



Economics of Education

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What is economics of education?

- What is economics?
- What is education?
- Economics of education is a branch of economics which uses economic tools to solve educational problems and tackle educational issues.
- Economics of education is one of the branches of ordinary economics, though, it is the study of how educational managers make official or approved choices from scarce available resources which is meant for the realisation of the best possible educational outcomes.



What is economics of education?

- The economics of education is the study of how people and society choose, with or without the use of money, to employ scarce productive resources to produce various types of training, the development of knowledge, skill, mind, character, et cetera – especially by formal schooling – over time and distribute them, now and in future, among various people and group of society.
- There are three decision makers or stakeholders in the educational system. These are (1) The society (2) The institutions or providers (suppliers) of education and (3) Individual or households (purchasers of educational services).



What is economics of education?

- The fundamental challenge of economics of education is how the society, institution and the households make use of the limited human and material resources they have, to best satisfy their unlimited wants for education.
- The solution to the fundamental challenge requires the application of certain economic concepts which we shall deal with in this course.



What is economics of education?

- Educational Resources are Limited: such as men, money, materials are limited in supply and serve as input into the educational system. These inputs include
 - 1. Men (M): teachers, policy makers, non-teaching staff;
 - 2. Materials (M): students (raw materials), teaching and research materials, teaching aids and other equipments;
 - 3. Money (M): cash, cheque and notes;
 - 4. Management (M): policies, plans, programmes, time table and educational laws; and
 - 5. Time.



Historical Context to Economics of Education

- Of course, one can trace economic questions to do with education back to well before this time (for example, the potential importance of education for raising the productive capacity of society was raised by Adam Smith in *The Wealth of Nations* in 1776).
- The origin of the economics of education as a significant field within economics probably dates back to the theoretical and empirical developments made by American economists in the 1960s.
- During this period, a number of highly influential economists (like Gary Becker, Jacob Mincer and Theodore Schultz) conducted major, innovative research applying economics to education questions.



Historical Context to Economics of Education

- Commentators on these origins of the economics of education as an independent field of research refer to Theodore Schultz's presidential address to the 1960 AEA meetings.
- And to the Special Issue of the 1962 *Journal of Political Economy* edited by Schultz entitled 'Investment in Human Beings' as early instances of the start of the rise of the subject.



Historical Context to Economics of Education

- The development of the human capital approach by Becker (1964) in his classic book Human Capital is absolutely central to the economics of education.
- He presented an analytical framework to explain why individuals invest in education and training in a manner analogous to investments in physical capital.
- The resulting human capital theory still forms the basis of, or the starting point, for much research in the economics of education field today.



Historical Context to Economics of Education

- Many new ideas were developed in the field, including theoretical work that challenged the human capital approach (Spence 1973, 1974 and Stiglitz 1975), critical appraisals of the rise of human capital theory (Blaug 1972, 1976) and detailed empirical work on issues like over-education (Freeman 1976) or on private and social rates of return to education (Layard and Psacharopoulos 1974; Psacharopoulos 1973).
- However, after the heyday of the 1960s and 1970s, there was a significant decline, especially outside of the USA. More recently, however, this decline has been reversed and there has been a huge upsurge of interest.



Historical Context to Economics of Education

- This is because *(i)* there have been some significant developments in data provision and quality and this almost certainly has aided and promoted research in the economics of education, and *(ii)* the spillover from other research fields within economics like:
 - the impact of human capital in cross-country growth regressions (e.g. Barro 1991; Krueger and Lindahl 2001):



Historical Context to Economics of Education

- the importance of education/skill in explaining shifts in labour market inequality (e.g. Berman et al. 1998; Katz and Murphy 1992; Machin and Van Reenen 1998);
- the focus on education in development economics (e.g. Duflo 2001; Miguel and Kremer 2004);
- empirical public finance, especially on issues to do with financial resources devoted to schools (Hanushek 1986); and
- the large and rapidly growing literature on intergenerational mobility (see Solon 1999).



Methods used in Economics of Education

- It is evident there is much more 'quasi-experimental' work in the field of economics of education as compared with Industrial Organization where much there is more structural econometrics.
- There are many examples of this in recent empirical work (see Angrist and Krueger 1999) including the use of instrumental variables, treatment-control type programme evaluations, exploiting regression discontinuities etc.
- The comprehensive framework of Todd and Wolpin (2003) on how to specify education production functions and to interpret estimated parameters from different (often complex) econometric specifications



Policy Issues in Economics of Education

- There are three major policy implications of economics of education found in literature:
- There have been important *recent contributions on school resources and teacher quality* (e.g. Hanushek et al. 2005) and on the sometimes heated debate about *the education effectiveness of class size reductions* (Angrist and Lavy 1999; Krueger 1999, 2003; Krueger and Whitmore 2001; Hanushek 2003)



Policy Issues in Economics of Education

- The second area emphasizes the point that early education interventions are more likely to be successful and to yield higher economic and social returns and this observation has been made in a series of papers by Heckman and colleagues (e.g. Carneiro and Heckman 2003; Heckman 2000; Heckman and Lochner 2000).
- The third area of policy importance is the financing of education, especially in India by JBG Tilak and NV Varghese of NIEPA.

Demand for Education



1. Education as creation of minimal capabilities

- Amartya Sen has repeatedly drawn attention to the fact that mere ownership of economic resources does not necessarily imply an increase in utility, since a person might be unable to benefit from the additional economic resources.
- This may depend on individual capability to transform resources into behaviours so as to function adequately.
- Being able to read, calculate and process information can be thought of as a functioning necessary for conducting a normal social life.
- Individual demands education to perform ordinary life acts that require some education:
 - *Using public transport, finding a street address, checking a bill in a restaurant, signing a cheque, enrolling your child at school and reading the instructions on an electrical appliance.*

1. Education as creation of minimal capabilities

- The public provision of compulsory education is equivalent to the provision of any other public good.
- Capabilities of reading and computing in the entire population constitute a non-excludable public good.
- Whenever the externalities from individual choices are strong enough, there are good reasons to ensure a positive production of it.
- Public goods are characterised by underproduction in a market solution, because private demand would fall short of optimal provision.
- This may offer a rationale for the widespread diffusion of some compulsory and freely provided education in all modern states since the French Revolution.

2. Education as investment in human capital

- Many individuals choose to attend school beyond the minimum requirement.
- *Education as a commodity: people go to school because they enjoy acquiring new knowledge.*
- However, this explanation is at odds with most of the educational choices regarding tertiary education. (increased cost without increased pleasure in attending university lectures).
- Thus education cannot be conceived of merely as a commodity.

