EDUCATIONAL INVESTMENT DECISION OF RURAL HOUSEHOLDS:

Theoretical Explorations and Econometric Evidence from West Bengal

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CERTIFICATE

This is to certify that the dissertation entitled ***EDUCATIONAL INVESTMENT DECISION OF RURAL HOUSEHOLDS: Theoretical Explorations and Econometric Evidence from West Bengal***, submitted by Susmita Banerjee in partial fulfillment of the requirements for the award of the degree of **MASTER OF PHILOSOPHY** of this University, has not been previously submitted for any degree of this or any other University. To the best of our knowledge this is a bonafide work.

We recommended that this dissertation be placed before the examiners for evaluation.

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I am solely responsible for any shortcomings of this thesis.

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SUSMITA BANERJEE

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Chapter 1

INTRODUCTION

1.1 HUMAN CAPITAL: An Introduction

People enhance their capabilities as producers as well as consumers by investing in themselves, which forms the basis of generating human capital. An obvious question that arises is: *what is the contribution of human capital to economic growth?* Economists raised this question when they realised that production in advanced industrial economies has been growing much faster than what could be explained by the growth in their stock of inputs of physical capital and labour force. In an early path-breaking study by Solow (1956) introduced a new model of economic growth. Deviating from the assumption of constant returns to each factor of production, Solow assumed diminishing marginal returns to each factor but constant returns to scale. He identified two sources of growth – first, a rise in the capital labour ratio resulting from a faster growth of capital relative to labour and second, improvement in technology raising labour productivity and output. The Solow growth model makes a strong claim: in the absence of technical progress, a country cannot sustain a growth in per capita income indefinitely. In the absence of technical progress, if capital grows faster than labour, the hypothesis of diminishing marginal returns to capital will imply a fall in the growth rate of output, and therefore, of capital. But if we assume continuous technical progress, then it outweighs the adverse effects of diminishing marginal returns to capital and there is no reason why growth in per capita income cannot be sustained indefinitely.

Solow (1957), in his pioneering growth accounting exercise, concluded that during 1909 to 1949, surprisingly only $1/8^{th}$ of the growth of the United States per capital GNP could be explained by the growth of its endowment of physical factors, leaving the

remaining $7/8^{th}$ to a "residual" which was termed as technical progress by him. Indeed this result shattered the basic tenets of the conventional wisdom on economic growth in the form of the Harrod-Domar model.

Technological progress is assumed to be exogenously given in Solow's growth model. In reality, technclogical progress results from a combination of research, invention, development and innovation, all of which are endogenously determined depending on the socio-economic condition and stage of development of the country. The ***quality of labour*** plays an important role in this process. A country can improve the quality of its labour force by investing in ***human capital***, which can overcome many of the characteristics of the labour force that acts as impediments to greater productivity, such as poor health, lack of education and enlightenment causing inertia towards change and movement. These may be pre-conditions for successful introduction and absorption of sophisticated and advanced technologies. Indeed, the capacity to introduce and absorb technological progress may be severely limited by lack of investments in human capital. In fact, Professor T.W.Schultz, in his presidential address to the American Economic Association in 1961, was one of the first to suggest that growth in the United States *unexplained* by conventional factor inputs might be due to the rapid increase in the quality of labour through education. This in a sense marks the entry of human capital into mainstream economic theory. In particular, growth theory saw an explosion of new models endogenousing technical progress and investments in human capital to explain economic growth.[1]

The recent literature on 'endogenous growth' has stressed on the important role that human capital plays in economic growth and development (Romer, 1986, 1990, 1993

[1] Not only in growth theory, human capital has played an important role in international trade theory as well. Inclusion of skills (or human capital) as a third factor of production in an extended Heckscher-Ohlin framework has helped to resolve, at least partially, the so-called *Leontief paradox* by explaining why capital rich countries like the US may export labour intensive products and import capital-intensive ones.

and Lucas, 1988). Romer (1986, 1990, 1993) postulates that human capital directly influence productivity by determining the capacity of nations to innovate new technologies suited to domestic production. An additional role for human capital may be as an engine for attracting other factors, such as physical capital, which also contributes to per capita income growth. Lucas (1988) suggested that physical capital fails to flow to poor countries because of their relatively poor endowments of complementary human capital. Benhabib and Spiegel (1994) also showed empirically that level of human capital indeed plays an important role in attracting physical capital. Besides, it had been noted earlier by Nelson and Phelps (1966) that the ability of a nation to adopt and implement a new technology from abroad is a function of its domestic human capital stock, which affects the speed of country's technological catch-up and diffusion.

Given that human capital can play a crucial role in the growth process, policy makers in less developed economies must treat investments in human capital as equally important as investments in physical capital. However, human capital is also a major social and political issue particularly in less developed countries. The economic perspectives on human capital reflects the desire and aspiration of people throughout the world – people anxious to add weight to their demands for action against disease and illiteracy – by showing that such action is not only humanitarian but also makes a major contribution to economic growth.

1.2 EDUCATION AS HUMAN CAPITAL

There are two interlinked micro theoretic dimensions of the theory of human capital: (1) returns to human capital and (2) investment in human capital. In this study, we propose to examine the microeconomic dimensions of *human capital investments*.

There are several ways to invest in human capital. It includes schooling, on the job training, medical care, vitamin consumption and acquiring information. Through all of these channels, the physical and mental ability of people are improved and thereby raises their income prospects. But each of these methods of human capital investments differs with respect to the amount of resources invested, the size of returns and the perceived link between investment and return. Here we focus only on *investment through education*.

Investment in education expands and extends knowledge, which in turn raises productivity. The principal hypothesis underlying this treatment of education is that some increase in national income is a consequence of additions to the stock of this form of capital. At the aggregate level, there are strong theoretical reasons for linking the expansion of education to higher rates of economic growth. Micro economic theory suggests different ways in which education can affect productivity. Becker's (1975) theory of human capital argues that education teaches workers valuable skills that make them more productive. There is also evidence that educated workers have faster rates of learning by doing than uneducated workers. It widens a workers' access to different sources of information and increase a workers' ability to learn from past experience. Not only that, educated workers have comparative advantage over the uneducated workers in adopting and implementing new technology as they posses better ideas of how to use them. For example, the National Human Development Report 2001 (2002) reports that in agriculture the productivity of a farmer with four years of elementary education is on an average, 8.5 percent higher than his uneducated counterpart. Besides the above, it is also cited that the educated workers are more productive for industry also. More strikingly, the skill and knowledge intensive sectors have been the fastest growing service sector in India in the recent years.

1.3 THEORY OF INVESTMENT IN EDUCATION

Education possesses characteristics of both consumption goods as well as investment goods. It is sometimes viewed as a filter that selects more productive individual. Depending on these there are three groups of theories.

The Human Capital theory developed by Schultz (1960 and 1963) and Becker (1975) regarded education as an investment. Student invests time and money now in return for future rewards. The underlying assumption is that education enables students to become more productive worker and thus raise their lifetime earning potential.

The second group of theories viewed education as a consumption activity (Kim, 1988, Campbell and Seigel, 1967). The main idea behind this theory is that, every individual receives some additional satisfaction from social and intellectual amenities that arises from their schooling.

But it is often argued that consumption approach supplements and enriches the investment approach and both consumption and investment motives simultaneously determines the optimal level of investment in education. Kodde and Ritzen (1984), Schaafsma (1976) explore the theoretical implications of integrating consumption and investment motives of education.

A third group of theories regards education as a filter that selects more productive students. This is known as *Screening Hypothesis* (Arrow, 1973), which states that earning differentials in wage labour markets are primarily determined by differences in ability rather than differential level of human capital acquired through education. It is argued that education selects more able students who are assumed to be more productive. This higher expected productivity leads to higher earnings with more education. Employers use 'education' as an informal 'signal' to differentiate high-quality workers from low-quality workers and hence, individual invests in education in order to signal employers.

Investment decisions on human capital are mostly taken by the parents on behalf of their children, especially in LDCs. Thus, the family plays a central role in this decision-making. The idea that the family plays an important role in shaping economic outcomes of its members is hardly a new one. But the existing literature on human capital (surveyed in chapter two) by and large deals with the investment in human capital in the context of developed countries. Much of these theoretical and empirical literatures on this topic fail to capture the basic characteristics of less developed countries. The present study makes an attempt to contribute to this literature incorporating these characteristics of less developed countries. We intend to analyse the process of human capital investment by rural households in LDCs.

1.4 OBJECTIVE AND RESEARCH QUESTIONS

The main objective of this study is to investigate the rural household's (farm family as well as non-farm households) educational investment decision-making process in less developed countries.

The study makes an attempt to seek answers to the following questions:

- *What are the driving forces behind educational investment decisions of rural households in LDCs?*
- *Do farm and non-farm households differ in their educational investment behaviour?*
- *How do these households decide to allocate their children's time between education and work?*
- *When education is regarded as consumption good as well as an investment, what would be their behaviour?*

- *Do credit markets play any role in determining the optimum level of investment in education by rural households?*

Most of these questions will be addressed with the help of micro theoretic analysis, supplemented by micro-econometric models. For the econometric analysis, we generate a primary data set of 80 rural households from West Bengal.

1.5 OUTLINE OF THE THESIS

The study is divided into five chapters. After this introduction, chapter 2 will present a survey of the existing literature. In chapter 3, we will present our theoretical models to explain educational investment decision-making process of rural households (both farm and non-farm). Chapter 4 presents an econometric analysis. Chapter 5 concludes with a summary of the main findings.

Chapter 2

A SURVEY OF LITERATURE ON HUMAN CAPITAL

2.1 DEFINITION OF HUMAN CAPITAL

Activities that influence future real income through the imbedding of resources in people are known as investment in human capital. It is **human** because it becomes a part of a man and it is **capital** because it is a source of future earnings or source of future satisfaction or both of these. The principal characteristic that distinguishes human capital from other physical capital is that human capital is embodied in the person investing. Among the various channels of investing in human capital, we focus only on investment through education in our study.

2.1.1 Education as Human Capital

Before proceeding further let us define **education**. According to the Oxford dictionary, education refers to *systematic training and instruction designed to impart knowledge and develop skills*. Education should ideally be viewed as a production process where inputs of schooling (or investment in education) get transformed into outputs of productivity augmenting skills. Investment in education (schooling and other educational inputs) expands and extends knowledge of a human being. The output of education in the form of productivity augmenting skills is a durable capital asset as it increases future income of an individual. Since this output becomes a part of the person receiving it, we can refer to this capital asset as ***human capital***. Being an integral part of

the person, the human capital assets cannot be bought and sold or treated as tangible property unlike physical capital.

There is also a direct consumption value of education in the sense that the process of acquiring it and making use of it acts as a source of satisfaction irrespective of its monetary rewards.

2.2 THEORIES OF INVESTMENT IN HUMAN CAPITAL

2.2.1 Becker's Generalized Formulation

Becker (1962,1965,1975) and Schultz (1960,1961) pioneered the theory of human capital investments. We begin with Becker's formulation as it provides a generalized framework for explaining investments in human capital by looking at the demand as well as the supply side of investment. Indeed, Becker (1975) made one of the earliest attempts to analyse investment in human capital with special reference to the education. According to him school can be defined as an institution specializing in the production of skills[1]. The opportunity cost of time spent in school can be measured in terms of the income that he could have earned by supplying his labour during this time. Besides this opportunity cost, there are also direct costs of schooling like school fees, cost of books, stationary, conveyance etc. The decision to invest in schooling will therefore depend on the returns to this investment, net of all costs (direct and opportunity).

To understand the decision-making process with regard to human capital investments, Becker made a clear distinction between factors affecting the demand for investment in education and the supply of investment in education. The former includes age, ability, life span, market-size, wage-differential and risk and uncertainty.

Young people have a greater incentive to invest because, opportunity cost of education increases with age. A more able individual will be able to extract greater return from education and will intend to invest more. An increase in the life span of an individual would also *ceteris paribus* increase the rate of return to investments in education made in any period. The larger the market size the larger will be the demand for skilled labour, and hence the larger will be demand for investment in education. The returns to education are measured by the absolute income gain or by absolute income differential between persons differing only in the extent of their educational level. Some wage differential between workers with different education levels is, therefore, a pre-requisite to induce individuals to invest in education. Finally, since human capital is an illiquid and risky asset, an informed rational individual would invest in education only if the expected rate of return is higher than the sum of the interest rate on risk-less assets, the liquidity and the risk premium associated with human capital investments.

Effectively, therefore, it is the monetary benefit (or perhaps the monetary equivalent of psychological benefit) that determines an individual's demand for investment in education. Becker (1975) derived the demand curve for educational investment by taking the marginal benefit from investment in education on vertical axis and age on the horizontal axis, where marginal benefits shows the difference between returns and costs of education at the margin. With increasing age the marginal benefit from accumulation of education is likely to decline, implying a negatively sloped demand curve. Becker suggests several reasons behind this decreasing marginal benefit.

First, human capital is embodied in the person investing and is facilitated by his personal attributes like memory, absorptive capacity etc. Given that these qualities are

limited in amount, as the education level of the person concerned increases with age, it becomes increasingly difficult for him to make further additions to his education levels at the margin. He might have to spend greater time and effort to acquire them. This raises the marginal cost of education and thus reduces the net marginal benefit.

Second, with finite lifetime, human capital investment made later in life will yield a stream of future benefits for a shorter duration compared to investment made at an early age. Hence the net marginal benefits will decline with age.

Third, as an individual continues to invest in human capital, the opportunity cost of his time spent on education increases as it embodies the level of human capital already acquired. This raises the marginal cost of education and reduces the net marginal benefits with rising levels of education.

The considerable uncertainty about future benefits also contributes to the negatively sloped demand curve if there is increasing marginal aversion to risk. Indeed, with age one tends to become more risk averse.

The supply curve of investment on human capital shows the marginal cost of financing an additional unit of human capital. This can be measured by the rate of interest that must be paid to finance a unit of capital at the margin. In the real world, capital market is extremely segmented. The result is that although certain sources of funds are cheaper then the others, the amount available to any person from these cheaper sources are usually rationed (since the total demand for the funds tends to exceed their supply). This means a person accumulating capital must shift from the cheapest to the second cheapest and eventually on to expensive sources. This shift from the cheapest to more expensive sources gives rise to an upward sloping supply curve. There could be several

individual-specific parameters that will enter this supply function, e.g., ability and family background. An individual with greater ability, *ceteris paribus*, will enjoy cheaper and easier access to investible funds. The same will be the case for individuals with superior family background defined in terms of family income or resources and parents' education and enlightenment.

The path of human capital accumulation depends on both the net marginal benefits of human capital investment and the cost of financing it. A rational individual will select a path that maximizes the present value of the difference between the net benefits and financing costs. Maximization occurs at a point where marginal benefits equal marginal financing costs. This point of intersection of the marginal benefits and marginal cost curve gives us the optimum level of human capital investment.

The parameters determining these curves vary from individual to individual. Hence the total amount invested in human capital will differ among individuals because of differences in demand and/or supply parameters. Indeed there are some common parameters affecting both demand as well as supply. For instance greater ability will lead to upward parametric shifts in both demand and supply.

To summarize, Becker (1975) presents a generalized framework for the human capital investments based on demand as well as supply considerations. He derives the investment demand function for education as a function of several variables like opportunity cost of education, direct cost of education, ability, degree of risk and uncertainty associated with investment in education, age, life span, market size, and wage differentials. He also posits a supply function of investment in education as a function of credit market imperfections, initial (family) wealth, parents' income and education levels

and the individual's ability. The optimum level of investments in human capital is determined by the intersection of these demand and supply schedules.

Further theoretical developments focus either on the demand side or on the supply side of human capital investments, which we discuss below.

2.2.2 The Demand for Investment on Education

Opportunity Cost:

Opportunity cost or foregone earnings play a major role in determining the demand for investment in education. Opportunity cost is basically the cost of investor's own time, i.e., the amount of income forgone in order to produce one unit of human capital. Measurement of opportunity cost can pose a major problem. Schultz (1960) made a pioneering attempt in this regard.

According to Schultz (1960), more than half the total resources that enter into high school, college and university education consists of the time and effort of the student. This means that foregone earnings constitute the most important part of total cost of education. In order to estimate foregone earnings, Schultz (1960) drew an arbitrary line between elementary and secondary school, and assumed that the children attending elementary schools forego no earnings. Beyond the 8^{th} grade, foregone earnings become relevant. If these students were not in school, they would be gainfully employed against wage payment. There is, therefore, an opportunity cost of attending secondary school. Schultz (1960) took the average earnings per week of young men and woman of comparable age and sex who are not attending school (or of students while they are not in school) as a measure of the value of productivity of student's time and effort.

Parsons (1974), however, criticized Schultz's (1960) method of measurement of opportunity cost and suggested that this conventional method based on the earnings differential of a youth out of and in school as an indirect measure of school time cost, underestimates foregone earnings. Implicit in this indirect measure of schooling time cost is the presumption that the student will reduce his work hours by the number of hours spent in school. Instead, Parsons (1974) assumed that schooling time comes from leisure activity as well as from work hours. Individuals who find schooling more productive will tend to reduce time devoted to leisure also and hence wage rate need not accurately reflect the opportunity cost of his time spent in school. According to him, students usually face imperfect capital market and are forced to self-finance their schooling by working part-time. The demand for investment in schooling can be obtained by maximizing individual's utility, which is a function of leisure and composite market goods (present and future consumption), subject to his budget constraint. Wage is assumed to be an increasing function of past schooling investment. There exist capital market constraints and hence the individual can never be a net borrower. Schooling is undertaken only when the net discounted flow of incremental income exceeds the sum of school related cost.

There is always a tendency to acquire knowledge early in the life cycle, since the stream of returns to given educational investment will be larger the earlier the investment is undertaken. But at the same time, schooling costs, occurring in early years, will be weighed more heavily than future return in the face of borrowing constraints arising out of imperfections in the capital market. In fact, being forced to self-finance education, an individual may even have to drop out of school to earn money sufficient to eliminate the

capital constraint. He will generally find schooling less profitable than his counterpart enjoying greater initial wealth or better borrowing prospect and has been able to invest in schooling earlier in his life cycle. Based on the utility maximization for students and non-students, Parson's (1974) result show that leisure time in equilibrium would be more valuable to a youth in school than a comparable youth out of school. For non-students, leisure time affects only the current earnings, whereas for students, it affects current income as well as future earnings potential through human capital. Hence measuring opportunity cost of schooling time by foregone earnings can lead to gross underestimation.

Several theoretical models have also highlighted the importance of opportunity cost in determining the demand for education, most of which defined opportunity cost as the wage rate of children working outside.

Kodde and Ritzen (1985) studied the theoretical implications of demand for education under the imperfect capital market. They showed how capital market imperfection leads to under investment in education. They modelled investment in education under three credit market regimes: (1) constant borrowing rate, (2) interest rate increasing with borrowing and (3) credit rationing. Considering both direct and opportunity cost of education, an individual maximizes his intertemporal utility function subject to his expenditure equation and time constraint in order to determine his optimum level of investment in education. Opportunity cost is measured by the foregone wage earning. The result shows that under perfect capital market increase in opportunity cost decreases time devoted to education, while in case of imperfect capital market the effect is ambiguous.

Rosenzweig (1977) investigated theoretically and empirically the effect of opportunity cost on schooling enrolment decision of farm households. He defined the opportunity cost of schooling for the farm children as the value of the production or profit sacrificed as a consequence of the child's school attendance. An intertemporal model of farm family schooling decision is formulated in which the role of agriculture is considered explicitly. Maximizing households' lifetime utility function subject to the budget constraint, time constraint and schooling investment function, he estimated the optimal level of the school quantity. He has shown that the effect of any factor, which increases marginal productivity of unskilled labour, increases the opportunity cost of school quantity. The comparative static results however show that the effect of opportunity cost on optimal school quantity is ambiguous, because increase in opportunity cost not only implies negative substitution effect, but also positive income effect.

Kodde (1986) found that in the presence of uncertainty in future income, the effect of opportunity cost, which he has measured by first periods earning, is ambiguous. This result coincides with the result of the model where capital market is imperfect.

Buchmann and Brakewoud (2000) showed that the opportunity cost of schooling also depends on the structure of labour market. For instance the relative employment opportunities for the children and adults can influence the demand for human capital investment. Relatively higher employment opportunities for children will raise the opportunity cost of education, and hence reduce the demand.

Risk and Uncertainty:

Another important factor that determines the demand for education is risk and uncertainty. From the point of view of an individual, investment in human capital is more risky than investment in physical capital due to several reasons. First, there has always been considerable uncertainty about one's life span, which acts as an important determinant of the returns to human capital investment. Secondly, people are uncertain about their abilities, especially the younger people, who do most of the investment. Younger people are often prone to overestimating their ability. Third, investments in human capital have a high gestation lag compared to physical capital, which augments the degree of uncertainty as future supply and demand conditions can not be predicted with certainty. Fourth, investment in human capital is irreversible, while investments in physical capital can be altered depending of course on the degree of asset specificity. Fifth, the risks associated with investments in physical capital can be spread through diversification of asset portfolio. But the diversification of human capital is possible only if an individual acquires general education forgoing the advantages of specialization.

The issue of risk and uncertainty associated with human capital investment has received much attention in the literature. The most important contribution is by Levhari and Weiss (1974). They developed a simple two period model in order to analyse the effect of uncertainty on investment in human capital, where they explicitly consider foregone earnings but abstract from the direct cost of education. It is assumed that future earning depends on the amount of time invested in schooling and on the future unknown state of the world (which is a random variable with known distribution). According to Levhari and Weiss (1974) individual's planning involved decisions on the amounts

invested in human capital and physical capital and they will consider the former as the more risky investment if the expected marginal returns from it is higher than that of physical capital. Uncertainty is introduced in terms of uncertain input (which affects individual's future earning capacity) and uncertain output (which arises due to imperfect knowledge about future demand and supply conditions). Result shows that the effect of uncertainty on the demand for education is ambiguous and depends on the correlation between marginal and average rates of return to human capital. If this correlation is positive i.e. if the variance in future earning rises with the level of schooling, the investment in human capital will be discouraged. On the other hand, if the correlation is negative i.e. if the variance of future earning decreases with the level of schooling, the individual will hedge against states with low earnings by increasing his human capital.

A paper by Kodde (1986) is an extension of the study by Levhari and Weiss (1974), where future income is assumed to be random since future demand and supply conditions cannot be predicted with certainty. Kodde (1986) analysed the impact of income uncertainty on the demand for education in a two-period model of human capital formation under a perfect capital market, both theoretically and empirically. Contradicting the results obtained by Levhari and Weiss (1974), Kodde (1986) showed that the equality between the expected rate of return from human capital and physical capital at optimum is a mere accident. It depends on the correlation between the marginal utility from second period's consumption and the marginal impact of schooling on earnings. He showed that the sign of the covariance between the above two variables is indeterminate. This invalidates the important conclusion of Levhari and Weiss (1979) that increasing risk always discourages investment in education. According to Kodde

(1986), the effect of increasing risk on demand for education is not unambiguous and can only be ascertained empirically by looking at the above correlation.

Weiss (1972) presented some empirical evidence on the risky ness of the various educational opportunities for scientists in the United States and proposed a simple method of incorporating risk into conventional theory of human capital. He introduced the risk effect in a model of human capital using the mean variance rule. He assumed that given the level of education, occupation and type of employment, the individual assumes that his income at each future age will fall within the corresponding age group. But persons with same education and experience may differ in their income due to different levels of ability, social connection etc. Therefore, an individual considers his actual position on the income distribution as random. In this way an individual faces risk as his future income may differ from the mean. Weiss (1972) further assumed that an individual with fixed risk aversion seeks to maximize the expected discounted sum of utilities, which depends on current income. At each point of time, his preference among the various income distributions depends on the mean and variance. It is assumed that an individual is a risk averter, so that between two distributions with the same mean, he would prefer the one with the lower coefficient of variation. The higher the degree of risk aversion, the higher is the weight of the coefficient of variation in the individual's preference.

The result shows that his choice of income distribution will depend on two factors: earning differential and risk differential. The larger the relative increase in mean earnings and the larger the relative decrease in the coefficient of variation (CV), the higher will be the average rate of return for a given level of education. The relative

importance of these two (mean and CV) depends upon the nature of the utility function as well as on the degree of risk aversion. The net effect depends upon the relative size of the risk and earning differential. The result shows that under 'reasonable' degrees of risk aversion, risk differentials are found to be relatively unimportant. Hence, he concluded that changes in risk aversion affect considerably the rate of return from education and it is the inclusion of risk aversion rather than inclusion of risk that plays a major role in this situation.

Olsen, White and Shefrin (1979) formulated a model, where they specified risk and schooling investment in the presence of imperfect capital market and showed that even a moderate ability to borrow would invalidate the above *concavity dominance* result presented by Weiss (1972). They considered an individual with a constant relative risk aversion and who is allowed to borrow in order to consume while in school, but then must repay in a set of fixed instalments after discontinuing school. At the end of his school, he has to decide among available levels of post secondary schooling each of which involves a random income stream. Cardinal, additive separable, state independent, Von Neumann-Morgenstren type of utility function has been considered, which is a function of real life time consumption expenditure of an individual. It is assumed schooling is a full time activity, so that earning during schooling time is equal to zero. Individual can borrow when in school and this allows positive consumption while in school. When in school, real consumption expenditure of an individual thus depends on the amount of loan available to him and it is equal to income of that period when he is out of school. Thus they derived an indirect utility function, which depends on the entire shape of income stream including the borrowing amount. Saving is also considered.

