Chapter 7 – Intergenerational persistence

1. Introduction

So far we have considered individual choices of educational investments, somehow neglecting their implications for aggregate equilibrium in the labour market. We have also passed over the dynamic consequences of current choices. When an individual is educated, she does not only improve her future prospects in terms of employment probability, expected salary, quality of the job, but also raises the probability of her offspring to get educated as well, not to speak of the positive spill-over for society as a whole.

With the help of simple models in the present chapter we attempt to disentangle the different channels through which the educational choices of one generation affect those of future generations. We will also provide some cross-country comparative evidence on intergenerational mobility in educational attainments, as well as speculating about potential determinants of observed mobility.[1]

Before moving to formal models, let us review these channels in a cursory way. As we have already seen in previous chapters, educational choices are conditioned by individual unobservable abilities (labelled *talent*), family cultural background, family financial resources, public resources and more generally by social capital. Most of these factors exhibit intertemporal and intergenerational persistence.

The transmission of unobservable ability can be genetic, like race, height, eye colour, beauty, and so on. Despite the difficulty of separating traits that are genetic from traits that are culturally induced (a typical example being the propensity to smoke), the empirical evidence obtained from the twins sample indicates that the relative contribution from genetics to intertemporal persistence is low. Bowles and Gintis (2002) show that the contribution of measured IQ test scores contribute little to earnings, and use this evidence to gauge that its contribution to intergenerational persistence must be low.[2]

A separate channel consists of cultural influences, and works through the educational system. There is vast empirical evidence on the fact that children of educated parents are more likely to acquire education.[3] This may be partly due to parent imitation (if they see their parent reading a book, they get the idea that reading is a rewarding activity), but in most cases it works through induced educational choices. An educated parent is better aware of the psychological and economic value of education, and therefore puts more pressure onto her children to achieve more in school. In addition, if the educational system is not homogenous, an educated parent always has some advantage in collecting information about school quality, and can reorient her child choices towards better opportunities.[4] A strengthening factor derives from marital choices: as long as there is assortative mating (namely, better

---

[1] A review of existing approaches to intergenerational mobility from an economist's viewpoint is in Piketty 2000, whereas measurement problems are reassessed in Solon 1999. See also the symposium in the *Journal of Economic Perspective*, vol.16/3, 2002.

[2] "If the heritability of IQ were 0.5 and the degree of assortation, *m*, were 0.2 (both reasonable, if only ballpark estimates) and the genetic inheritance of IQ were the only mechanism accounting for intergenerational income transmission, then the intergenerational correlation would be 0.01, or roughly 2 percent the observed intergenerational correlation." (Bowles and Gintis 2002, p.11).

[3] Plug 2004 measures the impact of parental education on a sample of adopted children, thus being able to identify a "pure" family background effect purged of genetic effects.

[4] An interesting discussion about the intergenerational persistence of inequality of opportunities in accessing education is contained in the introduction to Shavit and Blossfeld 1993, also containing 13 country studies.

educated persons prefer to pair off with other educated persons), the cultural background within a family is made more homogenous, and the influences received by each parent reinforce one another.[5]

A third channel of intergenerational persistence derives from liquidity constraints. If access to education is limited by family financial resources, and acquired education gains access to higher jobs earning, this opens the door to a poverty trap: poor families are prevented from investing in the education of their children by lack of resources and inability to access financial markets, their children remain uneducated and poor, thus being unable to invest in their grandchildren.[6] From an empirical point of view it is not easy to distinguish between cultural linkages and financial ones, since education and income are correlated within each generation.[7] However, if we measure intergenerational persistence within the richest portion of the population (which is not liquidity constrained) we can get an approximate indication of the extent of intergenerational persistence attributable to cultural background.

A fourth source of intergenerational persistence emerges from territorial segregation, and is related to family wealth. If residential choices are influenced by evaluation of local school quality, and school quality affect house prices, then richer families will gain access to better schools by locating closer to them. Better school quality combined with more homogenous cultural neighbourhood yields greater social capital, thus providing a clear advantage to children raised in that environment.[8]

While it is not always easy to distinguish between alternative explanations of intergenerational persistence in educational choices, their effects are clearly detectable. If we have data on educational attainments of two contiguous generations from a representative sample of the population, we can

[5] See the seminal paper on *marriage markets* by G.Becker, where he proposes an analysis of assortative mating based on observable talents in the couple (reproduced as chapter 10 in Becker 1993). More recent evidence on the relative impact of assortative mating in intergenerational persistence is provided by Ermisch and Francesconi 2002, where they use the correlation between parent-in-law and children socio-economic status as measure of this channel. Esping-Andersen 2004b discusses the contribution of fertility to intergenerational persistence: if richer and better-educated families are more fertile, intergenerational mobility is enhanced. Sweden is taken as example of the relevance of this claim: "If my argument holds that universal, high-quality day care reduces the weight of the "cultural" effect, then a society that combines maximum female employment with universal day care should almost by definition produce more mobility and less inherited life chances". Mulligan 1997 holds an opposite view, since richer families are less altruistic because their cost of child rearing is higher: as a consequence they invest less in their children's education, fostering income convergence across families.

[6] The seminal paper by Loury 1981 is the first to make clear that in this second-best world redistributive policies may be efficiency enhancing: "If, however, such trades are impossible because the relevant markets have failed, then the distribution of income among parents will affect the efficiency with which the overall training resources are allocated across offspring" (p.844). Piketty 2000 distinguishes between *poverty traps* and *low mobility traps*. In the first cases, poor families cannot afford the educational investment because they are liquidity constrained, and therefore they achieve a lower level of income; a once-for-all subsidy can make poverty disappear (as in Galor and Zeira 1993). On the contrary, in the second case mobility is hampered by high interest rates, which are endogenously determined by supply (from richer families) and demand (from poorer families) of funds. In such a situation, the equilibrium is dependent on the initial wealth distribution, and redistribution is less effective (as in Piketty 1997). Similarly, the wage rate can be made dependent on the initial wealth distribution, obtaining similar results (as in Banerjee and Newman 1993).

[7] Following the suggestion by Becker and Tomes 1986, Mulligan 1997 and 1999 identify liquidity constrained families as those whose child has not received (and is not expecting to receive a bequest above 25000 US dollars). Ermisch and Francesconi 2001 use the income distribution across parents (and breaking of marriages between parents as treatment effect) to distinguish between "genetic" transmission of ability and financial bequests: "Thus if parents do not make gifts or bequests, the correlation between parents and child education is likely to represent primarily a causal effect of parent education. This is because human capital investment is not carried to the point at which the marginal return from education equals its marginal cost." (p.140).

[8] The list is obviously not conclusive, see for example the following statement by Bowles and Gintis 2002: "on the basis of this and other empirical regularities, it seems safe to conclude that the intergenerational transmission of economic status is accounted for by a heterogeneous collection of mechanisms, including the genetic and cultural transmission of cognitive skills and noncognitive personality traits in demand by employers, the inheritance of wealth and income-enhancing group membership, such as race, and the superior education and health status enjoyed by the children of high status families" (p.4).

measure the intergenerational persistence of educational attainment. Table 1 reproduces the marginal distribution for each generation in three countries according to their educational attainments. In order to improve comparability across countries, educational attainment has been classified according to four achievements, which are country and cohort specific: uncompleted compulsory education; completed compulsory education; beyond compulsory education without attaining a university degree; university degree.[9,10]

Table 1 – Population distribution in accordance to educational attainment

	ITALY		GERMANY		UNITED STATES	
Educational attainment:	*fathers*	*sons*	*fathers*	*sons*	*fathers*	*sons*
Uncompleted compulsory	47.72	10.84	17.54	7.55	42.04	13.98
Compulsory education	41.36	39.63	64.17	64.03	18.61	22.55
Beyond compulsory education	12.88	41.24	14.36	17.32	23.24	36.16
Tertiary education	3.03	8.30	3.92	11.10	16.10	27.29

It is easy to observe that educational attainment has significantly increased in the passage from one generation to the following, thanks to growth of per capita incomes and consequent mass scholarisation. The divergence between the marginal distributions of educational attainments in two adjacent generations is what is indicated in the literature as *structural mobility*, and can be attributed to the relaxation of liquidity constraints and/or to the increase in public resources invested in education.[11] However, two adjacent generations could exhibit the same marginal distributions and we could still observe differences between countries in terms of how families interchange their relative positions. This second aspect is typically called *exchange mobility* by sociologists and refers to the positive association between fathers and sons educational attainment.[12] Exchange mobility is likely to be affected by genetic and cultural aspects of intergenerational persistence. Table 2 reports intergenerational transition matrices in educational attainments, where alternative measures can be computed to ascertain the relative ordering of countries in terms of intergenerational mobility. As a consequence, different rankings emerge using different measures, since each indicator can be obtained by a different set of axioms. Suppose for example we are interested in the idea of equality of opportunity in accessing education: this would correspond to the case of (statistical) independence of the marginal distribution of sons from their fathers'. Thus the (Euclidian) distance of the currently observed matrices (reported in table 2) and an ideal matrix reporting the long run distribution of the educational attainment of the population could provide the required measure.[13] Conversely, if we are

---

9 We make use of sample analysed in Checchi 1997. The data for Germany (1351 couples fathers-sons) are from the public use version of the German Socio-Economic Panel Study. These data were provided by the Deutsches Istitut fuer Wirtschaftsforschung. The data for Italy (1615 couples fathers-sons) come from the data set developed by A.DeLillo and others, whose results are published among others in Cobalti and Schizzerotto 1994. The data for US (1037 couples fathers-sons) come from the PSID (Panel Study of Income Dynamics) panel developed by the University of Michigan.