2. Education as investment in human capital

- Many economists think of education as investment in human capital.
- **Investment in Human Capital VS Physical Capital**
- The main difference is that human capital is incorporated in human beings, and cannot be resold. While physical capital can be acquired at (almost) any desired amount in boom periods and be resold during recession on secondary markets, human capital can be acquired mostly at the beginning of individual life, its pace of accumulation is determined by physiological factors, and it cannot be resold.
- Potential market failures, which are absent in the case of physical capital.
- To begin with, human capital cannot be collateralised, apart from the case of slavery.
- The possibility of moral hazard behaviour, which is relevant for human capital, but not for physical capital.
- Difference in degree of control of the resources:
 - The owner of physical capital can be properly termed a capitalist, since he or she is in control of either employing it in a production process or converting it into a liquid asset, living on it as a *rentier*. In contrast, an educated person who owns his/her own human capital cannot employ it in a production process unless hired as a dependent worker, thus becoming a *wage earner*.

2. Education as investment in human capital

- Despite all the differences, the use of the term ‘investment in human capital’ as synonymous with ‘acquisition of education’ has become pervasive.
- Each worker is paid up to the point corresponding to his/her marginal productivity, which will differ in accordance with the embodied human capital input.
- In general, education induces the self-sorting of individuals, who therefore differ not only in terms of acquired education but also in terms of many other unobservable characteristics that may be valuable to a firm.
- Suppose that, for simplicity, the life of an individual $i, i = 1, \dots, n$, can be divided into two periods: youth (in period t) and adulthood (in period $t + 1$). The i -th individual can devote a fraction S_{it} of his/her time in each period of life to schooling, in order to increase his/her stock of human capital H_{it} . Human capital is rewarded in the labour market at its marginal productivity rate β_t .
- $W_{ij}(H_{ij}) = \beta_j H_{ij}; j = t, t + 1$ (2.1)
- W_{ij} = labour earnings of individual i in period j .

2. Education as investment in human capital

- The accumulation of human capital is not instantaneous, but requires time;
- Human capital depreciates with time at rate δ , as assumed by the following relationship
- $H_{it+1} = H_{it}(1 - \delta) + \Delta H_{it}$ (2.2)
- $\Delta x_t = x_t - x_{t-1}$; denotes first-time differences.
- Devoting a fraction S_t of time to schooling produces new human capital.
- If A_i is individual unobservable ability, we assume that abler individuals are advantaged in acquiring education (less effort to study / characterised by a better family environment).
- We also assume that more human capital is produced when more resources E_{it} are used in schooling (say, more and/or better teachers, libraries and so on).
- Finally, it is also assumed that there are decreasing returns on time spent in education

2. Education as investment in human capital

- Individual preferences that consist of the discounted value of lifelong earnings:

- $V_i = W_{it}(H_{it}) - S_{it}W_{it}(H_{it}) - \gamma_t S_{it} +$

$$\frac{W_{it+1}(H_{it+1}) - S_{it}W_{it+1}(H_{it+1}) - \gamma_{t+1}S_{it+1}}{1 + \rho}$$

- $V_i = \beta_t(H_{it}) - S_{it}\beta_t(H_{it}) - \gamma_t S_{it} +$

$$\frac{W_{it+1}(H_{it+1}) - S_{it}W_{it+1}(H_{it+1}) - \gamma_{t+1}S_{it+1}}{1 + \rho}$$

- $V_i = \beta_t H_{it}(1 - S_{it}) - \gamma_t S_{it} +$

$$\frac{\beta_{t+1} H_{it+1}(1 - S_{it+1}) - \gamma_{t+1} S_{it+1}}{1 + \rho}$$

(2.4)

- γ_t = direct cost of school attendance; ρ = subjective rate of intertemporal discount.

2. Education as investment in human capital

- There are various sources for the costs of acquiring education.
- (i) *Direct monetary costs*, here represented by factor γ_t . They consist of tuition fees, book purchases, transport and living costs.
- *Indirect monetary costs (or opportunity costs)* corresponding to forgone income due to school attendance. In equation (2.4) they are represented by the term S_{it} , W_{it} : if the time fraction S_{it} is devoted to school attendance, it cannot be employed in the labour market; as a consequence, the student gives up a corresponding fraction of the income that would have been earned had the entire time-span been spent in the labour market.
- Opportunity costs are related to labour market outcomes: while, for simplicity, we are assuming here full employment, *higher (youth) unemployment reduces the costs of school attendance*.
- Non-monetary costs (effort put in to education acquisition) are ignored.

2. Education as investment in human capital

- maximise utility (2.4) subject to constraints (2.1)–(2.3), including an existence interval $0 \leq S_{ij} \leq 1, i = 1, \dots, n, j = t, t + 1$. we obtain;
- $\max_{S_{it}, S_{it+1}} V_i = \max_{S_{it}, S_{it+1}} \beta_t H_{it} (1 - S_{it}) - \gamma_t S_{it} +$

$$\frac{\beta_{t+1} [H_{it} (1 - \delta) + (A_i S_{it} E_{it} H_{it})^\alpha] (1 - S_{it+1}) - \gamma_{t+1} S_{it+1}}{1 + \rho}$$

(2.5)

- The first-order condition with respect to S_{it+1} gives;
- $\frac{\partial V_i}{\partial S_{it+1}} = - \frac{\beta_{t+1} [H_{it} (1 - \delta) + (A_i S_{it} E_{it} H_{it})^\alpha] - \gamma_{t+1}}{1 + \rho} (\because S_{it+1} = 0 \quad (\text{The optimal choice is “0”})).$
- Given the simplified structure of the model, it does not pay to acquire education in the second period of life, because it augments the human capital to be sold in a hypothetical third period, when the individual will (presumably) be dead. This result is general: if an individual demands more education in order to increase his/her

2. Education as investment in human capital

- $\max_{S_{it}, S_{it+1}} V_i = \max_{S_{it}, S_{it+1}} \beta_t H_{it} (1 - S_{it}) - \gamma_t S_{it} +$

$$\frac{\beta_{t+1} [H_{it} (1 - \delta) + (A_i S_{it} E_{it} H_{it})^\alpha] (1 - S_{it+1}) - \gamma_{t+1} S_{it+1}}{1 + \rho}$$

(2.5)

- Taking the first-order condition with respect to S_{it} , we get the following result:

- $\frac{\partial V_i}{\partial S_{it}} =$

$$\beta_t H_{it} \frac{\partial}{\partial S_{it}} (1 - S_{it}) - \frac{\partial}{\partial S_{it}} \gamma_t S_{it} + \frac{\partial}{\partial S_{it}} \frac{(\beta_{t+1})(1 - S_{it+1}) [H_{it} (1 - \delta) + (A_i S_{it} E_{it} H_{it})^\alpha]}{1 + \rho} =$$

$$0$$

- $\Rightarrow \beta_t H_{it} ((-1) - \gamma_t) + \frac{(\beta_{t+1})(1 - S_{it+1}) \frac{\partial}{\partial S_{it}} [(A_i E_{it} H_{it})^\alpha (S_{it})^\alpha]}{1 + \rho} = 0$

- $\Rightarrow \beta_t H_{it} + \gamma_t = \frac{(\beta_{t+1})(1 - S_{it+1}) (A_i E_{it} H_{it})^\alpha \alpha (S_{it})^{\alpha-1}}{1 + \rho}$