Optimal level of invest in education is determined by maximizing expected indirect utility function subject to the budget constraint. The result shows that if we assume moderate ability to borrow, it does not discourage investment in education, when future earnings are very uncertain even under the assumption of risk aversion.

Olsen, White and Shefrin (1979) further estimated a statistical model of the log of an individual's real income as a linear function of his characteristics, such as, his schooling attainment, his work experience, his I.Q. level, person effect (assumed to arise from those variables, which we can't measure, such as motivation, which tends to keep an individual's income permanently either above or below his predicted value) etc. Schooling attainment is also considered as a set of dummy variable in order to capture the non-linearity in the mean effect of schooling on log income. Calculating the expected indirect utility function at various loan rates and various degrees of risk aversion, their empirical results show that college should be taken as a package or not at all. Taken as a package, college appears to have a substantial rate of return if loans are generous and the decrease in unanticipated income variation associated with college attendance increases the attractiveness of college as an investment.

Kodde (1988) extended the human capital theory and tried to analyse the relationship between the probability of unemployment and the demand for education. His results show that the demand for education increases if employment opportunities improve. Of course, employment prospects of an individual may depend upon the level of education (rising with education level) or it may be independent of education levels. Kodde's(1988) result holds in either case and does not depend on the assumption of

absolute risk aversion. Unemployment by itself demotivates additional education, since it reduces expected future financial benefits.

Ability:

A more able person will tend to invest more on human capital because their future-earning prospect is higher than their counterparts. In fact, conventional theory views the rate of return from investment in education (human capital) as an index of ability. Higher ability entails a higher marginal rate of return, and hence *ceteris paribus* a higher rate of investment.

According to Weiss (1971), the relation between ability and education is a 'reduced form' relation. Its nature will depend on the form of the structural relations in the individual maximization problem. In a simple framework, he analysed the effect of increase in ability on the optimal level of investment in the presence of perfect capital market by comparative static analysis. His result shows that an individual will invest up to that level, where the marginal gain in earning power resulting from additional schooling must be equal to the marginal loss caused by the loss of current earning and foregone work experience and the effect of increase in ability on the optimum level of investment is indeterminate. The sign also depends on interest rate and borrowing opportunities of an individual.

Weiss (1971) came to the conclusion that a more able individual can use his education more efficiently, but he also suffers from higher opportunity cost in terms of foregone current earning and experience. Not only that, following Becker (1975), he has concluded that it is not possible to separate the effects of 'capacity' and 'opportunity'

from each other. Level of investment in education is determined not only by ability, but also by opportunity.

We will discuss the role of ability in case of determining the level of investment later in details along with the supply side of investment in education.

Family Background:

Another factor, which motivates an individual to invest more in education, is the family background, which includes both father's as well as mother's education and their occupation. We know that the key decision-maker regarding the investment in education is a parent. They will invest if the utility they derive from such investment exceeds the cost of education. Parental education level may raise their utility derived from sending their children to school in three ways (Gertler and Glewwe (1990)). First, parents' education may be positively correlated with children's ability, which in turn results in more education received per year of schooling. This augments the parents' utility obtained per year of their children's schooling. Secondly, better-educated parents may value children's schooling more than their uneducated counterparts. Thirdly, educated parents can provide an environment conducive to better learning, such as directly helping children with schoolwork, which will also raise the human capital acquired by the child per year of schooling. However, empirically it has been found that parental completion of high school and one or two years of post secondary schooling typically have a larger effect on children's schooling than years of parental schooling beyond that level.

2.2.3 The Supply Side of Investments on Education

In the supply side of investment on education, we generally consider differences in family resources and environment, credit market access, subsidies and luck which provide greater investment opportunities to some individuals than others. Effectively, investment opportunity for an individual will depend on the availability of investible funds. We now discuss some of the above supply side determinants of investment on education.

Credit Market Imperfections:

It is difficult to borrow funds for investment in human capital because such capital cannot be offered as collateral. The embodiment of human capital in people ought to affect its value as security for loan. The productivity of human capital hence depends on the co-cooperativeness of the original borrower and the prohibition of the slavery makes it impossible to seize the capital from the borrower who does not honour his debt. It follows that credit constraint may be an important source of educational difference. It also implies that we can't use future labour earning as collateral on loan.

Credit market imperfections have further implications. First of all, internal financing would be common and consequently wealthier families would tend to invest more than the poorer families. Secondly, since employee's specific skills are part of the intangible assets and can be offered as collateral along with tangible assets, capital would be more readily available for specific rather than for general investment.

There is another reason why economists particularly stress on capital market imperfections when discussing investment in human capital. Young persons are especially prone to be ignorant of their abilities and of the investment opportunities

available. Therefore the investor in human capital, being younger, would be less aware of opportunities and thus more likely to make mistakes than the investor in tangible assets. Several studies have focussed on this aspect of credit market imperfection in explaining human capital investment.

Ljugqvist (1993) showed that in less developed countries, people prefer to stay uneducated even in the face of higher wage differentials between skilled and unskilled labour due to credit market imperfections. Unskilled labour with no or few assets does not have access to credit and hence he chooses not to obtain education since the loss of utility from foregone consumption in order to saving for educational expenditures is greater than the welfare gains from higher future earnings.

Kodde and Ritzen (1985) showed how capital market imperfection leads to under investment in education. Their result shows that in case of imperfect capital market the separation theorem no longer holds and optimal level of education depends on non-labour income and commodity prices.

Gregorio (1996) has shown how the inability of an individual to borrow against future income reduces the incentives for human capital accumulation. According to him both human capital as well as physical capital are inputs in the production of human capital. Specifically an individual who has initially a level of skill equal to H_t and spends h (t) units of time on education during time t will accumulate Human Capital in period (t+1) as:

$$H_{t+1} = d.H_t + q.\ h(t).k(t)^{a}.H_t^{(1-a)}$$

Where 'd' represents the rate of depreciation of human capital and q represents the efficiency of the process of human capital accumulation. De Gregorio (1996) introduced

the notion of borrowing constraints by assuming that individual cannot borrow more than a certain amount of their current income. Thus the amount of credit is constrained by current income. His result shows that borrowing constraint reduces time devoted to education and encourages savings. Empirical evidence supports these results. Borrowing constraints were found to be negatively correlated with enrolment ratio.

Bell (1984) examined the theoretical issues concerning the relationship between the private pecuniary returns to college education and the fraction of high school graduates who chooses to enrol in college. He developed a two period utility maximization model of an individuals' investment decision and showed that if there are imperfections in the capital market in the sense that borrowing rate exceeds the lending rate, enrolment rates may not always be directly related to the net present value of education. An individual may choose to forego education both before and after an increase in the net present value of the education investment project.

Family Wealth and the Role of Intergenerational Transfers:

In the face of credit market imperfections and credit constraints, family wealth and intergenerational transfers can act as important supply side determinants of investment in education. It is commonly held that individuals are often motivated to develop non-market institutions to overcome market deficiencies. Such informal institutions like family arrangements and intergenerational transfers can overcome problems of moral hazard and adverse selection, which lead to the failure of formal credit markets.

Barro (1974) as well as Altig and Davis (1989) argued that credit constraints could partly be overcome through intergenerational transfers. By ameliorating the effects

of borrowing constraints, it allows individuals to have more education as well as consumption when young. But the effects will not be completely eliminated, since borrowing itself is distortionary and affects the choice between consumption and education at the margin.

Guiso and Jappelli (1991) investigated the existence of a system of family finance and the extent to which it can offset capital market imperfections. They developed a simple model of intergenerational transfers to show that a chain of operative intergenerational transfers targeted towards liquidity-constrained households could offset borrowing constraints.

Glewwe and Jacoby (1994) showed how household economic variables affect schooling decision. If the parents can borrow then there will be no motive to postpone schooling decision, as education is a worthwhile investment. Under this ideal condition children would leave school at the point where marginal rate of return is equal to the interest rate. But if the household faces credit constraint, the decision will depend on the household's economic condition.

Berhman, Pollack, and Taubman (1989) showed unequal access to resources affect investment in education depending on family size. According to them large family size leads to unequal access because parental expenditure per child is inversely related to the number of children in the family. The non-family financing is most costly than family financing. So, children from large families who have to rely on outside financing pay more to obtain the same amount of education as compared to children from small families. This constitutes unequal access for children from large families, which results in

under-investment in education. With equal access the model predicts no systematic relationship between family size and educational attainment.

There are studies, which have explained educational investments by households essentially in a reduced form framework without making a distinction between the supply side and demand side determinant of educational investment. In reality, demand side and supply side both are correlated and optimum level of investment is determined by these two factors simultaneously.

Jose De Gregario and Se Jik Kim (2000) considered both demand side as well as supply side simultaneously. They have shown how credit markets affect time allocation of individuals with different educational abilities. The role of intergenerational transfers in overcoming the absence of credit market, as well as other form of credit market imperfections is also discussed. The result shows that in the presence of credit market, the possibility of borrowing and lending allows individuals to specialize in the activity in which they have a comparative advantage. Hence individual spends all their non-leisure time in either education or work, but not in both. In the presence of credit market, the more able can devote all their youth on education, whereas the less able can become full time worker. In the absence of credit market, all the individuals have to engage in both activities during their youth. The more able have to spend at least a part of their youth in working, because they cannot borrow, and the less able have to spend a part of their time in studying because the only way they can save for the future is through increasing skills. Thus the introduction of credit markets allows the more able to specialize in education and the less able to specialize in working, and hence enhances the average level of education in the economy. They have also shown that intergenerational transfer may

overcome the credit market imperfection, by allowing children with higher level of abilities to specialize in education. But the degree of specialization is higher in case of perfect credit market.

Priya Ranjan (2001) developed an overlapping generations general equilibrium model where he showed that inefficient child labour arises due to credit constraint. It is shown in the model that, in the absence of credit market and depending on the level of the ability of children, parents will decide whether to send their child to school or work. It is assumed that in the first period, given the level of talent of the child, both types of parents will choose that option which maximizes their lifetime utility. Skilled parents always send their child to school, whereas the unskilled parents will send the child to school if and only if the ability of a child (σ) is greater than the minimum level of ability (σ_u: at which unskilled parents are indifferent between sending their children either to school or to work). It is explained in the model that for each level of ability there is a threshold level of parental income such that households below that threshold level send their child to work. The reason is that, the high marginal utility of present consumption for low-income households and their inability to smooth consumption through borrowing induce them to use their children as a consumption-smoothing device.

It is evident from the discussion of the existing literature that, how much an individual will invest in education depends on the supply factors as well as on the demand factors. Demand side factors are opportunity cost, risk and uncertainty, family background (which, includes parents' education, family size etc) and ability, while the supply side determinates are credit market, family income and existence of intergenerational transfer. Several attempts have been made to analyse the educational investment behaviour of an

individual in context of the above mentioned factors, e.g., imperfect capital market, uncertainty of future income and employment prospect, ability, family background and family income etc.

Theoretical models show that individuals' educational investment decision is a positive function of availability of credit, parents' income, ability of an individual, presence of family financing and parents' education and a negative function of the family size and direct cost of education. However, the effect of opportunity cost of education and uncertainty depends on the form of credit market and degree of uncertainty associated with returns from education. The effects are indeterminate in the presence of either imperfect capital market or uncertainty, though they are inversely related with the demand for education under the assumption of perfect credit market and certain future return. It is evident from the above discussion that individuals take decisions regarding investment in education by considering both demand as well as supply side factors simultaneously.

2.3 REVIEW OF EMPIRICAL LITERATURE

Apart from the theoretical literatures, there exists a vast empirical literature on the educational investment behaviour of individuals. This empirical literature considered both the demand as well as the supply side factors simultaneously.

2.3.1 Demand Side Factors

Opportunity Cost Of Education:

It is quite evident from the discussion of the theoretical models that the demand for education is a negative function of opportunity cost if the individual faces either

perfect credit market or no uncertainties regarding the future returns to education. In the presence of imperfect capital market or uncertain future income, however, the effect is ambiguous. Increase in opportunity cost leads to two opposite forces: one hand it raises family income and increases the demand for education through positive income effect, while on the other hand it raises the cost of education and reduces the demand for education through substitution effect. Empirical results by and large show an overall negative effect, implying that the substitution effect always dominates the income effect.

Rosenzweig (1977) investigated theoretically and empirically the effect of opportunity cost on schooling enrolment decision of farm households. He defined opportunity cost of schooling for farm children as the value of the production or profit sacrificed as a consequence of the child's school attendance. He used aggregate measure for educational demand: the natural logarithm of one minus the school enrolment rates of 15-18 years old in the farm population is taken as the proxy for demand for education. Opportunity cost is measured by those factors which affects marginal productivity of unskilled labour, e.g. land size, expected product price etc. Using U.S. state level data and applying 'two stage least squares multiple regression' he showed the that the opportunity cost of school quantity is a significant deterrent to school attainment among the farm population.

Kodde (1986, 1988) using the data of high school graduates from Netherlands, found a negative impact of opportunity cost on the demand for education in the presence of either income uncertainty (Kodde 1986) or in the presence of employment uncertainty (Kodde 1988)). He used expected monthly income foregone as a measure of opportunity

cost of education. This contradicts the theoretical result that opportunity cost has an ambiguous impact on demand for education in the face of income uncertainty.

Catsiapis (1987) puts forth the idea that college going students take their decision regarding further education in terms of the expected net present value of the educational investment. The parameters determining the probability of enrolment are estimated using the 'probit' model. In this model, opportunity cost is measured in terms of foregone earnings. The results show a negative effect of opportunity cost on demand for education.

Dushesne and Nonneman (1998) investigated the determinants of higher education enrolment decision in Belgium since 1953. Following the integrated approach of education as investment and consumption, they empirically tested their model using time series data between 1953 and 1992. Demand for education is measured as freshmen enrolment rate. Foregone earnings are defined as real average yearly earning per worker corrected by the unemployment rate, i.e.,

Forgone earnings = average yearly earnings (1– unemployment rate) + 60% (average yearly earning)(unemployment rate)

It is assumed that unemployed gets 60% of their potential income as benefits.

Using OLS they find that the demand for education is positively related with the family income and negatively with the opportunity cost, though the demand for education is more elastic with respect income than with respect to price.

Risk and Uncertainty:

The theoretical models suggest that an increase in the uncertainty of returns to education reduces the demand for education and encourages youths to leave school and work. However this proposition has not received much empirical support.

Kodde and Ritzen (1986) analysed the impact of uncertainty of future income on the demand for post secondary education in Netherlands from both theoretical and empirical point of view. The theory is tested with a sample of high school graduates containing information on subjective expectations. They have employed binomial logit model and found that increasing risk of future earnings raises the demand for education, in contrast with the theoretical result of a negative relationship.

In another paper, Kodde (1988) considered uncertainty in the form of uncertain job prospect and analysed the demand for education both theoretically as well as empirically. By fitting a binomial logit model to a sample of educational choices of Dutch high school graduates, he has shown that if the probability of finding a job with an additional post-secondary education increases then enrolment rises. He concludes that high unemployment, by itself, does not drive youth towards additional education but different employment prospects for different education levels may induce the youth to strive for more education with a view to improving their employment prospects and raise the demand for education.

Ability:

Another important factor, which determines individual's educational demand, is ability. Depending on this factor, individual choose in their early stage of life, the optimal time allocation between work and education. Theory shows that there is a positive

correlation between theses two. Though it is difficult to measure ability, many studies have made an attempt to find out the effect of ability on the demand for education, empirically.

Eckstein and Wolpin (1999) developed and structurally estimated a sequential model of high school attendance and work decisions. Using data from the NLSY' 79 (the 1979 youth cohort of the National Longitudinal Surveys of labour market experience), they showed that lower ability implies lower demand for high school attendance forcing students to work. They argued that those who have lower ability or motivation have lower expectation about the rewards from graduation and have a comparative advantage at jobs that are done by non-graduates. They, therefore, place higher value on leisure and have a lower consumption value of school attendance.

Kodde (1986) examined the relation between ability and the demand for education in the presence of uncertainty in future income using the data set of high school graduates from Netherlands. He used scores in mathematics and language as a proxy of ability and found a positive relationship between ability and the demand for education where mathematics scores appear to have a stronger effect compared to language scores.

Family Background:

Family background includes parents' education, number of school going children in the family etc. Theory predicts a positive relation between the demand for education and parent's education level and negative relationship with family size. Empirical studies in this regard have by and large support the theoretical predictions.

Kodde and Ritzen (1988) analysed determinants of demand for post secondary education in Netherlands. They found a substantial positive impact of parental education

level on educational choices. But the incorporation of the other determinants like parents income, students' scholastic ability decreases the role of parental education level, though the effect is still significant.

Rosenzweig (1977) investigated theoretically and empirically the effect of parental education on schooling enrolment decision of farm households. Using U.S. state level data he showed a positive impact of parental education on school enrolment rate.

Kodde (1988, 1986) also found a positive relation between parental education and the demand for education. But the effect does not appear to be very strong.

Gertler and Glewwe (1990) have shown empirically how family background plays a role in determining children's level of education. Their study was based on a sample of rural Peruvian children between the age group of 10-18. They considered both direct as well as indirect costs of education for deriving the educational demand function. Their result shows that parent's level of education is positively correlated with enrolment. The presence of other children in the family of secondary school age has a small negative effect on the desire to enrol children in school. Poor school quality also has a negative effect on school enrolment.

Ermisch and Francesconi (2001) have studied the impact of family background and family income on young people's educational attainment using British data. Their results show that parent's educational attainment is a very powerful predictor of children's educational attainment. Also, young individuals whose parents are in the bottom quartile of the family income distribution have lower educational attainment. They also found that greater number of siblings reduces educational attainment because

scarce family resources (both money and time) in larger families get distributed for education of many children reducing the educational attainment of each.

Apart from parental education, family income constitutes another important dimension of family background affecting households' investment in education. Most of the empirical models have actually considered parental education and family income together in explaining investments in education as a demand side factor. But family income actually affects the supply of invest able resources available to the household and hence should be considered as a supply side determinant discussed below.

2.3.2 Supply Side Determinants

Family income:

Many studies have made an attempt to investigate the impact of family resources on schooling enrolment decision.

Campbell and Siegel (1967) estimated demand for education function for the U.S. using time series data. They have taken education as a function of household income and direct cost measured by tuition fees deflated by the consumer price index. They estimated a demand for education function taking macro level data and the result shows that the enrolment ratio tends to vary directly with variation in real household income and inversely with the index of relative tuition cost. They have also calculated the price and income elasticity's of educational demand.

Kodde and Ritzen (1988) investigated empirically the impact of parents' income on the demand for education using the samples of secondary school graduates of Netherlands. The sample contains both graduates who pursued higher education and

graduates who have entered into the labour market. He employed logit technique, considering the continuous optimal 'demand for education' variable as a latent variable. The result shows that family earnings have a substantial positive effect on the demand for education, which is consistent with the theoretical findings.

Kodde (1988,1986) also found the same result in estimating individuals' educational decisions in the presence of uncertainty of future income (Kodde 1988) and future employment (Kodde 1986).

Acemoglu and Pischke (1987) analysed the impact of family income on the demand for education. The uniqueness of this paper lies in the fact that, they have considered 'changes in the distribution of family income' in order to capture the effect of change in family income. Using the data on changes in the distribution of family income that have taken place over the past 30 years, they have applied 'fixed effect regression' in order to find out the probability of attending college within two years of high school. This study exploits the fact that families at the bottom of the income distribution were much poorer in the 1990s than they were in 1970s, while the opposite happens for the families in the top quartile of the distribution. The estimate shows a large positive effect of family income on enrolment. In fact, a 10% increase in the family income is associated with a 1.4% increase in the probability of attending a four-year college.

Eckstein and Wolpin (1999), Gertler and Glewwe (1990), Catsiapis (1987), Leibowtiz (1974) separately analysed the effect of family income on the demand for education and all of them have established a positive relationship between family income and educational investment decision.

Credit Market Conditions:

We have already seen that the theoretical implications of human capital theory depend on the assumptions governing the capital market as it is used to finance education. Presence of perfect capital market allows individual's to smoothen their lifetime consumption through borrowing and lending. Theory predicts that the absence of perfect capital market leads to under investment in education. Though the role of credit in determining the demand for education, receive ample attention in theoretical literature, it is not substantiated by the adequate empirical literature.

2.3.3 Consumption versus Investment Aspects

We have already discussed the *two different aspects* of educational investment decision. Conventionally, education is viewed as an investment good, but education has some characteristics of consumption good as well. Accordingly, there are *two approaches to the theory of educational demand.* One-approach views the decision to enrol in school as an investment decision, while the other views it as a current consumption decision, though the consumption approach actually supplements and enriches the investment theory of educational demand. We shall discuss this issue in detail in chapter 3. Here we only highlight the empirical and theoretical results pertaining to this consumption versus investment aspects of educational demand.

The paper by Kodde and Ritzen (1984) consider the consumption aspect of education along with the investment aspect in order to determine theoretically the optimum level of investment in education. The model is based on the assumption of perfect capital market. Consumption aspect is considered by assuming that time devoted

to education has a positive impact on individuals' utility function. In this integrated model 'pecuniary' and 'non pecuniary' benefits of schooling jointly determine the optimal demand for education. It is shown that because of the presence of 'non pecuniary' benefits, people will invest in education even if it seems unprofitable for them.

Schaafsma (1977) integrated the pure investment model of education and consumption aspect of education in order to explain how the demand for education is affected by changes in the underlying variable that the pure investment model fails to explain adequately. He has shown that individual determines the optimal level of investment in education by maximizing his utility, which is a function of present value of anticipated life time stream of monetary as well as non-monetary benefits, subject to two constraints – one relates the demand for education with the present value of expected stream of life time net income, while the other relates it with the present value of anticipated non-monetary benefits. The result shows that the level of education at which the present value of an anticipated lifetime stream of non-monetary benefit is a maximum (E^2), can be higher or lower than that level at which the present value of anticipated stream of lifetime net income is a maximum (E^1). The amount of education a person will acquire, will lie somewhere between these two and depends on the marginal rate of substitution between these two. The comparative static result shows that the effect of change either in the marginal productivity of the individual or in the present value of expected future income, is ambiguous and depends on whether $E^1 > E^2$ or $E^1 < E^2$. It is, however, interesting to note that if these two levels coincide then the demand for education remains unaffected.

Kim (1988) estimated educational demand function taking education as pure consumption good. He has taken indirect utility function as a function of all commodity prices including education and consumers money income. Translog-LES is taken in order to estimate the indirect utility function, which ensures that education function is non-homothetic and non-separable. Demand function for education has been estimated along with other commodities, like durable goods, non-durable goods and services. An interesting aspect of this study is that here educational demand depends on the demand for other commodities. So there is possibility of substitution, which has been estimated by Kim (1988). Estimated income elasticities are found to be positive and high and the compensated own price elasticities are negative.

2.4 EDUCATIONAL INVESTMENTS IN LDC: ISSUES AND PECULIARITIES

Most of the theoretical literature on human capital investment in education has evolved in the context of developed countries. These models, therefore, have often failed to capture adequately the peculiarities of developing economies. Ljungqvist (1993) is perhaps a unique exception that modelled human capital in the context of a typical less developed country. The empirical literature, on the other hand, includes some LDC studies, although the major bulk of the empirical analyses also pertain to developed countries. In this section, we intend to identify and elaborate on the special characteristics of less developed countries, which deserve closer attention in explaining rural households' investment decision on human capital. The existing theoretical models, developed primarily in the context of developed countries, have often failed to incorporate these idiosyncrasies of LDCs.

Direct versus Opportunity Cost of Schooling:

As already discussed, households' decision to invest in education depends on the direct as well as opportunity costs of schooling. In less developed countries, the government is the principal, if not the sole, provider of education especially in rural areas. Even non-government rural schools are usually run by charitable trusts and are therefore highly subsidized. As a result, the direct cost of schooling is almost negligible for rural households in LDCs.

However, the opportunity cost of schooling measured in terms of foregone labour hours proves to be overwhelmingly important. This is because children in rural LDC households often make substantial contribution to family income by providing labour hours for farm-work, wage employment or household work (which releases adult labour hours). This is often a compulsion for these households due to their abject poverty. As Bhagwati (1973) suggests, there is a large cost that poor families have to bear when they send their children to school.

Moreover, these impoverished households have a very high rate of time preference for the present vis-à-vis future income. This means the future rate of return on investment in education of their children is highly discounted by them in favour of the loss of current income due to schooling.

Given that school timings often coincide with peak periods of agricultural activity (planting and harvesting) and high seasonal demand for agricultural labour, it adds to the opportunity cost of schooling for these rural households. Clearly these opportunity costs are likely to vary inversely with the income level of the household. As a result of these

opportunity costs, schooling proves to be very costly for poor households, negligible direct costs of subsidized school education notwithstanding.

Risk and Uncertainty:

The risks and uncertainties associated with the returns to education prove to an important determinant of educational investment as already explained. In case of less developed countries, investment in human capital is much more risky than in case of developed countries. Here, not only the returns from education, i.e. future wage and income are uncertain, but also the job prospects are subject to a high degree of uncertainty. Future return is uncertain either because the student may fail to complete his education or because expected post education opportunities may not materialize. Less developed countries labour markets are often characterized by high unemployment rates both in rural as well as in urban areas. All job seekers do not succeed in finding employment.

But it is interesting to note that in the face of a highly competitive job market, job seekers often respond by acquiring more schooling resulting in a process of "filtering down"[iii] in the labour market. These uncertainties reduce the profitability of education in developing countries.

