ENROLMENT IN SCHOOL AND HIGHER EDUCATION: ROLE OF PUBLIC POLICY

DISSERTATION SUBMITTED TO JADAVPUR UNIVERSITY IN PARTIAL FULFILMENT OF THE DEGREE OF MASTER OF PHILOSOPHY (ARTS)

IN

ECONOMICS

SESSION: 2017-19

SUBMITTED BY

SAYOREE GOOPTU

DEPARTMENT OF ECONOMICS

JADAVPUR UNIVERSITY

KOLKATA – 700032

Acknowledgement

First and foremost, I express my heartfelt gratitude to my supervisor, Professor Vivekananda Mukherjee, Jadavpur University, under whose guidance I completed my MPhil thesis. His deep insight has helped me properly define the scope of my research and broaden my perspectives in this new field. I sincerely thank him for always being there, at every juncture of my work. His immense support and patience has made this journey a lot easier. I am indebted to him for the extensive discussions and resourceful ideas.

I am also grateful to the professors present at the International Conference on "Human Development and Delivery of Public Services in the Post Reform Period", Kalyani University. I especially thank my discussant Professor Anirban Mukherjee (Department of Economics, Calcutta University) for his valuable comments.

I also thank Professor Achin Chakraborty (Institute of Development Studies Kolkata), my Research Advisory Committee convenor for the recommendations which provided scope for improvisation.

I am thankful to Professor Joydeep Bhattacharya (Department of economics, Iowa State University) for his suggestions, which helped me refine certain aspects of my work.

I am thankful to Jadavpur University, Department of Economics for arranging a pre-submission seminar of my MPhil Thesis. I have benefitted from the comments and the ongoing discussions.

The departmental library and other facilities provided by the Department of Economics have also been extremely beneficial.

Lastly, I would like to thank my parents and my sister for their constant support, encouragement and love. It would never have been possible without their faith in me.

Contents

CHAPTER I

INTRODUCTION

I.I Motivation

Educational policies have increasing importance in developmental concerns in an economy such as issues related to labour productivity, economic growth, mitigating inequality, curbing unemployment. It is in this context that the government plays a salient role in shaping the economy mediated through its policy undertakings. This intervention is especially important in a developing country like India, where there is predominance of a large young population, thus paving the way for a huge potential of demographic dividend. However, according to the Economic Survey 2017-18, the Central and the State governments together have been spending less than 3% (2.7%) of the country's GDP in education. The investment in higher education has been at an extremely low level of 0.63% of GDP in 2013-14. Though the enrolment in school education has steadily increased after adoption of Millennium Development Goals, according to Ministry of Human Resource and Development Report (2016), the enrolment ratio substantially falls from school education to higher education[1]. According to the Census 2011, about 10.1 million (3.9% of the child population) children are engaged in the labour force, either as 'main' or 'marginal' workers. In addition, 42.7 million children in India are out of school. Though the incidence of child labour has reduced by 2.6 million between 2001 and 2011, the reality still remains grim enough to ponder about. There is no clear policy direction regarding how to efficiently spend

[1]In India, according to Ministry of Human Resource and Development Report (2016) enrolment in school education at primary level was 100.1%, with 98.9% for males and 101.4% for females. Enrolment in secondary education was 78,5% with 78.1% for males and 78.9% for females. However, enrolment in higher education was estimated to be substantially low at only 24.3%, with 25.3% for males and 23.2% for females.

the limited budget that is available for education in its different branches like higher education and school education. However, from the policy point of view, it is absolutely important to know how a government, with a fixed budget on education, should allocate the budget among different education levels, in order to meet its variety of objectives like ensuring higher enrolment in education, improving quality of education, stopping of child-labour and increasing income of the nation. This work presents a theory of allocation of a fixed budget between different levels of education such that a government's objective of increasing enrolment in higher education is fulfilled.

The theoretical modelling takes into account the typical features of educational production function that (i) household investment and institutional investment are complementary to each other in determining educational outcome; and (ii) there is path dependence in choice of educational investment at the higher level; (iii) there is interdependence between the school education and the higher education outcome. The equilibrium determines the quantity (measured as enrolment) and the quality at both the school (measured as score) and higher education (measured as the highest degree achieved) as a function of institutional investment and the wages available at various skill levels. The comparative static exercise shows how the institutional investment can be manipulated by a government to achieve its objective.

The complementarity between the institutional investment and household investment is a typical feature of educational production function which was appropriately stressed upon by Majumder (1983) in his survey of economics of education[2]. While the former type of investment creates educational infrastructure like the building and teaching staff; the latter utilises them by spending some costly effort like sacrificing wage at the labour market or sacrificing consumption or both. The two kinds of investments are so inter-

[2] See (Chattopadhyay, 2012).

dependent that dearth of any one would result in poor educational outcome. Although the institutional investment can also be provided by private sector, for sake of simplicity, in modelling of the complementarity the study has taken the institutional investment as government investment alone[3]. Majumder (1983) also pointed out that in determination of educational outcome there is a severe path dependence problem: the nature of investment in formal education is sequential in nature. The school outcome has serious implication for higher education: the set of opportunities that is available at higher education depends on the irreversible investment made at the school level. One cannot consider past investment opportunities as alternatives to present decisions. Similarly, one cannot consider future opportunities as alternatives, if they are contingent on the present. For example, the prospect of earning higher returns from pursuing a course in higher education, cannot withhold a household from investing less in school education, which promises a much lower return in itself. Other than the two above-mentioned features while planning its educational allocation between school and higher education, a government should also consider the fact that the quality of school education depends on the higher education outcome since the school-teachers are produced by the higher education system only. This positive externality which a household may generate on the rest of the society is rarely taken into account by an individual household. Therefore, the government steps in by increasing its investment in higher education.

In the theoretical model presented in the work a Constant Elasticity of Substitution (CES) production function for educational quality has been considered, with allowance for complementarity between household and government investment in education. However, the quality of education also depends on the ability of the student. We assume that each

[3] Financing of institutional investment in education is an important problem in its own right. In developing countries, it is normal to find participation of both the private and public sector in it. But in most of the countries, the private investment in education is heavily regulated by the governments.

household has only one child to educate and the household has complete awareness about the ability levels of the child[4]. For simplicity the model also assumes that the labour market return as the only return to education. The quality of education along with ability of the student determines the labour market return. The path dependence between school and higher education has been reflected with school quality considered as an input determining higher education quality. In the model, higher education quality improves the quality of teachers in school education which in turn improves the school education output. However, households are heedless of this. They consider themselves to be too insignificant to the average higher education quality in the economy. A household takes an educational investment decision at two stages of life. Initially, it decides whether to send the child to school or not; and then, after completion of school it decides whether to send him/her for higher education or not. The market wage compensates for the skill level of an individual. With education the acquired skill helps the children to receive higher wage at the labour market. A household neither has a control over the wage rate prevailing at the labour market nor can ensure that the child gets absorbed at the high-skilled labour market: by default, everyone who goes to school gets absorbed in the semi-skilled labour market. When a household withholds its child from receiving any education, the child earns a low wage at the non-skill labour market. Those who drop out after attending the school, get to work in the semi-skilled labour market with a wage-premium over the non-skill wage rate; the premium being determined by the school quality. Similarly, those having higher education gets a chance to work in the skilled labour market offering a wage premium over the semi-skill wage rate. At the equilibrium in the choice of their educational investment the households self-select themselves according to ability level of their child: it turns out that the children with their ability level below certain

[4] In contrast, Banerjee and Duflo (2011) points out that sometimes the households may not be sure about the ability level of its child. The violation of this assumption brings out a different set of results from what has been presented in this model. We consider them in a separate work.

threshold are not sent to the school; the children with their ability level above certain threshold are given both school and higher education; the students at the intermediate ability level drops out after the school education.

The work finds that in developing economies increase in government expenditure either on school education or in higher education unambiguously raises enrolment in school; however, the net effect on higher education enrolment is not so clear. It crucially depends on the responsiveness of higher education quality to school education quality. If the responsiveness is low, an increase in infrastructural investment in either school or higher education may not have the desired result of increased higher education enrolment[5]. Also, when the government balances the budget between school and higher education, under certain instances, a rise in school education expenditure may result in a fall in school enrolment. Another stark observation that comes out of the model is, child labour can never be completely obliterated by governmental investment in education. However, it may be substantially reduced. In the context of developed economies, the results of the model refute the proposition by Hidalgo-Hidalgo and Ormaetxe (2012) that a balanced budget increase in public investment in school education necessarily increases higher education enrolment.

I.II Plan of Work

The plan of work is as follows. Chapter 2 consists of a literature on economics of education. Chapter 3 formulates a theoretical model and derives the results. Chapter 4 concludes the work and provides a brief sketch of possible extensions.

[5] In India, in spite of a huge capacity expansion in higher education, the effectiveness of such policies has been questionable. Growth in educational facilities has outgrown growth in number of students enrolled. Between 1990-91 and 2017-18, the rise in number of colleges is more than five times (7346 to 39050). However, the number of students enrolled (in million) has only increased from 4.9 to 36.6. This is very small compared to the entire population.(See Sen(2018))

CHAPTER II

Literature Review

The inclusion of education in economic theory stems from the very early works on human capital theory. Adam Smith (1776) was the proponent of characterization of expenditure on education as investment expenditure, drawing up analogies between man and machines. He illustrated educated man as a proxy of human capital. Education has a vital role to play in upgrading skills of humans engaging in production activities and also in shaping individuals to become better citizens thus improving their standard of living. Schultz (1961), Becker (1975), Mincer (1958) made prodigious contributions to the literature of human capital, reinstating the importance of investing in humans. One of the propositions stated by Schultz focussed on the fact that the decision to spend scarce resources on education is an investment.