10 The educational attainment classification can be derived from the following table (see Checchi 1997 for details):

	ITALY	GERMANY	UNITED STATES
Uncompleted compulsory	no certificate if born before 1952 LICENZA ELEMENTARE afterwards	no certificate	no certificate
Compulsory education (ISCED 1-2)	LICENZA ELEMENTARE if born before 1952 LICENZA MEDIA afterwards	MITLERE REIFE	HIGH SCHOOL DIPLOMA (grade 12) if born after 1918
Beyond compulsory education (ISCED3-5)	MATURITÀ or DIPLOMA	ABITUR or FACHARBEITERBRIEF	DIPLOMA from vocational schools
Tertiary education (ISCED 7)	LAUREA or DOTTORATO DI RICERCA	STAATS-DIPLOMPRUFUNG OR DOKTORPRUFUNGEN	BACHELOR, MASTER or PHD

11 See Erikson and Goldthorpe 1993 for a general discussion of the concept of social mobility, which incorporates aspects of both structural and exchange mobility.

12 For an axiomatic treatment of mobility indices that distinguish between absolute (*structural*) and relative (*exchange*) mobility, see Checchi and Dardanoni 2002.

13 However, given the fact that the long run distribution is country specific (as it can be obtained from repeated application of the transition matrices – it corresponds to the eigenvector associated to the second maximum eigenvalue), this mobility

concerned with the degree of relative immobility of a society, we could sum the population falling in the cells along the main diagonal: this corresponds to families where nothing has changed in the passing from one generation to the other.[14]

Table 2.a – Intergenerational mobility in educational attainment

Italy (1987)

→ sons education ↓ fathers education	*Uncompleted compulsory*	*Compulsory education*	*Beyond comp. education*	*Tertiary education*
Uncompleted compulsory	20.72	56.67	21.16	1.45
Compulsory education	4.34	32.93	56.59	6.14
Beyond compulsory education	1.44	13.46	60.10	25.00
Tertiary education	0.00	2.04	34.69	63.27

Germany (1986)

→ sons education ↓ fathers education	*Uncompleted compulsory*	*Compulsory education*	*Beyond comp. education*	*Tertiary education*
Uncompleted compulsory	14.77	72.57	11.39	1.27
Compulsory education	7.50	70.13	14.65	7.73
Beyond compulsory education	1.03	39.18	32.47	27.32
Tertiary education	0.00	16.98	32.08	50.94

United States (1990)

→ sons education ↓ fathers education	*Uncompleted compulsory*	*Compulsory education*	*Beyond comp. education*	*Tertiary education*
Uncompleted compulsory	25.46	28.44	33.94	12.16
Compulsory education	10.88	27.98	35.23	25.91
Beyond compulsory education	3.73	17.84	46.06	32.37
Tertiary education	2.40	7.78	28.74	61.08

Table 3 – Intergenerational mobility in educational attainments and incomes

	ITALY	GERMANY	UNITED STATES
Rank correlation (Spearman) for educational attainments	0.53	0.38	0.43
Rank correlation (Spearman) for occupational incomes	0.37	0.32	0.35
Regression coefficient between father and son occupational incomes *	0.364 (15.03)	0.447 (13.34)	0.388 (13.25)

* OLS regressions including age and age squared; t-statistics in parenthesis.

In table 3 we have reported alternative measures of (relative) mobility, obtained from either education (first line) or from incomes (second and third lines). While Germany would emerge as the most mobile country thanks to the lowest association between children and parent outcomes, any judgment is heavily dependent on the statistical indicator adopted in the analysis (as witnessed by the third line, where the country order is reversed). It should therefore appear clear that we do not possess a unique and everlasting measure for intergenerational mobility,[15] and that cross-national comparisons should state clearly from the onset which properties they subsume in their interpretation of this concept.[16] In

measure is heavily dependent on the choice of the reference point. Using the long run distribution as reference point, the Euclidian measures are respectively 0.18 for Italy, 0.15 for Germany and 0.12 for the United States.

[14] The percentage of families along the main diagonal is respectively 33.1% for Italy, 54.2% for Germany and 36.4% for the United States.

[15] For an axiomatic approach to the measurement of mobility, see Shorrock 1978, Dardanoni 1993 and Fields 2000.

[16] On the recognition of increased mass scholarisation in modern societies, leading to saturation of educational attainments (and therefore to vanishing influence of social origins), other authors have adopted alternative measures to assess the extent of mobility. For example the studies reported in Shavit and Blossfeld 1993 consider age cohort sub-samples to analyse the

the economic literature the most widely used measure of mobility is the regression coefficient of children income onto parental income (see a review of the results in section 6 below). Its adoption is justified in terms of regression to the mean, which has some bearing on the concept of equality of opportunities. Most recent versions take into account the possibility of structural changes by making reference to the correlation index between incomes of the two generations, to be corrected with the ratio of the standard deviations in incomes for the two generations. On the contrary, the traditional approach followed by sociologists measures relative chances offered to individuals from different backgrounds (*odds ratios* – see Erikson and Goldthorpe 2002). But the differences between economic and sociological approaches can barely be reduced to statistical indicators. Sociologists stress the fact that people are embedded in social hierarchical relations, like different types of labour contracts, which are beyond individual control.[17] Since embeddedness does not derive from intentional choice, intergenerational persistence looks like a mechanical dynamic law, and scholars are left without the possibility of testing theoretical predictions. According to Grawe and Mulligan 2002, this is the main advantage of economic analysis of intergenerational mobility. If agents are depicted as maximising their dynastic welfare flow, they will select optimal money transfers and educational investments in their children (based on their expected abilities) aiming at intertemporal consumption smoothing.[18] An additional implication of the potential existence of liquidity constraints is the possibility of non-linearities in the pattern of intergenerational mobility, with stronger persistence in the lower tail of the parents' income distribution. However, the empirical analysis of Grawe (2004) and Couch and Lillard (2004) suggests that income persistence is higher at both extremes of the distribution. A final implication of optimising agent models is the potential crowding out of private educational investment by public expenditure on education, evidence of which is rather weak.[19]

The impossibility of achieving univocal conclusions about mobility measurement does not imply that the theoretical analysis of mobility is worthless. On the contrary, theoretical models help us to identify different channels of persistence, which in principle can be separately tested using structural models. As an example of the complex interplay of factors affecting intergenerational mobility, let us consider the following figure 1. It depicts each individual i belonging to generation t with a triplet (A_{it}, Y_{it}, E_{it}), where A_{it} is ability endowment, Y_{it} is earnings and E_{it} is education. If we neglect on-the-job training, education is predetermined with respect to labour market status, and therefore with respect to earnings. If we consider that ability increases labour productivity, we should observe that

$$Y_{it} = \beta E_{it} + \varepsilon A_{it} + \omega_{1t}, \qquad \omega_1 \sim (0, \sigma_1^2) \tag{7.1}$$

impact of parental education, finding support to the theory of persistent inequality in access opportunities. Similarly, in IALS dataset Esping-Andersen 2004b finds a decline of impact of parental education in the youngest cohorts of Nordic countries (Sweden, Denmark and Norway) but not for Anglo-Saxon ones (US, UK and Germany). Applying an analogous approach to a different dataset (TIMMS 1995), Woessman 2004 compares the extent of equality of opportunities offered by different national educational systems: he finds that France exhibits the lowest impact of family background, while UK has the highest, and Germany is in between.

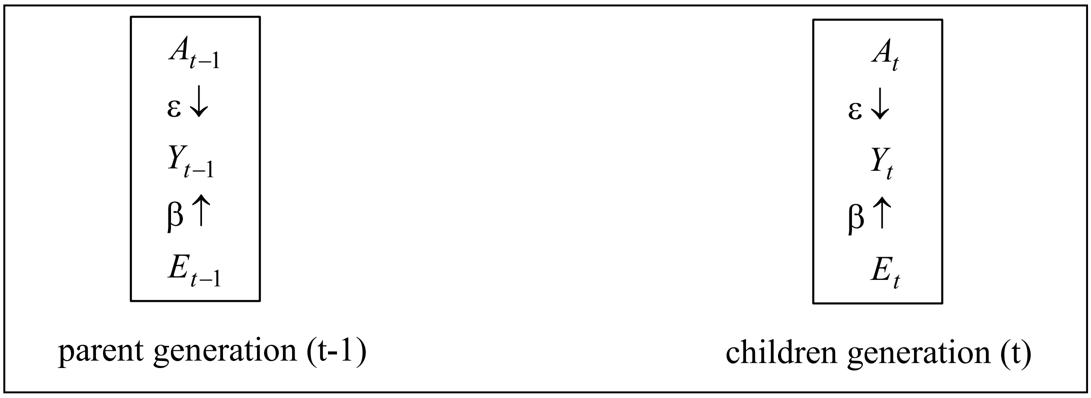
17 Erikson and Goldthorpe 1992 give the following definition: "The aim of the class scheme is to differentiate positions within labour markets and production units or, more specifically, one could say, to differentiate such positions in terms of employment relations that they entail." (p.37). As an application … "a *service* relationship…is likely to be found whether it is required of employees that they exercise *delegated authority* or *specialised knowledge and expertise* in the interests of their employing organisation"(p.42). At the other extreme they envisage standard labour contacts, without any requirement of monitoring (like piece-rate jobs).