The Structure of Labour Market:

We have mentioned earlier that in economies that primarily rely on agriculture, individuals may be discouraged from pursuing higher education since there are abundant low skill jobs and few opportunities for well-educated adults. In case of small subsistence farms where children may need to contribute to farm labour, demand for education may be low. But large farms (primarily cash crop) often employ significant amount of wage-

labour (including child-labour). Their own children therefore do not bear the burden of labour and can go to school. But school enrolment in that area may decline due to their demand for seasonal labour (including children) from the neighbouring poor wage labour households.

Industrial labour markets sometimes depress school enrolment by providing full time labour opportunities to school going children. Labour market of less developed countries is such that, it provides opportunities for school going children and survival strategies of the poor families often include sending children to work instead of school. In fact child labour is very common phenomenon in case of developing countries.

Imperfect capital market: Non Availability of Credit for education:

I If the parents can borrow against the future earnings of their children while they are taking decision regarding their child's education, then the life cycle consumption and human capital investment path would be chosen independently. Child labour would not interfere with school attendance since parents could finance current consumption by borrowing rather than relying on children's present earnings.

Once the limitation of self-finance is reached credit transaction plays an important role in the accumulation of human capital. Less developed countries are characterized by the coexistence of formal and informal credit markets and greater reliance on the later. The near absence of the formal credit market can be attributed to the problems of 'moral hazard' and 'adverse selection' arising out of asymmetric information and lack of adequate enforcement mechanisms. Since the cost of monitoring is very high, borrowers have limited liabilities and the principal (the lender in this case), therefore, insists on collateral. But poor people do not have any collateral, which makes them rely on informal

money- lenders, who accept collateral in kind or in terms of labour-contracts. So loans from relatives, friends, landlord, traders, or employers are a very common phenomenon in LDCS.

Formal credit market hardly exists in rural areas and hence has very limited role to play in determining the educational demand of the rural households. It implies that education involves huge opportunity costs from foregone labour income and the young individual reduces his time devoted to education to increase work time.

In such situations, family income plays an important role. Parents, depending on their income decide how much they should spent on the education of their children, how much time their children should devote in school and how much in work. Intergenerational transfers and initial level of wealth play a key role in determining the educational demand.

2.5 CONCLUSION: RESEARCH QUESTIONS

Despite the idiosyncrasies of the LDCs and the resulting constraints faced by the rural households in investing in education, it is interesting to observe that enrolment rates have been rising significantly at all educational levels in less developed countries, not only in urban areas but especially in the rural areas. Recent data shows that the overall literacy rate has increased from 52.21% in 1991 to 65.38% in 2001. Among children, the primary school gross enrolment ratio (GER: ratio of children enrolled in school to population of school going age) has increased from 42.6% in 1950-51 to 94.9 % in 1999-00(class I-V, age between 6 to 11 years). However the GER for upper primary level (class VI – VIII) is still low at 58% (almost 420 lakhs person in 1999-00). The enrolment

rate at secondary stage has increased from 1.5 million in 1950-51 to 27.8 million in 1998-99.

In 1987-88 the all India figure showed that about 40% of rural children (46.47% of boys and 32.3% of girls) and 74% of urban children (77% of boys and 70% of girls) were attending school. The data for 1993-94 showed that in rural areas almost about 63% of children (70% of boys and 55% of girls) in the age group of 5-14 were attended school and in urban areas the figure was 83% (84.5% of boys and 80% of girls).

It is therefore imperative to identify the determinants of children's schooling decision and to understand what makes poor rural household to invest in education, notwithstanding all the problems and constraints discussed above compounded by extreme poverty and high opportunity cost.

The main objective of this study is to investigate the rural household's (farm-family as well as non-farm family) decision-making process with regard to investment in human capital (education). Our study will consist of a micro-theoretic and a micro-econometric analysis of household behaviour in a less developed country. In order to investigate the educational investment decision of farm and non-farm households at the micro-theoretic level, models with overlapping generations will be formulated. Instead of considering the above problem as an individuals' utility maximization problem (where he himself takes the decision regarding his level of education), we shall assume that household on behalf of their children take decision on how much time their children should devote in education and in work.

Schooling behaviour of rural farm population may differ significantly from that of non-farm population. In farm households, children can readily participate in farm

production and thus contribute to family income. This acts as a major component of the opportunity cost of the schooling in these households. In non-farm household labour market opportunities for children solely determines the opportunity cost of schooling. Not only schooling investment increases the earning capacity of children in the family farm, but also it enables them to leave the agriculture as education increases their earning capacity outside the farm activity. In reality, investment in education is viewed by the rural household as a means of gaining access to urban labour market. This will be taken into consideration in our theoretical analysis.

We shall consider pure investment aspect as well as integrated consumption and investment aspect of education, separately, assuming that households take the decision regarding their children's education on the basis of both consumption and investment motives. This is a quite realistic assumption for these poor rural households of less developed country. The consumption aspect will be captured by assuming that the time devoted to education exerts a positive direct impact on the household's utility function.

We know that one of the basic characteristics of less developed country is the absence of a formal credit market and reliance on informal institutions, such as those provided by arrangement within family. We shall consider these features of less developed countries i.e. imperfect credit market or absence non-existence of credit market and existence of family financing, in our theoretical as well as empirical model in order to investigate to what extent presence of perfect credit market affects households' decision-making process. First we shall show the aforesaid problem in the context of non-farm households and then for farm households and then we will compare these two.

Uniqueness of this study lies in the fact that we will analyse rural household's lifetime utility maximization problem considering integrated model of educational choice, imperfect capital market and existence of intergenerational transfer, together and we shall consider the case of farm and non-farm household separately.

We shall test the main theoretical results obtained from the above analysis by generating the small data set of 80 rural households of West Bengal. Three types of dependent variable shall be constructed as a proxy for the demand for education. The first is the probability of sending children to school. The other two pertain to children who are not in school and to continuing students respectively. In the first case, the level of educational attainment (year of schooling) will be used as a dependent variable, while in the second case time devoted to education will be taken as a measure of the educational demand.

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[i] The development of certain skills might require both specialization as well as experience and can be acquired partly from school and partly from work.

[ii] The imbalance in the growth of supply and demand exerts a downward pressure on the returns received in urban labour markets by educated workers. The existence of wage rigidities in the urban labour market may prevent both the compression of the educational structure of wages and the decline of wages of educated workers already in employments. Nevertheless, the supply - demand imbalance results in other labour market adjustments. In particular, the education –occupation matrix changes from one cohort to the next. The successive cohorts of workers with a given level of education move into lower level occupations – a process commonly referred to as "filtering down" (Knight, 1979).

Chapter 3

THEORETICAL MODELS

3.1 INTRODUCTION

In this chapter, we develop models of rural households' decision to invest in children's education. Our objective is to determine the optimum level of schooling in order to analyse the determinants of rural households' investments in education in developing countries.

We shall consider both farm and non-farm households separately since there are some basic differences between them. First, school age children in farm households can contribute to family income by participating in farm production rather than attending school, while for non-farm households the opportunity cost of time spent by children in school depends only on labour market opportunities for children. Second, for farm households, the returns to education is not just limited to enhanced future earning potential from wage employment (given that wage is an increasing function of the level of schooling). Even if the educated child opts to continue with farming, education enters as an input into the agricultural production function leading to higher agricultural productivity and output.

We formalize the decision making process of rural households (non-farm as well as farm household) by adopting a two-period overlapping generations model. For constructing the model, we shall consider education both as consumption good as well as an investment good.

Conventionally, education is viewed as an investment good. Parents invest in educating their children (both in terms of money and children's time spent in schooling) to reap the benefits of future returns in terms of increased lifetime earnings potential of the children. The underlying assumption here is that education augments productivity and

translates into a higher lifetime earning potential. Direct as well as opportunity costs of education relative to discounted future earnings determine the optimal level of education according to this view.

The consumption aspect of education recognizes the fact that individuals find education useful in it, irrespective of its future returns. In other words, education directly enters as an argument in the household's utility function with a positive slope. The consequence of the positive marginal utility of education is that pecuniary and non-pecuniary benefits of education jointly determine the optimal level of education.

Based on these two dimensions of education, there are two approaches to theory of educational demand. One approach views the decision to enrol in school as an investment decision, while the other views it as a current consumption decision. However, the consumption approach actually supplements and enriches the investment theory of educational demand. First, it allows offsetting part of the current cost of schooling with positive current benefits. Second, it strengthens the commonly held positive income effect underlying the demand for schooling. Accordingly, if both present and future benefits from education are normal goods, an increase in income should lead directly to an increase in enrolment demand. Finally, the consumption approach also shows that educational demand is sensitive to the money cost of schooling relative to the prices of current consumption goods.[1]

In our models, we shall first consider only the investment aspect of education. Next we shall develop an integrated model considering education as consumption as well as investment good. A related question pertains to the role of credit in determining the demand for education. In our modelling exercise, we first consider the case of a perfect

[1] See Campbell and Siegel (1967)

capital market and subsequently introduce imperfections in the capital market in the form of credit rationing through imposition of credit ceiling.

Educational demand will be modelled as a time allocation problem where time devoted to education comes at the cost of time devoted to labour. Optimum time devoted to education will be derived for farm as well as non-farm households separately in order to investigate the basic difference between their educational investment decisions.

3.2 NON-FARM HOUSEHOLDS

3.2.1 MODEL 1: Educational Investment Decision under Perfect Capital Market when Education is Regarded as an Investment Good only

To construct our model of schooling decisions of rural households, we consider an overlapping generations model with two periods. In the first period parents work, consume and decides regarding the time allocation of their children (i.e. whether to send their offspring to school or make them work). In the second period parents depend on the income of their children. It is in this regard that they have to make a trade-off between their incomes in the two periods. If they choose to educate their children, their earnings prospect in the second period improves at the cost of their first period earnings since they cannot use their children's labour hours.

In this integrated two period models it is assumed that the household chooses its optimal commodity bundle of current and future consumption and the optimum level of education for the children in period 1 by the maximization of household's utility function subject to its budget and time constraints.

We make the following assumptions:

1. Household's utility function takes an additive form

$$U = U_1 + U_2$$

where, U_1 denotes first period's utility function of household and U_2 denotes second period's utility function. Here we are not considering any discount factor, which implies that future is as important as present.

We further assume that

$$U_1 = \ln X_1 \text{ and } U_2 = \ln X_2$$

where X_1: house hold's first period's consumption and X_2: house hold's second period's consumption

Here we are considering education only as an investment good so that time devoted to education (v) does not enter the household's utility function directly.

2. Prices are constant in both periods 1 and 2, say, P_1 and P_2.
3. Total available non-leisure time for the children in the first period is 1. Household divides the available time of children between education and work. Here for the sake of simplicity we ignore leisure without any loss of generality. Hence, the time constraint in the first period is given by

$$1 = l_c + v$$

l_c: time spent on working

v: time spent on education

4. All available non-leisure time, which is equal to 1, of the parents is devoted to work.
5. Children of the first period become adults in the second period and devote their entire time in period 2 (l_{c2}) to work. We assume $l_{c2} = 1$.
6. Parent's education as well as income level is exogenously determined. We denote parent's income in the first period by Y_p.
7. Total cost of education consists of direct cost of education (P_v) and foregone earnings or opportunity cost, i.e. the loss of income while in school. P_v includes

tuition fees, cost of books plus additional expenses, while opportunity cost depends on the first period wage rate W_1, assuming away uncertainties of getting a job in the first period.

Hence, $(W_1 + P_v)$. v = total cost of education.

8. Time devoted to education raises the future wage rate, so that, $W_2 = W_2(v)$

   And, $W_2'(v)>0$, $W_2''(v)<0$

   Where, $W_2'(v)= \partial W_2(v)/ \partial v$ and $W_2''(v)= \partial^2 W_2(v)/ \partial v^2$

   Here also we assume away wage uncertainties.

9. Intergenerational transfer within the family will be considered. We shall assume that transfer originates from middle-aged individual and flow towards both the younger and the older generation. We shall start from middle aged individual who in the first period transfer part of his income to the younger generation for their consumption as well as education and part of this they make gift to the older generation (αY_p). Here we are not considering savings for the sake of simplicity. In the second period parents' income is the gift that they receive from next generation, $\alpha W_2(v)$.

10. Capital market is perfect so that individual can borrow any amount, B. With perfect credit market, first period's borrowing is equal to the difference between first periods income and expenditure and second period's income is equal to second period's expenditure on consumption and borrowing repayment.

In the first period family's total income is:

$Y_p + W_1 l_c + g + B$ where

g = initial wealth, $W_1 l_c$ = children's wage income, B = borrowing

The family's expenditure in period 1 is:

$(P_v v + P_1 X_1 + \alpha Y_p)$ where

α is proportion of parent's income goes to the older generation ($0<\alpha<1$)

P_1: price of consumption in the first period.

P_v: price (direct cost) of education in the first period

Therefore the first period's budget constraint is

$$(Y_p + W_1 l_c + g + B) - (\alpha Y_p + P_1 X_1 + P_v v) = 0$$

Or, $W_1 (1-v) + g + Y_p + B - \alpha Y_p - P_1 X_1 - P_v v = 0$ (since $v + l_{c1} = 1$)

Or, $W_1 + g + B + (1-\alpha) Y_p = P_1 X_1 + (P_v + W_1) v$

Income in period 2 is: $\alpha . W_2 . lc_2$

which is nothing but the proportion of child's income received by the parents in the second period.

Expenditure in period 2 is: $P_2 X_2 + B (1+r)$

where, r denotes rate of interest.

And, second period's budget constraint is

$$\alpha W_2 (v) = P_2 X_2 + B (1+r)$$

Now the problem of the household is to maximize their utility function subject to the first period budget constraint, the second period budget constraint and the children's time constraint.

We can write the problem in the following way:

Max $\quad U = \ln X_1 + \ln X_2$

Subject to $\quad W_1 + g + B + (1-\alpha) Y_p = P_1 X_1 + (P_v + W_1) v$

$$\alpha W_2 (v) = P_2 X_2 + B (1+r)$$

$$1 = l_c + v, \; v \in (0,1)$$

The Lagrange function is:

$$L = \ln X_1 + \ln X_2 + \lambda_1\{W_1 + g + B + (1-\alpha)\, Y_p - P_1X_1 - (P_v + W_1)\, v\} + \lambda_2\{\alpha W_2\,(v) - P_2X_2 - B\,(1+r)\}$$

Where, λ_1, λ_2 are Lagrange multiplier.

Differentiating L with respect to X_1, X_2, B, v, λ_1, λ_2 and equating each partial derivative with zero we get the first order conditions.

(1) $\lambda_1 = 1/P_1X_1$

(2) $\lambda_2 = 1/P_2X_2$

(3) $\lambda_1 - \lambda_2\,(1+r) = 0$

(4) $\lambda_1/\lambda_2 = \alpha W_2'(v)/(P_v + W_1)$

(5) $W_1 + g + B + (1-\alpha)\, Y_p - P_1X_1 - (P_v + W_1)v = 0$

(6) $\alpha W_2\,(v) - P_2X_2 - B\,(1+r) = 0$

From (1), (2), (3), (5) and (6) we solve for 'B' in terms of 'v'.

(7) $B = \frac{1}{2}[\{\alpha W_2\,(v)/(1+r)\} + (P_v + W_1)\, v - W_1 - g - (1-\alpha)\, Y_p]$

From (1), (2), (4), (5), (6) and (7) we solve for 'v' in terms of all the parameter of the model.

(8) $v = [\{\alpha W_2(v)/(1+r)\} + W_1 + g + (1-\alpha)Y_p] / (P_v + W_1)$

It is evident that optimum 'v' is always positive (v>0).

From the first order conditions (3) and (4) we can see, $\{\alpha W_2'(v)/(1+r)\} = (P_v + W_1)\}$, which means that rural households will invest on children's education (in terms of their time devoted to education 'v' up to a level where the discounted marginal rate of return from education is equal to the total cost (direct as well as opportunity) of education. We find that optimum 'v' depends on several parameters, like parent's income (Y_p), initial wealth (g), opportunity cost of education (W_1), direct cost of education (P_v), rate of

interest (r) and future wages (W_2). We derive a few comparative static results to examine how these parameters affect educational investment.

Comparative static analysis:

- Parent's income

  $\partial v/\partial Y_p = (1-\alpha) / (W_1+P_v) > 0$

  As parents' income increases, households tend to invest more on their children's education by allocating more of the child's time (v) to education.

- Initial Wealth

  $\partial v/\partial g = 1/ (W_1+P_v) > 0$

  Increase in initial wealth of the family raises family's demand for education.

- Wage Rate in Period 1 (Opportunity cost of education)

  $\partial v/\partial W_1 = [P_v - [(1-\alpha)Y_p + g + \{ \alpha W_2(v)/(1+r)\}]] / (W_1+P_v)^2$

  The sign depends on the numerator, $[P_v - \{(1-\alpha)Y_P + g + \alpha W_2(v)/(1+r)\}]$, i.e., on the difference between direct cost of education and discounted present value of income of household in two periods. In most of the developing countries, especially in the rural areas, the government funds education and hence direct cost of education is usually negligible. So we can reasonably assume that the direct cost of education is less than the household's income. The sign of the numerator will therefore be negative. The implication is that a rise in the opportunity cost of education (W_1) will reduce the demand for education.

  In fact an increase in the first periods' wage rate has two opposite effects. It not only increases the opportunity cost of education in the first period but also increase the income of the household. While the first one has negative impact on time devoted to education, the second one has a positive effect. The sign is determined by the relative

strength of these two opposite effects. In this, perhaps the negative substitution effect dominates the positive income effect.

- Direct Cost of Education

$\partial v/ \partial P_v = (-) [(1-\alpha)Y_p + g + W_1 + \{\alpha W_2(v)/(1+r)\}] / (W_1 + P_v)^2 < 0$

An increase in the direct cost of education has a negative impact on demand for education.

- Rate of Interest

$\partial v/ \partial r = -[\alpha W_2(v)/\{(1+r)^2 \times (W_1+P_v)\}] < 0$

A rise in the interest rate will depress the demand for education. This is because higher 'r' implies higher cost of borrowing and a lower discounted future return from education.

- Share of income transferred to older generation

$\partial v/ \partial \alpha = [\{W_2(v)/(1+r)\} - Y_p] / (W_1 + P_v)$

Here the sign is ambiguous. The sign depends upon the numerator.

$W_2(v) / (1+r)$ is the discounted value of children's second period's income while Y_p is the parents' income in the first period. If the difference between these two is positive, i.e., if the educated children's second period earnings exceed parents income in the first period, they will invest more in education as 'α' rises. Increase in 'α' has two opposite effect. On the one hand it raises household's future income, but on the other hand it decreases household's present net income. First one has positive impact on demand for education, while the second one has negative impact on time devoted to education. And these two opposite forces ultimately determine the effect of change in 'α'.

- Schooling-Earning Profile

$\partial v/\partial W_2'(v) = 0$

The responsiveness of wages in period 2 to level of schooling ($W_2'(v)$) has no impact on demand for education.

3.2.2 MODEL 2: Educational Investment Decision under Imperfect Capital Market when Education is Regarded as an Investment Good only

In this model we only relax the assumption of perfect capital market, keeping all others assumptions in tact. We assume imperfect capital market where imperfection occurs in the form of credit rationing. Under credit rationing, borrowers do not have unlimited or unrestricted access to credit. Let us suppose that households can borrow only up to a specific amount, say B_2. This credit limit of B_2 is assumed to be exogenously given and the household in question utilises the entire credit limit.[2] In the second period household repay the principal along with interest: $B_2(1+r)$.

The household's optimisation problem now becomes:

$$\text{Max} \qquad U = \ln X_1 + \ln X_2$$

$$\text{Subject to} \qquad W_1 + g + B_2 + (1-\alpha) Y_p = P_1 X_1 + (P_v + W_1) v$$

$$\alpha W_2 (v) = P_2 X_2 + B_2(1+r)$$

$$1 = l_c + v, \; v \in (0,1)$$

The Lagrange function is:

$$L = \ln X_1 + \ln X_2 + \lambda_1 \{W_1 + g + B_2 + (1-\alpha) Y_p - P_1 X_1 - (P_v + W_1) v\} + \lambda_2 \{\alpha W_2 (v) - P_2 X_2 - B_2 (1+r)\}$$

Where, λ_1, λ_2 are Lagrange multiplier.

Differentiating L with respect to X_1, X_2, v, λ_1, λ_2 and equating each partial derivative with zero we get the first order conditions.

The first order condition for a maximum is given by

(9) $\lambda_1 = 1/ P_1X_1$

(10) $\lambda_2 = 1/ P_2X_2$

(11) $\lambda_1/ \lambda_2 = \alpha W_2'(v)/ (P_v + W_1)$

(12) $W_1 + g + B_2 + (1-\alpha)Y_p - P_1X_1 - (P_v + W_1) = 0$

(13) $\alpha W_2 (v) - P_2X_2 - B_2 (1+r) = 0$

From the above equations we can determine the value of 'v' in terms of all the exogenous variables in the model.

(14) $v = [\ [\alpha W_2'(v)\{(1-\alpha)Y_p + g + B_2 + W_1\}] - [\{\alpha W_2(v) - B_2(1+r)\}(W_1+P_v)]\ ]$

$/\ \{[\alpha W_2'(v)(W_1+P_v)]\}$

We see that the optimum 'v' in this model is not unambiguously positive as in model 1.

Lemma 1: Households invest less on education under credit constraint

It can be shown that optimum v in model 1 definitely exceeds the optimum v in model 2.

From 8 we get optimum v in model 1 (V_1) as

$V_1 = [\{W_1 + g + (1-\alpha)Y_p\}/(P_v + W_1)] + [\{\alpha W_2(v)/(1+r)\}/(P_v + W_1)]$

And from model 2 we can see optimum 'v' (say, V_2) is

$V_2 = [\{(1-\alpha)Y_p + g + B_2 + W_1\}/(W_1+P_v)] - [\{\alpha W_2(v) - B_2(1+r)\}/\{\alpha W_2'(v)\}]$

It is quite evident, if we compare 'V_1' and 'V_2', that the former is greater than the later and hence we can draw the conclusion that household invest less under credit constraint.

Now, 'v' is a function of parent's income (Y_p), initial wealth (g), wage earning profile ($W_2'(v)$), future wage rate (W_2), rate of interest (r), level of borrowing (B_2), opportunity cost (W_1), direct cost of education (P_v) and the share of household's income

[2] In case the household's optimum borrowing happens to be less than the credit limit, our problem becomes similar to that of model 1.

that goes to older generation as a gift (α). We again perform comparative static analysis to study the impact of these parameters on 'v'.

Comparative static analysis:

- Parent's income

  $\partial v/ \partial Y_p = (1-\alpha)/ (W_1+P_v) >0$

  Increase in parent's income implies that household will invest more on their children's education.

- Initial wealth

  $\partial v/ \partial g = 1/ (W_1+P_v) >0$

  Increase in initial wealth of the family raises family's demand for education.

- Opportunity cost of education (first periods' wage rate)

  $\partial v/ \partial W_1 = [P_v - \{(1-\alpha)Y_P + g + B_2\}] / (W_1+P_v)$

  The sign depends on the numerator, $[P_v - \{(1-\alpha)Y_P + g + \alpha W_2(v)/(1+r)\}]$, i.e., on the difference between direct cost of education and discounted present value of income of household in two periods. As before we assume that the sign of this derivative will be negative.

- Direct cost of education

  $\partial v/\partial P_v = (-)[(1-\alpha)Y_P+g+W_1+B_2] / (W_1+ P_v)^2 <0$

  An increase in direct cost of education has a depressing effect on the demand for education.

- Schooling-Earning profile

  $\partial v/\partial W_2'(v)= (-) [-\{\alpha W_2(v)-B_2(1+r)\}\alpha] / [\alpha W_2'(v)]^2 > 0$

  An increase in future wage-schooling profile has a positive effect on time devoted to education. If household gets higher future return investing same amount of time in

education in the first period, then they will invest more time in education as it raises their profit from investment in education.

- Amount of Borrowing / credit ceiling

$\partial v/\partial B_2=[(\alpha W_2'(v)) + (1+r)\times(W_1 + P_v)] / [(\alpha W_2'(v))\times(W_1+ P_v)] >0$

The credit ration has a positive effect on schooling. Increase in level of borrowing implies increase in household's first period's income. And household can spend more both on education as well as on consumption. This is perfectly consistently with the result obtained in Lemma 1 above.

- Rate of interest

$\partial v/\partial r = B_2/ [\alpha W_2'(v)] >0$

The effect of the interest rate on education can be signed unambiguously. An increase in the borrowing rate raises demand for education. Higher borrowing rate decreases second period disposable income, which lowers second period consumption. This decrease is partially compensated by raising second period earnings through investment in education.[3]

- Share of income transferred to older generation

$\partial v/\partial \alpha = (-) [\{Y_p/ (W_1+P_v)\} + \{B_2(1+r)/\alpha^2 W_2'(v)\}] <0$

Increase in 'α' in the first period decreases household's income. As a result of this it decreases the time devoted to education. But it also raises the second period's discounted income and hence exerts positive impact on demand for education. When household faces borrowing constraint present income becomes much more important for them at the margin. So, the first negative effect dominates the positive effect. The net result is a fall in the time devoted to education.

[3] Bell (1984) and Kodde and Ritzen (1985).

3.2.3 Model 3: *Limiting Case when Borrowing is Not Allowed (i.e. $B_2=0$)*

Here all the assumptions are same as before. We are assuming that there is no possibility of borrowing, i.e., $B_2=0$ in this case.