The government's role in this respect is crucial. However, the sole contribution by the government in the investments made in education would never suffice. There needs to be a commensurate household investment to procure the educational facilities set up by the government. Majumdar (1983) was the proponent of this line of thought which he termed the 'domain distinction' argument. According to him, unless the two kinds of investments match, the resultant products would either be overcrowded classrooms or empty ones. This indicates a certain degree of inherent complementarity between government and household investments. A second argument raised by him was the path dependence between subsequent levels of education. Given the heterogeneity of the structure of individual investment decisions, the returns corresponding to different levels would be unsuitable for speculating the allocation of resources between successive levels of education. Just like one cannot consider past investment opportunities in education as alternatives, the prospect of earning more from pursuing higher education cannot withhold someone from investing in school education which promises a much less return in itself. The present work incorporates this idea by considering school quality as principal determinant of higher education quality of students. The same logic was refurbished by Duflo and Banerjee (2011) under the nomenclature “demand wallahs” and the “supply wallahs”. The demand wallahs harped on the prominence of demand for education. They believed that without demand, there was no point in supplying education. They considered education as a form of investment which would generate higher earnings in the future. However, whether the parents’ contribution would translate into their benefits in their old age, would depend on whether children would take care of their parents then. The model in the present analysis has considered that investment in education gives households a non-pecuniary benefit which increases their utility. Apart from sole dependence on economic returns, there are other decisive factors which stimulate demand for education. It is at this juncture, that the supply side gained prominence, with the argument that some parents needs a push to invest in their child’s education.

The first milestone in the literature of economics of education may be traced back to the Coleman Report (USA). It provided data on students and their achievements of over 3000 schools. This gave a very clear picture of elementary and secondary education in the country. A more important issue with respect to the present context is that, it shifted the attention to the relationship between school inputs and student achievements. The relationship later came to be known as educational production functions instead of simply input-output analysis. According to Hanushek (1979), production functions are statistical analyses relating observed student outcomes to the characteristics of students, their families, peers, and also on the school attributes. The most common procedure used to test student outcomes is by means of various standardised scores. According to empirical evidence, it is quite inconclusive whether there is actually linkage between test scores and subsequent achievements. However, it is still used to evaluate educational programmes and also in deciding the allocation of funds. In fact there are veritable reasons for use of test scores as output measures. Hanushek (1986) argues that parents tend to value higher test score as a reason to continue with higher education. The paper also tells us that there is lot of debate on the issue of selection of inputs for the education production function. This is mostly because of input specification did not receive any proper attention in the past analysis. Even in the Coleman Report (1966), there is no mention of any underlying conceptual model. According to Hanushek and Kain (1972), most researchers accept a general model. The model states that the achievement of an individual at any point of time is a function of his/her characteristics and also that of his family and peers, cumulative to that point of time. It also depends on his innate ability & also the quantity and quality of school inputs consumed throughout his/her lifetime. Though this conceptual model was never mentioned anywhere in the Report, it was implied all through.

Apart from investments in education made by household and the government, ability of individuals has a role in determining attainment and achievement in education. Restuccia and Urrutia (2004) develops an intergenerational model of human capital and earnings inequality which features innate ability of individuals and investments in early and college education. In their model, young parents decide on investing for early education on the basis of their human capital and innate ability of the children. Old parents however differ in human capital and acquired ability of their children, which itself is composed of their innate abilities and expenditures in early education. The model uses the role of innate ability to account for exogenous correlation of earnings across generations. The persistence is further augmented by investment in early education by households. Hence, the paper suggests policies to be aimed at early education to be more effective. There exist two definitions of ability in the literature – First, in terms of IQ, personality and motivation, without any consideration to earnings and second, in terms of earnings which is independent of opportunities. Becker's (1975) approach comprises the relation between this second form of ability or capacity as perceived by a student (investor in education).

Hanushek and Kain (1972), Hidalgo-Hidalgo and Iturbe-Ormaetxe (2012), Ghate et al.(2014) also includes the ability component in the production function for determining outcomes in education. The pioneering work on income distribution by Galor and Zeira (1993) reconciles an overlapping generation model concerning decisions to invest in human capital. Unlike the present work, they have considered individuals to be identical with regard to potential skills and they only differ in their endowment of initial wealth.

Hanushek (2016) points out that simply presuming educational attainment as the measure of human capital and skills may not be accurate. It is the portion of schooling that is directly related to generation of skills in students that is significant and has a role to play in cross-country differences in growth rates. Thus, an extension of years of schooling does not always imply a richer endowment of skills in an individual. However, the government may be keen on setting up more and more educational facilities with the objective of increasing participation in education. The theoretical model presented in this work yields a counterintuitive result which says that increasing government infrastructural investment in higher education may not always raise enrolment rates in higher education.

The structure of present study bears a close resemblance to the model set up of Hidalgo-Hidalgo and Iturbe-Ormaetxe (2012) and Arcalean and Schiopu (2008). The first paper encompasses government intervention in two stages of education – basic and college and explores the effect of transferring resources from one stage to another on equity and efficiency. However, it considers basic education to be mandatory and fully funded by the government like in many developed countries. Hence, for basic education, the government expenditure affects only the quality of education with no change in enrolment. Another factor which has been unaccounted for in the paper is the incidence of unemployment in the formal labour market. The second paper by Arcalean and Schiopu (2008) enunciates the interaction between private and public expenditure on education in a two-stage framework and finds their effects on economic growth. At each stage, the human capital generated is a function of both public and private investments in education. Since the literature has not been able to reach a consensus on the degree of substitutability between the two, a general CES production function has been considered, which is similar to the model presented here. They do model the path dependence in education in the sense that human capital accumulated in school education is considered to be an essential input in tertiary education. However, ability has not been incorporated as a factor of production, which is considered in the present work. The model in this thesis constructs a two-period decision making structure which decides on the optimum household investment choices at each stage, and how the government intervenes to ameliorate enrolment outcomes. The household investment choices are functions of wages which are dependent on ability levels of individuals.

The problem of child labour is also intricately linked with education. At the onset of the school going age of a child, parents may decide on sending their children to the labour market instead of formal schooling. Several laws have been enacted in India with the intent of abolishing child labour in the economy. The Child Labour Act 1986 was born out of need for child labour laws, to admonish about the intensity of growing child labour in the economy. It barred certain sectors from hiring child labour completely. However, the law was heavily criticised and thus paved the way for further amendments. The seminal paper by

Basu-Van (1998) discusses the possible precarious effects of a ban on the economy. Bharadwaj et al. (2013) argues that a ban on child labour unambiguously deteriorates household welfare. The ban reduces household welfare through any of the two channels – either by lowering of consumption or by lowering of asset holding of households in order to maintain the previous standard of living. The authors also shed light on alternative strategies which may be designed to grapple over the situation and reduce the incidence of child labour. Cash transfers, increasing investments in education etc. are some of the instruments discussed in the paper. However, according to our work, instruments like government investment in education, though are able to reduce the problem of child labour, is not sufficient to stop it completely. According to Beegle, Deheja and Gatti (2009), households send their children to the labour market depending on an array of dimensions, both observable and unobservable. The observable characteristics include education, wealth and occupation, while unobservable factors include social network, parent's knowledge of ability of their child. The model in this thesis assumes that parents have private information about the child's ability and shows if the ability of the child is below a certain threshold he is not sent to school, but sent to unskilled labour market as child labour.

CHAPTER III

III.1. *The Model*

Consider an economy consisting of households with one child. The households are identical to each other except that ability level a of the child differs in one household to another and follows a uniform distribution over $[0, A]$. A household lives for two periods. In period 0 it is born, and it dies at the end of period 1. The household invests in its child's education. It may do so at two different points in its lifetime: at $t = 0$ it may send the child to school and then, after completion of school, at $t = 1$, it may send him for higher education. The model abstracts away from household bargaining and assumes that parents make all the decisions on behalf of their child regarding the child's education. It is also assumed that the child's ability is perfectly known by his parents. In the economy there exists three different kinds of labour markets: for unskilled labour, for semi-skilled labour and for skilled labour. At $t = 0$, if the child is not sent to school, he is sent to unskilled labour market where he surely gets a job. At $t = 1$, if the child is not sent to higher education, he is sent to semi-skilled labour market where also he gets a job for sure. The child is eligible to enter the skilled-labour market only after successful completion of higher education, However, it is common knowledge that a job is not guaranteed at the skilled-labour market: only δ proportion of higher education degree holders gets a skilled job; all others get employment at the semi-skilled labour market. The timeline of a household's decisions is described in the figure below.

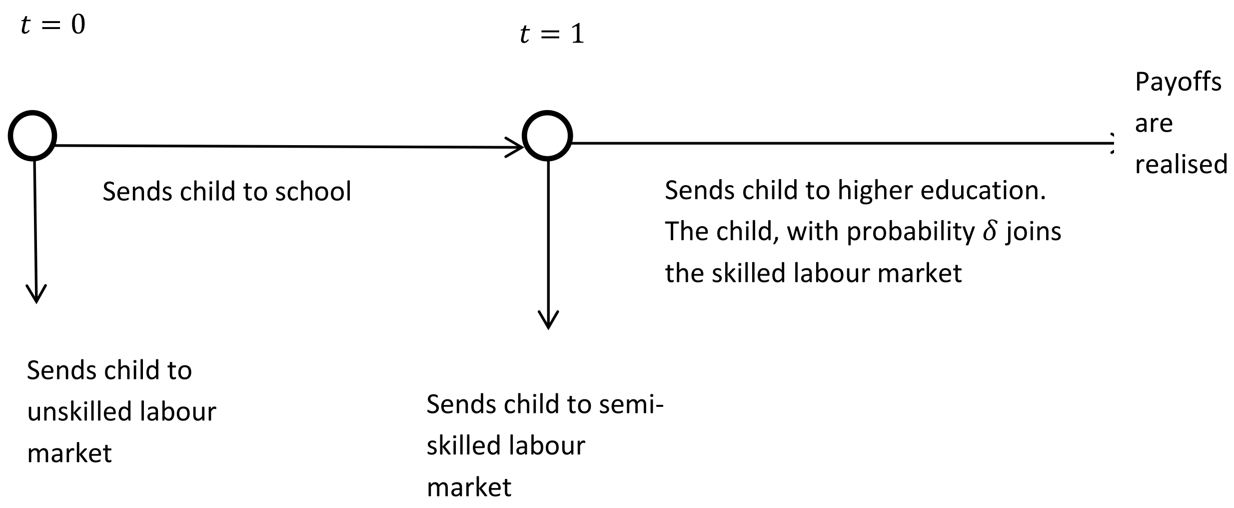

Figure 1: Decision Tree of Representative Household

The complementarity between household and infrastructural investment in production of educational quality both at school and higher education stage is focal point of the paper[6]. We assume, the infrastructural investment is provided by the government[7]. Following Bearse et al. (2005), we capture the complementarity between the two types of investment through use of Constant Elasticity of Substitution (CES) production function at both the stages of education. Specifically, the higher education production function is written as

$$q_H = a q_S [\alpha_1 (c_1^H)^{\rho_1} + \beta_1 (c_1^G)^{\rho_1}]^{\frac{1}{\rho_1}} \qquad (1)$$

where q_H and q_S are the quality of higher education and school education respectively; c_1^H and c_1^G are the household and government investment in higher education and $\alpha_1 > 0$, $\beta_1 > 0$ are the weights of these investments in determination of the quality. The degree of complementarity between the two investment levels is represented by $\rho_1 \in (-\infty, 1)$. The

[6] The degree of complementarity between the two, however, is quite a debatable issue and the literature has not yet been able to reach a consensus on this.