18 Among nine theoretical predictions advanced in Mulligan 1999, two of them have relevance with respect to educational choices: "…vi. human capital investments are less correlated with parental income among unconstrained families. vii. greater public provision of schooling increases intergenerational earnings mobility and decreases intergenerational consumption mobility" (p.S193). His empirical analysis finds little support to most of his theoretical predictions, leading him to conclude that "because the empirical success of the nine implications is so limited, one can conclude that the observed intergenerational dynamics of measures of economic status are not the result of borrowing constraints" (p.S215).

19 See the discussion of the issue in Grawe and Mulligan 2002.

where the relationship between earnings, education and ability is assumed linear for simplicity. ω_1 is an i.i.d. error term, capturing the idea of luck in the labour market. Following previous informal discussion, we now consider four potential channels through which one generation may influence the following one.

Figure 1 – Individual in the intergenerational process



If ability is genetically (or mechanically) inherited, we indicate this with the α-arrow and we write

$$A_{it} = \delta + \alpha A_{it-1} + \omega_{2t}, \qquad \omega_2 \sim \left(0, \sigma_2^2\right) \tag{7.2}$$

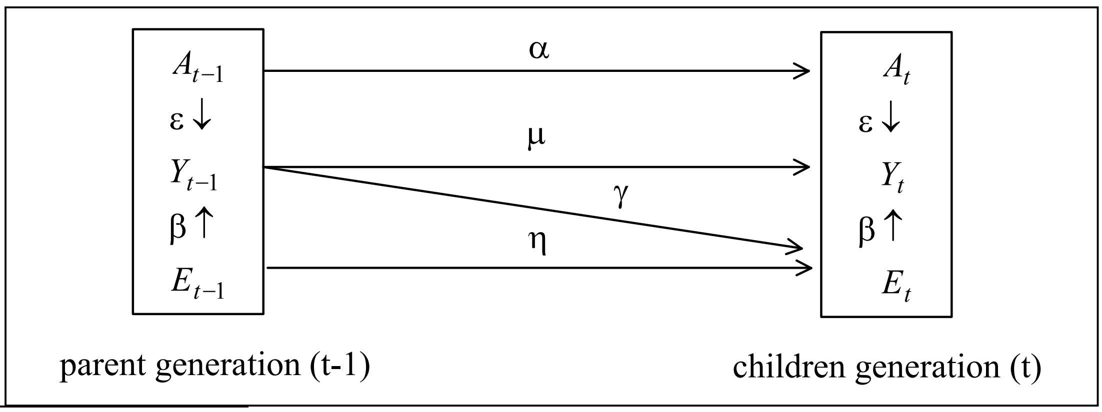
Cultural influence can be described by the η-arrow. However we have discussed the possibility of liquidity constraints, reducing the optimal investment in education from poor families. We indicate this channel with the γ-arrow and we write[20]

$$E_{it} = \eta E_{it-1} + \gamma Y_{it-1} \tag{7.3}$$

Finally, we may consider the possibility of family networking and neighbourhood effects, giving access to better job opportunities (Montgomery 1991, Benabou 1993). We indicate this channel with the μ-arrow, and we amend equation (7.1) by adding a further term

$$Y_{it} = \beta E_{it} + \varepsilon A_{it} + \mu Y_{it-1}\omega_{1t}, \quad \omega_1 \sim \left(0, \sigma_1^2\right) \tag{7.4}$$

Figure 2 – Intergenerational persistence



[20] Notice that for simplicity we are abstracting from the fact that ability could positively affect educational attainment, since it lowers marginal cost and raises marginal revenue.

Intergenerational persistence in this framework is a dynamical system that maps $\Re^3 \to \Re^3$, whose stability and speed of convergence are strictly related to the eigenvalues of the associate Jacobean. However, without entering into the details of the mathematical analysis, by repeated substitution we can dispense of equation (7.2), since the dynamical system is block-recursive, obtaining

$$\begin{cases} E_{it} = (\eta + \gamma\beta)E_{it-1} + \gamma\mu Y_{it-2} + \gamma\varepsilon A_{it-1} + \gamma\omega_{1t-1} \\ Y_{it} = \beta(\eta - \alpha)E_{it-1} + (\beta\gamma + \mu + \alpha)Y_{it-1} - \alpha\mu Y_{it-2} + \varepsilon\delta + \omega_{2t} - \alpha\omega_{1t-1} \end{cases} \tag{7.5}$$

By observing the dynamic process described by equation system (7.5), we may infer that income and educational attainment are more persistent the higher is the return to education β and the impact of liquidity constraint γ. In addition, income persistence will also depend on genetic inheritability α and on neighbourhood effects μ, whereas schooling persistence is affected by cultural constraints η. Finally, notice that a proper specification of the intergenerational persistence process should take into account grandfathers' earnings Y_{t-2}, which affect positively educational attainment (because parental education is raised), but negatively the earnings dynamics (due to the mean reversion nature of the processes described in equations (7.2)-(7.3)-(7.4)).[21] The utility of such a scheme is to provide interpretative clues when comparing intergenerational mobility estimates across countries (or across years). Other things being constant, this sketch model suggests that intergenerational mobility will be lower whenever returns to education are high or poverty is widespread (and therefore the extent of liquidity constrainedness is high).[22] Similarly intergenerational mobility in educational attainment should increase as long as schools are able to reduce the impact of family background on educational attainment (the cultural constraint η).[23]

For these reasons, in the following four sections we will review some theoretical models that in our opinion shed light on the issue of intergenerational persistence. In the concluding section, we will review existing empirical evidence on intergenerational mobility. Still our analysis retains a peculiar perspective, since our focus is on persistence in educational attainments, while most of the literature deals with income persistence.

---

21 Solon 2004 presents a model that has some similarities to the present one. In his model, educational attainment is generated by public and private investment, which are assumed to be perfect substitutes, and ability, which is partially inherited across generations. Altruistic parents allocate part of their income to the education of their children: as a consequence, education of the children is positively correlated with the income of their parents. The intergenerational persistence will then be higher the higher is the return to education (the β coefficient in our model) and the higher is the productivity of the parental investment in education (which in our model is replaced by the size of the impact of liquidity constraints γ). He also takes into account the progressivity of the tax system. A different model is proposed in the appendix of Bowles and Gintis 2002, where genotypes of both parents affect children's genotypes, which in combination with the environment and parental incomes determines children's incomes. A socio-psychological model of intergenerational transmission is presented in Hauser et al. 2000.

22 Both conditions seem to apply in developing countries, where effectively the measured mobility is low: see Grawe 2004.

23 Once there is agreement on the model structure, and conditional on avoiding causal interpretations, it can be used to decompose observed correlations into constituent components. For example, Bowles and Gintis 2002 propose the following decomposition of an estimated 0.2 correlation between father-son incomes: IQ conditional on schooling (0.04), schooling conditional on IQ (0.07), wealth (0.12), personality traits (0.07).

2. An initial model of intergenerational persistence

We will begin by presenting a base model, able to account for alternative channels of persistence previously mentioned.[24] We consider an overlapping generation model, where each individual lives for two periods. Each individual is born with an ability endowment A_t, obtains an inheritance from her parents equal to X_t and (an implicit transfer of) public resources invested in education equal to E_t. Abstracting from the individual choice of time allocation, her human capital formation will follow the following relationship[25]

$$H_{t+1} = f\left(\underset{+}{X_t}, \underset{+}{A_t}, \underset{+}{E_t}\right) \tag{7.6}$$

An increase in initial endowments, be it family wealth or public resources, raises human capital formation in the young generation. Equation (7.6) has to be taken as a mechanical relationship, with no role for individual choice. However, individual heterogeneity in talent endowment leads to the accumulation of different amounts of human capital. Notice also that family human capital has been neglected for simplicity.[26] In the second period each individual obtains an income Y_{t+1} that is proportional to accumulated human capital

$$Y_{t+1} = \gamma H_{t+1} + \nu_{t+1}, \qquad \nu \sim \left(0, \sigma_\nu^2\right) \tag{7.7}$$

where ν_t represents (unpredictable) luck during working life, and is described by a random error with zero mean. Each individual gives birth to a child, allocates her income between second period consumption and inheritance, and then leaves the scene. The budget constraint is given by

$$Y_{t+1} = C_{t+1} + X_{t+1} \tag{7.8}$$

where C_{t+1} is consumption when old (consumption when young is left out for simplicity) and X_{t+1} is the inheritance left over to the child. Each agent is assumed to be altruistic, thus concerned with her own consumption and with the future income of her child Y_{t+2}.[27] Thus she faces a trade-off between her own welfare and the her child's welfare, as described by the following relationship

---

24 We follow the structure of the model proposed by Becker and Tomes 1979 and 1986 (also published as chapter 10 in Becker 1993). Notation has been modified in accordance with previous chapters.