- $\Rightarrow \beta_t H_{it} + \gamma_t = \frac{(\beta_{t+1})(1 - S_{it+1}) \alpha (A_i E_{it} H_{it} S_{it})^\alpha}{(1 + \rho) S_{it}}$

- From earlier $S_{it+1} = 0$ & $(A_i E_{it} H_{it} S_{it})^\alpha = \Delta H_{it}$

- So, $\beta_t H_{it} + \gamma_t = \frac{\beta_{t+1}}{1 + \rho} \frac{\alpha \Delta H_{it}}{S_{it}} \quad (2.6)$

2. Education as investment in human capital

- $\beta_t H_{it} + \gamma_t (\text{Marginal Cost}) = \frac{\beta_{t+1}}{1+\rho} \frac{\alpha \Delta H_{it}}{S_{it}^*} (\text{Marginal Benefit}) \quad (2.6)$
- Equation (2.6) tells us that each individual chooses to acquire education up to a point where the cost of acquisition, including direct and indirect monetary costs) equals the benefit of acquisition.
- we rearrange equation (2.6) in order to obtain the reduced form in terms of the optimal demand for education in the first period of life, we get;
- $\beta_t H_{it} + \gamma_t \times S_{it}^* = \frac{\beta_{t+1}}{1+\rho} \alpha \Delta H_{it}$
- $S_{it}^* = \frac{\beta_{t+1} \alpha \Delta H_{it}}{(1+\rho) \beta_t H_{it} + \gamma_t}$
- $S_{it}^* = \frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha \Delta H_{it}}{H_{it} + \gamma_t / \beta_t}$
- $S_{it}^* = \frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha (A_i E_{it} S_{it} H_{it})^\alpha}{H_{it} + \gamma_t / \beta_t}$
- $S_{it}^* = \frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha S_{it}^\alpha (A_i E_{it} H_{it})^\alpha}{H_{it} + \gamma_t / \beta_t}$

2. Education as investment in human capital

- $$\frac{S_{it}^*}{S_{it}^{*\alpha}} = \frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha(A_i E_{it} H_{it})^\alpha}{H_{it} + \gamma_t / \beta_t}$$
- $$S_{it}^{1-\alpha} = \frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha(A_i E_{it} H_{it})^\alpha}{H_{it} + \gamma_t / \beta_t}$$
- $$S_{it} = \left(\frac{\beta_{t+1}}{\beta_t(1-\rho)} \frac{\alpha(A_i E_{it} H_{it})^\alpha}{H_{it} + \gamma_t / \beta_t} \right)^{\frac{1}{1-\alpha}} = S(A_i, H_{it}, \beta_{t+1} / \beta_t, \rho, \gamma_t, E_{it}) \quad (2.7)$$
- $$+, - \& +, +, \quad -, -, +$$

(i) More talented people will demand more education, because their marginal return is higher. Equation (2.3) assumes that unobservable ability A_i raises the production of new human capital for any unit of time spent in school.

(ii) The demand for education is higher when future expected gain β_{t+1} is higher relative to current β_t . The former affects expected

2. Education as investment in human capital

$$S_{it} = \left(\frac{\beta_{t+1}}{\beta_t(1+\rho)} \frac{\alpha(A_i E_{it} H_{it})^\alpha}{S_{it}^*} \right)^{\frac{1}{1-\alpha}} = S(A_i, H_{it}, \beta_{t+1}/\beta_t, \rho, \gamma_t, E_{it}) \quad (2.7)$$

(iii) Future gains are discounted to the present in accordance with the subjective intertemporal discount rate. The higher the ρ parameter the more myopic the agent, the more he/she evaluates current costs in exchange for future gains and, consequently, the lower is his/her demand for education.

- When financial markets exist, the ρ parameter is replaced by the market interest rate, because the individual could borrow money to cover current costs (when young) and repay when future benefits start accruing (when adult). In this case, an increase in the market interest rate lowers the demand for education

(iv) The demand for education is more intense the lower the starting level of human capital H_{it} . However, this incentive declines with the accumulation of human capital, because of decreasing marginal productivity in the formation of new capital.

(v) Finally, the demand for education declines if there is an increase in direct cost γ_t of school attendance, but increases if greater and better resources E_{it} are employed in the education production function.

2. Education as investment in human capital

- The cost schedule is drawn as upward-sloping (higher levels of education are associated with increasing costs (both monetary and non-monetary)).
- The return schedule is downward-sloping. (Due to the decreasing return on the production technology of new human capital).
- S_{it} = years of education acquisition.

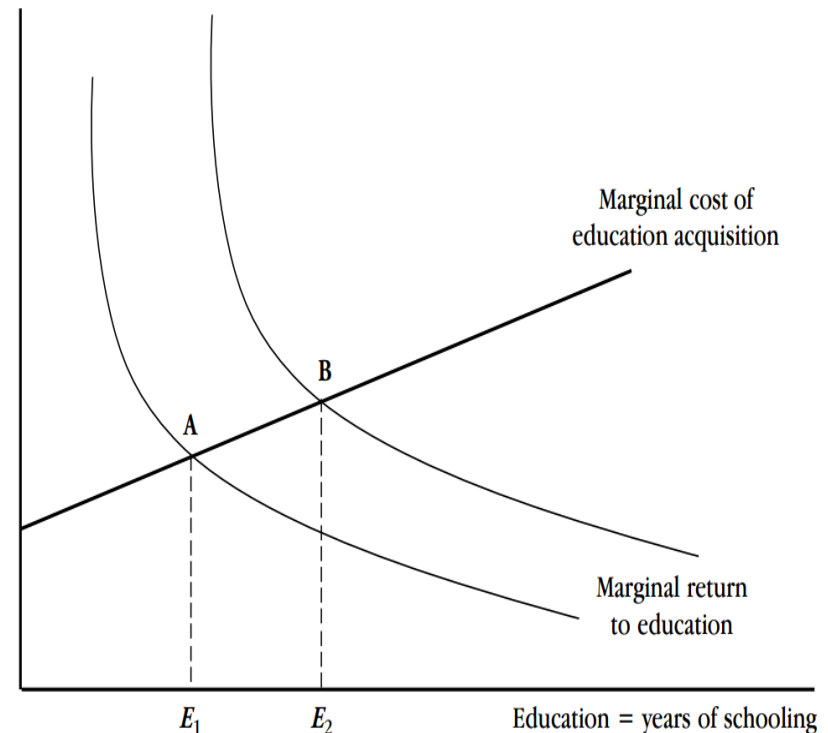


Figure 2.1 The model of human capital investment

2. Education as investment in human capital

- Suppose that an individual is optimally choosing the amount of education E_1 corresponding to the intersection of marginal cost with marginal benefit at point A.
- When he/she expects that in the next period there will be an increase in the demand for skilled labour, the (perceived) relative return to education will rise (since β_{t+1}/β_t is expected to be higher). This is represented as an outward shift of the marginal return, provoking an increase in the demand for education up to