[7] The optimal ownership of infrastructural investment in education is also debated. However, the magnitude of positive externality associated with it, makes the government natural choice for provision of such an investment.

quality of education is affected by the innate ability a of the child which is required for absorption of knowledge; all other things remaining the same higher a implies higher q_H. Also, it is important to notice from equation (1) that quality of school education of a student has an impact on the quality of higher education he can achieve; higher q_S implies higher q_H. While the quality of schooling is measured by the marks or grades obtained by the student in the final school level examination, the quality of higher education is measured by the level of higher education degree achieved.

Like the higher education production function, the school production function can be written as:

$$q_S = aT(Q_H)[\alpha_0(c_0^H)^{\rho_0} + \beta_0(c_0^G)^{\rho_0}]^{\frac{1}{\rho_0}} \qquad (2)$$

where c_0^H and c_0^G represent the respected levels of household and public investment at school education; $\rho_0 \in (-\infty, 1)$ represents the degree of complementarity between the two. The parameters $\alpha_0 > 0$ and $\beta_0 > 0$ are the weights of these two types of investments in determination of quality of school education. The quality of school education positively depends on the teaching quality T at schools and since the teachers are appointed from the higher education system, T is assumed to be a positive monotonic function of average quality of higher education in the economy represented by Q_H. However, households consider that the aggregate quality of higher education is given, and they are too small to influence it through their own decision.

The wage rate at the labour market depends on the innate ability of a labour and his education. We assume, $w_0(a)$ is the wage rate received by a labour of ability level a at the unskilled labour market who has not received even the school education. We also assume that the responsiveness of unskilled wage to ability is extremely low i.e. $w_0{}'(a) \approx 0$. $w_0(a)$ may be imagined as minimum wage which a labour of ability a receives on joining labour market. Education attracts a premium over it. A semi-skilled individual with ability a who joins the labour force after finishing school education receives $w_I(q_s, a) > w_0(a)$. After completing the higher education, the same individual receives $w_F(q_H, a) > w_I(q_s, a) > w_0(a)$ if she manages a job at the skilled labour market. However, a job is received in the skilled labour market only with probability δ. If he fails to receive a job in the skilled labour market, we assume, he surely gets it at the semi-skilled labour market. Thus, the expected labour-market return from higher education is given by $w_I(q_S, a) + \delta(w_F(q_H, a) - w_I(q_S, a))$. The term $(\delta(w_F(q_H, a) - w_I(q_S, a)))$ signifies the wage premium that the household receives on sending the child for higher education.

Assumption 1: $w_F(q_H, a) = w_0(a) + \gamma q_H$ and $w_I(q_S, a) = w_0(a) + \mu q_S$ where $\gamma q_H > \mu q_S$. As $a \to 0, w_0(a) \to w_0(0) \approx \underline{w}, w_0{}'(a) \approx 0.$[8]

Assumption 1 implies for all ability levels $a \in [0, A]$, $w_0(a) \approx \underline{w}$. Also, notice that equations (1) and (2) along with Assumption 1 imply as $a \to 0$,

$$w_F(0, 0) = w_I(0,0) \to w_0(0) \approx \underline{w}.$$

(3)

In period $t = 0$, the household endowment and consumption are denoted by y_0 and x_0 respectively. In period $t = 1$, the household has an endowment of y_1, spends x_1 and from period $t = 0$ carries over $(y_0 - c_0^H - x_0)$ as savings and earns interest income on it at the prevailing market interest rate of r. If $(y_0 - c_0^H - x_0) < 0$, $(1 + r)(y_0 - c_0^H - x_0)$ stands for the amount the household has to pay back on its borrowing in period $t = 1$. However, it is

[8] In the literature, earlier Restuccia and Urrutia (2004), Hidalgo-Hidalgo and Ormaetxe (2012) made similar assumptions.

found later in the model that this distinction between savings and borrowing hardly matters at the equilibrium, leaving the results unchanged.

The representative household's career-choice problem for its child involves maximization of the life time utility function of the household $u(c_0^H, c_1^H, x_0, x_1)$ by choice of $\{c_0^H, c_1^H, x_0, x_1\}$ subject to the budget constraint. We assume, $\frac{\partial u}{\partial c_0^H} > 0, \frac{\partial u}{\partial c_1^H} > 0, \frac{\partial u}{\partial x_0} > 0$ and $\frac{\partial^2 u}{\partial c_1^{H\,2}} < 0$, $\frac{\partial^2 u}{\partial c_0^{H\,2}} < 0, \frac{\partial^2 u}{\partial x_0} < 0$. We also assume, $\frac{\partial}{\partial c_0^H} \cdot \left(\frac{\partial u}{\partial c_1^H}\right) > 0$ which captures the complementarity that exists between school education and higher education in the household's preference. However, $\frac{\partial}{\partial c_1^H} \cdot \left(\frac{\partial u}{\partial c_0^H}\right) = 0$ since a household knows that although Q_H affects its marginal utility from c_0^H, Q_H is determined at the aggregate level, which he individually cannot affect. In addition, we consider $\frac{\partial}{\partial x_i} \cdot \left(\frac{\partial u}{\partial c_i^H}\right) = 0$ and $\frac{\partial}{\partial c_i^H} \cdot \left(\frac{\partial u}{\partial x_i}\right) = 0 \;\; \forall i \in \{0,1\}$ indicating that incurring additional expenditure on consumption have no effect on the marginal utility of investment in education by households and vice versa. The presence of c_0^H and c_1^H in the utility function of households is indicative of the non-pecuniary benefits the household receives from the child's education apart from its labour market return.

For tractability we allow $u(c_0^H, c_1^H, x_0, x_1)$ to adopt the following form:

$$v = u(c_0^H, c_1^H, x_0) + x_1 \qquad \text{………………..(4)}$$

which preserves all the major results of the model unchanged.

The household maximizes v by choosing $\{x_0, c_0^H\}$ at $t = 0$ and $\{x_1, c_1^H\}$ at $t = 1$ subject to the budget constraint faced by it in either of the periods. With the specific features of the model described above, the decision tree of the household given in figure 1 can be re-represented as,

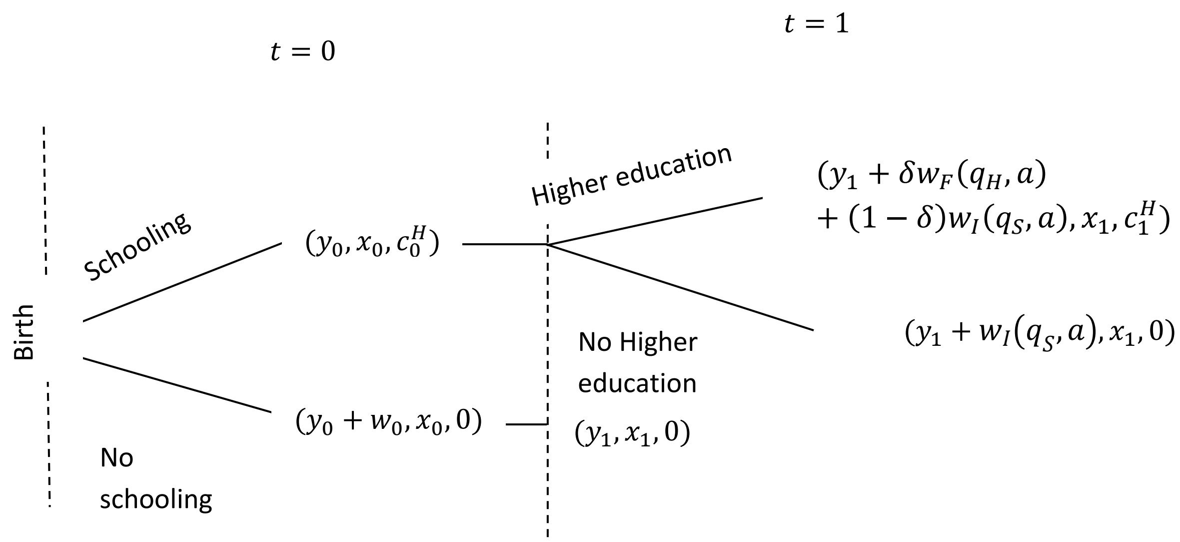

Figure 2: The Formal Representation of the Decision Tree of Representative Household

We solve the household's decision-making problem by application of backward induction method starting at $t = 1$.

$t = 1$

Option 1: the household sends its child to higher education and decides about $c_1^H > 0$.

Given its period 0 choice of $\{x_0, c_0^H\}$, while maximizing v by choosing $\{x_1, c_1^H\}$ the household faces an uncertainty as there is no guarantee that after completion of higher education the child lands up a job at the skilled labour market of the economy. With probability $(1 - \delta)$ he can end up at the semi-skilled labour market. If the child can join the skilled labour market and earns $w_F(q_H, a)$, the budget constraint of the household becomes:

$$x_1{}^h \leq y_1 + (1 + r)(y_0 - c_0^H - x_0) + \underline{w} + \gamma q_H - c_1^H.$$

However, if he finds his job in the semi-skilled labour market, the budget constraint of the household becomes:

$$x_1{}^{l} \leq y_1 + (1+r)(y_0 - c_0^H - x_0) + \underline{w} + \ \mu q_S - c_1^H.$$

Since v is monotonically increasing in x_1, in either of the situations the household chooses $x_1{}^{h}$ and $x_1{}^{l}$ in such a way that the respective budget constraints are satisfied. Therefore, while deciding about c_1^H the household maximizes its expected utility given by:

$$v = u(c_0^H, c_1^H, x_0) + y_1 + (1+r)(y_0 - c_0^H - x_0) + \underline{w} + \delta\gamma q_H + (1-\delta)\mu q_S \ - \ c_1^H.$$

Using the higher education production function from equation (1), the first order condition for choice of $c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma) > 0$ is written as:

$$\frac{\partial u}{\partial c_1^H}(c_0^H, c_1^H) + \delta\gamma . \frac{\partial q_H}{\partial c_1^H}(q_S, a, c_1^G) = 1 \qquad \text{…………………………………(5)}$$

At the equilibrium $c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma)$ balances the expected marginal benefit of investment in higher education with its marginal cost given by 1. From (1), $c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma)$ also determines the quality of higher education received by a child as:

$$q_H = a q_S [\alpha_1 (c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma))^{\rho_1} + \beta_1 (c_1^G)^{\rho_1}]^{\frac{1}{\rho_1}}. \qquad \text{… … … … … … … … … … … (6)}$$

Observation 1: (i) $\frac{dc_1^H}{dc_0^H} > 0, \frac{dc_1^H}{da} > 0, \frac{dc_1^H}{dq_S} > 0, \frac{dc_1^H}{dc_1^G} > 0, \frac{dc_1^H}{d\delta} > 0, \frac{dc_1^H}{d\gamma} > 0.$

(ii) $\frac{\partial q_H}{\partial c_0^H} > 0, \frac{\partial q_H}{\partial a} > 0, \frac{\partial q_H}{\partial q_S} > 0 \ \frac{\partial q_H}{\partial c_1^G} > 0, \frac{dq_H}{d\delta} > 0, \frac{dq_H}{d\gamma} > 0.$

Proof: (i) Follows from equation (5) and the assumptions of the model.