25 A crucial assumption for the sequel is the following: "Ability, early learning, and other aspects of family's cultural and genetic 'infrastructure' [what we denote as talent A_i here] usually raise the marginal effect of family and public expenditure on the production of human capital." (Becker 1993, p.262). In symbols $\frac{\partial^2 H_{t+1}}{\partial A_t \partial j_t} > 0, j = X, E$.

26 While it is easy in principle to replace equation (7.6) with a more general one that includes parental human capital H_t within its arguments (i.e. $H_{t+1} = f\left(\underset{+}{X_t}, \underset{+}{A_t}, \underset{+}{E_t}, \underset{+}{H_t}\right)$), this would introduce a second source of dynamics (in addition to the genetic transmittability of ability described by equation (7.10)) and the long run dynamics would be more complicated to analyse.

27 In chapter 2 we assumed that altruistic parents were concerned with their own consumption and with the level of inheritance left over. Should the children be all alike, the two approaches would yield the same solution. But in the present context children are different because they are born with different talent endowments. In such a case, the inheritance may compensate the differences in abilities.

$$\max_{X_{t+1}} U_t = U(C_{t+1}, Y_{t+2}) = U[Y_{t+1} - X_{t+1}, \gamma H_{t+2}(X_{t+1}) + \nu_{t+2}] \qquad (7.9)$$

Given the random component ν_{t+2} affecting the future income of the child, the optimal choice of the level of inheritance is taken under uncertainty. Each parent is ignorant of the exact talent endowment of her child, but she knows that there is some persistence across generations, as described by the following autoregressive process[28]

$$A_{t+1} = \alpha + \beta A_t + u_{t+1}, \;\; u \sim (0, \sigma_u^2) \qquad (7.10)$$

It can be proved that the optimal solution (in implicit form) to the problem posed by equation (7.9) is given by

$$X^*_{t+1} = \chi\Big(\underset{+}{A_{t+1}}, \underset{-}{E_{t+1}}, \underset{-}{r}\Big) = \chi\Big(\alpha + \underset{+}{\beta A_t} + u_t, \underset{-}{E_{t+1}}, \underset{-}{r}\Big) \qquad (7.11)$$

where r is the (average) private return to education.[29] Equation (7.11) indicates that the level of inheritance is positively correlated with the expected ability of the child: thus more talented children obtain greater resources to be devoted to their education. This may look counterintuitive, since we would have expected an altruistic parent willing to compensate for adverse nature depriving the ability endowment of a child. However a more talented child exhibits a greater marginal rate of return, and therefore attracts more resources. For the same reason, public resources invested in education crowd out private resources. The negative sign of the intertemporal discount rate can be explained by the consumption/saving choice of the parent: since investing in the human capital of the child competes with alternative financial assets, when a competing returns raise, a rational investor will reduce the investment in these assets.

Using recursively equations (7.7), (7.6), (7.11) and (7.10), we obtain the intertemporal link between the income of parents and the income of the child. We start by endogenising the optimal inheritance choice

$$\begin{aligned} Y_{t+2} &= \gamma H_{t+2} + \nu_{t+2} = \gamma[f(X_{t+1}, A_{t+1}, E_{t+1})] + \nu_{t+2} = \\ &= \gamma[f(\chi(A_{t+1}, E_{t+1}, r), A_{t+1}, E_{t+1})] + \nu_{t+2} = \varphi(A_{t+1}, E_{t+1}, r) + \nu_{t+2} \end{aligned} \qquad (7.12)$$

Then we proceed by linearising the φ function and exploiting equation (7.10)

$$Y_{t+2} = \varphi_A A_{t+1} + \varphi_E E_{t+1} + \varphi_r r + \nu_{t+2} = \varphi_A(\alpha + \beta A_t + u_{t+1}) + \varphi_E E_{t+1} + \varphi_r r + \nu_{t+2} \qquad (7.13)$$

By lagging equation (7.13) one period, expressing it in terms of A_t and reintroducing it in the same equation we finally get

[28] Given the absence of a precise specification of A_t, equation (7.10) may represent either purely genetic transmission of unobservable ability (clever parents generate clever children) or may capture the effect of family cultural background (children from correctly speaking parents learn to speak correctly without any effort). Becker and Tomes 1986 make a further crucial assumption, that the parents know their own endowment of ability. In such a case they can compute the expected talent of their child by simply applying the mapping described by equation (7.10). In section 4 we will remove this assumption and we will replace it with the more realistic one that talent is revealed by schooling experience (and failure).

[29] Under the assumption of a perfect financial market, equation (7.11) can be derived by equating the market interest rate and the return to education for the child. In other words, investing in one's child's education represents an alternative financial assets to achieve (dynastic) intertemporal consumption smoothing: as a consequence, in equilibrium it must ensure the same return as any other asset.

$$Y_{t+2} = \varphi_A \alpha + \varphi_A \beta \left(\frac{1}{\varphi_A} Y_{t+1} - \frac{\varphi_E}{\varphi_A} E_t - \frac{\varphi_r}{\varphi_A} r - \frac{1}{\varphi_A} \nu_{t+1} \right) + \varphi_A u_{t+1} + \varphi_E E_{t+1} + \varphi_r r + \nu_{t+2} = \\ = \varphi_A \alpha + \beta Y_{t+1} + \varphi_E (E_{t+1} - \beta E_t) + \varphi_r (1-\beta) r + \nu_{t+2} - \beta \nu_{t+1} + \varphi_A u_{t+1} \tag{7.14}$$

By looking at equation (7.14), we notice that under the assumption of perfect financial markets[30] the autoregression coefficient β describes the intergenerational dynamics of incomes; in addition the same dynamics is observed in the dynamics of abilities. The higher the β coefficient, the more persistent is the (cross individual) inequality. If we define $\overline{Y}$ as the equilibrium steady state (such that $Y_{t+2} = Y_{t+1} = \overline{Y}$), we can re-express equation (7.14) as

$$Y_{t+2} - \overline{Y} = \beta (Y_{t+1} - \overline{Y}) \tag{7.15}$$

Whenever $|\beta| < 1$ individual incomes converge monotonically to their long run equilibrium value; this convergence is often indicated in the literature as *regression to the mean* (or β-convergence). The speed of convergence is higher the lower is the β coefficient. Let us suppose a parental income corresponding to the double of long run level; then the child income will be equal to $(1+\beta)\overline{Y}$. If β is close to one, we obtain long lasting persistence: children from rich (above the mean) parents will remain rich for many generations, and similarly occurs to poor dynasties. Conversely, if β is close to zero, the relative position of parents is almost irrelevant to predict the future position of children.

Within the simplicity of the present model, the same persistence can be observed in the level of acquired education. From equation (7.7) we can infer the human capital stock from the earned income

$$H_{t+1} = \frac{Y_{t+1} - \nu_{t+1}}{\gamma} \tag{7.16}$$

We the use equation (7.16) to re-express equation (7.14) as

$$H_{t+2} = \frac{\varphi_A \alpha}{\gamma} + \beta H_{t+1} + \frac{\varphi_E (E_{t+1} - \beta E_t) + \varphi_r (1-\beta) r + \varphi_A u_{t+1}}{\gamma} \tag{7.17}$$

where we obtain that the same level of intertemporal persistence observed in abilities and incomes can also be traced in educational attainments. By comparing equations (7.10), (7.14) and (7.17) we infer that under a condition of equality of access opportunities (namely, that all individuals face the same financial conditions to invest in their children education) the observed inequality and persistence in educational attainments is the mere reflection of talent distribution, which can hardly be changed when passing from one generation to the following.

Two assumptions remain crucial for these conclusions:

---

[30] The perfect financial market assumption ensures that all individuals obtain the same return on human capital investment. If we abandon this assumption, the equation (7.11) has to be replaced by $X^*_{t+1} = \chi\left(\underset{\pm}{A_{t+1}}, \underset{-}{E_{t+1}}, \underset{-}{r}, \underset{+}{Y_{t+1}} \right)$, because the possibility to leave an inheritance is limited by availability of family incomes. In such a case, the autoregression coefficient β in the equation (7.14) rises.

i) in order to undertake the optimal investment in their children, parents have to predict the ability of their children, which can be done only when the β parameter is known with certainty;
ii) there are no other impediments to access education that are correlated with family incomes.

In the first case, it is obvious that it is impossible to observe the actual intergenerational transmission of ability. However, under the structure of the model, the β coefficient can be estimated by looking at the dynamics of incomes (or even at the dynamics of educational attainments). If we consider the richest portion of the population, it is rather plausible to consider it as financially unconstrained; when current income does not condition educational choices (since borrowing is potentially unlimited, up to the point where the marginal return on human capital investment equates the return on any other financial investment), the only observable intergenerational correlation observed in incomes can be explained by correlation in abilities.[31] When we consider that the observability of talent transmission is an excessively heroic assumption, we have to take into account that parental investment is conducted under a veil of ignorance about the true ability of their children. When schools play a role of screening of actual student abilities, then the incentive to invest in education are modified, since schooling provide information that can be valuable by itself.