Here the first order conditions are

(14) $\lambda_1 = 1/ P_1X_1$

(15) $\lambda_2 = 1/ P_2X_2$

(16) $\lambda_1/ \lambda_2 = \alpha W_2'(v)/ (P_v + W_1)$

(17) $W_1 + g + (1-\alpha) Y_p - P_1X_1 - (P_v + W_1) v = 0$

(18) $\alpha W_2 (v) - P_2X_2 = 0$

From here we can determine the value of 'v'.

(19) $v = [\alpha W_2'(v) \times \{W_1 + g + (1-\alpha) Y_p\} - \{\alpha W_2 (v) \times (P_v + W_1)\}] / [\alpha W_2'(v) (P_v + W_1)]$

We find that 'v' can be zero or it can be positive depending upon the magnitude of the parameters. In the same lines as in Lemma 1, it can be shown that optimum 'v' in this case will be even lower than that in model 2. Indeed, we have already shown that optimum 'v' is a positive function of the credit limit. Hence it is bound to be the lowest when this limit is zero (model 3).

Comparative Static Analysis

- The effect of increase in parent's income and initial wealth are same as before.
- Schooling-Earning profile

  $\partial v/\partial W_2'(v) = W_2 (v)/ (W_2'(v))^2 > 0$

  The effect of future school-earning profile is positive as it was in case of credit rationing.
- First periods' wage rate (opportunity cost)

$\partial v/\partial W_1 = [\, P_v - \{(1-\alpha)Y_p + g\}] / (W_1+P_v)$

The sign of this effect is negative as we get in case of credit rationing.

- Direct cost of education

$\partial v/\partial P_v = [-\{(1-\alpha)Y_p+g+W_1\}] / (W_1+P_v)^2 < 0$

A raise in the direct cost of education decreases the time devoted to education.

- Share of income transferred to older generation

$\partial v/\partial \alpha = (-Y_p)/(W_1+P_v) < 0$

The sign of this effect is same as before.

3.2.4 Summary of the results of Pure Investment Model of Non-farm Household:

Table 1: Effects of Exogenous Variables on Time Devoted to Education by the Type of Credit

	Perfect capital market	Credit rationing	Non-existing capital market
V	$[\{(\alpha W_2(v)/(1+r))+W_1+ g+(1-\alpha)Y_p\}/(P_v+W_1)]$	$\{[\alpha W_2'(v)\{(1-\alpha)Y_p+g+W\}]-[\{\alpha W_2(v)-B_2(1+r)\}(W+P_v)]/\alpha W_2'(v)(W+P_v)]\}$	$[\alpha W_2'(v)\{W_1+g+(1-\alpha)Y_p\}-\{\alpha W_2(v)(P_v+W_1)\}]/\alpha W_2'(v)(P_v+W_1)$
$\partial v/\partial Y_p$	+	+	+
$\partial v/\partial g$	+	+	+
$\partial v/\partial W_1$	-	-	-
$\partial v/\partial P_v$	-	-	-
$\partial v/\partial W_2'(v)$	0	+	+
$\partial v/\partial \alpha$	?	-	-
$\partial v/\partial B_2$	*	+	*
$\partial v/\partial r$	-	+	*

3.2.5: Model 4: Integrated Model of Investment and Consumption Demand for Education under Perfect Capital Market

Instead of assuming education as an investment good, we now consider the consumption aspect of education as well. In this integrated consumption-investment model we stick to all the assumptions of model 1. The only difference is that, here time devoted to education (v) directly enters the household's utility function reflecting the

consumption aspect of education. We assume positive but diminishing marginal utility of 'v'. In other words, we assume

$\partial U/\partial v > 0$ and $\partial^2 U/\partial v^2 < 0$

Now we take the following functional form for the household's first period utility function

$$U_1 = \ln X_1 + \ln v$$

The second period's utility function is, as earlier,

$$U_2 = \ln X_2$$

We can write household's lifetime utility function as

$$U = U_1 + U_2$$

Or, $U = \ln X_1 + \ln v + \ln X_2$

Again we are assuming that the household does not discount future. Future is as important as present.

With perfect capital market, the budget constraints are the same as in model 1.

The household chooses his optimal bundle of education, current and future consumption by maximizing his utility function subject to the budget and time constraints.

The problem becomes:

$$\text{Max } U = \ln X_1 + \ln v + \ln X_2$$

$$\text{Subject to } W_1 + g + B + (1-\alpha) Y_p = P_1 X_1 + (P_v + W_1) v$$

$$\alpha W_2 (v) = P_2 X_2 + B (1+r)$$

$$1 = l_c + v, \; v \in (0,1)$$

The Lagrange function is:

$$L = \ln X_1 + \ln v + \ln X_2 + \lambda_1 \{W_1 + g + B + (1-\alpha) Y_p - P_1 X_1 - (P_v + W_1) v\} + \lambda_2 \{\alpha W_2 (v) - P_2 X_2 - B (1+r)\}$$

where, λ_1, λ_2 are Lagrange multiplier.

Differentiating first the Lagrange function with respect to X_1, X_2, v, B, λ_1 and λ_2 and equating each derivatives with zero we will get the first order conditions. Here B is endogenous variable.

First order conditions are

(1a) $\lambda_1 = 1/ P_1X_1$

(2a) $\lambda_2 = 1/ P_2X_2$

(3a) $\lambda_1 . \lambda_2 (1+r) = 0$

(4a) $1/v = \lambda_1(P_v + W_1) - \lambda_2 \alpha W_2'(v)$

(5a) $W_1+ g+ B+(1-\alpha) Y_p - P_1X_1 - (P_v + W_1)v = 0$

(6a) $\alpha W_2 (v) - P_2X_2 - B (1+r) = 0$

From (1a), (2a) and (3a) we can write, $P_2X_2 / P_1X_1 = (1+r)$.

From (5a) and (6a) we can write

(7a) $B= 1/2[\{\alpha W_2(v) / (1+r)\} + \{(W_1+ P_v)v -(1-\alpha)Y_p - g - W_1\}]$.

Using (1a), (2a), (4a), (5a), (6a) and (7a) we get

$$v = [\{(1-\alpha)Y_p + g + W_1\} + \{\alpha W_2(v) / (1+r)\}] / [3(W_1+P_v) - 2\{\alpha W_2'(v)/(1+r)\}]$$

(8a) $$v = [\{(1-\alpha)Y_p+g+W_1\}+\{\alpha W_2(v)/(1+r)\}] / [(W_1+P_v)+2[(W_1+P_v)-\{\alpha W_2'(v)/(1+r)\}]]$$

In model 1 (education as investment good), at equilibrium, we have

$$[(W_1+ P_v)-\{\alpha W_2'(v)/ (1+r)\}]=0$$ (from equation 3 & 4)

This difference is the net cost of education (the difference between full cost and incremental discounted earnings), which was equal to zero in equilibrium in model 1. If this were positive, the optimum 'v' would be zero in model 1.

In this integrated model, however, the net cost of education is always positive at the optimal level, because

$$[(\partial U/\partial v)/(\partial U/\partial X_1)] = [(W_1+P_v) - \{\alpha W_2'(v)/(1+r)\}] / P_1] > 0$$

since, $(\partial U/\partial v)>0$ as well as $\partial U/\partial X_1>0$

and in this model 'v' is also always positive.

Essentially, if marginal cost exceeds marginal return from education, it may prove to be an unprofitable investment proposition. But incorporating the consumption aspect of education, the possible pecuniary loss can be compensated by the addition tc parental satisfaction arising from more highly educated children, making 'v' positive.

Comparative static analysis:

- Parents' income

  $\partial v/\partial Y_p = [1-\alpha] / [3(W_1 + P_v) - 2\{\alpha W_2'(v) / (1+r)\}] > 0$

  Increase in parent's income will increase the demand for education.

- Initial wealth

  $\partial v/\partial g = 1 / [3(W_1 + P_v) - 2\{\alpha W_2'(v)/(1+r)\}] > 0,$

  Increase in initial wealth raises the demand for education.

- First periods' wage rate (opportunity cost of education)

  $$\partial v/\partial W_1 = [-2\{\alpha W_2'(v)/(1+r)\} + 3\{P_v - (1-\alpha)Y_p - g - (\alpha W_2(v)/(1+r))\}]$$

  $$/ [3(W_1+P_v)-2\{\alpha W_2'(v)/(1+r)\}]^2 < 0$$

  The sign depends upon the term $[P_v - (1-\alpha)Y_p - g - \{\alpha W_2(v)/(1+r)\}]$.

  Following the same logic as before, we assume the sign of this derivative to be negative.

- Direct cost of education

$$\partial v/\partial P_v = (-3)[\{(1-\alpha)Y_p+g+W_1\}+\{\alpha W_2(v)/(1+r)\}] / [3(W_1+P_v)-2\{\alpha W_2'(v)/(1+r)\}]^2 < 0$$

  The change in direct cost of education has a negative impact on time devoted to education.

- Schooling-earning profile

$$\partial v/\partial W_2'(v)=[2\alpha/(1+r)] \times [\{(1-\alpha)Y_p + g + W_1\} + \{\alpha W_2(v)/(1+r)\}] /$$

$$[3(W_1 + P_v) - 2\{\alpha W_2'(v)/(1+r)\}]^2 > 0.$$

Increase in wage-schooling profile raises the demand for education.

- Rate of interest

$$\partial v/\partial r = (-)[\{3\alpha W_2(v)(W_1 + P_v)/(1+r)^2\} + \{(1-\alpha)Y_p + g + W_1\} \times \{\alpha W_2'(v)/(1+r)^2\}] /$$

$$[3(W_1+P_v)-2\{\alpha W_2'(v)/(1+r)\}]^2 < 0$$

Increase in the rate of interest depresses the demand for education.

- Share of income transferred to older generation

$$\partial v/\partial \alpha = [[3(W_1 + P_v) - 2\{\alpha W_2'(v)/(1+r)\}] \times [\{W_2(v)/(1+r)\} - Y_p] +$$

$$[\{2W_2'(v)/(1+r)\} \times \{(1-\alpha)Y_p + g + W_1\} + \{\alpha W_2(v)/(1+r)\}]]$$

$$/ [3(W_1 + P_v) - 2\{\alpha W_2'(v)/(1+r)\}]^2$$

As earlier, the sign depends upon, $[\{W_2(v)/(1+r)\} - Y_p]$. If this is positive, optimum 'v' increases with α. Otherwise, the sign is indeterminate.

3.2.6 MODEL 5: Integrated Model of Investment and Consumption Demand for Education under Credit Rationing

In this case the assumptions are the same as in model 4. We only relax the assumption of perfect capital market and consider the case of credit rationing. Houscholds cannot borrow beyond the certain amount, B_2.

The problem becomes:

Max $U=\ln X_1 + \ln v + \ln X_2$

Subject to $W_1 + g + B_2 + (1-\alpha)Y_p = P_1X_1 + (P_v + W_1)v$

$$\alpha W_2(v) = P_2X_2 + B_2(1+r)$$

$$1 = l_c + v, \; v \in (0,1)$$

The Lagrange function is:

$L = \ln X_1 + \ln v + \ln X_2 + \lambda_1\{W_1 + g + B_2 + (1-\alpha)\, Y_p - P_1X_1 - (P_v + W_1)\, v\} + \lambda_2\{\alpha W_2\,(v) - P_2X_2 - B_2\,(1+r)\}$

where, λ_1, λ_2 are Lagrange multiplier.

Differentiating first the Lagrange function with respect to X_1, X_2, v, λ_1 and λ_2 and equating each derivatives with zero we will get the first order conditions. Note that B_2 is exogenously determined.

Necessary first order conditions are

(9a) $\lambda_1 = 1/ P_1X_1$

(10a) $\lambda_2 = 1/ P_2X_2$

(11a) $1/v = \lambda_1(P_v + W_1) - \lambda_2 \alpha W_2\,'(v)$

(12a) $W_1 + g + B_2 + (1-\alpha)\, Y_p - P_1X_1 - (P_v + W_1)v = 0$

(13a) $\alpha W_2(v) - P_2X_2 - B_2(1+r) = 0$

Using (9a), (10a), (11a), (12a) and (13a) we can derive the value of 'v' (considering only the positive root):

(14a) $v = (-)\,[\{\alpha W_2\,(v) - B_2(1+r)\}/\,\{\alpha W_2\,'(v)\}] + [\{W_1 + g + B_2 + (1-\alpha)\, Y_p\}/2(P_v + W_1)] + [\,[\{\alpha W_2\,(v) - B_2(1+r)\}/\,\{\alpha W_2\,'(v)\}]^2 + [\{W_1 + g + B_2 + (1-\alpha)\, Y_p\}/2(P_v + W_1)]^2\,]^{1/2}$

Here v is always positive because the solution is of the form:

$$v = -y + x + (x^2 + y^2)^{1/2}$$

Given that $(x - y)^2 = x^2 + y^2 - 2xy$

$$(x - y) = (x^2 + y^2 - 2xy)^{1/2}$$

$$\therefore \quad (x - y) < (x^2 + y^2)^{1/2}$$

Hence, $v > 0$

Comparative static analysis

- Parents income

$\partial v/\partial Y_p=[(1-\alpha)/2(P_v+ W_1)] + [(1-\alpha)\times\{ W_1 + g + B_2 + (1-\alpha)Y_p\}/4(P_v+W_1)^2\{Z\}^{1/2}]>0$

where $Z = [[\{\alpha W_2 (v)- B_2(1+r)\}/\{\alpha W_2 '(v)\}]^2 + [\{ W_1+ g+ B_2+(1-\alpha) Y_p\}/2(P_v + W_1)]^2]^{1/2}$

Increase in parents' income will increase the demand for education.

- Initial wealth

$\partial v/\partial g = [1/2(P_v + W_1)] + [\{ W_1 + g + B_2 + (1-\alpha) Y_p \} / 4(P_v + W_1)^2\times\{Z\}^{1/2}] >0$

where $Z=[[\{\alpha W_2 (v)- B_2(1+r)\}/\{\alpha W_2 '(v)\}]^2 + [\{W_1+g+B_2+(1-\alpha)Y_p\}/2(P_v+ W_1)]^2]^{1/2}$

Rise in initial wealth raises the demand for education.

- Opportunity cost of education

$\partial v/\partial W_1 = [\{P_v - (1- \alpha)Y_p - g - B_2\} / 2(W_1+P_v)^2] +$

$[\{P_v - (1- \alpha)Y_p - g - B_2\}\times\{W_1+g+B_2+(1-\alpha) Y_p\}] / 4(P_v + W_1)^3\times\{Z\}^{1/2}] < 0$

where $Z = [[\alpha W_2(v)-B_2(1+r)\}/\{\alpha W_2'(v)\}]^2+[\{ W_1+ g+ B_2+(1-\alpha) Y_p\}/2(P_v+W_1)]^2]^{1/2}$

The sign depends on the term, $[P_v - (1-\alpha)Y_p - g - B_2]$. Following the same logic as before, we can say the sign of this term is negative and so is the sign of the above derivative. Optimum 'v' falls as W_1 increases.

- Direct cost of education

$\partial v/\partial P_v = (-) [\{ W_1+ g + B_2 + (1-\alpha) Y_p\}/ 2(W_1+P_v)^2] -$

$[\{ W_1+ g + B_2 + (1-\alpha) Y_p \}^2 / 4(P_v + W_1)^3\{Z\}^{1/2}] < 0$

where $Z = [[\{\alpha W_2 (v)- B_2(1+r)\}/\{\alpha W_2'(v)\}]^2 + [\{W_1+g+B_2+(1-\alpha)Y_p\}/2(P_v+ W_1)]^2]^{1/2}$

Optimum 'v' falls with the cost of education.

- Schooling earning profile

$\partial v/\partial W_2'(v) = [\{\alpha W_2(v) - B_2(1+r)\} / \{2\alpha(W_2'(v))^2\}] \times$

$[1 - [\{\alpha W_2(v) - B_2(1+r)\}/\{2\alpha W_2'(v) Z^{1/2}\}]\} = ?$

where $Z = [\ [\{\alpha W_2(v) - B_2(1+r)\}/\{\alpha W_2'(v)\}]^2 + [\{W_1 + g + B_2 + (1-\alpha) Y_p\}/2(P_v + W_1)]^2\ ]^{1/2}$

The effect of schooling earning profile on the time devoted to education is ambiguous.

The derivative is positive, zero or negative according as

$\{\alpha W_2(v) - B_2(1+r)\} <=> \{2\alpha W_2'(v) Z^{1/2}\}$

- Credit ceiling/ borrowing limit

$\partial v/\partial B_2 = [(1+r) / 2\alpha W_2'(v)] + [(1/2)(W_1+P_v)] + [\{W_1 + g + B_2 + (1-\alpha)Y_p\}/2(P_v + W_1)^2] - [\{(1+r)(\alpha W_2(v) - B_2(1+r))\} / \{4(\alpha W_2'(v))^2 Z^{1/2}\}] = ?$

The effect of change in credit ceiling on time devoted to education is also uncertain.

- Rate of interest

$\partial v/\partial r = [B_2 / \{2\alpha W_2'(v)\}] - [B_2\{\alpha W_2(v) - B_2(1+r)\} / Z^{1/2}(2\alpha W_2'(v))^2] = ?$

The sign of this derivative is ambiguous.

- Share of income transferred to older generation

$\partial v/\partial \alpha = [B_2(1+r)/ 2\alpha^2 W_2'(v)] - [[Y_p/2(W_1+P_v)] - [\ [B_2(1+r)\{\alpha W_2(v) - B_2(1+r)\}]/ \{\alpha^3 (W_2'(v))^2\}] + [Y_p\{W_1 + g + B_2 + (1-\alpha) Y_p\} / 2(P_v + W_1)^2 Z^{1/2}] = ?$

The sign of the above derivative is also ambiguous.

3.2.7 MODEL 6: Integrated Model of Investment and Consumption Demand for Education in the Absence of Credit

Let us assume now that no borrowing is possible, so that $B_2=0$.

We can now write the problem in the following way:

Max $U = \ln X_1 + \ln v + \ln X_2$

Subject to $W_1 + g + (1-\alpha) Y_p = P_1 X_1 + (P_v + W_1)v$

$$\alpha W_2(v) = P_2X_2$$

$$1 = l_c + v,\ v \in (0,1)$$

The Lagrange function is:

$$L = \ln X_1 + \ln v + \ln X_2 + \lambda_1\{W_1 + g + (1-\alpha) Y_p - P_1X_1 - (P_v + W_1) v\} + \lambda_2 \{\alpha W_2(v) - P_2X_2\}$$

where, λ_1, λ_2 are Lagrange multiplier.

Differentiating first the Lagrange function with respect to X_1, X_2, v, λ_1 and λ_2 and equating each derivatives with zero we will get the first order conditions.

Following the same procedure, which we have followed earlier, we can derive the value of 'v' from the first order conditions.

(15a) $$v = [\{\alpha W_2'(v)\}\{W_1 + g + (1-\alpha) Y_p\}] + [[\{\alpha W_2'(v)\} \times \{W_1 + g + (1-\alpha) Y_p\}]^2 + 4(P_v + W_1)[\{\alpha W_2(v)\}\{W_1 + g + (1-\alpha) Y_p\}]]^{1/2}$$

Here 'v' is always positive.

Comparative static analysis:

- Parents Income

  $\partial v/\partial Y_p > 0$

  We can say from this result that parents' will devote more of their children's time to education, as their income increases.

- Initial Wealth

  $\partial v/\partial g > 0$

  Increase in initial wealth raises demand for education.

- Opportunity cost of education

  $\partial v/\partial W_1 < 0$

  Demand for education is inversely related with opportunity cost of education.

- Direct cost of education

$\partial v/\partial P_v < 0$

Increase in direct cost of education reduces the time devoted to education.

- Schooling earning profile

$\partial v/\partial W_2'(v) = ?$

In the absence of credit market the effect of schooling-earning profile on demand for education is ambiguous.

- Share of income transferred to older generation

$\partial v/\partial \alpha = ?$

As we have mentioned earlier, the increase in 'α' have two opposite effect on demand for education: first, it raises future income of the household. Second, it reduces the present income of the parents and relative strength of theses two opposite forces determines the optimum amount of child's time which parents devote in their children's education. Under this aforesaid situation, however, the affect is indeterminate.

So, we can conclude from the above comparative static analysis that the results are the same as in the case of credit rationing in model 5.

3.2.8 Summary of the Results of Integrated Model of Non-farm Household:

Table 2: Effects of Exogenous Variables on Time Devoted to Education by the Type of Credit

	Perfect capital market	Credit rationing	Absence of credit market
$\partial v/\partial Y_p$	+	+	+
$\partial v/\partial g$	+	+	+
$\partial v/\partial W_1$	-	-	-
$\partial v/\partial P_v$	-	-	-
$\partial v/\partial W_2'(v)$	+	?	?
$\partial v/\partial \alpha$	?	?	?
$\partial v/\partial r$	-	?	*
$\partial v/\partial B_2$	*	?	*

3.3 FARM HOUSEHOLDS

Let us now turn our attention to the problem of educational investment decision of farm households in order to understand how it differs from the educational investment decision of non-farm households. As earlier, our objective is to identify the major determinants of educational investment decision of farm family.

As before we shall first consider only the investment aspect of education and then we develop integrated investment-consumption models, both under different forms of capital market. The structure and assumptions of these models will be the same as the models of non-farm households. The only difference is that now we take the value of agricultural production as the farm household's income. We therefore incorporate an agricultural production function in our model with education as a direct and explicit input into the production process.

3.3.1 Model 7: Educational Investment Decision under Perfect Capital Market Considering Education as an Investment Good.

Let us first consider utility function of a farm household, which is a function of first period's consumption (X_1) as well as second period's consumption (X_2).

$\therefore U = U_1 (X_1) + U_2 (X_2)$

where, $U_1 (X_1)$ = household's first periods' utility function

and $U_2 (X_2)$ = household's second periods' utility function

Utility function takes the following functional form as in case of non-farm household:

$U_1 = \ln X_1$ and $U_2 = \ln X_2$

Hence, the lifetime utility function for the farm household can be written as:

$U = \ln X_1 + \ln X_2$

The problem is to

Maximize $U = \ln X_1 + \ln X_2$

Subject to $P_{y1}Y_1 + B = P_{x1}X_1 + P_v v + P_{q1}Q_1$

$P_{y2}Y_2 = P_{x2}X_2 + P_{q2}Q_2 + B(1+r)$

$L + v = T$ (time constraint) and $v \in [0,1]$

where Y_i denotes the agricultural production function of the i^{th} period.

P_{yi}: price of agriculture product in the i^{th} period.

$P_{yi}Y_i$: income from agriculture in the i^{th} period.

P_v: price of per unit education.

$P_v v$: direct cost of education.

$P_{xi}X_i$: total expenditure on consumption in the i^{th} period.

$P_{qi}Q_i$: cost of production in the i^{th} period.

We shall consider a very simple form of agricultural production function for the sake of computational simplicity. Let the production function take the following multiplicative form:

$$Y = A K_0 (L_p + s(v) L)$$

where

A: any parameter other than labour and capital, which, affects agricultural production (technology, land size etc.).

K_0: existing capital stock, which is constant.

L_p: labour supplied by parents, embodying their education and skills, which we assume to be exogenously given.

L: amount of labour supplied by the child in the first period, given that $L + v = T$

T: denotes total available time for the child.

v: time devoted to education

s: denotes skill formed in the second period through investment in education in the first period, hence 's' is a function of time devoted to education, 'v'.

$$s = s(v), \text{ where, } \partial s/\partial v > 0 \text{ and } s(0) = 1$$

Note that even if v>0 in period 1, there is no skill formation in period 1 ie, s(.) = 1

Here we are considering education as an input into agricultural production. Education is embodied in the skills and knowledge of individual members of labour force. The idea is, educated farm workers can more readily adopt new productive techniques and therefore can enjoy higher return in a dynamic production environment.

The production function can be simplified as:

$$Y = AK_0 \{L_p + s(v)(T - v)\} = AK_0 L_p + AK_0 s(v)(T-v)$$

$$= AK_0 (L_p + s(v) T) - AK_0 s(v) v$$

So in the first period we have a production function of the form

$$Y_1 = A K_0 (L_p + L) \text{ (since, } s(0) = 1)$$

Or $Y_1 = A_0 + A_1 L$, where $A_0 = AK_0 L_p$ & $A_1 = AK_0$ (since A, K_0, L_p all are constant)

$$= A_0 + A_1 (T-v)$$

$$= A_0 + A_1 T - A_1 v$$

We have mentioned earlier that a major component of the cost of education (opportunity cost) is the value of the production sacrificed as a consequence of a child school attendance. In this case opportunity cost is '$P_{y1} A_1 v$'.

In the second period, the child becomes an adult and devotes his entire time to farming, so that v = 0 and L = T. Parents continue to devote L_p and hence the production function is:

$$Y_2 = A_0 + A_1 s(v) T$$

Here we are assuming that skilled and unskilled labours are perfect substitute but the former is more productive than the later. The ratio of marginal products of the two types of labour is s (v).

Farm children with more schooling are more likely to leave agriculture because school investment not only increase the earning capacity of children in production on the family farm but in other activities as well. In this model we are assuming that no one quits from the agriculture in the second period even with education. In fact, individuals will leave agriculture if and only if their expected earning prospects from other activities exceed their income gains from agriculture. We assume that individuals will decide about optimum investment in education based on the latter (income gains from agriculture) which denotes a certain minimum return from their investment.