(ii) Follows from equation (6) and the statement of the first part of the proposition. □

Observation 1 specifies the factors responsible for increasing a household's investment in higher education. All the parameters that increases expected return form investment from its child's higher education commands higher investment in the child's higher education. *Ceteris* *paribus* if the household spends more on its child's school education, the marginal utility of spending more on the child's higher education increases and the household spends more on the child's higher education. The quality of higher education of the child also improves as more is spent privately on higher education. Any exogenous improvement of the quality of school education will have similar effect. More is spent on a child who is more able as he/she is expected to do better both in school and higher education. Because of complementarity of household and public investment in higher education production function, any increase in public investment in higher education improves quality of higher education of the child. The household investment in higher education also increases if the probability of entering the skilled labour market and the sensitivity of skilled wage rate to higher education quality improves. This also increases the quality of higher education as the household investment in higher education increases.

Thus, if a household decides to send its child to higher education, its indirect utility is written as:

$$v_{SH} = u(c_0^H, c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma), x_0) + y_1 + (1+r)(y_0 - c_0^H - x_0) + \underline{w} + \delta\gamma q_H(a, q_S, c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma), c_1^G) + (1-\delta)\mu q_S - c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma) \text{.........} \quad (7)$$

Option 2: $c_1^H = 0$.

After the school, if the household decides against admitting the child for higher education, its indirect utility becomes:

$$v_{S0} = u(c_0^H, 0, x_0) + y_1 + (1+r)(y_0 - c_0^H - x_0) + \underline{w} + \mu q_S. \quad \text{.....................}(8)$$

Which of these two options are preferred? An answer to this question requires comparison of v_{SH} and v_{S0}. Using (7) and (8) we obtain:

$$v_{SH} - v_{S0} = \varphi(a) - u(c_0^H, 0, x_0), \tag{9}$$

where,

$$\varphi(a) = u(c_0^H, c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma), x_0) + \delta\,[\gamma q_H(a, q_S, c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma), c_1^G) - \mu q_S] - c_1^H(c_0^H, q_S, a, c_1^G, \delta, \gamma). \tag{10}$$

Lemma 1: (i) $\varphi(a)$ is a monotonically increasing continuous function of a;

(ii) $\frac{\partial\varphi}{\partial c_0^H} = \frac{\partial u}{\partial c_0^H}$, $\frac{\partial\varphi}{\partial c_1^G} = \gamma\frac{\partial q_H}{\partial c_1^G}$, $\frac{\partial\varphi}{\partial q_S} = \delta[\gamma\frac{\partial q_H}{\partial q_S} - \mu]$, $\frac{\partial\varphi}{\partial\delta} = \gamma q_H - \mu q_S > 0$, $\frac{\partial\varphi}{\partial\gamma} = \delta q_H$, $\frac{\partial\varphi}{\partial x_0} = \frac{\partial u}{\partial x_0}$, $\frac{\partial\varphi}{\partial\mu} = -\delta\mu$.

Proof: Follows from application of (5) on equation (10). □

Observation2: (i) If $\varphi(0) < u(c_0^H, 0, x_0) < \varphi(A)$ there exists a value of $a = \bar{a}(c_0^H, q_S, c_1^G, \delta, \gamma, \mu, x_0) \in [0, A]$ that satisfies $\varphi(\bar{a}) = u(c_0^H, 0, x_0)$ and at $t = 1$, a household opts for higher education of its child if and only if $a \geq \bar{a}$.

(ii) If $u(c_0^H, 0, x_0) \leq \varphi(0)$, a household opts for higher education of its child independent of his ability level.

(iii) If $u(c_0^H, 0, x_0) > \varphi(A)$, no household opts for higher education of their child.

Proof: As $a \to 0$, since $q_H \to 0$ (from (6)), $\varphi(a) \to \varphi(0)$. Since $\varphi(a)$ is a continuous monotonically increasing function over $[0, A]$ from lemma 1 and $u(c_0^H, 0, x_0) > 0$ but independent of a, if $\varphi(0) < u(c_0^H, 0, x_0) < \varphi(A)$ from (9) the statement of the first part of the observation follows.

If $u(c_0^H, 0, x_0) \leq \varphi(0)$, for all values of a in $[0, A]$, $\varphi(a) > u(c_0^H, 0, x_0)$. Therefore, the statement of the second part of the observation follows from (9).

If $u(c_0^H, 0, x_0) > \varphi(A)$, for all values of a in $[0, A]$, $\varphi(a) < u(c_0^H, 0, x_0)$. Therefore, the statement of the third part of the observation follows from (9). □

Part (ii) of Observation 2 states that there exist situations where all households who independent of ability of their child send the child to higher education. Similarly, part (iii) suggests that there are situations where no household sends its child to higher education. However, since the objective of the present paper is to analyse the factors behind enrolment at higher education, in what follows, we assume, $\varphi(0) < u(c_0^H, 0, x_0) < \varphi(A)$ and the first part of Observation 2 applies.

Assumption 2: At all values of $(c_0^H, q_S, c_1^G, \delta, \gamma, x_0)$, $\varphi(0) < u(c_0^H, 0, x_0) < \varphi(A)$ holds.

Now, we discuss the household's decision at $t = 0$.

$\underline{t = 0}$

Here, a household faces two options: either to send the child to the school by investing $c_0^H > 0$ or to send the child to the unskilled labour market where she earns $\underline{w}$. While deciding about its choice of $c_0^H > 0$, the household realizes that the action would take it to the decision node at $t = 1$, where, as observation 2 suggests a child with ability $a \geq \bar{a}$ is sent for higher education and v_{SH} is obtained; and a child with $a < \bar{a}$ is not sent for higher education and v_{S0} is obtained. Therefore, the household takes account of the ability level of its child along with v_{SH} and v_{S0} while evaluating its options at $t = 0$. We discuss the options separately below.

Option 1: $c_0^H = 0$.

Since the household does not invest in school education, its choice is limited in deciding only the value of x_0 that maximizes $u(0,0,x_0) + y_1$ subject to the budget constraint $x_0 \leq y_0 + \underline{w}$. Clearly, the household chooses $x_0 = y_0 + \underline{w}$ and generates indirect utility of

$$v_{NS} = u(0,0,y_0 + \underline{w}) + y_1. \quad \text{……………. (11)}$$

Notice that, v_{NS} is unresponsive to the ability of the child.

Option 2: $c_0^H > 0$.

Case1: $a \geq \bar{a}$.

The household chooses $\{c_0^H, x_0\}$ to maximize v_{SH} as in (7) subject to the budget constraint: $x_0 + c_0^H \leq y_0$. Notice that, v_{SH} is non-monotonic either in c_0^H or in x_0. Therefore, the budget constraint in consideration may either be binding or non-binding for this maximization problem. Since in our context the qualitative results are similar in either of the cases, without loss of generality we proceed with the case under which the constraint is binding i.e. $x_0 + c_0^H = y_0$. For interior solutions for both c_0^H and x_0, applying (5), the first order conditions for maximization are:

$$\frac{\partial u}{\partial c_0^H}(c_0^H) + \frac{\partial q_S}{\partial c_0^H}\left(\mu(1-\delta) + \delta\gamma . \frac{\partial q_H}{\partial q_S}\right) = 1 + r + \lambda; \quad \text{………………………. (12)}$$

$$\frac{\partial u}{\partial x_0}(x_0) = 1 + r + \lambda; \quad \text{…………………………………(13)}$$

and

$$x_0 + c_0^H = y_0. \quad \text{………………………………..………..(14)}$$

where $\lambda > 0$ stands for the value of Lagrange multiplier.

Equations (12), (13) and (14) are solved for $c_0^H(c_0^G, a, c_1^G, \delta, \gamma, r, \mu) > 0$ and $x_0(c_0^G, a, c_1^G, \delta, \gamma, r, \mu) > 0$.

Observation 3: $\frac{dc_0^H}{da} > 0, \frac{dc_0^H}{dc_1^G} > 0, \frac{dc_0^H}{dc_0^G} > 0, \frac{dc_0^H}{dr} < 0, \frac{dc_0^H}{d\delta} >< 0, \frac{dc_0^H}{d\gamma} > 0, \frac{dc_0^H}{d\mu} > 0.$

Proof: From (12), (13) and (14) by application of (5).

Substituting $c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu)$ and $x_0(a, c_1^G, c_0^G, \delta, \gamma, r, \mu)$ in equation (2), the equilibrium value of q_S is derived as

$$\bar{q}_S = aT(Q_H)[\alpha_0(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu))^{\rho_0} + \beta_0(c_0^G)^{\rho_0}]^{\frac{1}{\rho_0}}. \quad (15)$$

Observation 4: $\frac{\partial \bar{q}_S}{\partial c_0^G} > 0, \frac{\partial \bar{q}_S}{\partial a} > 0, \frac{\partial \bar{q}_S}{\partial c_1^G} > 0, \frac{\partial \bar{q}_S}{\partial r} < 0, \frac{\partial \bar{q}_S}{\partial \delta} >< 0, \frac{\partial \bar{q}_S}{\partial \gamma} > 0, \frac{\partial \bar{q}_S}{\partial Q_H} > 0, \frac{\partial \bar{q}_S}{\partial \mu} > 0$

Proof: Follows from Equation (2) by application of Observation 3.

