.005
	(1.670)*	(1.609)	(1.738)*	(1.668)*	(2.106)*	(2.406)**
Transitory Income (1,000 Rs)	0.031	0.033	0.042	-0.100	-0.100	-0.103
	(1.434)	(1.561)	(2.004)**	(2.635)***	(2.752)***	(2.909)***
Residual Income (1,000 Rs)	0.002	0.002	0.002	-0.002	-0.003	-0.002
	(1.516)	(1.548)	(1.512)	(1.017)	(1.057)	(1.114)
Number of Siblings at School						
Number of elder brothers at school	-0.027	-0.022		-0.135	-0.128	
	(0.435)	(0.358)		(1.516)	(1.448)	
Number of elder sisters at school	0.441	0.416		-0.712	-0.699	
	(3.992)***	(3.806)***		(3.618)***	(3.542)***	
Number of younger brothers at school	-0.020			-0.062		
	(0.281)			(0.696)		
Number of younger sisters at school	0.163			-0.200		
	(1.664)*			(1.831)*		
Number of Siblings out of School						
Number of elder brothers out of school	-0.160	-0.134		-0.084	-0.078	
	(3.357)***	(3.735)***		(1.196)	(1.158)	
Number of older sisters out of school	0.100	0.090		0.007	0.020	
	(2.312)**	(2.115)**		(0.112)	(0.317)	
Number of younger brothers out of school	-0.084			0.045		
	(1.614)			(0.632)		
Number of younger sisters out of school	-0.034			-0.001		
	(0.773)			(0.013)		
Number of Siblings						
Number of elder brothers			-0.127			-0.077
			(3.272)***			(1.450)
Number of elder sisters			0.130			-0.040
			(3.339)***			(0.668)
Gender Variable						
Dummy =1 if female; =0 otherwise	-1.175	-1.169	-1.129	1.661	1.613	1.564
	(9.424)***	(9.417)***	(9.192)***	(8.952)***	(8.859)***	(8.674)***
Relation-to-head of household						
Dummy =1 if son/daughter of the household head	0.377	0.350	0.475	0.068	0.073	0.046
	(1.880)*	(1.756)**	(2.408)**	(0.250)	(0.267)	(0.171)
Dummy =1 if grandchild of the household head	0.831	0.764	0.731	0.277	0.251	0.347
	(3.397)***	(3.165)***	(3.060)***	(0.803)	(0.743)	(1.038)
Total number of observations	2675	2675	2675	1270	1270	1270

Note: Estimation includes village fixed effects, age dummy variables, and year dummy variables. The conditional maximum likelihood method is employed.
* statistically significant at 10% level
** statistically significant at 5% level
*** statistically significant at 1% level