The Lagrange function is:

$$\phi = \ln X_1 + \ln X_2 + \lambda_1 (P_{y1}Y_1 + B - P_{x1}X_1 - P_v v - P_{q1}Q_1) + \lambda_2 \{P_{y2}Y_2 - P_{x2}X_2 - P_{q2}Q_2 - B(1+r)\}$$

(20) $$\phi = \ln X_1 + \ln X_2 + \lambda_1 [P_{y1}(A_0 + A_1 L) + B - P_{x1}X_1 - P_v v - P_{q1}Q_1] + \lambda_2 [P_{y2}(A_0 + A_1 s(v)T) - P_{x2}X_2 - P_{q2}Q_2 - B(1+r)]$$

Differentiating (20) with respect to X_1, X_2, B, v, λ_1, λ_2 and equating each derivative equal to zero we will get the first order conditions. Following are the first order conditions.

(21) $(1/X_1) + \lambda_1(-P_{x1}) = 0$

(22) $(1/X_2) + \lambda_2(-P_{x2}) = 0$

(23) $\lambda_1 [-P_{y1}A_1 - P_v] + \lambda_2 [P_{y2}. A_1.s'(v) T] = 0$

(24) $\lambda_1 - \lambda_2 (1+r) = 0$

(25) $P_{y1}(A_0 + A_1 T) - P_{y1}A_1 v + B - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(26) $P_{y2}\{A_0 + A_1 s(v) T\} - P_{x2}X_2 - P_{q2}Q_2 - B(1+r) = 0$

From (23) and (24) we can say individual will continue to invest until their marginal discounted second period's earning is equal to the full price of education.

From equation (21), (22) and (24) we get

$P_{x2} X_2 = (1+r) P_{x1} X_1$

From equation (25) and (26) we can derive $P_{x2} X_2$, $P_{x1} X_1$. Putting this value in the above equation we get:

(27) $P_{y2}\{A_0 + A_1 s(v)T\} - P_{q2}Q_2 - B(1+r) = (1+r)[Py_1(A_0 + A_1(T-v)) + B - P_v v - P_{q1}Q_1]$

Solving this equation we can derive the value of 'B'.

(28) $B = (1/2)\times[\,[\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2\}/(1+r)] - [P_{y1}\{A_0 + A_1(T-v)\} - P_v v - P_{q1}Q_1]\,]$

From (21), (22), and (23) we get

(29) $[P_{y1}A_1 + P_v]\times(P_{x2} X_2) = [P_{y2}.\ A_1.s'(v)\ T]\times(P_{x1} X_1)$

Again from equation (25) and (26) we can derive the value of $P_{x2} X_2$ and $P_{x1} X_1$.

Using (25), (26), (28) and (29) we can derive he value of 'v' in terms of all the parameters of the model.

(30) $v = [\ \{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2\}\ /\ (P_{y1}A_1 + P_v)(1+r)\ ]\ +$

$$[\ \{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}\ /\ (P_{y1}A_1 + P_v)\ ]$$

It is evident from the above solution, that v is always positive and a function of the following parameters:

Price of agricultural product in the first and second period (P_{y1}, P_{y2} respectively), rate of interest (r), skill formation through education (s), direct cost of education (P_v), price of agricultural input in both periods (P_{q2}, P_{q1}) and agricultural production function parameters A_1 and A_0.

We derive some comparative static analysis in order to analyse the effect of these exogenous variables on 'v'.

Comparative static analysis:

- Price of agricultural product in the first period

$$\partial v/\partial P_{y1} = [\ P_v(A_0 + A_1 T) + P_{q1}Q_1A_1 - [A_1\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2\}/(1+r)]\ ]$$

$$/\ (P_{y1}A_0 + P_v)^2 = ?$$

From here we cannot say definitely the relation between price of agricultural product and the demand for education. P_{y1} is one of the components of opportunity cost of education. Increase in price of agricultural product means increase in family income. But on the other hand it will increase opportunity cost of education. The first effect will increase demand for education while the second will decrease the demand for education. So, what will be the net effect is ambiguous.

- Direct cost of education

$$\partial v/\partial P_v = (-)\,[\,[\{P_{y2}(A_0+A_1 s(v)T) - P_{q2}Q_2\}/(1+r)] + [P_{y1}(A_0+A_1T) - P_{q1}Q_1]\,]$$
$$/\,(P_{y1}A_1 + P_v)^2 < 0$$

So here we can say that there is an inverse relation between demand for education and price of education.

- Marginal productivity of education in skill formation

$\partial v/\partial s'(v)=0$,

Increase in education's productivity in skill formation has no impact on demand for education.

- Rate of interest

$$\partial v/\partial r = (-)\,[\,\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2\}/(1+r)^2(P_{y1}A_1 + P_v)\,] < 0$$

An upward shift of the borrowing rate decreases demand for education. Increase in the rate of interest means increase in the cost of borrowing. Hence fewer funds will be available for investment in education and hence through income effect 'r' will decrease the demand for education.

- Increase in the parents' labour input

$$\partial v/\partial L_p = [\,AK_0 \times \{P_{y1}(1+r) + P_{y2}\}/\{(1+r)\times(P_{y1}A_1 + P_v)\}\,] > 0.$$

The effect of increase in L_p can be signed unambiguously. Note that, with full employment of parents' labour time, a rise in L_p can only come about by increasing skills and knowledge embodied in parents. This means that if there is improvement in parental education, which raises productivity of parent's, it will encourage investment in education.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\,[\,\{P_{y2}\, s(v)T/(1+r)\} + P_{y1}T\,]/(P_{y1}A_1 + P_v)\,] -$$

$$[\,P_{y1} \times [\{(P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2)/(1+r)\} + P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\,]/$$

$$(P_{y1}A_1 + P_v)^2\,] = ?$$

The impact of increase in agricultural productivity is less clear-cut. If there is any change in technology, land size or any other factors, which raises agricultural productivity, it leads to an increase in the child's earning as an unskilled labour (i.e. increasing the opportunity cost of education). On the other hand it raises the parental income. Hence there are two opposing effects on the demand for education and the net result is ambiguous.

The effect of increase in any factor that increases marginal productivity of unskilled labour is ambiguous since it results in conflicting income and price effects.

3.3.2 Model 8: Educational Investment Decision under Imperfect Capital Market Considering Education as an Investment Good

Let us now relax the assumption of perfect capital market and consider a case where capital market is imperfect in the sense that household cannot borrow beyond a certain amount, B_2. That is, the case of credit rationing as we have assumed in model 2. All the assumptions are same as before. So now amount of borrowing is not endogenous variable, it is exogenously given now.

Hence the problem of the household is to maximize household utility function subject to first period's budget constraint, second period's budget constraint and time constraint for the children. So we can write

$$\text{Max } U = \ln X_1 + \ln X_2$$

Subject to $P_{y1}Y_1 + B_2 = P_{x1}X_1 + P_v v + P_{q1}Q_1$

$$P_{y2}Y_2 = P_{x2}X_2 + P_{q2}Q_2 + B_2(1+r)$$

and $L + v = T$ (time constraint) where $v \in [0,1]$

where $Y_1 = (A_0 + A_1 s(0) L)$

$= A_0 + A_1 L$

and $Y_2 = (A_0 + A_1 s(v) T)$

All the assumptions and notations are same as before.

The Lagrange function is:

$$\phi = \ln X_1 + \ln X_2 + \lambda_1(P_{y1}Y_1 + B_2 - P_{x1}X_1 - P_v v - P_{q1}Q_1) + \lambda_2\{P_{y2}Y_2 - P_{x2}X_2 - P_{q2}Q_2 - B_2(1+r)\}$$

Or,

(31) $\phi = \ln X_1 + \ln X_2 + \lambda_1(P_{y1}(A_0 + A_1 L) + B_2 - P_{x1}X_1 - P_v v - P_{q1}Q_1) + \lambda_2\{P_{y2}(A_0 + A_1 s(v) T) - P_{x2}X_2 - P_{q2}Q_2 - B_2(1+r)\}$

Now B_2 is exogenous variable. So differentiating (31) with respect to X_1, X_2, v, λ_1, λ_2 and equating each derivative equal to zero we will get the following first order conditions.

(32) $(1/X_1) + \lambda_1(-P_{x1}) = 0$

(33) $(1/X_2) + \lambda_2(-P_{x2}) = 0$

(34) $\lambda_1[-P_{y1}A_1 - P_v] + \lambda_2[P_{y2}. A_1.s'(v) T] = 0$

(35) $P_{y1}\{A_0 + A_1(T-v)\} + B_2 - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(36) $P_{y2}\{A_0 + A_1 s(v) T\} - P_{x2}X_2 - P_{q2}Q_2 - B_2(1+r) = 0$

From equation (32), (33), (34), (35) and (36) we can derive the value of 'v' in terms of all the parameters of the model.

(37) $v = [\ \{P_{y1}(A_0+A_1T) + B_2 - P_{q1}Q_1\} / (P_{y1}A_1 + P_v)\ ] -$

$[\ \{P_{y2}(A_0+A_1s(v)T) - P_{q2}Q_2 - B_2(1+r)\} / (P_{y2}\ A_1s'(v)T\ )\ ].$

This is basically the difference between the ratio of first period's net income and cost of education and the ratio of second period's net income relative to returns from education. 'v' is not necessarily always positive. It can be zero if the difference between these two is negative. Along the lines of 'Lemma 1', it can be shown that optimum 'v' is lower in case of imperfect capital market than in case of perfect capital market for farm households also, i.e. farm households invest less on education under capital market imperfection.

Comparative static analysis:

Comparative static analysis yields somewhat different results compared to our model of perfect capital market (model 7). The results are summarized below:

- Price of agricultural product in the first period

$$\partial v/\partial P_{y1} = [\ \{(P_{y1}A_1 + P_v)\times(A_0 + A_1T)\} - A_1\{P_{y1}(A_0+A_1T) + B_2 - P_{q1}Q_1\}\ ] / (P_{y1}A_1 + P_v)^2$$

$$= [\ P_v(A_0 + A_1T) - (B_2 - P_{q1}Q_1)A_1\ ] / (P_{y1}A_1 + P_v)^2 = ?$$

The result is same as what we get in case of perfect credit market. For the non-farm household the effect of opportunity cost on demand for education is not indeterminate. The relationship is negative.

- Direct cost of education

$$\partial v/\partial P_v = (-)[\ P_{y1}(A_0+A_1T) + B_2 - P_{q1}Q_1\}\ ] / (P_{y1}A_1 + P_v)^2 < 0$$

So here we can say that there is an inverse relation between demand for education and price of education. This result is same as in case of perfect capital market and also in case of non-farm household.

- Rate of interest

$$\partial v/\partial r = [\ \{B_2(1+r)^2\} / (P_{y2}A_1s'(v)T)\ ] > 0$$

In case of perfect credit market the demand for education is inversely related to the rate of interest. But in case of imperfect capital market they are positively related. This result is easy to explain though it has an opposite sign compared to the traditional human capital model. A higher borrowing rate decreases second period's disposable income, which lowers second period's consumption. This decrease can be partially compensated by increasing second period's earning through investment in education.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\ P_{y1}\{\ P_vT+P_{q1}Q_1 - P_{y1}A_0 - B_2\ \} / (\ P_{y1}A_1 + P_v)^2\ ] +$$

$$[\ \{P_{q2}Q_2 + B_2\ (1+r) - P_{y2}A_0\ \} / (A_1^2P_{y2}s'(v)T)\ ] = ?$$

Increase in A_1 increases family's first period's income on one hand, and on the other hand it also implies an increase in the opportunity cost of education. While the first one increases demand for education, the second one decreases it. The net effect is ambiguous as in the case of perfect capital market. In this case the sign depends on the difference between parent's net income from agriculture in the second period and the amount require to repay the loan in the second period i.e. on the second term

$\{P_{q2}Q_2 + B_2\ (1+r) - P_{y2}A_0\}$. (The first term is always negative as we have mentioned in the case of non-farm household, that direct cost of education is negligible and hence is lower than family's income). Now if the difference is negative or, parents' income is higher than amount of borrowing repayment we can definitely conclude that the relationship is negative.

- Increase in the parents' labour input

$$\partial v/\partial L_p = [\ AK_0 \times \{\ P_{y1}A_1s'(v) - P_{y1}A_1 - P_v\} / \{A_1s'(v)T\} \times \{P_{y1}A_1 + P_v\}\ ] = ?$$

Even if there is an increase in parental labour input (may be through greater embodiment of education and skills), it does not always ensure that demand for

education will increase if the household faces borrowing constraint. The sign depends on the term, $\{P_{y1}A_1s'(v) - P_{y1}A_1 - P_v\}$. i.e. if the value of marginal productivity of skilled labour at current price is greater than the total cost of education the effect is positive. With perfect capital market this result is always positive.

- Marginal productivity of education in skill formation

$$\partial v/\partial s'(v) = [\ \{\ P_{y2}\ (A_0+A_1s(v)\ T) - P_{q2}Q_2 - B_2(1+r)\ \}\ /\ \{P_{y2}A_1T(s'(v))^2\}\ ] > 0.$$

This result is same as what we get in case of non-farm household. Under perfect credit market increase in productivity of schooling in skill formation had no impact on demand for education.

- Borrowing limit / credit ceiling

$$\partial v/\partial B_2 = [\ \ [\{P_{y2}A_1Ts'(v)\}+\{(1+r)\times(P_{y1}A_1 + P_v)\}]\ /\{(P_{y1}A_1+ P_v)\times(P_{y2}A_1s'(v)T)\}\ ]>0$$

Increase in the amount of credit limit increases the demand for education. If more credit is available to the household, then their demand for education will increase due to income effect.

3.3.3 Model 9: Educational Investment Decision in the Absence of Credit Market:

This is the extreme case of credit rationing when $B_2 = 0$. Here the problem is same as in case of credit rationing.

$$\text{Max } U = \ln X_1 + \ln X_2$$

Subject to $P_{y1}Y_1 = P_{x1}X_1 + P_vv + P_{q1}Q_1$

$$P_{y2}Y_2 = P_{x2}X_2 + P_{q2}Q_2$$

and $L + v = T$ (time constraint) where $v \in [0,1]$

where $Y_1 = (A_0 + A_1\, s(0)\, L)$

$$= A_0 + A_1L$$

and $Y_2 = (A_0 + A_1 s\,(v)\, T)$

All the assumptions and notations are same as before.

The Lagrange function is:

$$\phi = \ln X_1 + \ln X_2 + \lambda_1(P_{y1}Y_1 - P_{x1}X_1 - P_v v - P_{q1}Q_1) + \lambda_2\{P_{y2}Y_2 - P_{x2}X_2 - P_{q2}Q_2\}$$

Or, $\phi = \ln X_1 + \ln X_2 + \lambda_1\{P_{y1}(A_0 + A_1 L) - P_{x1}X_1 - P_v v - P_{q1}Q_1\} +$

$$\lambda_2\{P_{y2}(A_0 + A_1 s(v)T) - P_{x2}X_2 - P_{q2}Q_2\}$$

Differentiating (38) with respect to X_1, X_2, v, λ_1, λ_2 and equating each derivative equal to zero we will get the following first order conditions.

(39) $(1/X_1) + \lambda_1(-P_{x1}) = 0$

(40) $(1/X_2) + \lambda_2(-P_{x2}) = 0$

(41) $\lambda_1[-P_{y1}A_1 - P_v] + \lambda_2[P_{y2}. A_1.s'(v) T] = 0$

(42) $P_{y1}\{A_0 + A_1(T-v)\} - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(43) $P_{y2}\{A_0 + A_1 s(v) T\} - P_{x2}X_2 - P_{q2}Q_2 = 0$

From equation (39), (40), (41), (42) and (43) we can derive the value of 'v' in terms of all the parameters of the model.

Following the same procedure we can derive 'v'.

(44) $v = [\{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\} / (P_{y1}A_1 + P_v)] -$

$$[\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2\} / \{P_{y2} A_1 s'(v) T\}].$$

Optimum 'v' can be zero. The result is similar to what we obtained in case of credit rationing. The comparative static results are exactly the same as it in the case of credit rationing.

Comparative static analysis:

- Price of agricultural product in the first period

$$\partial v/\partial P_{y1} = [\{(P_{y1}A_1 + P_v)\times(A_0 + A_1 T)\} - A_1\{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}] / (P_{y1}A_1 + P_v)^2$$

$$= [P_v(A_0 + A_1 T) + P_{q1}Q_1 A_1] / (P_{y1}A_1 + P_v)^2 > 0$$

In the absence of credit market increase in price of agricultural product raises demand for education. This result however differs from the earlier case of perfect capital market and the case of credit rationing. Even this result differs from the result, which we derive in case of non-farm household. For non-farm household the effect of opportunity cost on demand for education is negative.

- Direct cost of education

$$\partial v/\partial P_v = (-)[\ P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}\ ] / (P_{y1}A_1 + P_v)^2 < 0$$

So here we can say that there is an inverse relation between demand for education and price of education.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\ P_{y1}\{P_v T + P_{q1}Q_1 - P_{y1}A_0\} / (P_{y1}A_1 + P_v)^2\ ] +$$

$$[\ \{P_{q2}Q_2 - P_{y2}A_0\} / (A_1^2 P_{y2} s'(v)T)\ ] = ?$$

Increase in A_1 increases family's first period's income on one hand, and on the other hand it also implies an increase in the opportunity cost of education. While the first one increases demand for education, the second one decreases it. The net effect is ambiguous. We can use the same argument here also what we have used in case of credit rationing.

- Increase in the parents' labour input

$$\partial v/\partial L_p = [\ AK_0 \times \{P_{y1}A_1 s'(v) - P_{y1}A_1 - P_v\} / \{A_1 s'(v)T\} \times \{P_{y1}A_1 + P_v\}\ ] = ?$$

Even if there is an increase in parental labour input (may be through greater embodiment of education and skills), it does not necessarily ensure that demand for education will increase if the household faces borrowing constraint. The effect as we have mentioned in case of credit rationing, depends upon the sign of the term $(P_{y1}A_1 s'(v) - P_{y1}A_1 - P_v)$.

- Marginal productivity of education in skill formation

$$\partial v/\partial s'(v) = [\ \{\ P_{y2}\ (A_0+A_1 s(v)\ T) - P_{q2}Q_2\} \ /\ \{P_{y2}A_1 T(s'(v))^2\}\ ] > 0.$$

Increase in marginal productivity of skill formation raises demand for education among farm households.

3.3.4 Summary of the Results of Pure Investment Model of Farm Household:

Table 3: Effects of Exogenous Variables on Time Devoted to Education by the Type of Credit

	Perfect capital market	Credit constraint	No credit
$\partial V/\partial P_{y1}$	?	?	+
$\partial V/\partial P_v$	-	-	-
$\partial V/\partial A_1$	?	?	?
$\partial V/\partial L_p$	+	?	?
$\partial V/\partial r$	-	+	*
$\partial V/\partial B_2$	*	+	*
$\partial V/\partial s'(v)$	0	+	+

3.3.5 Model 10: Educational Investment Decision of Farm Household in the Integrated Model of Investment and Consumption under Perfect Capital Market

Instead of assuming education as an investment good, we now consider the consumption aspect of education as well. In this integrated consumption-investment model we stick to all the assumptions of model 1. The only difference is that, here time devoted to education (v) directly enters the household's utility function reflecting the consumption aspect of education. We assume positive but diminishing marginal utility of 'v'. In other words, we assume

$\partial U/\partial v > 0$ and $\partial^2 U/\partial v^2 < 0$

The first period utility function is given by

$$U_1 = \ln X_1 + \ln v$$

And second period's utility function is given as

$$U_2 = \ln X_2$$

So the lifetime utility function for the household is

$$U = U_1 + U_2$$

Or, $U = \ln X_1 + \ln v + \ln X_2$

Budget constraints are same as before. First period's budget constraint is given by

$$P_{y1}(A_0 + A_1 L) + B = P_{x1}X_1 + P_v v + P_{q1}Q_1$$

And second period's budget constraint is

$$P_{y2}(A_0 + A_1 s(v)T) = P_{x2}X_2 + P_{q2}Q_2 + B(1+r)$$

So the problem is same as before.

Maximize $U = \ln X_1 + \ln v + \ln X_2$

Subject to $P_{y1}(A_0 + A_1 L) + B = P_{x1}X_1 + P_v v + P_{q1}Q_1$

$P_{y2}(A_0 + A_1 s(v) T) = P_{x2}X_2 + P_{q2}Q_2 + B(1+r)$

And $L + v = T$ (time constraint), where, $v \in [0,1]$

Hence the Lagrange is,

(16a) $\phi = \ln X_1 + \ln X_2 + \ln v + \lambda_1(P_{y1}(A_0 + A_1 L) + B - P_{x1}X_1 - P_v v - P_{q1}Q_1) +$

$\lambda_2\{P_{y2}(A_0 + A_1 s(v)T) - P_{x2}X_2 - P_{q2}Q_2 - B(1+r)\}$

Differentiating (16a) with respect to X_1, X_2, B, v, λ_1, λ_2 and equating each derivative equal to zero we will get the first order conditions. Following are the first order conditions.

(17a) $(1/X_1) + \lambda_1(-P_{x1}) = 0$

(18a) $(1/X_2) + \lambda_2(-P_{x2}) = 0$

(19a) $(1/v) + \lambda_1[-P_{y1}A_1 - P_v] + \lambda_2[P_{y2}. A_1.s'(v) T] = 0$

(20a) $\lambda_1 - \lambda_2(1+r) = 0$

(21a) $P_{y1}(A_0 + A_1 L) + B - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(22a) $P_{y2}\{A_0 + A_1 s(v)T\} - P_{x2}X_2 - P_{q2}Q_2 - B(1+r) = 0$

From equation (19a) and (20a) we can say that at equilibrium discounted present value of marginal return from education is equal to marginal cost of education. Here marginal return includes both pecuniary as well as non-pecuniary return from education. In this

case at the optimal, pecuniary returns from education is less than marginal cost of education, while with pure investment model they are equal. In this integrated model at the equilibrium possible pecuniary loss is just compensated by the parental satisfaction arising from educated child. Thus even if investment in education seems unprofitable they will continue to demand it.

From equation (17a), (18a) and (20a) we get

$P_{x2} X_2 = (1+r) P_{x1} X_1$

From equation (21a) and (22a) we can derive $P_{x2} X_2$, $P_{x1} X_1$. Putting this value in the above equation we get

$P_{y2} (A_0 + A_1 s (v) T\} - P_{q2}Q_2 - B (1+r) = (1+r)[P_{y1} (A_0 + A_1 L) + B - P_v v - P_{q1}Q_1]$

Solving this equation we can derive the value of 'B'.

(23a) $B=(1/2)[\{(P_{y2} (A_0+A_1 s (v)T) - P_{q2}Q_2) / (1+r)\} - \{ P_{y1}(A_0+A_1 L) - P_v v - P_{q1}Q_1\}]$

From equation (19a) and (20a) we get

(24a) $(1/v)= \lambda_1[(P_{y1}A_1 + P_v)-\{(P_{y2}. A_1.s'(v) T)/(1+r)\}]$

Now from (17a) we can write

$$(1/ P_{x1}X_1) = \lambda_1$$

Where, $P_{x1}X_1= 1/2[\{(P_{y2} (A_0 + A_1 s (v) T)- P_{q2}Q_2) /(1+r)\} + \{P_{y1} (A_0+A_1 L) - P_v v- P_{q1}Q_1\}]$

Putting this value in (24a) we get 'v' in terms of the exogenous variable of the model.

(25a) $v = [\{(P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2)/(1+r)\} + \{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}]$

$$/ [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}. A_1.s'(v)T) / (1+r)\}]$$

In this integrated model net cost of education is positive (as we get in case of non-farm household). As we have argued earlier,

$$(\partial u/\partial v)/(\partial u/\partial X_1) = [(P_{y1}A_1+P_v) - [\{P_{y2}. A_1.s'(v) T\}/(1+r)]] > 0$$

Hence, v is always positive.

Comparative static analysis:

- Price of agricultural product at the first period

$$\partial v/\partial P_{y1} = [\ [A_0 + A_1 T] \times [3P_v - \{2P_{y2}A_1 s'(v)T / (1+r)\}\ ] +$$

$$3A_1[\ P_{q1}Q_1 - \{(P_{y2}Y_2 - P_{q2}Q_2) / (1+r)\}]\ ] / \theta^2 = ?$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$

Increase in P_{y1} means increase in first period's income as well as increase in opportunity cost of education. Demand for education will increase due to income effect, and it will decrease because of substitution effect of rising opportunity cost. The net effect is ambiguous.

- Direct cost of education

$$\partial v/\partial P_v = (-)\ [\ \{P_{y1}Y_1 - P_{q1}Q_1\} + \{\ (P_{y2}Y_2 - P_{q2}Q_2) / (1+r)\}\ ] / \theta^2 < 0$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$

This shows that demand for education is inversely related to the price of education. For the non-farm household we get the same result.

- Marginal productivity of education in skill formation

$$\partial v/\partial s'(v) = [2P_{y2}A_1 T/ (1+r)] \times [\ \{P_{y1}Y_1 - P_{q1}Q_1\} + \{(P_{y2}Y_2 - P_{q2}Q_2)/(1+r)\}\ ] / \theta^2 > 0$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$.

Increase in productivity of education in skill formation, raises the demand for education. This is analogous to an increase in schooling earning profile ($\partial v/\partial w\ '(v)>0$) in case of non-farm households and has the same effect on demand for education.

- Increase in the parents' labour input

$$\partial v/\partial L_p = AK_0\{\ P_{y1} + P_{y2}\ (1+r)\}/\ \theta > 0.$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$.

The effect of increase in L_p can be signed unambiguously. Note that, with full employment of parents' labour time, a rise in L_p can only come about by increasing skills

and knowledge embodied in parents. This means that if there is improvement in parental education, which raises productivity of parents, it will encourage investment in education.