As far as the second assumption is concerned, we can easily think of other channels through which family income may limit the access to education. The easiest one is thinking of residential choices: when school funding is derived from property taxes, we observe positive correlation between family incomes and resources allocated to education. Unless funding from a central government is able to undo the financial segregation of schools, we could observe positive correlation between family resources and educational investment. In addition, the presence of a private sector in education provision (where the access is typically rationed according to available incomes – see previous chapters 3 and 5) reinforces this correlation.

Further implications can be derived in similar set-ups, the most important one being the intergenerational consumption smoothing (Mulligan 1997 and 1999): it implies that consumption persistence across generations must be higher than that in incomes or educational attainments.[32]

3. Intergenerational persistence with perfect information on children's talent

Previous discussion suggests that intergenerational persistence in educational attainments is higher than the persistence in incomes. Among potential explanations we can list both the intergenerational persistence in talents and the funding of education, partially based on family resources. With respect to the first aspect, the basic model by Becker and Tomes (1986) assume that parents know their own talent, and based on that knowledge they predict the expected talent of their child: knowing the dynamic evolution described by equation (7.10), the best prediction of the child talent is

[31] This is the route undertaken by Becker and Tomes 1986, who estimate a value of β lower than 0.20 on American data, and they argue that intergenerational transmission of "genetic" traits is limited. However, Cooper, Durlauf and Johnson 1994, divide the population into three segments, finding different estimates of the β coefficient within each group (respectively 0.53, 0.13 and 0.43 for low, middle and high income groups). Similarly Shea 2000 shows that a 2SLS estimate for β (using as instruments the unionisation rate, industry sector dummies and also closures of industrial plants, all factors that affect parental incomes independently of parental ability) is not statistically different from zero, whereas the same estimates for the sub-sample of poor families yields an estimate comprised between 0.32 and 0.79.

[32] In its extreme version (absence of financial market imperfections, partial revelation of child talent), consumption should follow a random walk across generations (i.e. the autoregression coefficient must be unitary). But this empirical claim does not find support in the data, forcing the author to introduce an explanation based on different degrees of altruism along the income distribution (Mulligan 1997).

$E[A_{t+1} \mid A_t] = \alpha + \beta A_t$. Despite its wide adoption in the literature, it is not always in accordance with the empirical evidence.

In fact, the knowledge of the (expected) talent of the child implies that parents take the crucial decision over the educational career of their children once and for all. This may prove appropriate for tracked educational systems (like the German one), where at the age of 13 a child is destined to become a blue collar, a white collar or a professional, according to her school performance up to that point.[33] But it is at odds with comprehensive systems, where educational choices are taken at different stages, with possibility of revisions and a progressive approximation of the unobservable abilities of a student. Under such circumstances, the more appropriate assumption would probably be the gradual revelation of the hidden talent, thanks to the screening activity of the schools. However, very few papers take this perspective,[34] whereas most of them side on one or the other of the extreme assumptions: *perfect information* (as in the previous case) or *absence of information* (parents only know the statistical distribution of unobservable talent). Results in terms of persistence crucially depend on which of the two extreme assumptions is adopted. In the sequel we present two models that retain the basic structure (two-periods overlapping generation model, with educational choices in the first period, and work, consumption and inheritance choice in the second period).

The model proposed by Owen and Weil (1998) corresponds to the first approach, since they assume that talent endowment A_t is randomly and independently distributed in each generation, but is perfectly observable before undertaking the educational choice. The educational choice is a discrete one: if one is educated, she will work in the second period of life as skilled, otherwise she will remain unskilled. An important assumption concerns the complementarity/substitutability of skill levels. If we assume that total labour input is obtained from a combination of skilled L^s and unskilled labour L^n, considered as imperfect substitutes, we may write total output Y_t as the result of a constant return to scale technology

$$Y_t = F(L_t, K_t) = \left[L_t^{n^{\gamma}} L_t^{s^{1-\gamma}} \right]^{\beta} K_t^{1-\beta} \tag{7.18}$$

where K_t is the stock of physical capital. If we assume wage flexibility, we will obtain full employment for both types of workers. Given a marginal rate of return on physical capital R (for example from foreign financial markets), the wage differential between skilled and unskilled workers (i.e. the incentive to acquire education) is only dependent on the relative supply of skilled workers. From profit maximisation of the firm we obtain that the wage (per efficiency unit) must equate the marginal productivity of each type of work[35]

$$W_t^s = \frac{\partial Y_t}{\partial L_t^s} = \beta \left[\frac{K_t}{L^{n^{\gamma}} L^{s^{1-\gamma}}} \right]^{1-\beta} \cdot (1-\gamma) L^{n^{\gamma}} L^{s^{-\gamma}} \tag{7.19}$$

[33] See the description of the German tracking system in Schnepf 2002.

[34] One partial exception is represented by Bertola and Coen-Pirani 1997, where schools screen students in order to reveal their true talent endowment, and the precision of the estimates varies with the amount of resources invested in education.

[35] It is possible to recognise that Inada's conditions apply at the boundaries $\lim_{L^i \to \infty} W^i = 0, \lim_{L^i \to 0} W^i = \infty, i = s, n$. This ensures that in equilibrium we do not observe zero values for L^s or L^n.

$$W_t^n = \frac{\partial Y_t}{\partial L_t^n} = \beta \left[\frac{K_t}{L^{n^\gamma} L^{s^{1-\gamma}}} \right]^{1-\beta} \cdot \gamma L^{s^{1-\gamma}} L^{n^{\gamma-1}} \tag{7.20}$$

Normalising the size of the labour force to unity (such that $L^s + L^n = 1$), we get

$$\frac{W_t^s}{W_t^n} = \frac{1-\gamma}{\gamma} \cdot \frac{L_t^n}{L_t^s} = \frac{1-\gamma}{\gamma} \cdot \frac{\left(1 - L_t^s\right)}{L_t^s} = f\left(\underset{-}{L_t^s} \right) \tag{7.21}$$

Equation (7.21) indicates that the return to education declines with the increase in the supply of educated people. Each individual takes for given the existing differential, and ignores the (marginal) impact of her choice on the aggregate outcome. If we interpret the talent as equivalent to the number A_{it} of efficiency units obtained as endowment at birth, each individual compares the expected income as skilled worker $\left\lfloor A_{it} \cdot W_t^s \right\rfloor$ with the expected income when unskilled $\left\lfloor A_{it} \cdot W_t^n \right\rfloor$.[36] Since acquiring education implies a fixed cost B_t, an individual will do so education if

$$A_{it} \cdot W_t^s - B_t \geq A_{it} \cdot W_t^n \tag{7.22}$$

or otherwise if

$$A_{it} \geq \frac{B_t}{W_t^s - W_t^n} \tag{7.23}$$

In order to acquire education one must possess a sufficient level of talent (a sufficient number of efficiency units A_{it}) or face either a sufficiently low cost of acquisition B_t or a sufficiently high wage differential for skilled workers. Under perfect financial markets, the condition (7.23) describes the relevant talent threshold for (economic) convenience in becoming skilled. Under imperfect (or even absent) financial markets, educational choices are financed through received inheritances X_t. In such a case, we obtain a double threshold, given by talent and wealth endowments (as represented in figure 3).

If we now introduce a standard assumption of homothetic preferences, the inheritance left to a child is proportional to earned income. Since the talent variable A_{it} is assumed to be *i.i.d.* (*identically independently distributed*), each individual, irrespective of her social origin (whether born of rich and/or educated parents), faces a positive probability to achieve an income that is sufficiently high to leave an inheritance capable to cover the educational cost of her child. However this probability is not independent of the educational attainment of parents and even grandparents, as it can be seen from equation (7.24)

$$A_{it} \geq \frac{B_t}{W_t^s - W_t^n} = \frac{X_t}{W_t^s - W_t^n} = \int_{-\infty}^{B_{t-1}} \left[\frac{\alpha(A_{it-1} W_{t-1}^n)}{W_t^s - W_t^n} \right] dX_{t-1} + \int_{B_{t-1}}^{+\infty} \left[\frac{\alpha(A_{it-1} W_{t-1}^s - X_{t-1})}{W_t^s - W_t^n} \right] dX_{t-1} \tag{7.24}$$

where α is the income share devoted to inheritance and where we have adopted the extreme case of absent financial markets (up to the point where educational costs can be financed only thorough inheritance). Having a rich grandfather increases the probability of having an educated parent (the

[36] In order to make such a comparison, the number of efficiency units must be perfectly observable, by both the worker and the firm.

second addend on the right hand side of equation (7.24)), who in turn is more likely to be richer and to leave a higher inheritance. Thus we observe intergenerational persistence attributable only to liquidity constraints. If these obstacles could be removed, the intergenerational link would cease to exist, because educational attainments and incomes would be solely based on talent, which is randomly distributed in each generation.[37]

Thus the cost of education is positively correlated with the measure of intergenerational persistence, up to the point of perfect mobility, when parents' achievements are replicated in children's ones. Owen and Weil (1998) also show that equilibria characterised by low/zero mobility are inefficient,[38] since they prevent talented individuals from fully exploiting their endowment.[39]

In the same model there is also a negative correlation between inequality and mobility. When inequality declines, we observe an increase in school attendance, and mobility rises as a consequence. And conversely, an increase in mobility is accompanied by an increase in the supply of skilled labour, which translates into a decline of wage differentials (see equation (7.21)).[40] Summing up, under perfect observability of talent, absence of inheritability of talent and imperfect financial market, the cost of attending education is negatively correlated with intergenerational mobility and positively correlated with income inequality.