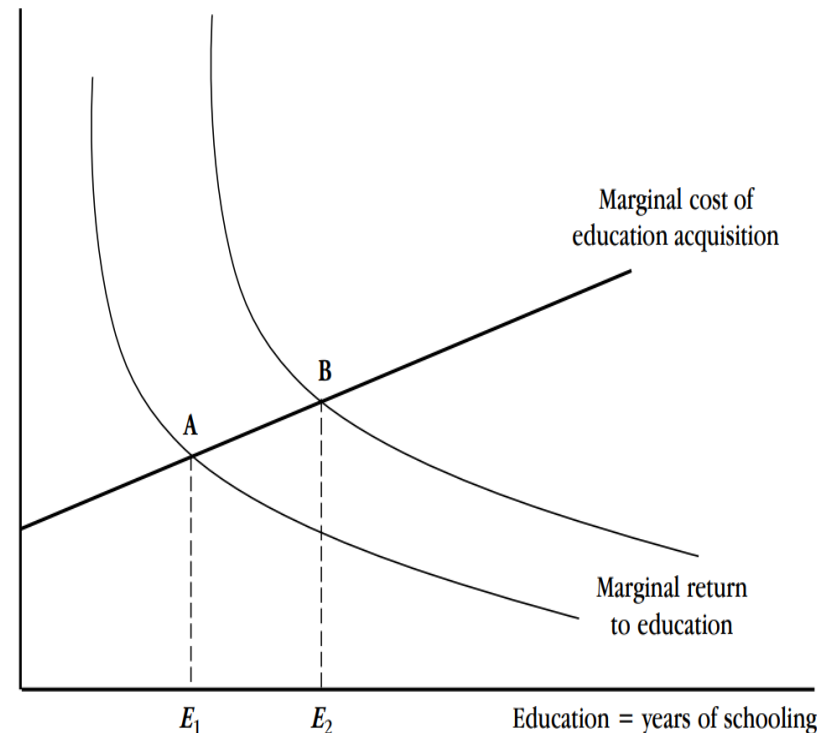


Figure 2.1 The model of human capital investment

2. Education as investment in human capital

- Why do different individuals demand different amounts of education?
- Ans: Unobservable ability or ‘talent’.
- More talented individuals demand more education, and obtain higher human capital. (Equation 2.7)
- This is due to the fact that they experience a higher marginal return for any portion of time invested in education.
- This can be seen by looking at earnings in the second period of life;
- Substituting equation 2.2 into 2.1 for W_{it+1} , we get;
- $W_{it+1} = \beta_{t+1}H_{it+1}$
- $W_{it+1} = \beta_{t+1}[H_{it}(1 - \delta) + \Delta H_{it}]$
- Substituting equation 2.3 into equation 2.1
- $W_{it+1} = \beta_{t+1}[H_{it}(1 - \delta) + (A_i E_{it} S_{it} H_{it})^\alpha] \quad (2.8)$

2. Education as investment in human capital

- $W_{it+1} = \beta_{t+1}[H_{it}(1 - \delta) + (A_i E_{it} S_{it} H_{it})^\alpha]$ (2.8)
- Differentiating equation (2.8) w.r.t. S_{it}
- $\frac{\partial W_{it+1}}{\partial S_{it}} = \beta_{t+1} \frac{\partial}{\partial S_{it}} (A_i E_{it} S_{it} H_{it})^\alpha$
- $= \beta_{t+1} \frac{\partial}{\partial S_{it}} \alpha (A_i E_{it} H_{it})^\alpha (S_{it})^{\alpha-1}$
- $= (\beta_{t+1}) (A_i E_{it} H_{it})^\alpha \alpha (S_{it})^{\alpha-1}$
- $= \beta_{t+1} (A_i E_{it} H_{it})^\alpha \alpha (S_{it})^{-(1-\alpha)}$
- $\frac{\partial W_{it+1}}{\partial S_{it}} = \beta_{t+1} \left[\frac{\alpha (A_i E_{it} H_{it})^\alpha}{S_{it}^{1-\alpha}} \right]$ (2.9)
- Equation (2.9) tells us that an additional year of schooling does not have the same impact on earnings for each individual.
- More talented people (higher A_i), as well as those attending better schools (greater E_{it}) expect a higher return because they ‘accumulate’ more human capital per unit of time, and therefore have an incentive to stay in school longer.
- In terms of condition (2.6), the right-hand side (marginal benefit) is higher for these people; in terms of figure 2.1, this is equivalent to the case where agents look at point B instead of point A.

2. Education as investment in human capital

- A second case of differentiated demand for education emerges when we consider the problem of financing educational choices.
- If we look at the first-period budget constraint implicit in equation (2.4)
- $\beta_t H_{it}(1 - S_{it})$ (*Income obtained in the first period of life*) = $\gamma_t S_{it}$ (*Direct Cost of Schooling*)
- But nothing ensures that; $\beta_t H_{it}(1 - S_{it}^*) \geq \gamma_t S_{it}^*$
- $= \beta_t H_{it} - \beta_t H_{it} S_{it}^* \geq \gamma_t S_{it}^*$
- $= \beta_t H_{it} + \gamma_t S_{it}^* \geq \beta_t H_{it} S_{it}^*$
- $= \beta_t H_{it} - \beta_t H_{it} S_{it}^* - \gamma_t S_{it}^* \geq 0$
- $= \beta_t H_{it} - S_{it}^* (\beta_t H_{it} + \gamma_t) \geq 0$
- $= \beta_t H_{it} \geq S_{it}^* (\beta_t H_{it} + \gamma_t)$
- $= \frac{\beta_t H_{it}}{(\beta_t H_{it} + \gamma_t)} \geq S_{it}^*$
- i.e., The income obtained in the first period of life (when partially employed) exceeds the direct costs of optimally demanded schooling.
- If financial markets exist, any agent can borrow any required amount to finance educational expenditures, to be repaid in the second period when earning a higher income.

2. Education as investment in human capital

- But what about unobservable abilities?
- Investing in education is a risky investment, and the borrower has better information than the lender about the real chance of succeeding at school, his/her prospective outcomes in the labour market, whereas a bank does not.
- Result: Demand for collateral or high interest rate by banks to avoid default risk.
- Only people from poor families are discriminated against because of their lack of financial resources and they are the people who borrow to finance schooling.
 - when bank demands collateral, the amount of education that an agent can demand is upwardly constrained by available wealth.
 - when the bank charges a higher interest rate, this reduces the optimal amount of education in accordance with equation (2.7).