Observation 3 characterizes the parametric changes in household investment in school education of a child and Observation 4 characterizes the corresponding changes in his quality of school education. Notice that except the rate of interest r and the probability of securing a skilled job δ, all the other parameters in the model unambiguously raises the marginal benefit of investing in school education for the household. It follows from complementarity of investments that household investment rises in tune with public investment in school education. Like Observation 1, here also, higher the ability of the child, greater is the incentive of the parents to invest in his school education. On the other hand, responsiveness of skilled and semi-skilled wages to quality of school education determines how household investment in school education responds to change in probability of getting a skilled job. If $\gamma \frac{\partial q_H}{\partial q_S} > \mu$, then it rises with a rise in δ. Otherwise falls. The effect works through a rise in expected value of x_1. If $\gamma \frac{\partial q_H}{\partial q_S} > \mu$, with an increase in δ, the prospect of realizing a higher period 1 consumption rises, which incentivises parents to invest more in school education of their child. A rise in interest rate has a negative impact on household investment in schooling. The greater spending on school education leaves a lower amount of savings to carry in the next period. This adversely affects the quality of higher education of the child and reduces the effectiveness of expenditure on school education.

Substituting $c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu)$, $x_0(a, c_1^G, c_0^G, \delta, \gamma, r, \mu)$ and $\bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu)$ in (7), we obtain the reduced form value of v_{SH} as:

$$\bar{v}_{SH} =$$

$$u\begin{pmatrix} c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), a, c_1^G, \delta, \gamma), \\ x_0(a, c_1^G, c_0^G, \delta, \gamma, r, \mu) \end{pmatrix} +$$

$$y_1 + \underline{w} + \delta\gamma q_H(a, \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S, a, c_1^G, \delta, \gamma), c_1^G) +$$

$$(1-\delta)\mu\bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu) -$$

$$c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), a, c_1^G, \delta, \gamma)$$

………………………(16)

Comparing equations $\bar{v}_{SH}$ and v_{NS} from equations (16) and (11) respectively we get:

$$\bar{v}_{SH} - v_{NS} = \psi(a) - u(0,0, y_0 + \underline{w})$$ …………………….. (17)

where, $\psi(a) =$

$$u\begin{pmatrix} c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), a, c_1^G, \delta, \gamma), \\ x_0(a, c_1^G, c_0^G, \delta, \gamma, r, \mu) \end{pmatrix} +$$

$$\underline{w} + \delta\gamma q_H(a, \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S, a, c_1^G, \delta, \gamma), c_1^G) + (1 -$$

$$\delta)\mu\bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu) - c_1^H(c_0^H(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), \bar{q}_S(a, c_1^G, c_0^G, \delta, \gamma, r, \mu), a, c_1^G, \delta, \gamma).$$

…………………………(18)

Lemma 2: $\psi(a)$ is a monotonically increasing continuous function of a in the range $[\bar{a}, A]$.

Proof: Follows from Equation (18) and (16) that

$$\psi'(a) = \frac{\partial \bar{v}_{SH}}{\partial a} = \mu(1-\delta).\frac{\partial \bar{q}_S}{\partial a} + \gamma\delta.\frac{\partial q_H}{\partial a} + \gamma\delta.\frac{\partial q_H}{\partial q_S}.\frac{\partial \bar{q}_S}{\partial a} > 0. \qquad \square$$

Observation 5: (i) If $\psi(\bar{a}) \geq u(0,0,y_0 + \underline{w})$, all the children with their ability level $a \geq \bar{a}$ are sent to school and higher education.

(ii) If $\psi(\bar{a}) < u(0,0,y_0 + \underline{w}) < \psi(A)$, there exists a threshold of ability level $\hat{a} \in (\bar{a}, A]$ such that all the children with $a \geq \hat{a}$ are sent to school and higher education; the children with $\bar{a} \leq a < \hat{a}$ are not sent to school and higher education.

(iii) If $u(0,0,y_0 + \underline{w}) > \psi(A)$, no children with their ability level $a \geq \bar{a}$ are sent to school and higher education.

Proof: A child with $a \geq \bar{a}$ is sent to higher education if and only if $\bar{v}_{SH} \geq v_{NS}$ i.e. $\psi(a) \geq u(0,0,y_0 + \underline{w})$. Since from Lemma 2, $\psi(a)$ is continuous and monotonically rising in a for all values of $a \in [\bar{a}, A]$, if $\psi(\bar{a}) \geq u(0,0,y_0 + \underline{w})$, it must be true that $\psi(a) \geq u(0,0,y_0 + \underline{w})$ for all values of $a \in [\bar{a}, A]$. Therefore, the first part of the observation follows. However, if $\psi(\bar{a}) < u(0,0,y_0 + \underline{w}) < \psi(A)$, lemma 2 implies that there exists a threshold of ability level $\hat{a} \in (\bar{a}, A]$ and for all $a \geq \hat{a}$, $\psi(a) \geq u(0,0,y_0 + \underline{w})$ holds. For all values of $a < \hat{a}$, $\psi(a) < u(0,0,y_0 + \underline{w})$ holds. Therefore, the second part of the observation follows. Similar argument follows for the third part of the observation as well. $\square$

Case 2: $a < \bar{a}$.

The household chooses $\{c_0^H, x_0\}$ to maximize v_{S0} as in (8) subject to the budget constraint: $x_0 + c_0^H \leq y_0$. Notice that, v_{S0} is non-monotonic either in c_0^H or in x_0. Therefore, the budget constraint in consideration may either be binding or non-binding for this maximization problem. Since in our context the qualitative results are similar in either of the cases, without loss of generality we proceed with the case under which the constraint is binding i.e. $x_0 + c_0^H = y_0$. For interior solutions for both c_0^H and x_0, the first order conditions for maximization are:

$$\frac{\partial u}{\partial c_0^H}(c_0^H, 0, x_0) + \mu \frac{\partial q_S}{\partial c_0^H} = 1 + r + \theta; \quad \ldots\ldots(19)$$

$$\frac{\partial u}{\partial x_0}(c_0^H, 0, x_0) = 1 + r + \theta; \quad \ldots\ldots(20)$$

and

$$x_0 + c_0^H = y_0 \quad \ldots\ldots(21)$$

where θ is the Lagrange multiplier. Equations (19), (20) and (21) are solved for: $c_0^H(a, c_0^G, \mu, r)$ and $x_0(a, c_0^G, \mu, r)$.

Observation 6: $\frac{dc_0^H}{da} > 0, \frac{dc_0^H}{dc_0^G} > 0, \frac{dc_0^H}{dr} < 0, \frac{dc_0^H}{d\mu} > 0.$

Proof: Follows from equations (19), (20) and (21) above. □

Substituting $c_0^H(a, c_0^G, r, \mu)$ and $x_0(a, c_0^G, r, \mu)$ in equation (2), the equilibrium value of q_S is solved from the following equation:

$$\tilde{q}_S = aT(Q_H)[\alpha_0(c_0^H(a, c_0^G, r, \mu))^{\rho_0} + \beta_0(c_0^G)^{\rho_0}]^{\frac{1}{\rho_0}}. \quad \ldots\ldots(22)$$

Observation 7: $\frac{\partial \tilde{q}_S}{\partial c_0^G} > 0, \frac{\partial \tilde{q}_S}{\partial a} > 0, , \frac{\partial \tilde{q}_S}{\partial r} < 0, \frac{\partial \tilde{q}_S}{\partial \mu} > 0, \frac{\partial \tilde{q}_S}{\partial Q_H} > 0.$

Proof: Follows from Equation (2) by application of Observation 6.

Unlike case 1 where $a \geq \bar{a}$, here, since the household does not send its child to higher education, the public investment in higher education does not have any bearing on the household investment on school education. Though Q_H gets positively affected by public investment in higher education, the individual households in their decision-making takes Q_H as given and does not internalize the impact of their behaviour on Q_H. The household investment however gets positively affected by the child's ability, public investment in school education and responsiveness of semi-skilled wage to quality of school education. Consequently, the schooling quality of the child also improves. On the other hand, higher market rate of interest incentivizes the household in spending less on school education of the child and the quality of his school education gets adversely affected.

A reduced form value of indirect utility is obtained by plugging $c_0^H(a, c_0^G, \mu, r)$ and $x_0(a, c_0^G, \mu, r)$ into equation (8) as:

$\bar{v}_{S0} = u(c_0^H(a, c_0^G, \mu, r), 0, x_0(a, c_0^G, \mu, r)) + y_1 + w_I(q_S(a, c_0^H(a, c_0^G, \mu, r), c_0^G), a)$…….. (23)

Comparing $\bar{v}_{S0}$ and v_{NS} we obtain

$\bar{v}_{S0} - v_{NS} = \tau(a) - u\big(0,0, y_0 + \underline{w}\big)$ ……………………………………….(24)

where $\tau(a) = u(c_0^H(a, c_0^G, \mu, r), 0, x_0(a, c_0^G, \mu, r)) + w_I(q_S(a, c_0^H(a, c_0^G, \mu, r), c_0^G), a)$.

Lemma 3: $\tau(a)$ is monotonically increasing continuous function of a in the range $[0, \bar{a})$.

Proof: Using equation (11), equation (24) can be written as: $(a) = \bar{v}_{S0} - y_1$. Therefore, by using (19) and (20) we obtain: $\tau'(a) = \frac{\partial \bar{v}_{S0}}{\partial a} = \mu . \frac{\partial \tilde{q}_S}{\partial a} > 0$ that follows from observation 7. The statement of the lemma follows. □

Observation 8: (i) If $\tau(\bar{a}) > u(0,0, y_0 + \underline{w}) \geq \tau(0)$, there exists an ability level $\tilde{a} \in [0, \bar{a})$ such that all the children with their ability level $a \geq \tilde{a}$ are sent to school. The children with $a < \tilde{a}$ are not sent to school.

(ii) If $\tau(\bar{a}) \geq \tau(0) \geq u(0,0, y_0 + \underline{w})$, every child with their ability in $[0, \bar{a})$ is sent to school.

(iii) If $\tau(\bar{a}) < u(0,0, y_0 + \underline{w})$, no children with their ability in $[0, \bar{a})$ is sent to school.