- Rate of interest

$$\partial v/\partial r = (-)[\ \{2P_{y2}A_1 s'(v)T\} \times \{P_{y1}Y_1 - P_{q1}Q_1\} + 3(P_{y1}A_1 + P_v) \times \{(P_{y2}Y_2 - P_{q2}Q_2) / (1+r)\}\ ] / \theta^2 < 0.$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$.

Increase in rate of interest decreases demand for education as borrowing becomes costly and hence less funds are available for investment in education. In case of non-farm household 'r' exerts the same influence on 'v' when capital market is perfect.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\ [\ \theta\ \{P_{y1}T + (\ P_{y2}s(v)T / (1+r))\ \}\ ] - [P_{y1}Y_1 - P_{q1}Q_1 + \{(P_{y2}Y_2 - P_{q2}Q_2) / (1+r)\}] \times [3P_{y1} - 2\{P_{y2}s'(v)T\ /(1+r)\}]\ ] / \theta^2 = ?$$

Where $\theta = [3(P_{y1}A_1 + P_v) - 2\{(P_{y2}.\ A_1.s'(v)T) / (1+r)\}]$.

Increase in A_1 increases family's first period's income on one hand, and on the other hand it also implies an increase in the opportunity cost of education. While the first one increases demand for education, the second one decreases it. The net effect is ambiguous.

3.3.6 Model 11: Educational Investment Decision of Farm Household in the Integrated Model of Investment and Consumption under Credit Rationing

In this case the assumptions are the same as before. We only relax the assumption of perfect capital market and consider the case of credit rationing. Households cannot borrow beyond the certain amount, B_2.

The problem is then

Maximize $U = \ln X_1 + \ln v + \ln X_2$

Subject to $P_{y1}(A_0 + A_1 L) + B_2 = P_{x1}X_1 + P_v v + P_{q1}Q_1$

$P_{y2}(A_0 + A_1 s(v)T) = P_{x2}X_2 + P_{q2}Q_2 + B_2(1+r)$

And $L + v = T$ (time constraint), where $v \in [0,1]$

Hence the Lagrange:

(26a) $\phi = \ln X_1 + \ln X_2 + \ln v + \lambda_1(P_{y1}(A_0 + A_1 L) + B_2 - P_{x1}X_1 - P_v v - P_{q1}Q_1) + \lambda_2 \{P_{y2}(A_0 + A_1 s(v)T) - P_{x2}X_2 - P_{q2}Q_2 - B_2(1+r)\}$...(11A)

Differentiating (26a) with respect to X_1, X_2, v, λ_1, λ_2 and equating each derivative equal to zero we will get the first order conditions. Following are the first order conditions.

(27a) $(1/X_1) + \lambda_1(-P_{x1}) = 0$

(28a) $(1/X_2) + \lambda_2(-P_{x2}) = 0$...(14A)

(29a) $(1/v) + \lambda_1[-P_{y1}A_1 - P_v] + \lambda_2[P_{y2}. A_1.s'(v) T] = 0$

(30a) $P_{y1}(A_0 + A_1 L) + B_2 - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(31a) $P_{y2}(A_0 + A_1 s(v) T\} - P_{x2}X_2 - P_{q2}Q_2 - B_2(1+r) = 0$

Now using equation (27a), (28a), (29a), (30a) and (31a) we can derive the value of 'v' in terms of the parameters.

(32a) $v = (-)[\{(P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r)\} / \{P_{y2}A_1 s'(v)\}] +$

$[\{P_{y1}(A_0 + A_1 T) + B_2 - P_{q1}Q_1\} / (P_{y1}A_1 + P_v)] + [[\{P_{y2}(A_0 + A_1 s(v) T) - P_{q2}Q_2 - B_2(1+r) / \{P_{y2}A_1 s'(v)\}]^2 + [\{P_{y1}(A_0 + A_1 T) + B_2 - P_{q1}Q_1\} / \{2(P_{y1}A_1 + P_v)\}]^2]^{1/2}$

or, $v = -\alpha + \beta + \delta^{1/2}$

where, $\alpha = [\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r)\} / \{P_{y2}A_1 s'(v)\}]$

$\beta = [\{P_{y1}(A_0 + A_1 T) + B_2 - P_{q1}Q_1\} / \{(P_{y1}A_1 + P_v)]$

and $\delta = \alpha^2 + \beta^2$

Here v is always positive because the solution is of the form:

$v = -y + x + (x^2 + y^2)^{1/2}$

Given that $(x - y)^2 = x^2 + y^2 - 2xy$

$(x - y) = (x^2 + y^2 - 2xy)^{1/2}$

$\therefore \quad (x - y) < (x^2 + y^2)^{1/2}$

Hence, $v > 0$

So, optimum 'v' is always positive. This result is similar to that in the case of non-farm household.

Comparative static analysis:

- Price of agricultural product in the first period

$\partial v/\partial P_{y1} = [\ \{P_v(A_0 + A_1T) + (P_{q1}Q_1 - B_2)A_1\}/(P_{y1}A_1 + P_v)^2\ ] \times$

$[1 + \{(P_{y1}(A_0 + A_1T) + B_2 - P_{q1}Q_1)/(P_{y1}A_1 + P_v)Z^{1/2}\}]$

where, $Z = [\{P_{y2}(A_0 + A_1 s(v)\, T) - P_{q2}Q_2 - B_2(1+r)/\{P_{y2}A_1 s'(v)\}]^2 + [\{P_{y1}(A_0 + A_1T) + B_2 - P_{q1}Q_1\}/\{2(P_{y1}A_1 + P_v)\}]^2$?

As in the case of non-farm households, the effect of an increase in the opportunity cost of education on the demand for education remains ambiguous.

- Direct cost of education

$\partial v/\partial P_v = (-)[\{P_{y1}(A_0 + A_1T) + B_2 - P_{q1}Q_1\}]/\{(P_{y1}A_1 + P_v)^2\}\ ] \times$

$[1 + \{(P_{y1}(A_0 + A_1T) + B_2 - P_{q1}Q_1)/(P_{y1}A_1 + P_v)Z^{1/2}\}]$

The demand for education is inversely related to the price of education. For the non-farm household we got the same result.

- Marginal productivity of education in skill formation

$\partial v/\partial s'(v) = [\{P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r)\}/\{P_{y2}A_1(s'(v))^2 T\}] \times$

$[1 - \{(P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r))/\{P_{y2}A_1 s'(v)TZ^{1/2}\}\ ] =$

?

The effect of increase in productivity of education in agricultural production on the demand for education is ambiguous when capital market is imperfect, while the relation is positive under perfect capital market.

- Rate of interest

$$\partial v/\partial r = [\, B_2 / P_{y2}A_1 s'(v)T \,] \times$$

$$[1-\{(P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r)) / P_{y2}A_1 s'(v)TZ^{1/2}\}] = ?$$

Unlike in the model of perfect capital market, the relationship between demand for education and rate of interest is ambiguous.

- Increase in the parents' labour input

$$\partial v/\partial L_p = A\, K_0 [\, \{P_{y1}A_1 s'(v)T - (P_{y1}A_1 + P_v)\} / (A_1 s'(v)T)(P_{y1}A_1 + P_v) \,] +$$

$$[\{(P_{y2}(A_0+A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r))/P_{y2}A_1 s'(v)T\} \times \{AK_0 / (A_1 s'(v)T)\} +$$

$$\{(P_{y1}(A_0 + A_1 T) + B_2 - P_{q1}Q_1) / (P_{y1}A_1 + P_v)\} \times \{ P_{y1}AK_0 / (P_{y1}A_1 + P_v)\}] \times Z^{-(1/2)} = ?$$

The sign depends on the term $\{P_{y1}A_1 s'(v)T - (P_{y1}A_1 + P_v)\}$. This is the difference between the value of marginal product of skilled labour and average/marginal cost (direct plus opportunity) of education. If the difference is positive, we have $\partial v/\partial L_p > 0$.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\, (P_{y2}A_0 - P_{q2}Q_2 - B_2(1+r)) / P_{y2}A_1^2 s'(v)T \,] -$$

$$P_{y1}[\, \{P_{y1}A_0 + B_2 - P_{q2}Q_2 - P_v T\} / (P_{y1}A_1 + P_v) \,] -$$

$$[\{ P_{y2}(A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r) \} / \{P_{y2}A_1 s'(v)T\} \times \{(P_{y2}A_0 - P_{q2}Q_2 -$$

$$B_2(1+r)) / P_{y2}A_1^2 s'(v)T\} + \{(P_{y1}(A_0 + A_1 T) + B_2 - P_{q1}Q_1) / (P_{y1}A_1 + P_v)\} \times$$

$$\{ P_{y1}(P_{y1}A_0 + B_2 - P_{q2}Q_2 - P_v T) / (P_{y1}A_1 + P_v)\} \,] \times Z^{-(1/2)} = ?$$

The relationship between demand for education and A_1 is ambiguous.

- Borrowing constraint / credit ceiling

$$\partial v/\partial B_2 = [\, (1 + r) / P_{y2}A_1 s'(v)T \,] \times$$

$$[1 - \{(P_{y2} (A_0 + A_1 s(v)T) - P_{q2}Q_2 - B_2(1+r)) / (P_{y2}A_1 s'(v)TZ^{1/2})\}] = ?$$

As in the case of non-farm households, the effect of raising the borrowing limit or credit ceiling on the demand for education is ambiguous. This is in contrast with the models of education as an investment good only where it has a clear positive impact on the demand for education.

3.3.7 Model 12: Educational Investment Decision in the Integrated Model of Education as Consumption and Investment in the Absence of Capital Market

This is the extreme case of credit rationing when $B_2 = 0$. Here the problem is same as in case of credit rationing.

Maximize $U = \ln X_1 + \ln v + \ln X_2$

Subject to $P_{y1}(A_0 + A_1 L) = P_{x1}X_1 + P_v v + P_{q1}Q_1$

$P_{y2} (A_0 + A_1 s (v) T) = P_{x2}X_2 + P_{q2}Q_2$

And $L + v = T$ (time constraint), where $v \in [0,1]$

Hence the Lagrange:

(33a) $\phi = \ln X_1 + \ln X_2 + \ln v + \lambda_1(P_{y1}(A_0 + A_1 L) - P_{x1}X_1 - P_v v - P_{q1}Q_1) +$

$\lambda_2 \{P_{y2} (A_0 + A_1 s(v)T) - P_{x2}X_2 - P_{q2}Q_2 \}$

Differentiating (34a) with respect to X_1, X_2, v, λ_1, λ_2 and equating each derivative equal to zero we will get the first order conditions. Following are the first order conditions.

(34a) $(1/ X_1) + \lambda_1(-P_{x1}) = 0$

(35a) $(1/ X_2) + \lambda_2(-P_{x2}) = 0$

(36a) $(1/v) + \lambda_1[-P_{y1}A_1 - P_v] + \lambda_2[P_{y2}. A_1.s'(v) T] = 0$

(37a) $P_{y1}(A_0 + A_1 L) - P_{x1}X_1 - P_v v - P_{q1}Q_1 = 0$

(38a) $P_{y2} (A_0 + A_1 s (v) T\} - P_{x2}X_2 - P_{q2}Q_2 = 0$

Now using equation (34a), (35a), (36a), (37a) and (38a) we can derive the value of optimum 'v' in terms of the parameters, following the same procedure as before.

(39a) $v = (-)[\ \{Py_2(A_0 + A_1 s(v)T) - P_{q2}Q_2\}/\ \{P_{y2}A_1 s'(v)\}\ ] +$

$$[\ \{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}\ /\ 2(P_{y1}A_1 + P_v)\ ] +$$

$$[\ [\ \{P_{y2}(A_0 + A_1 s(v)T)\ - P_{q2}Q_2\}\ /\ \{P_{y2}A_1 s'(v)\}\ ]^2 +$$

$$[\{\ P_{y1}\ (A_0 + A_1 T) - P_{q1}Q_1\ \}]\ /\ [2(P_{y1}A_1 + P_v)]^2\ ]^{1/2}$$

or, $v = -\alpha + \beta + \delta^{1/2}$

where, $\alpha = [\{\ P_{y2}\ (A_0 + A_1 s(v)T) - P_{q2}Q_2\ \}\ /\ \{P_{y2}A_1 s'(v)\}]$

$\beta = [\{P_{y1}\ (A_0 + A_1 T)\ - P_{q1}Q_1\}]\ /\ \{2(P_{y1}A_1 + P_v)\}\ ]$

and $\delta = \alpha^2 + \beta^2$

Optimum 'v' will always be positive as in the case of credit rationing. The comparative static results are also similar to those in the case of credit rationing.

Comparative static analysis:

- Price of agricultural product in the first period

$\partial v/\partial P_{y1} = [\ \{P_v(A_0 + A_1 T) + P_{q1}Q_1 A_1\}/\ (P_{y1}A_1 + P_v)^2\ ]\times$

$$[1 + \{(\ P_{y1}\ (A_0 + A_1 T) + P_{q1}Q_1)\ /\ (P_{y1}A_1 + P_v)Z^{1/2}\ \}] > 0$$

where, $Z = [\{P_{y2}\ (A_0 + A_1 s\ (v)\ T) - P_{q2}Q_2\ /\ \{P_{y2}A_1 s'(v)\}]^2 +$

$$[\{P_{y1}(A_0 + A_1 T) - P_{q1}Q_1\}/\{2(P_{y1}A_1 + P_v)\}]^2$$

It is evident from the above that in the absence of credit market, an increase in the price of agricultural product (which determines a component of the opportunity cost of education) raises the demand for education. Here the positive income effect dominates over the negative price effect of rising opportunity cost.

- Direct cost of education

$\partial v/\partial P_v = (-)[\{P_{y1}\ (A_0 + A_1 T)\ - P_{q1}Q_1\}]\ /\ \{(P_{y1}A_1 + P_v)^2\}\ ]\times$

$$[1 + \{\ (\ P_{y1}\ (A_0 + A_1 T) - P_{q1}Q_1)\ /\ (P_{y1}A_1 + P_v)Z^{1/2}\ \}]\ < 0$$

There is an inverse relationship between the demand for education and the price of education.

- Change in agricultural productivity due to change in technology, land size etc.

$$\partial v/\partial A_1 = [\,(P_{y2}A_0 - P_{q2}Q_2)/P_{y2}A_1^{\,2}s'(v)T\,] -$$

$$P_{y1}[\,\{P_{y1}A_0 - P_{q2}Q_2 - P_vT\}/(P_{y1}A_1 + P_v)\,] -$$

$$[\{P_{y2}(A_0 + A_1s(v)T) - P_{q2}Q_2\} / \{P_{y2}A_1s'(v)T\} \times \{(P_{y2}A_0 - P_{q2}Q_2)\} /$$

$$P_{y2}A_1^{\,2}s'(v)T\} + \{(P_{y1}(A_0 + A_1T) - P_{q1}Q_1)/(P_{y1}A_1 + P_v)\} \times$$

$$\{P_{y1}(P_{y1}A_0 - P_{q2}Q_2 - P_vT)/(P_{y1}A_1 + P_v)\}\,] \times Z^{-(1/2)} = ?$$

Increase in A_1 increases family's first period's income on one hand, and on the other hand it also implies an increase in the opportunity cost of education. While the former increases the demand for education, the latter tends to reduce it. The net effect is ambiguous.

- Increase in the parents' labour input

$$\partial v/\partial L_p = A\,K_0\,[\,\{P_{y1}A_1s'(v)T - (P_{y1}A_1 + P_v)\}/(A_1s'(v)T)(P_{y1}A_1 + P_v)\,] +$$

$$[\,\{(P_{y2}(A_0 + A_1s(v)T) - P_{q2}Q_2)/(P_{y2}A_1s'(v)T)\} \times \{AK_0/(A_1s'(v)T)\} +$$

$$\{(P_{y1}(A_0 + A_1T) - P_{q1}Q_1)/(P_{y1}A_1 + P_v)\} \times \{P_{y1}AK_0/(P_{y1}A_1 + P_v)\}\,] \times Z^{-(1/2)}$$

$$= ?$$

Even if there is an increase in parental labour input (may be through greater embodiment of education and skills), it does not always ensure that the demand for education will increase in the absence of a credit market.

- Marginal productivity of education in skill formation

$$\partial v/\partial s'(v) = [\{P_{y2}(A_0 + A_1s(v)T) - P_{q2}Q_2\} / \{P_{y2}A_1(s'(v))^2T\}] \times$$

$$[\,1 - \{(P_{y2}(A_0 + A_1s(v)T) - P_{q2}Q_2)/\{P_{y2}A_1s'(v)TZ^{1/2}\}\,] = ?.$$

Increase in the marginal productivity of skill formation raises the demand for education among farm households.

We can summarize the main results in Table 4.

3.3.8 Summary of the Results of the Integrated Model of Farm Household:

Table 4: Effects of Exogenous Variables on Time Devoted to Education by the Type of Credit

	Perfect capital market	Credit constraint	No credit
$\partial V/\partial P_{y1}$	?	?	+
$\partial V/\partial P_v$	-	-	-
$\partial V/\partial A_1$	?	?	?
$\partial V/\partial L_p$	+	?	?
$\partial V/\partial r$	-	?	*
$\partial V/\partial B_2$	*	?	*
$\partial V/\partial s'(v)$	+	?	?

3.4 SYNTHESIS AND CONCLUSION

In a nutshell, to investigate the educational investment decisions of non-farm and farm households, a two period overlapping generation model is formulated for each. We have identified different set of factors influencing the educational investment decision of the two sets of households - farm and non-farm.

For the non-farm households, the major determinants of schooling investment decision are:

- Direct cost of education (P_v)
- Opportunity cost of education (w_1)
- Parents' income (Y_p)
- Initial wealth of family (g)
- Future rate of return from education ($W_2'(v)$)
- Rate of interest (r)
- Amount of Credit ceiling (B_2)

In the case of farm households we have considered the role of education in agricultural production explicitly. Education is embodied in the skill and knowledge of

individual members of the labour force. The value of marginal product of children represents the opportunity cost. In this case the determinants of schooling enrolment decision are:

- Current price of agricultural product (P_{y1})
- Land size, technology of production etc (A_1)
- Direct cost of education (P_v)
- Parental labour input (L_p)
- Productivity of education in skill formation (s'(v))
- Rate of interest (r)
- Amount of credit ceiling (B_2)

As we see, the determinants are, by and large, quite similar for both types of households. Of course, the form of the factors like opportunity cost of education and returns to education differ. For the farm households, the marginal productivity of unskilled labour constitutes the opportunity cost, whereas for non-farm households it is represented by the unskilled wage rate. Similarly, future wages as an increasing function of education reflects the return to education for non-farm households, while for farm households generation of skills acting as an input into the agricultural production function determines the returns to education.

As mentioned earlier, there are two approaches to the theory of educational demand: pure investment theory and pure consumption theory. In this chapter we have analysed the demand for education among farm and non-farm households considering pure investment model and integrated investment-consumption model. We find that in case of a pure investment model, optimal time devoted to education is determined by equating the marginal cost of education (direct plus opportunity cost) with the future

marginal discounted earnings. In the integrated model, however, 'pecuniary' and 'non pecuniary' benefits of schooling jointly determine the optimal demand of education.

The aforesaid modelling exercises have been done under the assumption of three different types of capital (credit) market: perfect credit market, credit rationing and absence of capital market. Our comparative static results are summarised in the table 1,2,3 and 4. Table 1 and 3 contain comparative static results for the non-farm and farm households respectively when people take decision of enrolment in school on the basis of investment motive, while Table 2 and 4 contain those results when they consider education as an investment well as consumption good.

Our results show that the effects of the exogenous variables on the demand for education are by and large similar for both types of households but they vary according to the nature of the capital market.

In case of perfect capital market, for non-farm households the optimum time devoted to education, based on the pure investment model as well the integrated consumption-investment model, is a positive function of parents' income, initial wealth of the family and a negative function of the direct cost of education. opportunity cost of education, rate of interest. The effect of share of income transferred to the older generation is ambiguous. The results are more or less similar for farm households, with the exception of the effect of the opportunity cost, which remains ambiguous. We also observe that for both sets of households, the steepness of future earning function with respect to education (productivity of education in case of skill formation for the farm households) has a similar effect on the demand for education, which varies with the form of the model. In case of pure investment model, it has no impact on the demand for education, while the effect becomes positive when the households take their education investment decision on the basis of both investment as well as consumption motives.

In case of credit rationing, some of the variables behave in a similar way as in the case of the perfect credit market, independent of the form of the models. For the non-farm households the effect of the parents' income, family's initial wealth, direct cost of education and opportunity cost of education are the same as it was in the previous case of perfect capital market. In the pure investment model, the demand for education is a positive function of interest rate, credit ceiling and the rate of return from education and a negative function of the share of income transferred to older generation. But all these effects are, however, ambiguous in the integrated model. Most of the above results also hold for the farm households under credit ceiling. Only the effect of opportunity cost and parental labour input on their demand for education remain ambiguous.

The absence of credit market is only an extension of the case of credit rationing and all comparative static results of the credit rationing models remain valid for the non-farm households. Even for farm households all the results hold with the exception of current price of agricultural goods, which now positively affect the demand for education irrespective of the type of models.

Comparison of all the three types of credit market gives us an interesting result: an increase in credit ceiling raises demand for education among all types of households, when they consider it as an investment (though the effect is ambiguous in case of integrated model)

In conclusion, there are very few differences in the educational investment behaviour of farm and non-farm households. The behaviour differs only in case of opportunity cost of education, the effect of which is negative for the non-farm household and ambiguous for the farm households (though the effect of a rise in price of agricultural product in the first period, which is a component of the opportunity cost of education, is positive in the absence of credit market and that is true for both types of models).

Chapter 4

ECONOMETRIC ANALYSIS

4.1 INTRODUCTION:

Based on the theoretical results obtained in our comparative static analysis of chapter 3, we now develop and estimate econometric models of educational investment decisions of rural households (both farm and non-farm). From the theoretical analysis we recognise that parents themselves make the schooling decisions for their children, including when to enrol, how often to attend school, which school to go and when to terminate. The econometric analysis, presented in this chapter seeks to identify not only the determinants of educational investment decision of rural households, but also how do these household economic variables affect schooling decision.

The models are estimated on the basis of a primary data set generated from 80 households spanning over six villages in West Bengal.

The organisation of this chapter is as follows. The next section 4.2 describes the testable hypothesis. Section 4.3 presents the econometric framework for our empirical analysis. Section 4.4 reports and analyses the econometric results, while the final section 4.5 summarise and concludes.

4.2 TESTABLE HYPOTHESIS

Following Becker (1964), we categories the determinants of educational investment decision into two broad groups: supply side determinants, which influence the individual's supply of investible resources (e.g. family income, availability of credit etc) and demand side determinants, which, shape the individual's demand for investment in

education (e.g., direct cost of education, opportunity cost of education, risk and uncertainty, parent's level of education and child's ability).

The theoretical models developed in chapter 3 identify the determinants of schooling decision for both farm and non-farm households under different forms of credit market. The results show that the basic investment behaviour is by and large similar for both sets of households, although there are one or two specific determinants for each group. Moreover, the results also vary according to the type of credit market assumed and whether education is regarded as a pure investment good or as both investment and consumption. Based on these theoretical results, in this chapter we propose to test the following hypothesis using tools of applied econometrics.

- Households' educational investment decision is a function of various dimensions of family background, including parent's education, income, occupation, mother's workforce participation and family structure. It also depends on direct and opportunity cost of education.
- Availability of credit does play a role in determining the level of investment.
- Farm and non-farm households' do not differ in their investment behaviour.
- Moreover child specific factors like the gender of the child, his/ her native ability and the number of years of schooling completed by the child also act as major determinants of the demand for education by affecting both the marginal utility and marginal returns from schooling.

4.3 THE ECONOMETRIC SPECIFICATION

There are a number of empirical studies on individuals' educational investment decision. These studies have followed three different approaches as well as techniques. One set of studies used time series data on aggregate enrolments and estimates equations

explaining institutional, statewide or national enrolments as a function of characteristics of the population of potential enrolees and of the set of existing schools. Examples are Campbell and Siegel (1967), Galper and Dunn (1969), M.R.Rosenzweig (1977), Lehr and Newton (1978), Hoenack and Weiler (1979), Duchesne and Nonneman (1998) etc. The second approach used the theory of human capital to model the educational investment decision in terms of the expected net present value of the educational investment (George Catsiapis, 1986). The third approach used cross sectional data on educational choice to estimate models of demand for education, assuming that the enrolment decision of an individual student reflects his revealed preference among the available schooling and work alternatives. Examples of such studies are Kodde and Ritzen (1985,1986), Gertler and Glewwe (1990), Glewwe and Jacoby (1994), Fuller, Manski and Wise (1982), Ermisch and Francescon (2001) etc.

The present study is based on the third approach. Before proceeding further, let us specify the econometric model to be estimated.

$$Y = \beta X + u$$

where, Y: $n \times 1$ vector of dependent variables that measures the demand for education.

X: $n \times k$ vector of explanatory variables.

β: $k \times 1$ vector of coefficients of explanatory variables.

u: $n \times 1$ vector of random error term

n: no of observations

k: no of explanatory variables.