2. Education as investment in human capital

- The marginal rate of return to education is identical for all individuals, as in figure 2.1.
- If all agents had sufficient wealth and were not liquidity-constrained, they would all choose the optimal amount of education corresponding to point B.
- When some of them cannot entirely finance their demand for education up to point E2, they are forced to limit their acquisition of education to point E1.
- But this situation is inefficient, because there is a positive difference between the marginal return and the marginal cost of education (the distance between

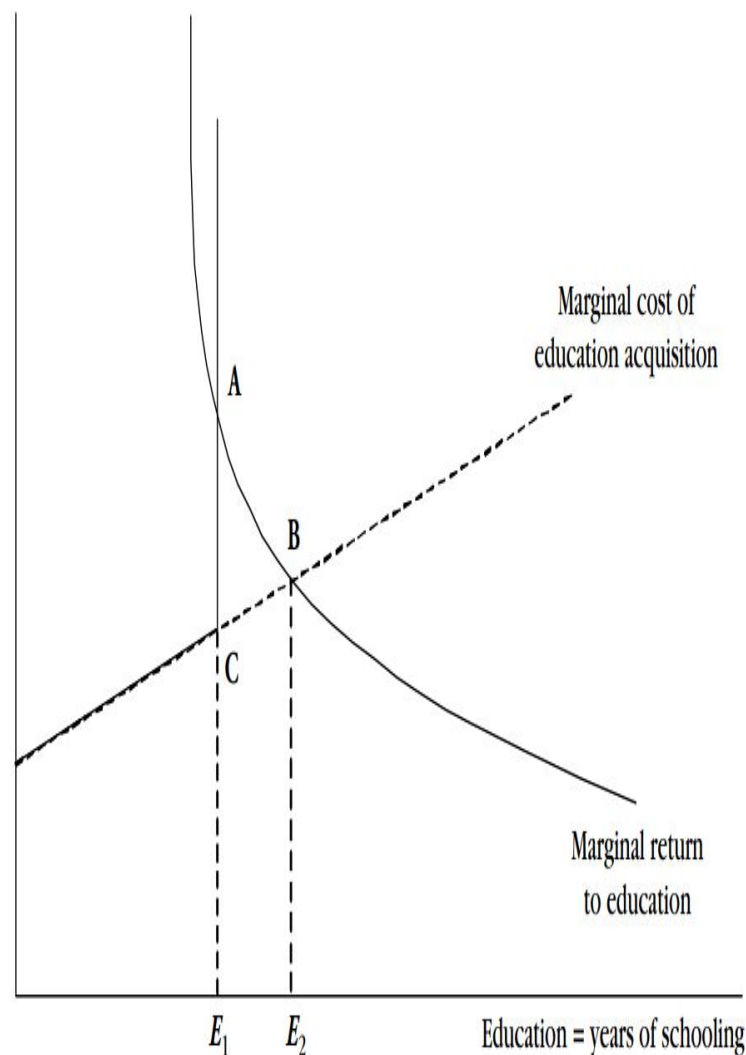


Figure 2.2 Human capital investment under liquidity constraints

2. Education as investment in human capital

- *Summary:*
- Human capital investment theory predicts that people will demand education up to the point where the marginal benefit is equal to the marginal cost. $\beta_t H_t + \gamma_t (Marginal\ Cost) = \frac{\beta_{t+1}}{1+\rho} \frac{\alpha \Delta H_{it}}{S_{it}^*} (Marginal\ Benefit)$
- Marginal benefits depend on labour market conditions, on resources invested in education and on individual ability. $(A_i E_{it} S_{it} H_{it})$
- Marginal costs depend on direct costs of schooling and, possibly, on individual ability.
- While, in principle, all individuals should demand the same amount of education, two factors contribute to differentiating educational attainment in the population.
 - One is talent (be it ‘pure intelligence’ or ‘better family background’), which boosts the human capital accumulation.
 - The other is family wealth, which can constrain poor families when financial markets are imperfect or absent.

2.3 The Role of Individual Talent

- When we look at educational attainment, it is difficult to distinguish whether a well-performing student is either a natural genius or the offspring of graduate parents.
- The problem arises from the fact that we do not possess good measures for factors such as ‘intelligence’, ‘creativity’, ‘cleverness’ and the like.
- Some authors have polemically claimed that unobservable ability is not only genetically dependent but is also intergenerationally transmitted. (Herrnstein and Murray, 1994)
- Should income inequality be abandoned from the political agenda, being an obvious outcome of ‘natural’ differences?
- No!
- The relationship may be spurious.
- Overall, the literature seems rather inconclusive on the role and measurement of unobservable ability. Some authors argue that education provides human capital which in turn raises

2.4 Imperfect financial markets and the indivisibility of human capital investment

- Under decreasing marginal returns of time spent in schooling and the homogeneity of agents, we should observe the convergence of human capital (and therefore of earnings) in the population.
- Actual financial markets do not offer an unlimited amount of lending to anyone.
- They ration the borrower by charging higher interest rates and/or require collateral in order to insure against default risks. (Hurts the poor!)
- As a consequence, other things being equal, individuals from poorer families tend to acquire less education than individuals from richer families.
- Thus imperfect financial markets could be responsible for persistent inequality, both in education and in income.
- However, from a theoretical point of view, the assumption of financial market imperfection is by itself insufficient to yield this result, and an additional condition is required: the indivisibility of

2.4 Imperfect financial markets and the indivisibility of human capital investment

- An overlapping generation model spread over two periods.
- In the first period, when young, individuals can choose whether to work or study; in the second period, when adult, they work either as skilled (if they studied in the first period) or as unskilled (if they worked in the first period).
- They also consume, give birth to offspring and die.
- The indivisibility of human capital investment is represented by a dichotomised choice: each agent can choose whether to pay a fixed cost γ for school attendance and obtain a degree, or work as an unskilled worker.
- The amount of human capital obtained by school attendance is fixed and identical across agents.
- All agents are identical in terms of unobservable ability, but they can differ in terms of inherited family wealth.
- Assumption: human capital investment always be profitable.

2.4 Imperfect financial markets and the indivisibility of human capital investment

- W_t^n = market wage for a skilled worker at time t ; W_{t+1}^s = corresponding wage of a skilled worker (i.e. a person who paid the amount γ and forwent the income obtainable working as unskilled when young in order to become skilled when adult); The profitability condition;
- $W_{t+1}^s - \gamma(1 + R) > W_t^n + W_{t+1}^n(1 + R) = W^n(2 + R)$ (2.10)
- R = market interest rate, W^n , W^s and R are exogenously given.
- Under the condition expressed by equation (2.10) everyone would like to obtain education. Those who do not attend schools are prevented from doing so by the impossibility of paying the fixed cost of access γ .
- If debt default is an open possibility and access to international financial market is barred to workers, the financial intermediary bears a monitoring cost Z in order to minimise the probability of this event from the borrower.
- In a competitive financial sector, profits are driven to zero, and therefore the cost of fund collection (by assumption they are obtained on international financial markets) must equal their use.