Proof: A child with $a < \bar{a}$ is sent to school if and only if $\bar{v}_{S0} \geq v_{NS}$ i.e. $\tau(\bar{a}) \geq u(0,0, y_0 + \underline{w})$. Since $u(0,0, y_0 + \underline{w}) > 0$ and independent of a, lemma 3 implies if $\tau(\bar{a}) > u(0,0, y_0 + \underline{w}) \geq \tau(0)$ holds, there must exist a value of a in $[0, \bar{a})$ such that $\tau(\tilde{a}) = u(0,0, y_0 + \underline{w})$ holds. The first part of the statement of the observation follows.

The proof of second and third part of the observation also follows from application of lemma 3. □

Observation 8 identifies the situations when a child who is not sent to higher education, is also not sent to school.

Lemma 4: (i) $\psi(\bar{a}) = \tau(\bar{a})$;

(ii) $\psi'(\bar{a}) > \tau'(\bar{a})$;

Proof: Under assumption 2, from observation 2 we know that given $(c_0^H, q_S, c_1^G, \delta, \gamma, x_0)$, $\bar{a}(c_0^H, q_S, c_1^G, \delta, \gamma, \mu, x_0) \in [0, A]$ solves $\varphi(\bar{a}) = u(c_0^H, 0, x_0)$ and at $\bar{a}, v_{S0} = v_{SH}$ holds. So, at $(c_0^H(a, c_0^G, \mu, r),\ x_0(a, c_0^G, \mu, r))$ it must be $\bar{v}_{S0} = \bar{v}_{SH}$. Therefore, the statement of the first part of the lemma follows from equations (18) and (24).

Given assumption 2, the second part of the proposition follows from (18) and (24) as well.

III.2. The Enrolment Profile

Observation 2, 5, 8 and lemma 4 discussed in the section above allows us to identify three different enrolment profile that may exist at different stages of education in such an economy. We describe them below.

<u>Profile 1</u>: $\psi(\bar{a}) = \tau(\bar{a}) \geq u(0,0,y_0 + \underline{w}) \geq \tau(0)$.

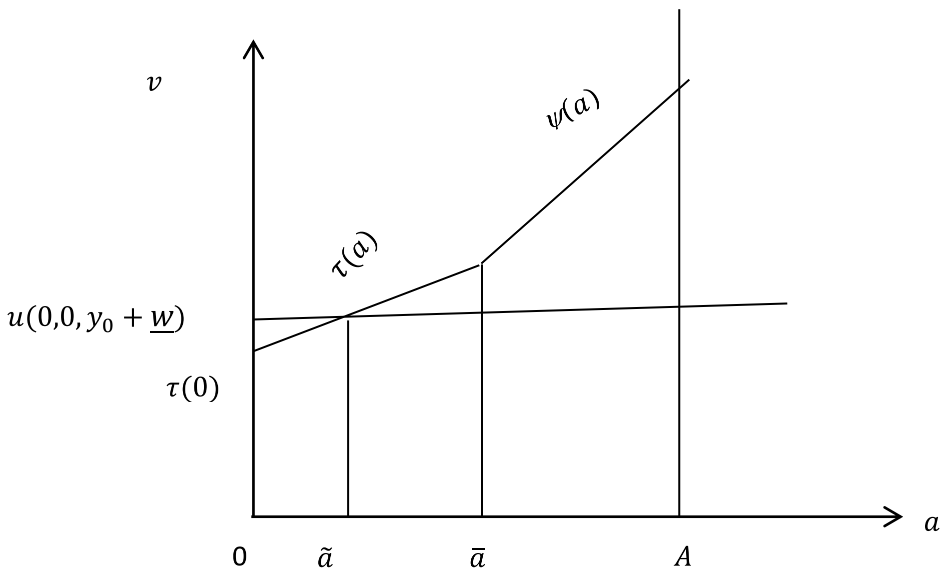

Figure 3: Enrolment structure in profile 1

Since the ability is distributed uniformly in $[0, A]$, with this profile the school enrolment is given by $E_S^1 = \frac{A-\tilde{a}}{A} = 1 - \frac{\tilde{a}}{A}$ and the enrolment in higher education is given by $E_H^1 = \frac{A-\bar{a}}{A} = 1 - \frac{\bar{a}}{A} < 1 - \frac{\tilde{a}}{A}$. The households with ability of their child lying in the range $[0, \tilde{a})$ do not send their child to school. The number of individuals in the economy who joins the unskilled labour market as child labour is given by $\frac{\tilde{a}}{A}$. Notice that profile 1 replicates the equilibrium that is observed mostly in the developing countries of the world since child labour exists in the economy and the number of children enrolled in higher education is lower than the number of children enrolled in school education[9].

The quality of higher education is given by $Q_H^1 = \int_{\bar{a}}^{A} q_H da$.

Profile 2: $\psi(A) > u\left(0,0, y_0 + \underline{w}\right) > \psi(\bar{a}) = \tau(\bar{a})$.

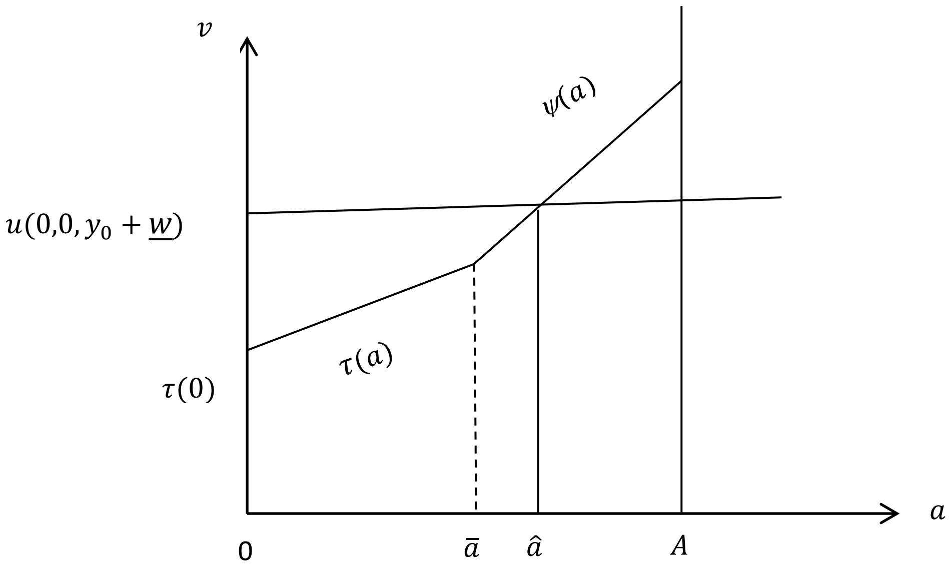

Figure 4: Enrolment structure in Profile 2

With this profile both the school education and higher education enrolment is the same and given by $E_S^2 = E_H^2 = \frac{A-\hat{a}}{A} = 1 - \frac{\hat{a}}{A}$. The households with ability of their child lying in the range $[0, \hat{a})$ do not send their child to school. The number of individuals in the economy who joins the unskilled labour market as child labour is given by $\frac{\hat{a}}{A}$. Since there is no post-school drop-outs, no one joins the semi-skilled labour market and such a market does not exist.

The quality of higher education is given by $Q_H^2 = \int_{\hat{a}}^{A} q_H da$.

[9] See footnote 1 for the Indian data.

This profile seems to be a mis-match either with the developing country equilibrium or the developed country equilibrium. Therefore, we do not discuss this profile any further.

Profile 3: $\psi(\bar{a}) = \tau(\bar{a}) \geq \tau(0) \geq u\big(0,0,y_0 + \underline{w}\big)$

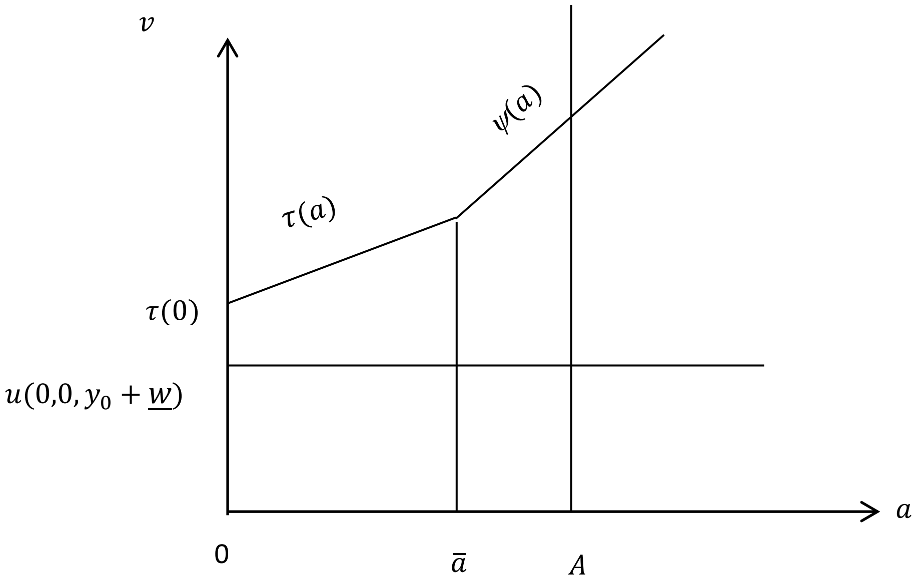

Figure 5: Enrolment structure in Profile 3

In this profile all the households send their child to school. Child labour and unskilled labour market does not exist. The school enrolment is given by $E_S^3 = 1$ and the enrolment in higher education is given by $E_H^3 = \frac{A-\bar{a}}{A} = 1 - \frac{\bar{a}}{A}$. Notice that profile 3 replicates the equilibrium that is observed mostly in the developed countries of the world since every child is sent to school.

The quality of higher education is given by $Q_H^3 = \int_{\bar{a}}^{A} q_H da$.

III.3. Results: Comparative Static with respect to c_0^G and c_1^G

Proposition 1: *If* $\psi(\bar{a}) = \tau(\bar{a}) \geq u\big(0,0,y_0 + \underline{w}\big) \geq \tau(0)$ *and*

(i) *public expenditure on either of school education infrastructure increases, enrolment in school rises. However, enrolment in higher education rises (falls) if* $\gamma.\frac{\partial q_H}{\partial q_S} > (<)\ \mu$.

(ii) *public expenditure on either of higher education infrastructure increases, enrolment in school rises. However, enrolment in higher education rises if* $\gamma.\frac{\partial q_H}{\partial q_S} > \mu$. *If* $\gamma.\frac{\partial q_H}{\partial q_S} < \mu$, *enrolment in higher education rises (falls) if and only if* $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] > (<)0$.