Figure 3 – Educational choices

[37] An alternative possibility, discussed in the original paper, is when the government is able to lower the cost of educational attendance (up to the point where the aggregate output is maximised). Going beyond that level (like for example pushing the educational cost B_t to zero) makes it convenient for everyone to achieve education, thus eliminating the wage differential $\left(W_t^s - W_t^n\right)$ and creating a situation of overeducation.

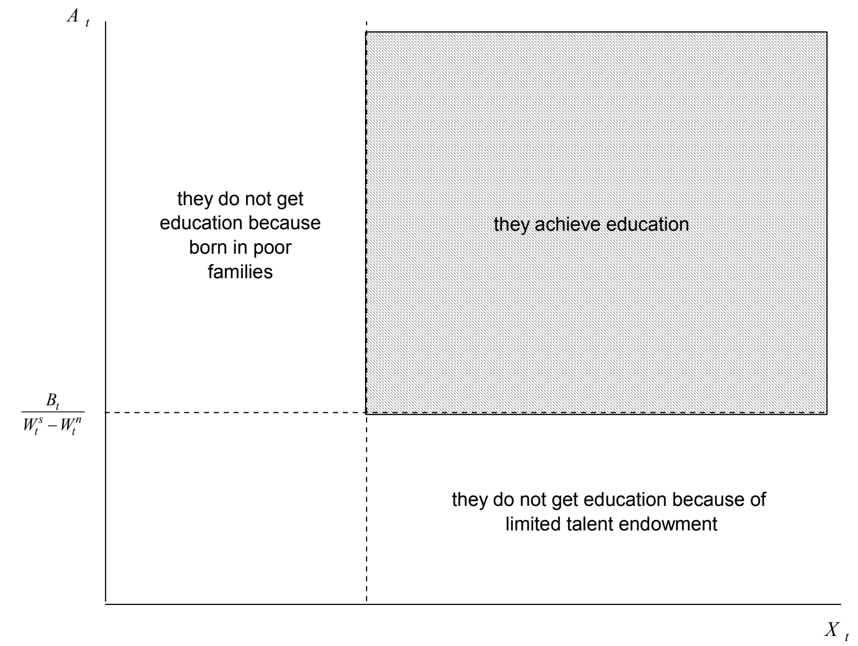
[38] Intergenerational mobility is measured by the ratio of conditional probabilities (*odds ratio*). If we define

$$ODDS = \frac{prob(\text{educated child} \mid \text{uneducated parent})}{prob(\text{uneducated child} \mid \text{educated parent})},$$

when $ODDS$ is equal to one we observe perfect mobility, whereas when $ODDS \to \infty$ mobility goes to zero.

[39] "It could achieve the same ratio of educated to uneducated efficiency units by educating some of the wealth-constrained high ability individuals… Such a redistribution of education could be achieved at a lower total cost since education costs are allocated per person and not per efficiency unit" (Owen-Weil 1978, p.96).

[40] A similar result is obtained in Aaberge et alt. 2002, where the proposed measure of intergenerational mobility is negatively correlated with the inequality measure (provided by the Gini index). The intuition is that greater mobility allows a more intensive reshuffling of income positions, thus lowering inequality when measured on a longer time horizon.



4. Intergenerational persistence with imperfect information on children's talent

When we remove the assumption of perfect observability of talent, additional factors can be introduced to account for intergenerational mobility. Following Checchi, Ichino and Rustichini (1999), let us suppose that individual talent cannot be freely observed, but it requires schooling experience to achieve a precise knowledge of individual endowment. In such a context, schools operate as a costly screening device. Individuals only know that talent can take two values ((A_1 and A_2, with $A_1 > A_2$), and that there is intergenerational persistence in talent transmission. If we indicate with $(1-\pi)$ the probability of persistence (i.e. the probability for an A_1 parent to generate an A_1 child, which is identical to the probability of an A_2 parent to generate an A_2 child), and with π the complementary probability of transition, we can represent the dynamic evolution of talent transmission as a first order Markov process, described by the following matrix

→ children's talent ↓ parents' talent	Low (A_2)	High (A_1)
Low (A_2)	$1-\pi$	π
High (A_1)	π	$1-\pi$

When $\pi = 1/2$ we are back to the situation where talent is randomly distributed in each generation. To retain some persistence in ability transmission, from now on we will maintain that $\pi < 1/2$. In this context, the only way to obtain information about one's talent endowment is to undertake a schooling career, which can be acquired at a fixed cost B.[41] By going to school, an A_1 type expands her human capital, her income and therefore her bequest to her child. On the contrary, an A_2 type does not

[41] In the original model by Checchi, Ichino and Rustichini 1999, this cost is represented by forgone leisure, since the educational production function depends on individual effort. In the present context, we have abstracted from effort supply in order to increase the model comparability.

acquire any additional human capital and makes losses (equal to the educational cost B). Since before undertaking the educational choice, an individual is ignorant of her own talent endowment, she takes expectations based on her parents' educational attainment. If her mother had not gone to school either, she is forced to go back in memory up to the point where an ancestor who went to school is found.

To see how this backward induction works, consider initially the case of the child of a parent who went to school. If this parent was successful, she was revealed to be of the A_1 type; thus her child has an expected talent equal to $[(1-\pi)A_1 + \pi A_2]$. Using previous notation, the child will choose to go to school whenever the expected return, net of school tuition, exceeds the certain return of not attending school, that is

$$(1-\pi)A_1W^s + \pi A_2W^n - B > A_2W^n \tag{7.25}$$

which can be rearranged as

$$(1-\pi) > \frac{B}{A_1W^s - A_2W^n} \tag{7.26}$$

Conversely, the child of a parent who went to school and failed[42] (proving to be of the A_2 type) will face a different arbitrage condition, which is more restrictive than the previous one[43]

$$\pi > \frac{B}{A_1W^s - A_2W^n} \tag{7.27}$$

In this way we have already introduced intergenerational persistence in educational choices, which depends on inheritability of talent (even when not directly observed). School failure in one generation lowers the probabilities of all the following generation. The school here plays the role of screening device, by revealing the talent endowment of any individual undergoing the screening test.

Let us now consider the case of a child of uneducated parents; as a consequence their talent endowment is unknown. If we indicate with ν_t^e the (expected) belief of being of type A_1 that the child attributes to herself, and if it is known that her mother held the same belief ν_{t-1}^e of being of type A_1, then coherence in beliefs requires that

$$\begin{aligned} \nu_t^e &= (1-\pi)\cdot(\text{probability mother } A_1) + \pi\cdot(\text{probability mother } A_2) = \\ &= (1-\pi)\cdot\nu_{t-1}^e + \pi\cdot\left(1-\nu_{t-1}^e\right) = \pi + (1-2\pi)\cdot\nu_{t-1}^e \end{aligned} \tag{7.28}$$

---

42 School failures can take different forms: to be held back (as in the French or Italian systems), to be oriented to vocational schools (as in the German system) or simply to drop out from school (as in the US system).

43 Under the condition $\frac{B}{A_1W^s - A_2W^n} > \frac{1}{2}$, children from A_2 type parents will never go to school, because it is never convenient to do so. We leave out this uninteresting occurrence by assuming $\frac{B}{A_1W^s - A_2W^n} < \frac{1}{2}$, which implies that the cost of acquiring education never reaches 50% of the potential gain associated to it.

When the number of generations about whom we do not have information goes up, the repeated application of equation (7.28) yields

$$\nu_t^e = \pi + (1-2\pi)^i \cdot \nu_{t-i}^e \qquad (7.29)$$

where i is the number of generations for which we do not have information. Since equation (7.29) represents an increasing difference equation of i^{th} order (since $(1-2\pi)>0$), it converges to ½ whatever the level of initial belief on ancestors. This implies that even after a school failure (that implies $\nu^e = 0$), and even if her descendants were negatively affected by this failure, the reminiscence of this event will vanish with the passing of time. Sooner or later a new generation will achieve a point such that the following condition holds[44]

$$\nu_t^e > \frac{B}{W^s - W^n} \qquad (7.30)$$

Even in this context we find that a lower cost of education (or equivalently a greater wage differential) raises the fraction of individuals who undergoes the screening test of schools, and therefore mobility increases. Thus cost of education and social mobility are negatively correlated. Unlike the previous model shown in section 3, we cannot argue that there is also an efficiency enhancing implication. In fact, with high costs of schooling there are individuals of type A_1 who do not dare to go to school for fear of failure, but whenever we lower them there is an increasing number of type A_2 individuals who go to school and fail, wasting resources.