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- The monitoring cost will therefore be charged to the borrower according to the following relationship: $iD = RD + Z$; i = lending interest rate & D = amount of debt. R = market lending rate, Z = Monitoring Activity (2.11)
- Each borrower considering the possibility of defaulting on his/her debt takes into account the costs involved in prosecution avoidance by the lender; these costs are assumed to be proportional to its monitoring activity and are indicated by;
- $\lambda Z, \lambda > 1$.
- Knowing the set of incentives of the borrower, the lender will choose a level of monitoring activity that is proportional to the amount of debt, up to a point where the borrower is indifferent between debt repayment and debt repudiation:
- $D(1 + i) = \lambda Z$ (2.12)

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- Making use of equations (2.11) and (2.12), we can show that the borrowing rate exceeds the lending rate, determined on international financial markets.
- From equation 2.11; $Z = iD - RD$
- Put the above solution in equation 2.12; $D(1 + i) = \lambda(iD - RD)$
- $D + Di = \lambda(iD - RD)$
- $Di = \lambda(iD - RD) - D$
- $i = \frac{\lambda iD - \lambda RD - D}{D} = \frac{D(\lambda i - \lambda R - 1)}{D} = (\lambda i - \lambda R - 1)$
- $i - \lambda i + \lambda R + 1 = 0$
- $i(1 - \lambda) + 1 + \lambda R = 0$
- $1 + \lambda R = -i(1 - \lambda)$
- $1 + \lambda R = -i + i\lambda = \lambda i - i = i(\lambda - 1)$
- $i = \frac{1 + \lambda R}{\lambda - 1}$

2.4 Imperfect financial markets and the indivisibility of human capital investment

- $i = \frac{1+\lambda R}{\lambda-1}$
- Adding one to both sides;
$$1 + i = 1 + \frac{1 + \lambda R}{\lambda - 1}$$
- $$= \frac{(\lambda-1)+(1+\lambda R)}{\lambda-1} = \frac{\lambda-1+1+\lambda R}{\lambda-1} = \frac{\lambda}{\lambda-1} + \frac{\lambda R}{\lambda-1}$$
- $1 + i = \frac{\lambda}{\lambda-1} (1 + R) \iff i > R \quad (2.13) \quad [\lambda \uparrow \rightarrow i \uparrow]$
- The poor families face an opportunity cost of borrowing given by the interest rate i , which is higher than the opportunity cost R faced by rich families.

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- Individuals are assumed to be altruistic, and therefore they care about the future welfare of their offspring by leaving a bequest X .
- Utility is defined over consumption in the second period of life and the bequest; when it takes a Cobb–Douglas formulation we get
- $$U_t = \alpha \log C_{t+1} + (1 - \alpha) \log X_{t+1} \quad (2.14)$$
- Each individual maximises his/her own utility for a given labour income and the inheritance received by his/her own parent.
- If I_{t+1} = total disposable income when adult, the optimal choice is;
- $$C^*_{t+1} = \alpha I_{t+1}, X^*_{t+1} = (1 - \alpha) I_{t+1} \quad (2.15)$$
- Substituting equation 2.15 in 2.14, we get;
- $$V_t = \alpha \log C^*_{t+1} + (1 - \alpha) \log X^*_{t+1}$$
- $$V_t = \alpha \log(\alpha I_{t+1}) + (1 - \alpha) \log((1 - \alpha) I_{t+1}) \quad (*)$$

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- $U_t = \alpha \log C_{t+1} + (1 - \alpha) \log X_{t+1} \quad (2.14)$
- $C^*_{t+1} = \alpha I_{t+1}, X^*_{t+1} = (1 - \alpha) I_{t+1} \quad (2.15)$
- Substituting equation 2.15 in 2.14, we get; we get the indirect utility function characterising each generation t, which is loglinear in disposable income.
- $V_t = \alpha \log C^*_{t+1} + (1 - \alpha) \log X^*_{t+1}$
- $V_t = \alpha \log(\alpha I_{t+1}) + (1 - \alpha) \log((1 - \alpha) I_{t+1})$
- $V_t = \alpha \log \alpha + \alpha \log I_{t+1} + (1 - \alpha) \log(1 - \alpha) + (1 - \alpha) \log I_{t+1}$
- (since, $\log x \times y = \log x + \log y$)
- $V_t = [\alpha \log \alpha + (1 - \alpha) \log(1 - \alpha)] + \alpha \log I_{t+1} + (1 - \alpha) \log I_{t+1}$
- $V_t = [\alpha \log \alpha + (1 - \alpha) \log(1 - \alpha)] + \log I_{t+1} (\alpha + 1 - \alpha)$
- $V_t = [\alpha \log \alpha + (1 - \alpha) \log(1 - \alpha)] + \log I_{t+1} \quad (2.16)$

2.4 Imperfect financial markets and the indivisibility of human capital investment

- Depending on the choice made with respect to education when young we observe three possible destinies in the model

Table 2.2 *Possible life destinies*

Possible destinies	Lifetime disposable income	Bequest left to the offspring
(a) Individuals who do not acquire education	$(X_t + W^n)(1 + R) + W^n$	$X_{t+1} = (1 - \alpha)[(X_t + W^n)(1 + R) + W^n]$
(b) Individuals who need to borrow to acquire education ($X_t < \gamma$)	$W^s + (X_t - \gamma)(1 + i)$	$X_{t+1} = (1 - \alpha)[W^s + (X_t - \gamma)(1 + i)]$
(c) Individuals who do not need to borrow to invest in their own education ($X_t > \gamma$)	$W^s + (X_t - \gamma)(1 + R)$	$X_{t+1} = (1 - \alpha)[W^s + (X_t - \gamma)(1 + R)]$

2.4 Imperfect financial markets and the indivisibility of human capital investment

- Depending on the choice made with respect to education when young, we observe three possible destinies in the model:
 - a) Unskilled workers, who did not acquire education when young and worked as unskilled in both periods of life;
 - b) Skilled workers from poor families, who did not receive an inheritance sufficient to finance their education, and therefore were forced to borrow in order to pay for it; and
 - c) Skilled workers from rich families, who did not incur debt to get an education.