Proof: *If* $\psi(\bar{a}) = \tau(\bar{a}) \geq u\left(0,0,y_0 + \underline{w}\right) \geq \tau(0)$, the enrolment profile 1 occurs. Therefore,

$$\frac{dE_S^1}{dc_0^G} = -\frac{1}{A}\left(\frac{d\tilde{a}}{dc_0^G}\right); \tag{25}$$

and

$$\frac{dE_H^1}{dc_0^G} = -\frac{1}{A}\left(\frac{\partial \bar{a}}{\partial c_0^G}\right). \tag{26}$$

From Observation 8 and equation (24) it follows:

$$\frac{d\tilde{a}}{dc_0^G} = -\frac{\frac{d\bar{v}_{S0}}{dc_0^G}}{\frac{d\bar{v}_{S0}}{da}} = -\frac{\mu\frac{\partial \tilde{q}_S}{dc_0^G}}{\frac{d\bar{v}_{S0}}{da}}. \tag{27}$$

Since, $\frac{\partial \tilde{q}_S}{dc_0^G} > 0$ from observation 7 and $\frac{d\bar{v}_{S0}}{da} = \tau'(a) > 0$, from equation (27) above $\frac{d\tilde{a}}{dc_0^G} < 0$. It follows from equation (25) that $\frac{dE_S^1}{dc_0^G} > 0$.

Observation 2 and equation (9) suggests that

$$\frac{d\bar{a}}{dc_0^G} = \frac{\frac{d\bar{v}_{S0}}{dc_0^G} - \frac{d\bar{v}_{SH}}{dc_0^G}}{\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a}} = -\frac{\delta.\frac{\partial \bar{q}_S}{\partial c_0^G}\left[\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right] + \mu\left[\frac{\partial \bar{q}_S}{\partial c_0^G} - \frac{\partial \tilde{q}_S}{\partial c_0^G}\right]}{\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a}}. \tag{28}$$

The existence of $\bar{a}$ requires that $\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a} > 0$. In the numerator of (28) if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu > 0$, $\frac{\partial \bar{q}_S}{\partial c_0^G} - \frac{\partial \tilde{q}_S}{\partial c_0^G} > 0$ and if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu < 0$, $\frac{\partial \bar{q}_S}{\partial c_0^G} - \frac{\partial \tilde{q}_S}{\partial c_0^G} < 0$[10]. The statement of the first part of the proposition follows.

Similarly,

$$\frac{dE_S^1}{dc_1^G} = -\frac{1}{A}\left(\frac{d\tilde{a}}{dc_1^G}\right); \tag{29}$$

and

$$\frac{dE_H^1}{dc_1^G} = -\frac{1}{A}\left(\frac{\partial \bar{a}}{\partial c_1^G}\right). \tag{30}$$

From Observation 8 and equation (24) it follows:

$$\frac{d\tilde{a}}{dc_1^G} = -\frac{\frac{d\bar{v}_{S0}}{dc_1^G}}{\frac{\partial \bar{v}_{S0}}{\partial a}} = -\frac{\mu\frac{\partial \tilde{q}_S}{\partial Q_H}\frac{\partial Q_H}{\partial c_1^G}}{\frac{\partial \bar{v}_{S0}}{\partial a}}. \tag{31}$$

Since, $\frac{\partial Q_H}{\partial c_1^G} > 0$ and $\frac{\partial \tilde{q}_S}{\partial Q_H} = a\,T'\left[\alpha_0\left(c_0^{H^*}|_{c_1^H=0}\right)^{\rho_0} + \beta_0(c_0^G)^{\rho_0}\right]^{\frac{1}{\rho_0}} > 0$, from equation (27) above $\frac{d\tilde{a}}{dc_1^G} < 0$. It follows from equation (25) that $\frac{dE_S^1}{dc_1^G} > 0$.

Observation 2 and equation (9) suggests that

$$\frac{\partial \bar{a}}{\partial c_1^G} = \frac{\frac{d\bar{v}_{S0}}{dc_1^G} - \frac{d\bar{v}_{SH}}{dc_1^G}}{\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a}} = \frac{-\frac{\partial Q_H}{\partial c_1^G}[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)] - \delta\gamma.\frac{\partial q_H}{\partial c_1^G}}{\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a}} \tag{32}$$

---

[10] From Equations (12) and (13), Let $MRS_{c_0^H,x_0}{}^1 = \frac{\left[\frac{\partial u}{\partial c_0^H}(c_0^H) + \frac{\partial q_S}{\partial c_0^H}\left(\mu(1-\delta) + \delta\gamma.\frac{\partial q_H}{\partial q_S}\right)\right]}{\frac{\partial u}{\partial x_0}} = 1$; and from Equations (19) and (20) $MRS_{c_0^H,x_0}{}^2 = \frac{\left[\frac{\partial u}{\partial c_0^H}(c_0^H) + \mu\frac{\partial q_S}{\partial c_0^H}\right]}{\frac{\partial u}{\partial x_0}} = 1$. If $\gamma.\frac{\partial q_H}{\partial q_S} > \mu$, $MRS_{c_0^H,x_0}{}^1$ is steeper at the latter's optimum. Therefore, $c_0^{H^*}|_{c_1^H>0} > c_0^{H^*}|_{c_1^H=0}$. Therefore, $\frac{\partial \bar{q}_S}{\partial c_0^G} = \bar{a}\left[\alpha_0\left(c_0^{H^*}|_{c_1^H>0}\right)^{\rho_0} + \beta_0(c_0^G)^{\rho_0}\right]^{\frac{1}{\rho_0}-1}\beta_0(c_0^G)^{\rho_0-1} > \frac{\partial \tilde{q}_S}{\partial c_0^G} = \bar{a}\left[\alpha_0\left(c_0^{H^*}|_{c_1^H=0}\right)^{\rho_0} + \beta_0(c_0^G)^{\rho_0}\right]^{\frac{1}{\rho_0}-1}\beta_0(c_0^G)^{\rho_0-1}$. The opposite happens if $\gamma.\frac{\partial q_H}{\partial q_S} < \mu$.

where, $\frac{\partial \bar{q}_S}{\partial Q_H} = a\,T'\left[\alpha_0\left(c_0^{H^*}|_{c_1^H>0}\right)^{\rho_0} + \beta_0(c_0^G)^{\rho_0}\right]^{\frac{1}{\rho_0}} > 0$. Since, $\frac{\partial \bar{v}_{SH}}{\partial a} - \frac{\partial \bar{v}_{S0}}{\partial a} > 0$, $\frac{\partial q_H}{\partial c_1^G} > 0$ from equation (1), $\frac{\partial Q_H}{\partial c_1^G} > 0$, if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu > 0$, $\frac{\partial \bar{q}_S}{\partial c_0^G} - \frac{\partial \tilde{q}_S}{\partial c_0^G} > 0$ and if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu < 0$, $\frac{\partial \bar{q}_S}{\partial c_0^G} - \frac{\partial \tilde{q}_S}{\partial c_0^G} < 0$, from equation (32) above $\frac{\partial \bar{a}}{\partial c_1^G} < 0$ if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu > 0$. If $\gamma.\frac{\partial q_H}{\partial q_S} - \mu < 0$, $\frac{\partial \bar{a}}{\partial c_1^G} > 0$ if and only if $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] < 0$; $\frac{\partial \bar{a}}{\partial c_1^G} < 0$ if and only if $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] > 0$. The statement of the second part of the proposition follows from equation (30) above.

□

As the government increases infrastructural investment in school, the quality of school education rises which boosts up the return of a child from joining either of the semi-skilled labour market or the high skilled labour market. Therefore, the households at the margin sends the child to school rather than sending him to the unskilled labour market where he earns the minimum wage $\underline{w}$. However, the choice of enrolling the child at higher education depends on responsiveness of the mark-up return in the higher education sector to quality of school education (i.e. $\gamma.\frac{\partial q_H}{\partial q_S}$). If the return is sufficiently responsive, higher than the responsiveness of the mark-up return at the semi-skilled labour market (i.e. μ), the enrolment in higher education rises. Otherwise, the enrolment in higher education falls. The same argument applies for an increase in investment in higher education infrastructure. As the investment in higher education infrastructure increases the quality of higher education rises and the teaching quality at schools improves. This leads to rise in quality of school education which raises the school enrolment. But the enrolment decision in higher education depends on the responsiveness of mark-up in higher education vis-a-vis the semi-skilled labour market to quality of school education as intuitively explained above.

As the infrastructural investment in higher education increases, two different effect comes into play: a direct effect that works through the rise in the quality of higher education and an indirect effect that works through the rise in quality of school education. If $\gamma.\frac{\partial q_H}{\partial q_S} > \mu$, the direct effect and indirect effect works in the same direction. If $\gamma.\frac{\partial q_H}{\partial q_S} < \mu$, the two effects may work in the opposite direction. If $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] > 0$ the direct effect dominates the indirect effect and enrolment in higher education rises. The opposite happens if $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] < 0$. Those households who send their child to the higher education invests relatively less in school education compared to those households who send their child to semi-skilled labour market after schooling. Consequently, the improved teaching quality fails to improve the quality of higher education if the former dominates the later. If the direct effect of rise in higher education quality fails to compensate for this loss, the enrolment in higher education falls. So, proposition 1 points out that in developing countries there are circumstances where increase in infrastructure investment in higher education paradoxically fails to improve enrolment in higher education.

Corollary 1: *If* $\psi(\bar{a}) = \tau(\bar{a}) \geq u\left(0,0,y_0 + \underline{w}\right) \geq \tau(0)$, increase in public investment either in school education or in higher education can definitely reduce the incidence of child labour but can never eradicate it.

Proof: Follows from proposition 1 and the discussion above and from the fact that $\tau(0)$ is independent of either c_0^G and c_1^G. □

Corollary 2: A government facing budget constraint in education, if raises its investment in school education and reduces its investment in higher education, the school enrolment may fall.

Proof: Follows from Proposition 1. □

Proposition 2: *If* $\psi(\bar{a}) = \tau(\bar{a}) \geq \tau(0) \geq u(0,0,y_0 + \underline{w})$ *and*

(i) *public expenditure on either of school education infrastructure increases, enrolment in higher education rises (falls) if* $\gamma.\frac{\partial q_H}{\partial q_S} > (<)\ \mu$.