So far we have abstracted from how individuals obtain their funding to afford educational choices. If we introduce the further assumption that human capital can be accumulated (and transmitted) across generations, a sequence of successful generations will be characterised by growing human capital, income and wealth. As a consequence, the implications in terms of inequality are far from straightforward, and depend on the way in which education is financed.

When we consider a *publicly financed schooling system*, each individual undertaking an academic career will receive the same amount of resources, and they will differ to the extent that parental human capital affects the accumulation of their own human capital. On the contrary, when we consider a *private schooling system* (where the amount of resources available for education is strictly dependent on family resources), the successful dynasties have a greater incentive to undertake an academic career, since part of their expected gains will spill over to their offspring. In the model by Checchi, Ichino and Rustichini (1999) the relationship between mobility (defined as the population share which attempts to go to school) and inequality holds negative, but varies in accordance with the public/private nature of the schooling system. Everything else being constant, a public schooling system ensures greater equality (thanks to the implicit redistribution operated by tax financed schooling) at the cost of reduced mobility (since the long-run incentives are lower).[45] The impossibility to transfer financial resources out of

---

[44] Since we have assumed that $\frac{B}{A_1 W^s - A_2 W^n} < \frac{1}{2}$, and it is easy to show that $\lim_{t\to\infty} \nu_t^e = \frac{1}{2}$, inequality (7.30) will apply with probability one.

[45] Iyigun 1999 proposes a model where school admission is based on academic potential (which is defined as innate ability and parental educational level). This creates ambiguous effects of current (educational) inequality on prospect mobility: "Thus an increase in the fraction of educated parents in any period has potentially offsetting effects. First, by increasing total output, it expands the supply of educational services. Holding everything else constant, this would make admissions to school less competitive and would increase intergenerational economic mobility. Second, an increase in the fraction of educated parents implies that some members of the young generation have greater academic potential. Everything else

taxation, reduces the effort of an individual, thus leading to an under-investment in the accumulation of the dynastic human capital. On the contrary, a private schooling system provides the correct incentives, and therefore is characterised by greater mobility, however at the cost of greater inequality, since more individuals will put more effort into accumulating human capital, leading to a more uneven distribution of incomes.

5. Intergenerational persistence and equilibrium inequality under imperfect information on talent

The relationship between inequality and mobility is discussed in most of the previously reviewed papers, leading to alternative views, often reflecting alternative assumptions. The model presented in section 3 suggests a negative relationship between (current) income inequality and intergenerational mobility, since the former strengthen the impact of liquidity constraints. Let us call it the *financing side* of the story. The model presented in section 4 adds another aspect, that is (current) income inequality provides incentive to acquire education and, everything else being constant, implies greater mobility. Let us call this the *incentive side* of the story.[46] But mobility also affects long run inequality, as clearly stated by Loury (1981, p.854): "…intergenerational social mobility is a property of the transition probability P, while cross-sectional inequality is (asymptotically) a property of the equilibrium distribution to which P gives rise".

In order to better analyse the relationship between inequality, mobility and growth, we will introduce some modifications to the model presented in section 3.[47] Production technology is still described by one-commodity economy, where skilled and unskilled workers are imperfect substitutes[48] (see equation (7.18)). Given competitive labour markets, inequality is measured by the wage differential, which depends on the relative supply of skilled workers (see equation (7.21), here reproduced for ease).

$$\frac{W_t^s}{W_t^n} = \frac{1-\gamma}{\gamma} \cdot \frac{L_t^n}{L_t^s} = \frac{1-\gamma}{\gamma} \cdot \frac{\left(1-L_t^s\right)}{L_t^s} = f\left(\underset{-}{L_t^s}\right) \tag{7.21}$$

It is easy to note that inequality disappears and output is maximised when $L^s = 1-\gamma$: therefore the economic relevant story occurs in the interval $L^s \in (0,1-\gamma)$, since the extreme values are never attained.[49]

constant, this would make admission to school more competitive and would lower intergenerational economic mobility" (p.698).

46 Hassler, Mora and Zeira 2003 build a model where inequality and mobility can be either positively or negatively correlated, depending on whether shocks affect the production sector or the education sector. While their model has some similarities with the Moaz and Moav 1999, they endogenise the cost of acquiring education through the relative wage of skill workers (on the assumption that teachers be skilled workers).

47 We will present a simplified version of the model proposed by Moaz and Moav 1999.

48 Eeckout 1999 considers an alternative model, where two types of workers are not substitutable, but the two types of produced commodities are. Given an increasing return to scale assumption, mobility is a (costly) move from the unskilled sector to the skilled one. Eeckout's economy is characterised by multiple equilibria, depending on the initial distribution of workers types.

49 When the supply of skilled workers go to zero, the wage differential goes to infinite, whereas when it tends to $(1-\gamma)$, the incentive to costly acquire education vanishes, and no one is willing to buy education. The maximal output can be obtained by setting $dY/dL^s = 0$, that is

Each individual lives two periods: in the first period she receives a bequest that can be consumed and/or used to buy an indivisible unit of education; in the second period, she works (either as skilled or unskilled worker) and allocate her earnings between consumption and inheritance. Altruism and preference of consumption smoothing can be represented by the following utility function

$$U_{it} = U(C_{it}, C_{it+1}, X_{it+1}) = \log C_{it} + \log C_{it+1} + \log X_{it+1} \tag{7.31}$$

which is maximised under the following budget constraint

$$\begin{cases} C_{it} + \delta_i \dfrac{B}{A_{it}} = X_{it}, \quad \delta_i = 0,1, \quad A \sim \left(\underline{A}, \overline{A}\right) \\ C_{it+1} + X_{it+1} = W_{it+1}, \quad W_{it+1} = W_{t+1}^n \text{ if } \delta_i = 0, \; W_{it+1} = W_{t+1}^s \text{ if } \delta_i = 1 \end{cases} \tag{7.32}$$

where C_{it} and C_{it+1} are the consumption levels of individual i when respectively young and old, X_{it+1} is the amount of bequest left over, δ_i is the educational choice (whether to go to school or not), B is the cost of education which varies inversely with the ability endowment A_{it} which is randomly selected from a given support in each generation. Financial markets are absent, so that only very talented individuals and/or offspring from very rich families find it convenient to acquire education. Given the homothetic utility function, whatever the earnings obtained in the labour market the optimal choice for the second period will be allocating half income to consumption and the remaining half to bequest.

By backward induction, first period choice (whether going to school or not) will incorporate the second period optimal solution. The child will become skilled if and only if

$$\log\left(X_{it} - \frac{B}{A_{it}}\right) + \log\left(\frac{W_{t+1}^s}{2}\right) + \log\left(\frac{W_{t+1}^s}{2}\right) \geq \log(X_{it}) + \log\left(\frac{W_{t+1}^n}{2}\right) + \log\left(\frac{W_{t+1}^n}{2}\right) \tag{7.33}$$

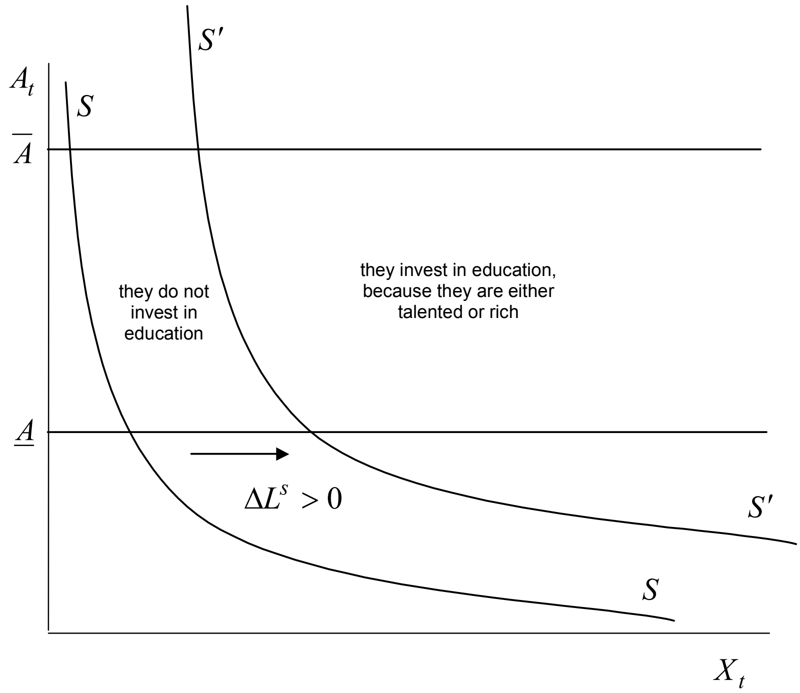
which simplifies to

$$\frac{B}{X_{it} A_{it}} \leq 1 - \left(\frac{W_{t+1}^n}{W_{t+1}^s}\right)^2 \tag{7.34}$$

The locus described by equation (7.34) can be represented by figure 4 as SS locus, which contrasts with previous figure 3, since now individual talent and family wealth can exactly compensate each other: only ablest people or children from rich families will become skilled. But the expansion of the supply of skilled workers tend to be self-defeating, since it shifts rightward the locus to $S'S'$, thus reducing the number of people that finds it convenient to become skilled.