2.4 Imperfect financial markets and the indivisibility of human capital investment

- Under the assumption for profitability for the investment in education (see equation (2.10)), all individuals would like to become skilled.
- Those who inherit sufficient funds (e.g. exceeding the cost of accessing education γ) become skilled.
- Among the remaining population, there will be a fraction that is so poor that it will be unable to afford the debt required to obtain education: they will not invest in education, and remain unskilled. They will earn a low income and will leave a low bequest, perpetuating the unskilled status in their dynasty.
- By equating cases (a) and (b) in table 2.2, we find the inheritance level at which it makes no difference whether an individual contracts a debt to become skilled or remains unskilled:
- $(X_t + W^n)(1 + R) + W^n = W^s + (X_t - \gamma)(1 + i)$
- $$\frac{W^n(2+R) - W^s + \gamma(1+i)}{i-R} = X_t = f \quad (2.17)$$

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- $(X_t + W^n)(1 + R) + W^n = W^s + (X_t - \gamma)(1 + i)$
- $X_t + X_t R + W^n + W^n R + W^n = W^s + X_t + X_t i - \gamma - \gamma i$
- $X_t + 2W^n + RW^n + X_t R = W^s + X_t + X_t i - \gamma(1 + i)$
- $X_t + W^n(2 + R) - W^s - X_t + \gamma(1 + i) = X_t i - X_t R$
- $W^n(2 + R) - W^s + \gamma(1 + i) = X_t(i - R)$
- $\frac{W^n(2+R) - W^s + \gamma(1+i)}{i-R} = X_t = f \quad (2.17)$
- “f” The inheritance level at which it makes no difference whether an individual contracts a debt to become skilled or remains unskilled

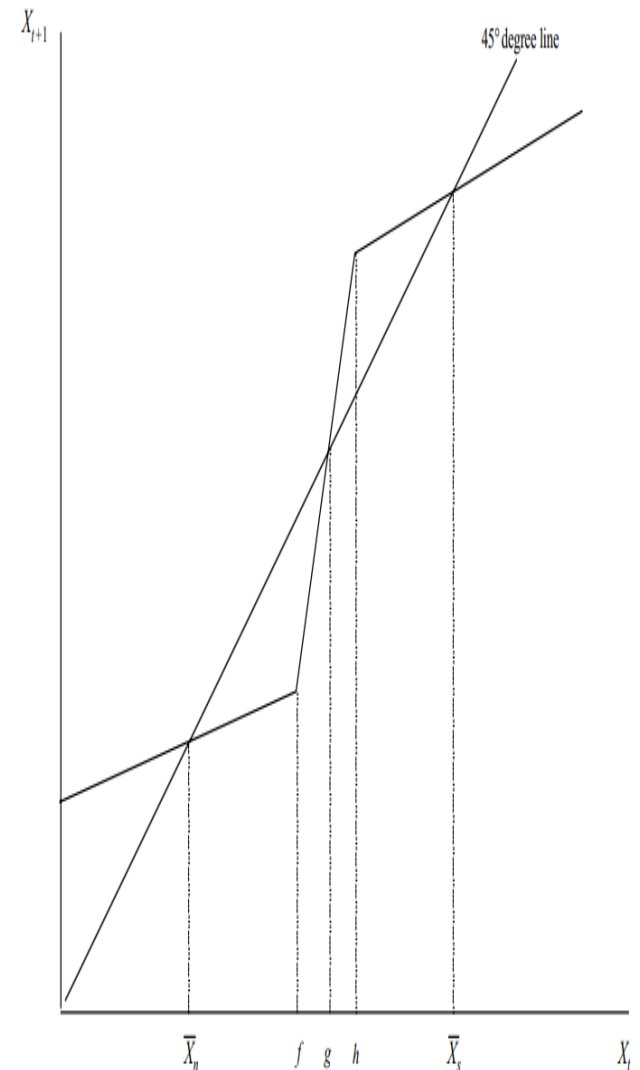


Figure 2.3 The dynamics of individual wealth

2.4 Imperfect financial markets and the indivisibility of human capital investment

- All individuals inheriting an amount lower than f are better off not investing in education, and their income evolves according to case (a) in table 2.2, converging to $\frac{\bar{X}_n}{1-\alpha}$, where \bar{X}_n is defined according to;

- $\bar{X}_n = (1 - \alpha) \left[\left(\bar{X}_n + W^n \right) (1 + R) + W^n \right]$

- $\bar{X}_n = (1 - \alpha) [X_n + X_n R + W^n + W^n R + W^n]$

- $\bar{X}_n = (1 - \alpha) [X_n (1 + R) + W^n (1 + R + 1)]$

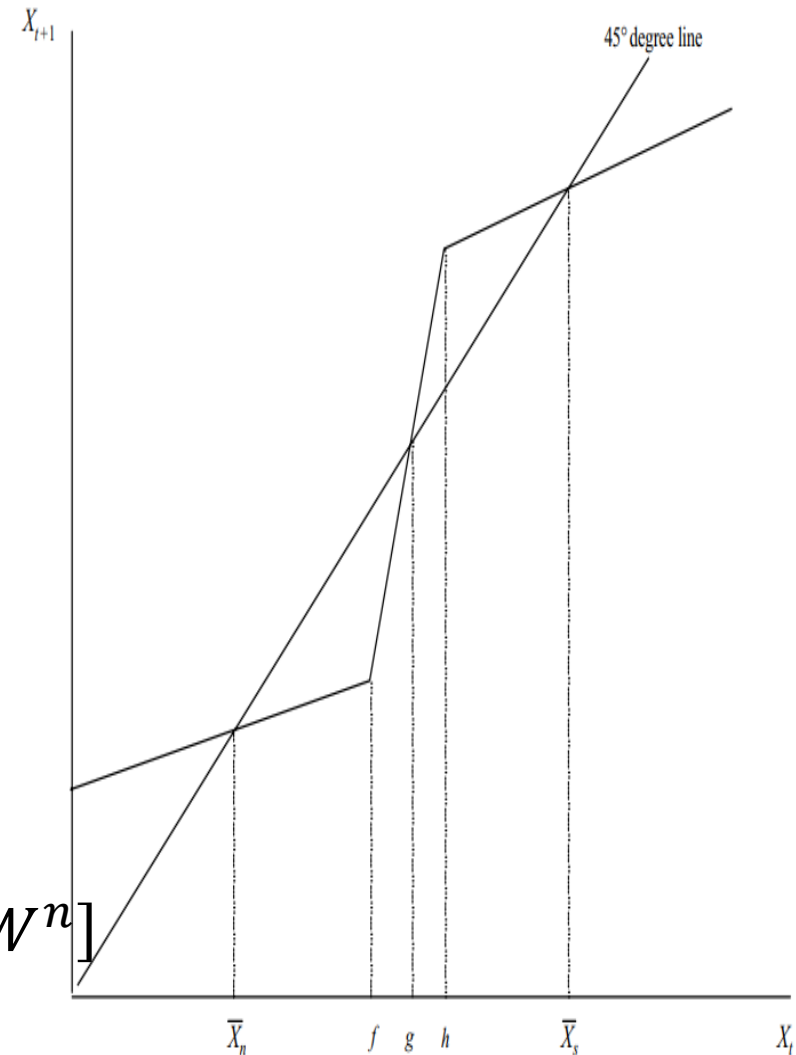


Figure 2.3 The dynamics of individual wealth

2.4 Imperfect financial markets and the indivisibility of human capital investment

- The individuals receiving an inheritance in the interval (f, g) will invest in education, but the debt burden exceeds their ability to pay, and they also converge to \bar{X}_n .
- The ‘happy few’ who get a bequest greater than g experience a growing level of income across the generations, converging to $\frac{X_s}{1-\alpha}$, where \bar{X}_s satisfies;