4.3.1 Description of Data

In order to test the theoretical results of our model, we generate a small data set of 80 households from six villages in West Bengal.The data set includes detailed information on educational background of all children, expenditure on education, time devoted to education for students, reasons of dropout from schools, details of family background including family's total income, parent's education, occupation, family size, number of children in the family, total land holding, sources of available credit, purpose of taking those credit as well as interest rates. We use 'purposive sampling' method under, which we use direct personal observation method in order to collect the requisite information. Sample is selected on the basis of individual judgement. No special technique is used for selecting this purposive sample; we pick out a typical or representative sample according to our own judgement depending on the personal factor. Chance has no role to play. This type of sampling is useful when the sample is small and moreover, the advantage of this purposive sampling is that it does not vary widely from the average.

We have also gathered community level information on local schools. Our survey reveals that all villages have their own primary, secondary as well as higher secondary schools. Colleges are also not very far from these villages. Moreover, all of these schools/ colleges are publicly funded and hence charge negligible fees. Effectively, there are no supply constraints on education.

Our original sample includes 196 dependent children. But in order to estimate demand for education among children we do not include children below 10 years as they are too young to enter the labour market and their opportunity cost of education tends to zero. Indeed, we find that most children under 10 attend school in our data set. In fact, there is near universal primary schooling. We also have very few (one or two) cases of

college education, but that appears to be more an exception than a rule. So we intend to estimate the demand for education from information on children in the age group of 10 years to 20 years (the likely age at which he should complete his higher secondary school). Only 138 students meet this criterion, among whom 96 children are continuing and 42 are non-continuing student. Nearly half of the children are female. We present a brief profile of this reduced sample in terms of parents' education, income and occupation.

***Parents Education*:**

In our data set, the highest educated father is a graduate, while the highest level reached by the mothers is higher secondary. Distribution of father's and mother education level is given below in table 4.1. It shows that none of them are highly educated.),

Table 4.1: Distribution of father and mother's education level.

	Father's education level		Mother's education level	
Education level	Frequency	Percentage (approx)	Frequency	Percentage (approx)
Illiterate	24	17.4	62	45
Up to primary level	40	29	18	13
Middle school (class 5 to 7)	28	20.2	18	13
Secondary level (class 8 to madhyamik level)	35	25.4	38	27.5
Above madhyamik level	11	8	2	1.5
Total	138	100	138	100

***Parents Income*:**

Data shows that the monthly average income of the household's is only Rs. 2699 and approximately 66% households earn below that average level. Households in our sample are by and large poor.

Parent's Occupation:

Parents have been classified into six occupational categories: farmer, weaver/ artisans etc., daily wage labourer, government servant, businessman and factory workers.

Data shows that average income of farm households are above the overall average income level, while that of weaver/artisans and daily wage labour are below the overall average monthly income.

We find that for almost 32% of children both parents work. Mother's occupation can influence demand for education in several ways. It can increase family's income and hence, can increase demand for education. As a result school enrolment rate can rise or children can devote more time to education. On the other hand, it can also depress educational demand especially for female children. It can be argued that if mother works outside, children (mostly female child) have to stay at home to look after the household chores. It is evident from table 4.2 that in rural areas female members work outside only if the family income is too low to survive.

Table 4.2: Income distribution of the family where both the parents work outside.

	No of households	
Income	Frequency	Percentage (approx)
Lowest income quartile	37	86
Middle income quartile	6	14
Upper income quartile	0	0
Total	43	100

We have classified mother's occupation into four groups: farmer, weaver/ artisans etc, daily wage earner (bidi making, agricultural labourer etc.) and service (working in local health centre, anganwari program etc).

Credit:

Our survey contains in-depth data on credit, including source of credit, purpose of taking loan and interest rate. Co-existence of formal and informal credit and predominance of the later is one of the basic characteristics of developing countries. India is not an exception. There are two sources of credit: formal source and informal source. Besides that there are almost 29% of households who could not avail any type of credit.

Rural households, especially those who belong to lower income quartile, often need credit to meet their cost of living and to educate their children. Due to lack of assets that can act as collateral, they are denied access to formal sources of credit which include Banks, Panchayats, Gramin Bank and Co-operatives etc. Most of them rely on informal sources like local moneylenders, relatives and friends.

Table 4.3: Frequency and average income of households: by type of available credit

		No of households	
Type of credit	Average monthly income (Rs.)	Frequency	Percentage
Formal credit	3521	66	48
Informal credit	2168	32	23
No credit	1788	40	29
Total	-	138	100

Data shows that formal credits are available only to those people who belong to the relatively higher income group.

Cost of Education:

The cost of education can be divided into two components: direct cost of education and opportunity cost of education. Direct cost of education is that part of the cost, which is incurred by the parents for, fees, books, private tuition etc. In West Bengal education is almost free from primary stage to higher secondary level as government runs most of the schools. Households do not have to pay tuition fees. What they have to pay is admission fees, examination fees etc. But private tuition charges constitute a major component of direct costs. Almost all students take help of private coaching for better performance in the examination and it has been included at the time of calculation of direct cost of education.

On the other hand, opportunity cost refers to the income that is foregone in attending schools. The opportunity cost can be calculated from education-earning profile. But in a country like India with high unemployment especially among the educated, it is

unrealistic to assume that all job seekers will succeed in getting jobs. So, the correct procedure is to make proper adjustment for unemployment rate at the time of calculating the opportunity cost for different levels of education as in Duchesne and Nonneman (1998). Unfortunately this cannot be done with our data set.

4.3.2 The Variables

Dependent Variable

***Demand for education*:** Households invest in education both in terms of money and child's time. They will invest in education if and only if that type of investment is profitable (either in monetary terms or in non-monetary terms). So, household's investment in education basically reflects their demand for education. Three types of dependent variables are considered in order to measure the demand for education.

First, demand for education can simply be measured in terms of whether or not a child goes to school. We construct a binary dummy variable (**CON**) such that

CON = 1 if the student is still in school, and 0 otherwise.

Implicit in the construction of this variable is the assumption that demand for education is reflected in parents sending their child to school.

Second, and a more commonly used measure of the demand for education is the level of educational attainment (**ELEVEL**). However, we cannot use this measure for continuing as well as non-continuing students together. For the former, existing ELEVEL does not reflect the individual's true demand for education since he or she is going to reach higher levels. For non-continuing students however, ELEVEL reflects the level of educational demand more accurately. Accordingly, we use this measure only for non-continuing children.

Finally, we use a third measure of educational demand for continuing students only. We calculate the child's time spent on education, **edu-time**, as a proxy for the household's educational demand. For the poor households, the child's time can prove to be a very important source of household income. In countries like India, the direct cost of education being negligible, it is the time cost of the child, which determines the educational investment decisions. Not all school going children will be able to devote the same time to education. Our presumption is that the time devoted to education will be a direct reflection of the household's demand for education. In order to estimate the time devoted to education we have considered time spent in school, time spent in private coaching as well as the time they study on their own.

Explanatory variables:

Gender (sex): Gender plays an important role in determining the demand for education since parents may discriminate against the girl child. Usually, it has been seen that parents have higher preference for male child and they tend to invest more on them. In rural areas girls are usually less educated due to reasons like marriage, lack of safety, absence of local girl's school and most importantly lack of parent's priority towards educating the girl child. We have used a dummy for gender (sex), where

sex = 1 if the student is male, and
= 0 otherwise.

Direct cost of education (dcost): To calculate direct cost of education we use household's expenditure on school fees, cost of textbooks and private tuition. Data shows that expenditure on school fees is negligible and expenditure on private tuition constitutes the major component.

Class completed by the child (classcom): This variable is measured by the number of years of schooling completed by child.

Family income (inc): This variable represents family income and is measured by adding the income of all household members from all sources. Income is the most important household economic variable, especially for those households that cannot borrow. There is always a problem of misreporting of income in any household survey, particularly among the non-salaried class. We have taken every care to ensure that the income figures are correctly reported by cross checking it with the amount of land holding reported by them as well as other sources of income, if any.

Father's level of education, Mother's level of education (eduf, edum): The variables 'eduf' and 'edum', representing parent's education level, are constructed as a discrete sequential variable, taking values, 0, 1, 2, 3, 4 for illiterate, when level achieved is primary (till class 4), middle school (class 5 to 7), secondary school (class 8 to 10) and post secondary school, respectively.

Number of school age children in the family (childno): This is measured as the total number of school age children in the family.

Father's occupation (occuf): In our survey, we record father's occupation in terms of six categories. For each occupational category, we construct a dummy variable as

occupf1 = 1 if father is a farmer, and
= 0 otherwise.

occupf2 = 1 if daily wage labourer,
= 0 otherwise.

occupf3 =1 if father is weaver/ artisans etc.
= 0 otherwise.

occupf4 = 1 if government servant,
= 0 otherwise.

occupf5 = 1 if father is businessman
= 0 otherwise, and

occupf6 = 1 if factory workers
= 0 otherwise.

Note that we cannot use all six dummies in a single regression model due to problem of dummy variable trap.

Mother's labour force participation (occupp): We introduce a dummy variable "occupp', such that

occupp = 1 if both the parents are working outside, and
= 0 otherwise.

Family's land holding amount (landsize): This is measured as the total amount of landholding belonging to the household.

Credit available to the household (creditfor, creditinfor, nocredit): With regard to credit, we classify households into three categories according to their access to credit from different sources. We construct a dummy variable for each category as follows:

creditfor = 1 if credit is available from the formal source, and
= 0 otherwise.

creditinfor = 1 if credit is available from the informal sources
= 0 otherwise.

nocredit = 1 if credit is not available to the household,
= 0 otherwise.

4.3.3. Econometric Methodology:

The objective of our econometric analysis is to estimate the determinants of the educational investment decision of rural household. We estimate three models.

Model 4.A: Probability of children attending school

$CON = \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 dcost + \beta_4 classcom + \beta_5 inc + \beta_6 occupp + \beta_7 occupf + \beta_8 credit + \beta_9 eduf + \beta_{10} edum + u_i$, where, u_i is the random variable.

Model 4.B: Estimation of the demand for education function for children who are no longer in school.

ELEVEL $= \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 classcom + \beta_4 inc + \beta_5 occupp + \beta_6 occupf + \beta_7 credit + \beta_8 eduf + \beta_9 edum + u_i$

Model 4.C: Estimation of the determinants of time allocation decision of continuing students, reflecting their demand for education.

edu-time $= \beta_0 + \beta_1 sex + \beta_2$ classcom $+ \beta_3 dcost + \beta_4$ childno $+ \beta_5$ eduf $+ \beta_6$ edum $+ \beta_7 occupf2 + \beta_8 occupf3 + \beta_9$ occupf4 $+ \beta_{10}$ occupf5 $+ \beta_{11} occupf6 + \beta_{12} occupprt + \beta_{13} creditfor + \beta_{14} inc + u_i$

MODEL 4.A:

In this model we have made an attempt to estimate the factors, which determine the probability of sending a child to school. The dependent variable, 'CON', is a dummy variable, which takes the value '1' if the student is still in school and '0' otherwise. So, we cannot use OLS method as it gives *inefficient* estimates of β. In order to avoid this problem we apply the *logit model*

A Note on *Logit Model*

We posit the following regression model to estimate the demand for education:
$Y^* = \beta' X_i + u_i$,
where, Y^* is an unobservable (latent) variable reflecting the educational demand.
β: vector of coefficients
X_i: vector of explanatory variables.
u_i: vector of random variables.

Since Y^* is unobservable, we construct a dummy CON such that
$CON_i = 1$ if the student is in school
$= 0$ otherwise.
$CON_i = 1$ implies that there is a demand for education among parents.

$P(CON_i = 1) = P(Y^* > 0)$
$= P(ui > -\beta' X_i)$
$= 1 - F(-\beta' X_i)$

The likelihood function is,
$L = \Pi_{y=0} F(-\beta' X_i) \Pi_{y=1} \{1 - F(-\beta' X_i)\}$
The functional form of 'F' depends on the cumulative distribution of u_i. Here we are assuming that u_i follows *'logistic distribution'*.
Hence, $F(-\beta' X_i) = \exp(-\beta' X_i) / [1 + \exp(-\beta' X_i)]$
$= 1 / [1 + \exp(\beta' Xi)]$
And $\{1 - F(-\beta' X_i)\} = \exp(\beta' X_i) / [1 + \exp(\beta' X_i)]$
Denoting CON=Y, we can write the *likelihood function* in the following way:
$L = \Pi_{i=1,n} [1 / \{1 + \exp(\beta' Xi)\}]^{1-Y_i} [\exp(\beta' X_i) / \{1 + \exp(\beta' X_i)\}]^{Yi}$
$= [\exp(\beta') \Sigma i_{=1...n} X_i Y_i] / \Pi_{i=1,n} [1 + \exp(\beta' Xi)]$

Now we want to find the *log likelihood estimate of 'β'*.

$\text{Log } L = \beta' \Sigma_{i=1...n} X_i Y_i - \Sigma i_{=1...n} \log [1+ \exp (\beta' Xi)]$

$\partial (\log L)/\partial\beta = 0$ gives

$S(\beta) = - \Sigma_{i=1...n} [\exp (\beta' X_i) / \{1+ \exp (\beta' X_i)\}] * X_i + \Sigma_{i=1...n} X_i Y_i = 0$

These equations are non-linear in β. We can solve this system of equations using *'Newton Raphson method'* or *'Scoring method'*. Usually, the standard procedure is to calculate estimates from a linear probability model and to use these as an initial guess. As each guess gets better and better, the value of *log-likelihood function* rises at each step until no improvement is possible and the solution is found.

In case of *'scoring method'* the *information matrix* is

$I(\beta) = E(\partial^2 \log L/\partial\beta\partial\beta')$

Information matrix is a *square, symmetric* matrix of the negative of the second order derivatives of the log-likelihood function.

Staring with some initial values of β, say β_0, we compute the values $S(\beta_0)$ and $I(\beta_0)$. By the method of scoring, the *logit estimates* are found in steps

$\beta_{f+1} = \beta_f + [I(\beta_f)]^{-1} S(\beta_f)$

Where the subscripts refer to the iteration toward finding a solution. This iterative procedure is repeated until convergence. Where the difference between β_{f+1} and β_f is close to zero, the process stops.

In the present case $I(\beta)$ is positive definite at each stage of iteration. Hence, the *iterative procedure* will converge to a maximum of the likelihood function, no matter what the starting value is. The change in the value of the coefficients from the successive iteration will be close to zero, when the score $S(\beta_f)$ is close to zero. If the final converged estimates are denoted by $\tilde{\beta}$, then the asymptotic covariance matrix is estimated by $[I(\tilde{\beta})]^{-1}$.

The regression relationship can be defined as

$$\mathbf{CON = \beta_0 + \beta_1 sex + \beta_2 age + \beta_3 dcost + \beta_4 classcom + \beta_5 inc + \beta_6 occupp + \beta_7 occupf + \beta_8 credit + \beta_9 eduf + \beta_{10} edum + u_i}$$

But before proceeding further we must perform the standard diagnostic tests to check for the presence of *Autocorrelation, Heteroscedasticity and Multicollinearity*. We shall get the best result if the error term is indeed homoscedastic, serially uncorrelated and if there is no correlation between the explanatory variables. In the cross section model the problem of serial correlation does not arise.

Presence of *multicollinearity* can be detected by looking at the *Pair Wise Correlation Coefficient* (Using *Pearson's Product Correlation Coefficient*) of the explanatory variables, separately for each pair of x variables. Test statistics is given by,

$t = [\tilde{\rho} (n-2)^{1/2}] / [1 - \tilde{\rho}^2]^{1/2}$. Under the null hypothesis i.e.H_0: $r = 0$ against H_1: $r \neq 0$, the above test statistics is asymptotically distributed as 't' with (n-2) degrees of freedom. The test for *multicollinearity* reveals that there is correlation between the explanatory variables (all the value lies above 0.45), for the following cases: *'creditfor'-'landsize'*,

'creditfor'-'creditinfor', *'creditfor'-'nocredit'*, *'creditinfor'-'nocredit'*, *'inc'-'dcos't*, *'creditfor'-' dcost'*, and *'occupf'-'landsize'*. Here, for the sake of simplicity and to avoid the 'multicollinearity' problem we shall drop the variable 'landsize' and shall use the other three variables separately.

Empirically we estimate

Model 4.A.1: CON = $\beta_0 + \beta_1$sex + $\beta_2$age + $\beta_3$dcost + $\beta_4$classcom + $\beta_5$inc + $\beta_6$occupp + $\beta_7$occupf + $\beta_8$creditfor + $\beta_9$eduf + β_{10}edum + u_i

Model 4.A.2: CON = $\beta_0 + \beta_1$sex + $\beta_2$age + $\beta_3$dcost + $\beta_4$classcom + $\beta_5$inc + $\beta_6$occupp + $\beta_7$occupf + $\beta_8$creditinfor + $\beta_9$eduf + β_{10}edum + u_i

Model 4.A.3: CON = $\beta_0 + \beta_1$sex + $\beta_2$age + $\beta_3$dcost + $\beta_4$classcom + $\beta_5$inc + $\beta_6$occupp + $\beta_7$occupf + β_8 nocredit + $\beta_9$eduf + β_{10}edum + u_i

To test for the presence of *heteroscedasticity* we use the *Cook Weisberg Test* (1983). This test statistics is defined by, $V(u) = \sigma^2 e^{xt} \sim \chi^2_{(n-1)}$, Where, x is the vector of independent variables. Under the null hypothesis of *homoscedasticity*, i.e. H_0: t = 0, against the alternative hypothesis H_1: $t \neq 0$, the test statistics is asymptotically distributed as chi-squared with degrees of freedom equal to the number of variables in x_i.

The *Cook-Weisberg test* shows that in our models, the residuals are *heteroscedastic*. This implies that the estimated regression coefficients ($\tilde{\beta}$) will no longer remain *'best'* or *"efficient"* and *"consistent"* although they are *"unbiased"* (Maddala and Nelson, 1975). White (1980) has proposed a method to estimate the variance of β, where the form of the *heteroscedasticity* is unknown. This is known as *'robust estimation'* (for note on robust estimation see appendix, A.1). We adopt this *'robust maximum likelihood estimation'* procedure for estimating our models.

We have used the software 'STATA' to solve the aforesaid problem. The STATA output for the *'logit'* estimates includes the value of the log-likelihood function as the program iterated to a solution. We can see that the value of the *'log likelihood'* increased with each guess. The test statistics distributed as χ^2 is analogous to the usual F-test. It is a

test against the null hypothesis that the slope coefficients are all equal to zero. And the t-value shows the test against the null hypothesis that the coefficient of the corresponding variable is equal to zero. In order to judge the *goodness of fit*, which is a summary statistic indicating the accuracy with which a model approximates the observed data, we use *psedu-R^2* measure derived from *likelihood ratio test.*

MODEL 4.B:

This model estimates the demand for education for those who are out of school. Student's educational attainment is taken as the proxy for the educational demand and is computed by the highest completed academic qualification of the children. This is a case of discrete choice model, where the dependent variable is the discrete sequential variable and hence we cannot use *ordinary least square* method in this case. The appropriate methodology in this case would be to apply the *ordered logit model.*

A Note on the Ordered Logit Model

$Y_i^* = \beta' X_i + u_i$

Where, Y_i^* measures *'the demand for education'* and ELEVEL acts as a proxy variable for the educational demand.

β: vector of coefficients

X_i: vector of explanatory variables

u_i: vector of random variables.

Let us assume that there are 'm' categories. 'Y^*' is unobservable, but we know in which of the 'm' categories it belongs to. It belongs to the 'j^{th}' category if $\alpha_j < Y^* < \alpha_{j-1}$

Where $\alpha_1 < \alpha_2 < \alpha_3 < \ldots < \alpha_m$ are set of constants.

Now let us define a ordinal variable 'Z_{ij}' such that

$Z_{ij} = 1$ Y_i falls in the j^{th} category, and

$= 0$ otherwise.

$\text{Prob}(Z_{ij} = 1) = F(\alpha_j - \beta' X_i) - F(\alpha_{j-1} - \beta' X_i)$

The functional form of 'F' depends on the assumption of the cumulative frequency distribution of u_i. Here we are assuming that u_i follows *logistic distribution* and hence we apply *logit technique.*

Hence, $F(\alpha_j - \beta' X_i) = \exp(\alpha_j - \beta' X_i) / [1 + \exp(\alpha j - \beta' X_i)]$

and, $F(\alpha_{j-1} - \beta' X_i) = \exp(\alpha_{j-1} - \beta' X_i) / [1 + \exp(\alpha_{j-1} - \beta' X_i)]$

The *likelihood function* for the model is

$$L = \Pi_{i=1\ldots n} \Pi_{j=1\ldots m} [F(\alpha_j - \beta' X_i) - F(\alpha_{j-1} - \beta' X_i)]^{Zij},$$

And the *log-likelihood function* is

$$L^* = \log L = \Sigma_{i=1\ldots n} \Sigma_{j=1\ldots m} Z_{ij} \log [F(\alpha_j - \beta' X_i) - F(\alpha_{j-1} - \beta' X_i)] \ldots (c)$$

In order to estimate the *maximum likelihood estimator* of 'β', we differentiate (c) with respect to 'β' and equating each derivative equal to zero we get a system of non-linear equations. Using *Newton Raphson method* or the *scoring method* we can solve these equations as described earlier in model 1.

Our model is

ELEVEL = β_0 + $\beta_1$sex + $\beta_2$age + $\beta_3$classcom + $\beta_4$inc + $\beta_5$occupp + $\beta_6$occupf + $\beta_7$credit + $\beta_8$eduf + $\beta_9$edum + u_i

The test for *multicollinearity* reveals that there is no severe correlation between the explanatory variables (all the value lies below 0.45), except for the case of 'creditfor'-'landsize','creditfor'-'creditinfor','creditfor'-'nocredit'and 'creditinfor'-'nocredit'. In order to avoid the *multicollinearity* problem we use the variables 'creditfor', 'creditinfor' and 'nocredit' separately as before.

We made an attempt to estimate the following relationships:

Model 4.B.1: ELEVEL = β_0 + $\beta_1$sex + $\beta_2$age + $\beta_3$classcom + $\beta_4$inc + $\beta_5$occupp + $\beta_6$occupf + $\beta_7$creditfor + $\beta_8$eduf + $\beta_9$edum + u_i

Model 4.B.2: ELEVEL = β_0 + $\beta_1$sex + $\beta_2$age + $\beta_3$classcom + $\beta_4$inc + $\beta_5$occupp + $\beta_6$occupf + $\beta_7$creditinfor + $\beta_8$eduf + $\beta_9$edum + u_i

Model 4.B.3: ELEVEL = β_0 + $\beta_1$sex + $\beta_2$age + $\beta_3$classcom + $\beta_4$inc + $\beta_5$occupp + $\beta_6$occupf + β_7 nocredit + $\beta_8$eduf + $\beta_9$edum + u_i

Cook Weisberg test reveals that the problem of *heteroscedasticity* exists in Model 4.B.1 and Model 4.B.2. In these cases we use *robust maximum likelihood estimation procedure* (for a note on robust estimation see appendix, A.1).

We obtain the t statistics for testing the null hypothesis H_0: $\beta = 0$ against the alternative hypothesis H_1: $\beta \neq 0$. The test statistics distributed as χ^2 is analogous to the usual F-test. It is a test against the null hypothesis that the slope coefficients are all equal to zero. In order to judge the *goodness of fit*, which is a summary statistic indicating the accuracy with which a model approximates the observed data, we use *psedu-R^2* measure derived from *likelihood ratio test.*

MODEL 4.C:

This model makes an attempt to estimate the determinants of the households' decision regarding the allocation of their children's time between education and work.

The relationship can be written as

edu-time = β_0 + $\beta_1$sex + β_2 classcom + $\beta_3$dcost + β_4 childno + β_5 eduf + β_6 edum + $\beta_7$occupf2 + $\beta_8$occupf3 + β_9 occupf4 + β_{10} occupf5 + β_{11}occupf6 + β_{12}occupprt + β_{13}creditfor + β_{14}inc + u_i , where, u_i is the random variable.

Here we apply *Ordinary Least Square Method* (OLS) to estimate the model using STATA. As before the test for '*heteroscedasticity*' and '*multicollinearity*' has been done. The *Cook-Weisberg test* for *heteroscedasticity* reveals that the error term is indeed homoscedastic. The test for *multicollinearity* shows that certain variables have correlation coefficient higher than 0.45, e.g. *eduf* and *creditfor* (0.48), *inc* and *occupf4* (0.49). These variables play important role in household's decision-making process and hence if we drop them it will affect the overall explanatory power of the model. So instead of dropping them, we have used a *principal component* of the correlated variables in our model. The principal component for '*inc*' and '*occupf4*' is '*pcincf4*' and that for '*creditfor*' and '*eduf*' is given by '*pcedufcf*' (for a note on principal components see appendix, A.2).

Our model is:

$$\textbf{edu-time} = \beta_0 + \beta_1\textbf{sex} + \beta_2\textbf{classcom} + \beta_3\textbf{dcost} + \beta_4\textbf{childno} + \beta_5\,\textbf{pcedufcf} + \beta_6\,\textbf{edum} + \beta_7\textbf{occupf2} + \beta_8\,\textbf{occupf3} + \beta_9\,\textbf{pcincf4} + \beta_{10}\textbf{occupf5} + \beta_{11}\textbf{occupf6} + \beta_{12}\textbf{occup} + \beta_{13}\textbf{creditfor} + \mathbf{u_i}$$

After obtaining the estimates of β, we test the following null hypothesis. H_0: $\beta = 0$ against the alternative hypothesis H_1: $\beta \neq 0$ using t-test and H_0: $\beta_j = 0$ for all j against the alternative hypothesis H_1: $\beta_j \neq 0$ for at least one j, using F-test. The overall explanatory power of the model would be obtained by *adjusted-*R^2.