(ii) *public expenditure on either of higher education infrastructure increases, enrolment in higher education rises if* $\gamma.\frac{\partial q_H}{\partial q_S} > \mu$. *If* $\gamma.\frac{\partial q_H}{\partial q_S} < \mu$, *enrolment in higher education rises (falls) if and only if* $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta\frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma.\frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma.\frac{\partial q_H}{\partial c_1^G}\right] > (<)0.$

Proof: *If* $\psi(\bar{a}) = \tau(\bar{a}) \geq \tau(0) \geq u(0,0,y_0 + \underline{w})$, the enrolment profile 3 occurs. Therefore,

$$\frac{dE_H^3}{dc_0^G} = -\frac{1}{A}\left(\frac{\partial \bar{a}}{\partial c_0^G}\right). \qquad (33)$$

From equation (28) we know $\frac{d\bar{a}}{dc_0^G} > (<)\ 0$ if and only if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu < (>)0$. Therefore, from equation (33) the statement of the first part of the proposition follows.

Similarly,

$$\frac{dE_H^3}{dc_1^G} = -\frac{1}{A}\left(\frac{\partial \bar{a}}{\partial c_1^G}\right). \qquad (34)$$

From equation (32) we know $\frac{d\bar{a}}{dc_1^G} < 0$ if and only if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu > 0$. Therefore, from equation (34) if $\gamma.\frac{\partial q_H}{\partial q_S} - \mu > 0$, $\frac{dE_S^3}{dc_1^G} = \frac{dE_H^3}{dc_1^G} > 0$. If $\gamma.\frac{\partial q_H}{\partial q_S} - \mu < 0$, $\frac{\partial \bar{a}}{\partial c_1^G} > 0$ if and only if

$\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta \frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma . \frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma . \frac{\partial q_H}{\partial c_1^G}\right] < 0$; $\frac{\partial \bar{a}}{\partial c_1^G} < 0$ if and only if $\left[\frac{\partial Q_H}{\partial c_1^G}\left[\mu\left(\frac{\partial \bar{q}_S}{\partial Q_H} - \frac{\partial \tilde{q}_S}{\partial Q_H}\right) + \delta \frac{\partial \bar{q}_S}{\partial Q_H}\left(\gamma . \frac{\partial q_H}{\partial q_S} - \mu\right)\right] + \delta\gamma . \frac{\partial q_H}{\partial c_1^G}\right] > 0$. The statement of the second part of the proposition follows from equation (34) above.

□

Proposition 2 refers to a developed country equilibrium where the problem of child labour does not exist; all the children are sent to school. Therefore, the public investment in school or higher education infrastructure has no effect on school enrolment. The higher education enrolment, however, responds in the same way to these investments as in the case of developing countries discussed above. Proposition 2 therefore refutes the result proposed by Hidalgo-Hidalgo and Ormaetxe (2012) that a balanced budget increase in public investment in school education necessarily increases higher education enrolment in the developed economies.

CHAPTER IV

Conclusions and Future Scope of Work

One of the many intents of the government regarding educational outcomes is an appraisal of enrolment rates in different educational levels. Especially in higher education, with staggering enrolment rates, the impact of government intervention is seriously felt. Though in the last few years, Gross Enrolment Ratio (GER) in India rose from 20.8% in 2011-12 to 24.5% in 2015-16, it is still low and needs to be addressed. The prevailing incidence of child labour is also a cause of concern.

The thesis presents a two-period career choice model of households for their child which allocates resources between two levels of education, school and higher education. The government contemplates household behaviour regarding their educational investment choices for their children and adopts measures accordingly to increase enrolment in schools and higher education institutions. The model considers a general CES production function to accommodate the property of complementarity between the household and infrastructural inputs in the production functions, which are in the form of investments (Majumdar (1983)). The model has also accounted for the path dependence between subsequent stages of education, with school quality affecting higher education quality. The only source of differentiation among households is the ability of their child, on which they have private information. The households take their educational investment decision based on ability of their child, the labour market return to different stages of education and the value the education generates for the household. At the equilibrium the model generates two enrolment profiles which replicates the reality of the developing countries and the developed countries. In the first, the children below a threshold ability level are not sent to school and are sent to unskilled labour market as child labour where they earn the minimum wage. The children above certain threshold are enrolled in both school and higher education who after completion of education with certain probability gets absorbed in high skilled labour market offering a wage premium over unskilled or semi-skilled labour market. The children with their ability level between the above thresholds after school education joins the semi-skilled labour market. In the second, the child labour does not exist. The children with all ability levels are sent to school. But only a fraction of them gets enrolled in higher education. The government is able to manipulate its infrastructural investment allocation between different stages of education and change these thresholds to meet its objective of higher enrolment.

The work finds that in developing economies increase in government expenditure either on school education or in higher education unambiguously raises enrolment in school; however, the net effect on higher education enrolment is not so clear. It crucially depends on the responsiveness of higher education quality to school education quality. If the responsiveness is low, an increase in infrastructural investment in either school or higher education may not have the desired result of increased higher education enrolment[11]. Also, when the government balances the budget between school and higher education, under certain instances, a rise in school education expenditure may result in a fall in school enrolment. Another stark observation that comes out of the model is, child labour can never be completely obliterated by governmental investment in education. However, it may be substantially reduced. In the context of developed economies, the results of the model refute the proposition by Hidalgo-Hidalgo and Ormaetxe (2012) that a balanced budget increase in public investment in school education necessarily increases higher education enrolment.

The present work can be extended in many directions. First, presently the model concentrates only on the supply side of the three different kinds of labour market mentioned

[11] Refer to Footnote 5.

above. Once the demand side is brought in, one can analyse the effect of demand side shock like the changing profile of Foreign Direct Investment on educational enrolment in an economy. Second, the model can be modified to discuss the issues of skill-mismatch at the labour market. Third, the model can be used to study the possible impact of policies like Universal Basic Income on educational enrolment and labour markets. Fourth, some results of the model crucially depend on sensitivity of higher education quality to school education quality, which can be measured empirically. Fifth, the model assumes the child's ability is private information to the households which may not be true in reality. The assumption can be relaxed in a future study. Sixth, in the present model the households ex ante have the same income profile. This assumption can be relaxed to analyse the impact of income inequality of enrolment profile. These remain as agenda for future research.

REFERENCES

Afridi, F. (2011). The Impact of School Meals on school Participation: Evidence from Rural India. *Journal of Development Studies*, 47, 1636-1656.

Arcalean, C., & Schiopu. (2009). Public versus Private investment and Growth in a Hierarchical Education System. *Journal of Economic Dynamics and Control*, 34(4), 604-622.

Banerjee, & Duflo. (2011). *Poor Economics.* Random House India.

Basu, K., & Pham, V. (1998). The Economics of Child Labour. *American Economic Review*, 88(3), 412-27.

Bearse, P., Glomm, G., & Patterson, D. M. (2005). Endogenous Public Expenditure on Education. *Journal of Public Economic Theory*, 7(4), 561-577.

Becker, G. S. (1975). Investment in Human Capital: Effects on Earnings. In G. S. Becker, *Human Capital: A Theoretical and Empirical Analysis with Special Reference to Education* (pp. 13-44). NBER.

Beegle, K., Deheja, R., & Gatti, R. (2009). Why should we care about child labour? - The education, labour market and health consequences of child labour. *Journal of Human Resources*, 44(4), 871-889.

Bharadwaj, Lakhdawala, & Nicholas. (2013). Perverse Consequences of Well Intentioned Regulation: Evidence From India's Child Labour Ban. NBER Working Papers 19602.

Castello-Climent, A., & Hidalgo-Cabrillana, A. (2012). The Role of Educational Quality and Quantity in the Process of Economic Development. *Economics of Education Review*, 31(4), 391-409.

Chattopadhyay, S. (2012). *Education and Economics: Disciplinary Evolution and Policy Discource.* Oxford University Press.

Coleman, J. S. (1966). *Equality of Educational Opportunities.* Oxford, England: US Department of Health, Education and Welfare, Office of Education.

Galor, & Zeira. (1993). Income distribution and Macroeconomics. *The Review of Economic Studies*, 60(10), 35-52.

Ghate, C., Glomm, G., & Stone, S. T. (2014). Public and Private Expenditures on Human Capital: Accumulation in India. (pp. 14-04). New Delhi: Indian Statistical Institute, Planning Unit.

Hanushek, & Kain. (1972). On the Value of Equality of Educational Opportunities as a Guide to Public Policy. In Mosteller, & Moynihan, *On Equality of educational Opportunity* (pp. 116-145). New York: Random House.

Hanushek, E. A. (1971). Teacher Characteristics and Gains in student Achevement: Estimation Using Micro Data. *American Economic Review*, 61(2), 280-288.

Hanushek, E. A. (1979). Conceptual and Empirical Issues in Estimation of Educational Production Functions. *Journal of Human Resources*, 14(3), 351-388.

Hanushek, E. A. (1986). The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of Economic Literature*, 24(3), 1141-1177.

Hanushek, E. A. (2004). The Economics of Schooling: Production and Efficiency in Public Schools. *Journal of economic Literature*, 24(3), 1141-1177.

Hanushek, E. A. (2016). Will more higher education improve economic growth? *Oxford Review of Economic Policy*, pp. 32(4), 538-552.

Hidalgo-Hidalgo, M., & Inigo, I. O. (2012). Should we transfer resources from college to basic education? *Journal of Economics*, 105(1), 1-27.

Jayaraman, R., & Simroth, D. (2011). The Impact of School Lunches in Primary School Enrolment: Evidence from India's Midday Meal Scheme. *The Scandinavian Journal of Economics*, 117(4).

Majumdar, T. (1983). *Investment in education and Social Choice.* Cambridge University Press.

Mincer, J. A. (1958). Investment in Human Capital and Personal Income Distribution. *Journal of Political Economy*, 66(4), 281-302.

Ministry of Finance, Government of India. (2017-18). *Economic Survey.* Oxford University Press.

Ministry of Human Resource and Development. (2016). Educational Statistics at a glance.

Restuccia, D., & Urrutia, C. (2004). Intergenerational Persistence of Earnings: The Role of Early and College Education. *The American Economic Review*, 94(5), 1354-1378.

Schultz, T. W. (1961). Investment in Human Capital. *The American Economic Review*, 51(1), 1-17.

Sen, D. (2018). Assessment of Quality in Higher Education in India. *International Journal of Research in Engineering*, 8(8), 120-122.

Unified District Information System for Education. (2015-16). *School education in India.*