- $$\bar{X}_s = \frac{(1-\alpha)\{(1+R)\bar{X}_s + [W_s - (1+R)\gamma]\}}{X_n} > \bar{X}_n \quad (2.19)$$
- From table 2.2; $X_s = (1-\alpha)[W^s + (X_s - \gamma)(1+R)]$
- $X_s = (1-\alpha)[W^s + X_s + X_s R - \gamma - \gamma R]$
- $\bar{X}_s = (1-\alpha)[W^s + \bar{X}_s(1+R) - \gamma(1+R)]$
- $$\bar{X}_s = \frac{(1-\alpha)\{(1+R)\bar{X}_s + [W_s - (1+R)\gamma]\}}{X_n} > \bar{X}_n \quad (2.19)$$

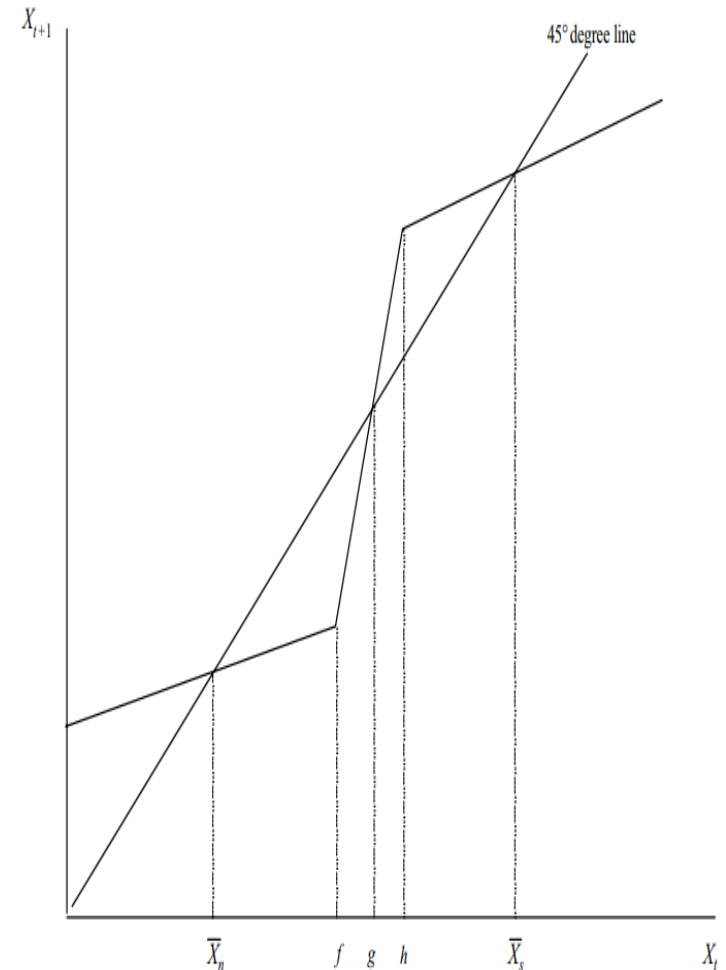


Figure 2.3 The dynamics of individual wealth

2.4 Imperfect financial markets and the indivisibility of human capital investment

- The speed of convergence rate will be lower for debtors (where $X_t < h$) than for people from rich families (where $X_t > h$), because of the different interest rate they pay to or receive from financial intermediaries. In the long run income distribution becomes bimodal, with a population share concentrated around $\frac{\bar{X}_n}{1-\alpha}$, and its complementary share concentrated around $\frac{\bar{X}_s}{1-\alpha}$.

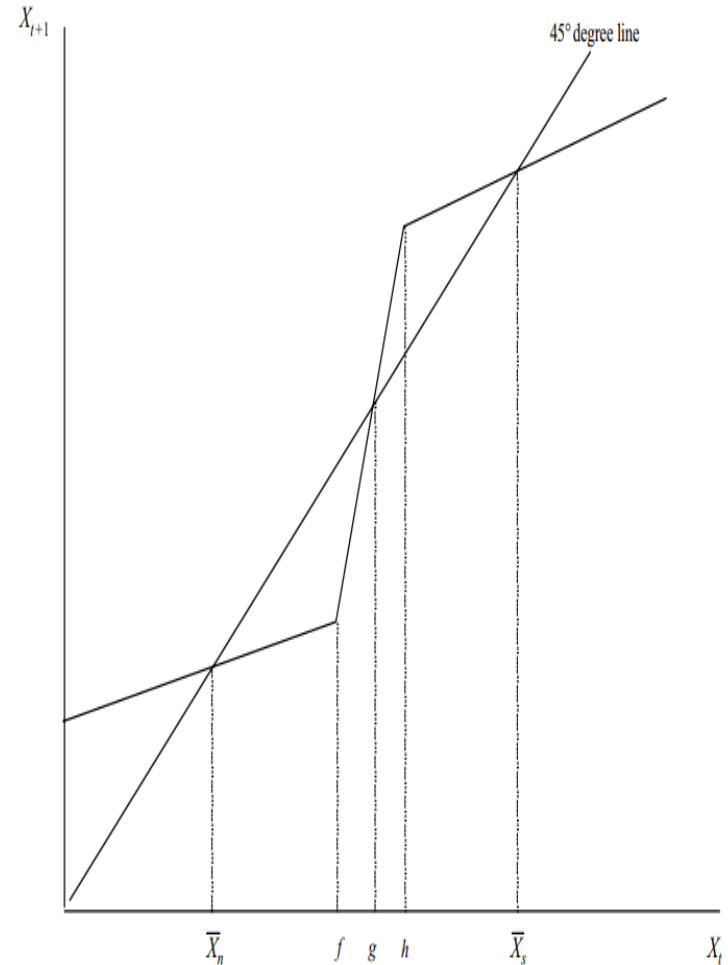


Figure 2.3 The dynamics of individual wealth

2.4 Imperfect financial markets and the indivisibility of human capital investment

- The mean income in the population is determined as weighted average, where weights depend on initial income distribution
- $$\bar{X} = \frac{n(g)}{n} \bar{X}_n + \left(1 - \frac{n(g)}{n}\right) \bar{X}_s = \bar{X}_s - \frac{n(g)}{n} (\bar{X}_s - \bar{X}_n) \quad (2.20)$$
- $\bar{X} = F(n(g))$
- $n(g)$ = indicates the number of individuals with initial wealth smaller than or equal to g .
- Given the deterministic nature of the model, their descendants will in the long run achieve an income level equal to $\frac{\bar{X}_n}{1-\alpha}$.
- An egalitarian economy will be characterised by a low share $n(g)$ of (relatively) poor individuals, and will experience a higher average income in the long run.
- Income redistribution from rich to poor raises average income (or wealth) in the economy, but it is inefficient!
- In contrast, intertemporal redistribution achieved by means of fiscal policy (subsidising the education of the young by taxing their income when adult) solves the market failure, lowers the debt cost and is therefore Pareto superior.



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THANK YOU