4.4 RESULTS AND INTERPRETATIONS:

Model 4.A:

Table 4.4: Logit Estimates of the probability of sending children to school
Dependent variable: CON

	Credit formal		Credit informal		nocredit	
Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
sex	-0.464	-0.97	-.0408	-0.87	-0.378	0.79
classcom	-0.277**	-2.23	-0.299**	-2.43	-0.319**	-2.77
dcost	0.008**	2.17	0.008**	2.26	0.009**	2.5
inc	0.0002	1.26	0.0001	0.84	0.00008	0.45
childno	0.977***	-3.56	-0.794***	-3.10	-0.7304***	-2.46
eduf	0.466*	1.91	0.449*	1.74	0.3808	1.52
edum	0.155	0.71	0.159	0.74	0.1645	0.78
occupp	-0.723	-1.24	-0.89	-1.57	-1.0195**	-1.79
occupf	0.491*	1.73	0.867	1.60	0.803	1.5
creditfor	-0.936	-1.6	#	#	#	#
creditinfor	#	#	0.665	0.96	#	#
nocredit	#	#	#	#	-0.4702	-0.75
Constant	3.204*	2.81	2.608**	2.02	3.035**	2.84
R^2	0.312		0.302		0.301	
Log likelihood	-58.35		-59.045		-59.302	
$X^2(10)$	29.61		30.17		30.29	
Prob>χ^2	0.001		0.0008		0.0008	

*10% level of significance, ** 5% level of significance, ***1% level of significance.

Our empirical results are by and large consistent with the conclusions we derived from our theoretical models. First of all, access to credit does not appear to be an important determinant of the decision to send a child to school. This is in line with our theoretical models 8, 9, 11 and 12 showing that the effect of credit availability on schooling investment is ambiguous.

Table 4.4 also shows that *occupf* has a positive but barely significant coefficient in only one of the specifications including *creditfor*. In the other two cases, it is insignificant. The implication is that farmers and non-farmers do not behave significantly differently with respect to schooling decisions, again in line with our theoretical findings.

Turning to other variables, we find that the important parameters of schooling decision are cost of education (*dcost*), level of educational attainment already achieved (*classcom*) and some of the family characteristics (*childno, educf, occupp*).

School fees in West Bengal are negligible and private tuition is very common. As students reach higher classes, the quantity of private tuition increases, raising the direct cost of education. Positive relation with *dcost* suggests that if parents are able to spend more on private tuition, children's probability of success and hence, probability of continuing school increases.

Table 4.4 further shows that child's probability of going school decreases as he reaches higher classes. This suggests that although rural households have demand for education, it tapers of with rising levels of education. In simple words, there is lower demand for higher education. This result is not surprising. The majority of the households in our sample are poor and their livelihood either from agriculture or from traditional non-farm activities (weaving, pottery etc.) often do not ensure subsistence or survival unless their children work with them. These children act as a source of labour as they grow up in order to supplement their family's income. These occupations need certain skills, which they have to acquire in their early stages of life and parents want their child to gain their traditional skills at the younger age. On the other hand, given the uncertainties of the job market and high unemployment rate among the educated youths, probability of getting a job after completion of school decreases. And due to resource constraint they are not able to send their children for higher studies (college and university or for some vocational courses), because theses are not free. Sometimes after spending few years in school these children do not want to work as a manual labour and hence after completion of their school they are left with absolutely no source of income. Due to these, the higher level of schooling is less attractive among the parents.

Another interesting result is the negative impact of *occupp* (both parents working) on schooling decision in the specification controlling for the lack of access to any credit. We have already seen that both working parents come from the poorest of the households. For such household's women's workforce participation do not reflect women's empowerment in terms of a greater bargaining power enjoyed by the female members within the family. Poverty forces female members to work for wages in order to supplement their family income. Under such circumstances, children (especially female children) have to shoulder the burden of domestic work to release their mother for wage work and these children cannot attend school.

Finally, we find that father's education has a weak but positive influence on schooling decision. We must also note that there appears to be no gender bias in so far as the decision to send a child to school is concerned.

Model 4.B:

Table 4.5: Ordered Logit Estimates of Educational Attainment
Dependent variable: ELEVEL

Variable	Formal credit		Informal credit		No credit	
	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Sex	1.28	1.32	1.5*	1.91	1.32*	1.67
Age	0.43**	2.27	0.37**	2.4	0.433***	2.64
Inc	0.0003	1.11	0.0006**	2.21	0.0003	1.1
Childno	1.22**	2.43	0.9289***	2.64	0.96***	2.96
Eduf	-1.32***	-3.22	-1.17***	-2.96	-1.07***	-3.08
Edum	1.27***	2.65	1.05**	2.41	0.907**	2.43
Occupp	-4.486***	-3.72	-3.78***	-3.94	-4.34***	-3.99
Occupf	0.362	0.42	-1.25	-0.17	0.3	0.37
creditfor	1.47	1.04	#	#	#	#
creditinfor	#	#	-2.168	-0.25	#	#
nocredit	#	#	#	#	-1.02	-1.2
Log-likelihood	-72.088		-73.28		-72.58	
R^2	0.291		0.28		0.29	
Wald $\chi^2(9)$	64.62		56.65		58.04	
Prob> χ^2	0		0		0	

*10% level of significance, ** 5% level of significance, ***1% level of significance.

In this case, we estimate the demand for education function among the non-continuing student. Again we find that access to credit has no impact on the demand for

education and farm and non-farm households do not behave differently. Both of these findings, as in case of the previous specification, support our theoretical results.

The determinants of the demand for education in this model appears to be gender, age, and family characteristics like family size, parents' education, mothers' work force participation and income.

Unlike in the previous case there is weak evidence of a gender bias against the girl child with regard to education. We find that educational attainment increases with the age of the child, as expected. *Childno* has a positive and significant impact on educational attainment. This implies that presence of more school-age children in the family increases the probability of attaining higher education. Although we have shown earlier that larger no of sibling reduces their probability of attending school, but if one child is single out to attend school he achieves higher level of education. The family enhances its income through the labour-time of these large number of children, most of whom may not be attending school and concentrate all resources to a select one or two for attaining high levels of education.

Parents' education also appears significant. While mothers' education level has the expected positive impact, fathers' education has a negative and significant impact on educational attainment. This is somewhat unexpected, but can be explained as follows. Given the uncertainties of the job market and high unemployment rate among the educated youth, parents are often apprehensive that their child may not get a suitable job after completing school. Moreover, after completion of school children are often not ready to work as a manual labour and/or accept their traditional family occupation. This leaves them with no source of income at all after they complete their high school. Educated fathers are more exposed to such job uncertainties. In many cases, the educated fathers themselves were constrained to accept occupations, which require little

educational levels beyond basic literacy and numeracy. Naturally educated fathers may not be too inclined to demand higher education levels for their children under the given circumstances. We must also admit that our conventional education system is not skill augmenting. Hence, instead of sending children to high school, educated fathers may prefer to send them to work as apprentices in occupations like gem-cutting, jewellery making, motor mechanic workshops etc. to acquire productive lifetime skills.

Mothers' workforce participation (*occupp*) again shows a negative and significant impact on child's educational attainment. Finally, family income has small positive impact on the demand for education.

Model 4.C:

Table 4.6: OLS Estimates of Demand for Education (time allocation)
Dependent variable: edu-time

Explanatory variables	Coefficient	t-value
sex	0.368	1.47
classcom	0.30***	4.41
dcost	0.002**	2.02
childno	0.05	0.41
edum	- 0.12	- 1.15
occupf2	- 0.024	- 0.07
occupf3	0.079	0.22
occupf5	1.05**	2.34
occupf6	0.013	0.03
occupp	0.36	1.23
pcincf4	0.22*	1.66
cedufcf	0.46**	2.19
constant	0.725***	13.52
R^2	49%	
F (12, 83)	6.65	

* 10% level of significance, ** 5% level of significance, *** 1% level of significance.

The most important determinants of time allocation decision for continuing children in rural households appear to be occupation, income, father's education and formal credit.

It is already mentioned earlier that household can be classified into six categories according to the father's occupation. Occupf1= farmer, occupf2= daily wage labourer,

occupf3 = non-farm household (weaver, artisans, potter etc.), occupf4 = government servant, occupf5 = businessman, and occupf6 = factory worker. In order to avoid dummy variable trap, we dropped the variable *occupf1*. It is evident that *occupf5* has significant positive effect at the 5%level of significance, on the time devoted to education. Besides that *pcincf* exerts significantly positive effect (at 10% level of significance) on time devoted to education. Which implies that the combined effect of *inc* and *occupf4* raise time devoted to education. It is thus evident that businessmen and government servants enjoying higher incomes have higher demand for education reflected in the time devoted to education. However, households belonging to other non-farm occupations do not differ significantly from farm households in this respect.

Coefficient of *pceducfcf* is positive and significant at 1% level. The positive coefficient of this variable states that the combined effect of *eduf* and *creditfor* exerts positive impact on time spent on education. In fact, perhaps the more educated fathers have greater access to formal credit and can afford to spend more time on education.

Moreover, direct cost of education as well as educational attainment also has a positive and significant impact on time devoted to education. Our sample shows that most of the children goes for private tuition for better performance in class. This raises not only the cost of education but also the time devoted to education. This trend continues to rise with rising educational levels. Children must increase their study time if they are in a higher class. Usually, as children reach higher classes they go for more private tuition for better performance in the class, resulting increase in the time devoted to education.

4.5 CONCLUSION

By and large, the results of our econometric analyses are consistent with our theoretical findings of chapter 3. In particular, we fail to find evidence of any significant difference in the behaviour of farm and non-farm households with respect to educational

investment decisions. We also find that access to credit has little impact on this decision making process. We believe that our econometric model echoes the theoretical results of our integrated model of demand for education as a consumption as well as investment good under conditions of imperfect capital market.

The determinants of educational demand that we identify from our econometric exercises, relate to costs of education, the child specific factors like his age and educational attainment, and family characteristics like family size, parents education, mothers' workforce participation and in some cases fathers' occupation and income. Gender bias in educational investment decision does not appear to be very strong. But mothers' workforce participation reduces educational investment. Mothers' education level shows some positive impact on demand for education of the child. But fathers' education level has a negative impact on the child's educational attainment although it raises the probability of sending the child to school. This means educated fathers prefer to send their child to school but does not want the child to attain higher levels of education. Family size, on the hand reduces the probability of a child attending school, but if a child from a large family attends he attains higher level of education. The cost of education (largely for private tuition) has a positive impact on the demand for education. It is because of these private tuitions that the child is able to perform well and continue in school.

APPENDIX

A.1. *A Note on Robust Estimation Method:*

Maximum likelihood estimators are basically no different from linear regression when it comes to the use of robust. Let us explain the *Robust Estimation* method considering the case of ordinary least squares regression. The OLS estimator of β is, $\tilde{\beta} = (x'x)^{-1}x'y$, Where 'y' is an n×1 vector representing the dependent variables and 'x' is an n×k matrix of non-stochastic explanatory variables. And $V(\beta) = (x'x)^{-1}[x'(\sigma^2 \Omega)\, x](x'x)^{-1}$, where $\sigma^2 \Omega$ is the variance co-variance matrix of error term.

Since, 'x' is fixed in repeated sampling, everything conditional on 'x' can be regarded as constant. Hence, the variance of $\tilde{\beta}$ is, $V(\tilde{\beta}) = (x'x)^{-1} V (x'y)(x'x)^{-1}$

Our attempt is not to estimate the matrix $[x'(\sigma^2 \Omega)\, x]$, but to construct a matrix from the sample that would represent this matrix. From above it is evident that the matrix $[x'(\sigma^2 \Omega)\, x]$ can be written as $V(x'y)$, which is a k×1 vector.

Let us consider its first element. It is

$x'y = x_{11}y_1 + x_{21}y_2 + \ldots + x_{n1}y_n$

Where x_1 is the first column of x. Since x is treated as a constant, we can write the variance as, $V(x'y) = x_{11}^2 V(y_1) + x_{21}^2 V(y_2) + \ldots + x_{n1}^2 V(y_n)$. Here we have assumed that y_j are independent.

The estimate for $V(y_j)$ is $\hat{e}_j^2$, the square of the residual $\hat{e}_j = y_j - x_j \tilde{\beta}$, where x_j is the j^{th} row of x. We must estimate the off diagonal terms of the covariance matrix for x'y as well.

$$V(x'y) = \Sigma\, \hat{e}_j^2 (x_j'x_j) \text{ for all } j = 1 \ldots n$$

Where, $x_j'x_j$ is a k×k vector. Hence the robust variance estimator is

$$\tilde{V}(\tilde{\beta}) = (x'x)^{-1} [\Sigma_{j=1\ldots n}\, \hat{e}_j^2 (x_j'x_j)] (x'x)^{-1}.$$

Now, consider the case of maximum-likelihood estimators. We can write our maximum-likelihood estimation equation as

$$G(\beta) = \sum S(\beta; y_j, x_j) = 0, \forall\, j = 1(1)\, n$$

Where $S(\beta; y_j, x_j) = \partial l_j / \partial \beta$ is the score vector and l_j the log-likelihood for the jth observation. Here β represents all the parameters in the model, including any auxiliary parameters. Using the first order Taylor-series expansion (i.e. the delta method), we can write the variance of $G(\beta)$ as

$$\tilde{V}(G(\beta))\,|_{\beta=\tilde{\beta}} = \partial G(\beta)/\partial\beta\,|_{\beta=\tilde{\beta}}\, \tilde{V}(\tilde{\beta})\, \partial G(\beta)/\partial\beta\,|'_{\beta=\tilde{\beta}}$$

Solving for $\tilde{V}(\tilde{\beta})$ gives

$$\tilde{V}(\tilde{\beta}) = \{[\partial G(\beta)/\partial\beta]^{-1}\, \tilde{V}(G(\beta))[\partial G(\beta)/\partial\beta]^{-T}\}\,|_{\beta=\tilde{\beta}}$$

But, $H = \partial G(\beta)/\partial\beta$,

is the Hessian (matrix of second-derivatives) of the log-likelihood. Thus we can write

$$\tilde{V}(\tilde{\beta}) = D\, \tilde{V}(G(\beta))\,|_{\beta=\tilde{\beta}}\, D$$

where $D = -H^{-1}$ is the traditional covariance estimate.

Now, $G(\beta)$ is simply a sum, and we can estimate its variance just as we would the sum of any other variable – it is n^2 times the standard estimator of the variance of a mean:

$$n / (n-1) \Sigma (z_j - \bar{z})^2$$

But, here, the scores $u_j = S(\tilde{\beta}; y_j, x_j)$ are (row) vectors. Also note that their sum, and thus their mean, is zero. So, we have

$$\tilde{V}(G(\beta))\,|_{\beta=\tilde{\beta}} = n / (n-1) \Sigma u_j' u_j$$

Putting it all together, our robust variance estimator is

$$\tilde{V}(\tilde{\beta}) = D\, (n / (n-1) \Sigma u_j' u_j)D$$

So we see that robust variance estimator is just the delta method combined with a simple estimator for totals. The above estimator for the variance of the total (the centre of the sandwich) is only appropriate when observations are independent. For clustered data and complex survey data, one appropriate for the independent units of the data replaces this estimator. Clusters are independent. So we can sum the scores within a cluster to create a "super-observation" and then use the standard formula for a total on these independent super-observations. Our robust variance estimator thus becomes

$\tilde{V}(\tilde{\beta}) = D\,[n_c / (n_c-1)\, \Sigma_{i=1\ldots}\, n_c\, (\Sigma_{j\in ci}\, u_j)'(\,\Sigma_{j\in ci}\, u_j\,)]D$

Where c_i contains the indices of the observations belonging to the ith cluster for i = 1,2, ...n_c, with n_c the total number of clusters.

(Stata Reference Manual, Release 5, Vol. 3, pp.155-156).

A.2. *A Note on Principal Component:*

This method can be seen as the transformation of the X's (vector of explanatory variables) to a new set of variables which will be pair-wise uncorrelated and of which the first will have the maximum possible variance, the second the maximum possible variance among those uncorrelated with the first, and so forth. Let the first such variable is $z_1 = Xa_1$, where $z_1$is an n-element vector and a_1 is a k-element vector. Hence the sum of squares of z_1 is, $z_1'z_1 = a_1'X'Xa_1$.

Our aim is to choose 'a_1' to maximize $[z_1'z_1]$ in order to do so we need to impose some restrictions, otherwise it could be made infinitely large. Let us normalize by setting $a_1'a_1 = 1$. Lagrange function can be written as,

$L = [z_1'z_1] - \lambda_1\,[a_1'a_1 - 1]$ or $L = a_1'X'Xa_1 - \lambda_1\,[a_1'a_1 - 1]$...(1).

Differentiating (1) with respect to a_1, and equating the derivative with zero we get,

$(X'X)\,a_1 = \lambda_1 a_1$. Thus a_1 is the latent vector corresponding to the root λ_1.

Hence, we can write, $z_1'z_1 = a_1'X'Xa_1 = \lambda_1 a_1'a_1 = \lambda_1$, since $a_1'a_1 = 1$. So, we must choose λ_1 as the largest latent root of X'X. The first principal component of X is therefore z_1.

Repeating the same procedure we can derive the second *principal component*, but only with an additional constraint that z_2 is to be uncorrelated with z_1. So, the problem can be written as: Max $z_2 = Xa_2$ subject to $a_2'a_2 = 1$ and $a_1'a_2 = 0$.

Let, λ_2 is the variance of z_2. if we repeat the same procedure for each of the k-roots of [X'X], we will get the k principal components of X such that $\lambda_1 > \lambda_2 > \ldots > \lambda_k$. We can represent these k *principal components* of X into a (n×k) matrix Z, such that,

$Z = XA$, $A = [a1\ a_2 \ldots a_k]$.

This variance covariance matrix of Z shows that all the *principal components* are pair-wise uncorrelated and the variances are given by, $z_i'z_i = \lambda_i$.

If the rank of X is r<k, (k-r) roots would be zero and the variation in the X's could be completely expressed in terms of r independent variables. Even if X has full column rank, some of the λ's may be fairly close to zero, so that a small number of *principal component* account for a substantial proportion of the variance of X's. The total variation in the X is given by,

$\Sigma_i\, \Sigma_t\, x_{it}^2 = tr\,(X'X)$. But $tr\,(z_1'z_1) = tr\,(A'X'XA) = tr\,(X'XAA') = tr\,(X'X)$, since $AA' = I$.

So we can write $tr\,(X'X) = \Sigma_i\, \Sigma_t\, x_{it}^2 = \Sigma_{i=1\ldots k}\, \lambda_i$.

Thus the proportionate contribution of each *principal component* of the total variation of X's is given by $(\lambda i / \Sigma_{i=1\ldots k}\, \lambda_i)$.

Chapter 5

CONCLUSION

The main objective of this thesis was to analyse the educational investment decision-making process of rural households (farm as well as non-farm) in less developed countries. We also made an attempt to understand the differences, if any, in the nature of this decision-making process between farm and non-farm households and the role of the credit market in determining the optimal level of investment in education. These research questions were addressed with the help of micro-theoretic analysis, supplemented by micro-econometric models.

In the micro-theoretic analysis, we formalise the decision making process of rural households by adopting a two period overlapping generations model. For constructing the model, we considered education both as consumption as well as an investment good. We considered both farm and non-farm households separately, since there are some basic difference between them, including their opportunity cost of education as well as future returns from education.

We have identified different set of factors influencing the educational investment decision of the two sets of households- farm and non-farm. For the non-farm households, the major determinants of the educational investment decision (demand for education) were direct cost of education, opportunity cost of education, family income, initial wealth of the family, future rate of return from education, interest rate and amount of credit ceiling. On the other hand, the major determinants of the educational demand for the farm household are direct cost of education, opportunity cost (as reflected by the factors

affecting the value of the marginal productivity of child's labour time, e.g., price of agricultural product, land size, technology of production etc.), parental labour input, productivity of education in skill formation, amount of credit ceiling and the rate of interest. Although some of the factors like opportunity cost of education, future return from education may not be identical for the two sets of households; the determinants of their educational investment decisions are by and large similar for both.

The comparative static results showed that investment decision of rural farm and non-farm households are more or less similar but they vary according to the nature of credit market and also with the way educational demand enters their utility function (i.e. whether they are treating education as pure investment good or also as a consumption good).

In the case of perfect credit market, the optimum time devoted to education by non-farm households is a positive function of parent's income, initial wealth of the family and a negative function of the direct cost of education, opportunity cost of education and the rate of interest. The effect of the share of income transferred to older generation is ambiguous. The above results are true for both pure investment model and integrated consumption-investment model. The results are more or less similar for farm households, with the exception that the effect of opportunity costs in the latter case remains ambiguous. We also observe that, the effect of increase in the future returns to education on the educational demand is similar for both sets of households. Under pure investment model, it has no impact on the demand for education, while the effect is positive when the households take their investment decision on education considering both investment and consumption motives.

In case of credit rationing (for non-farm households) the effect of some of the variables, like family income, family's initial wealth, direct and opportunity cost of education are the same as it was in the case of perfect credit market. Besides, in the pure investment model, the demand for education is a positive function of rate of interest, credit ceiling and future returns from education and a negative function of share of income transferred to older generation. In the integrated model, on the other hand, all these effects are indeterminate. Most of these results also hold true for farm households with the exception of the impact of opportunity cost and parental labour input. The effect of these two variables on educational investment decision of households remains ambiguous.

In the absence of credit market, all the results of credit rationing models remain valid for non-farm households. Even for farm households, all the results hold with the exception of current price of agricultural goods, which now affects educational investment decision positively.

Comparison of all the three types of credit market gives us an interesting picture. When education is considered as a pure investment good, the availability of credit has a positive impact on parents' decision to invest more of their children's time in education. But if education is also assumed to have properties of consumption good, the time devoted to education may not increase with credit availability.

Our micro-theoretic analysis was supplemented by micro-econometric analysis, which used a data set of 80 household derived from six villages of West Bengal. By and large, the results of our econometric analysis are consistent with our theoretical findings. Our econometric model basically echoes the theoretical results of our *integrated model* of

educational investment decision with imperfect credit market. We may therefore conclude that non-monetary benefits are important determinants of rural households' optimal level of investment in education in LDCs. We also found empirical evidence to suggest that access to credit has little impact on this decision making process and there is no significant difference in the educational investment behaviour of farm and non-farm households.

From the econometric analysis it is evident that the major determinants of demand for education among the poor rural household's are cost of education, child specific factors (like age and educational attainment), and family characteristics (like, parent's education, mother's work force participation, number of school-age children in the family and sometimes father's occupation and family income).

Gender bias in educational investment decision does not appear to be very strong, though male children are more likely to continue with higher education than their female counterparts. In all India level, for the year 1998-99, *Gross Enrolment Ratio* in classes I-V was 83 per cent for girls and 101 per cent for boys and in classes VI-VIII the numbers decreased to 65 per cent for boys and 49 per cent for girls. The gender gap in the rural areas was more significant for classes VI –VIII. While the drop out rate in classes I-V was 38 per cent for males and 41 per cent for females, in classes VI-VIII, it was 54 per cent and 60 per cent respectively. Our micro-econometric results are consistent with this macro profile.

Mother's work force participation was found to have a negative impact on the demand for education, both in terms of the probability of attending school as well as educational attainment levels. However, it has no impact on time devoted to education.

We also found that mother's level of education exerts a positive impact on child's educational attainment. But the interesting result is father's educational level has a negative impact on child's educational attainment, although it raises the probability of sending children to school. This may be a reflection of disillusionment among educated father regarding the employment prospects of an educated child. They would nevertheless prefer to send their children to school to get the minimum level of numeracy and literacy.

We also find that the presence of other school-age children in the family, though decreases the probability of going to school for each child, it raises the probability of achieving higher education. This result can be interpreted to imply that if a child is singled out and sent to school, parents are most likely to spend more resources on her/him, so that the child can reach higher levels of education and act as a source of future earning.

We found that the probability of attending school decreases as the child reaches higher classes reflecting increasing dropouts with rising educational levels. A National Sample Survey Organisation (NSSO) survey for the year 1995-96 also vindicates our finding. It shows that out of the *ever-enrolled* persons in the age group 5-24 years, 21 per cent dropped out before completing middle school, over three-fourth dropped out before attaining secondary levels and 90% could not complete secondary schooling.

However time-investment on education has been found to increases in higher classes. This may simply be a reflection of pervasive private tuition in rural West Bengal. The cost of education (particularly, the cost of private tuition) has a positive impact on the educational demand. This result perhaps implies that examination oriented private tuitions enable students to perform well and get promoted to higher classes. The implicit

presumption is that the cost of tuition also reflects the ability to pay and those who can afford it achieve higher education levels.

To summarise, our research failed to capture any significant difference in the educational investment behaviour between the farm and non-farm households, a slight variation in their determinants of educational demand notwithstanding. Moreover, impact of access to credit (both the amount and the nature of credit market) is noteworthy only if parents treat education as a pure investment good. In the integrated model, however, access to credit does not have any important role to play. Also, the form of credit market, although important in shaping the impact of other variables, does not influence the educational investment behaviour *per se.*

The simple modelling exercise undertaken here does not, however, include wage uncertainty. The impact of wage uncertainty may be extremely important in countries like India, where employment options for educated labour are often very low and shrinking. This may de-motivate parents from educating their children. Moreover, we could not validate our theoretical results pertaining to opportunity costs and expected future rates of return due to data constraints. This requires more extensive and rigorous empirical analysis based on an elaborate primary data set, which was beyond the scope of this study.

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