$$\frac{dY}{dL^s} = \frac{d\left[\left(\left(1-L^s\right)^{\gamma} L^{s^{1-\gamma}}\right)^{\beta} K^{1-\beta}\right]}{dL^s} = \left(\left(1-L^s\right)^{\gamma} L^{s^{1-\gamma}}\right)^{\beta-1} K^{1-\beta}\left(-\gamma\left(1-L^s\right)^{\gamma} L^{s^{-\gamma}}\right)\left(-\frac{L^s}{1-L^s} + \frac{1-\gamma}{\gamma}\right) = 0 .$$

Figure 4 – Educational choices (under individual specific cost of education)

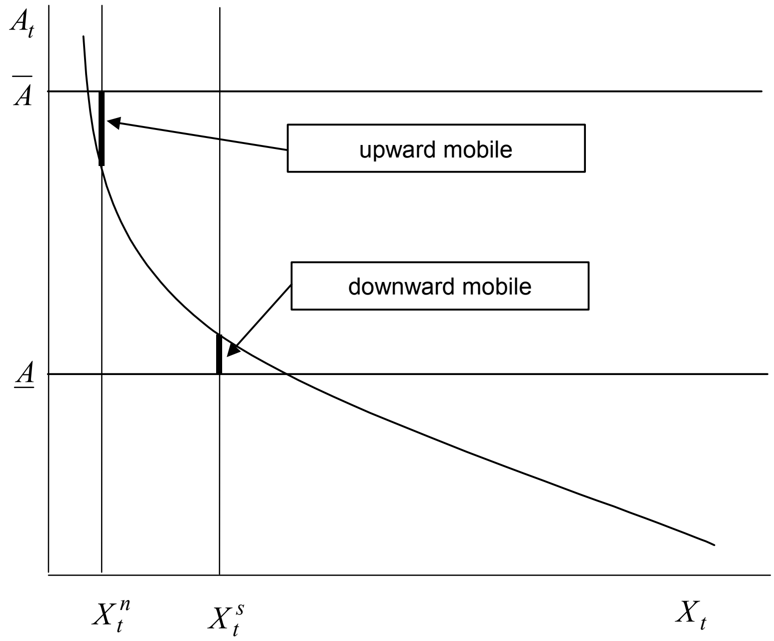


Given the non transmittability of talent and the impossibility of money transfer from one period to the following (such that each person is forced to spend all disposable income within each period), in each period we observe only two values for incomes, W_t^s and W_t^n, and as a consequence only two values for inheritance, $X_t^s = \frac{W_t^s}{2}$ and $X_t^n = \frac{W_t^n}{2}$. Among alternative configurations, which are dependent on initial conditions, we find it interesting to discuss the case represented in figure 5, which exhibits upward and downward mobility at the same time. Conditional to one of the two levels of inheritance received from previous generation, X_t^n or X_t^s, some children will obtain from nature an ability endowment high enough to facilitate the acquisition of education, while some others will not. In a steady state the SS locus must remain fixed, and this is possible if and only if L^s (the existing supply of skilled workers) remains constant. In turn, this requires that the number of upward mobile individuals will be equal to the number of downward mobile ones; under uniform distribution of talent over the $\left\lfloor \underline{A}, \overline{A} \right\rfloor$ support, this is equivalent to[50]

$$\overline{A} - \frac{B}{X^n} \cdot \left(\frac{{W^s}^2}{{W^s}^2 - {W^n}^2} \right) = \frac{B}{X^s} \cdot \left(\frac{{W^s}^2}{{W^s}^2 - {W^n}^2} \right) - \underline{A} \qquad (7.35)$$

[50] It corresponds to the $\overline{L}^s$ such that $\frac{\overline{A} + \underline{A}}{2B} = \frac{W^s\left(\overline{L}^s\right)}{W^n\left(\overline{L}^s\right)} \cdot \frac{1}{W^n\left(\overline{L}^s\right) - W^s\left(\overline{L}^s\right)}$ which is highly nonlinear in L^s. In the original model, Moaz and Moav 1999 assume that the cost of education B grows with the average wage, thus delaying the convergence to a steady state with mobility. There is a second potential steady state, with zero mobility, which corresponds to the vertical schedules of figure 5 crossing the SS locus above $\overline{A}$ or below $\underline{A}$. This represents another example of the poverty traps described by Piketty 2000.

Figure 5 – Intergenerational mobility



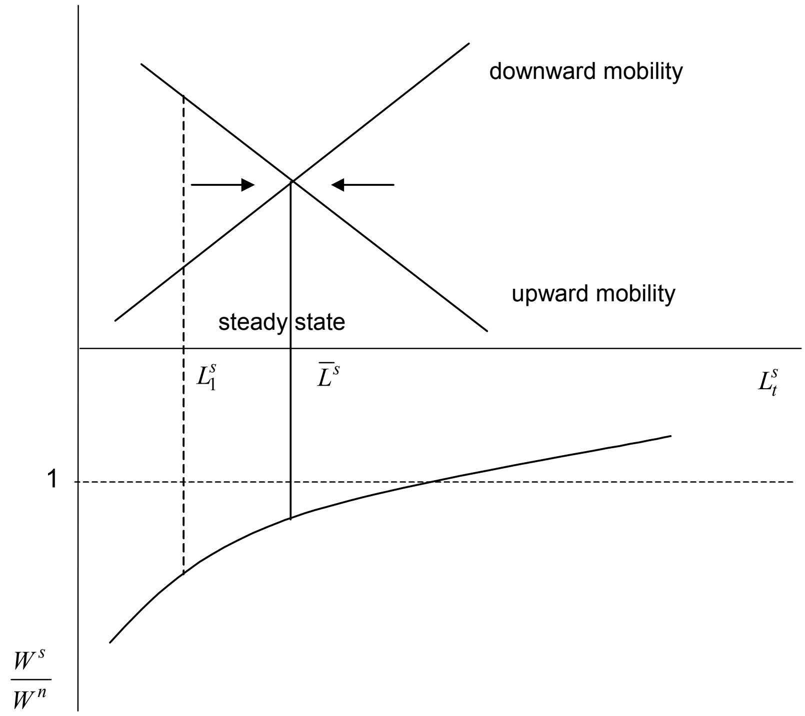
The working of the model can thus be represented by the following figure 6. When $L^s = L_1^s$, the limited supply of skilled workers yields a high wage differential, which has a double impact on mobility: on the financing side it prevents most (unskilled) parents to leave bequest high enough to cover educational expenses, but on the incentive side it creates a large prize for becoming skilled. Since the latter effect dominates the former one, the supply of L^s increases, progressively reducing the return to education (and therefore earning inequality) and raising output.[51]

The growth process also reduces the ascriptive component and increases the meritocratic component, since it increases bequests to abler individuals born to uneducated parents and lowers them to less talented individuals born to educated parents. As a consequence, the correlation between ability and education (and income) increases.[52]

Figure 6 – Mobility and inequality

[51] "The growth process, that stems from net upward mobility, decreases the wage earned by educated individuals and increases the wage earned by uneducated individuals. This process has two conflicting effects on future growth: on the one hand, the wage gap - the incentive for investment in education - declines. On the other hand, liquidity constraints on the poor are relaxed, leading to an increase in mobility. Although the cost of education increases with the average wage, liquidity constraints are relaxed since the increase of the wage of the uneducated workers is larger than the increase in the cost of education." (Moaz and Moav 1999, p.689). Whether mobility actually increases or decreases depends on the specific definition of mobility that is adopted. If we choose the number of people attaining an educational level different from their parents (the off-diagonal quotas), there is no presumption that mobility declines during the transition from L_1^s to $\overline{L}^s$: it will crucially depends on the shape of upward and downward mobility schedules, which in turn reflect the movements of the vertical schedules in figure 5.

[52] See proposition 4 in Moaz and Moav 1999.



6. What we know from the empirical analysis

When we move from the realm of formal models to the actual world of empirics, we may remain surprised by how little has been done so far to test alternative theories. Following Galton's lead, the stage has been dominated by the issue of correctly measuring the extent of mean regression in intergenerational incomes.[53] The article by Becker and Tomes (1979) put forward an estimates of the intergenerational elasticity of incomes in the order of 0.2, which implied that the American society was characterised by a great deal of social mobility. This was in sharp contrast with the analysis of Goldthorpe and Erikson (1992), who maintained the view that class mobility was limited and not very different across countries and years. Part of this divergence was actually due to measurement errors. As it was made clear by Solon (1992) and Zimmerman (1992), whenever the independent variable is measured with errors (and this is certainly the case for parental incomes, because one year measure does not necessarily represents a good approximation of permanent income, which is the relevant concept from a theoretical point of view) there is an attenuation bias, which is proportional to the variance of the measurement error.[54] An indirect confirmation of this potential bias came form the study by Atkinson (1981) on UK data (from the city of York), where due to the lack of information on incomes he relied on occupational incomes, finding a higher measure of intergenerational elasticity between 0.39 and 0.46.[55]

[53] A thoroughly review of the empirical literature can be found in Solon 1999 and 2002.

[54] See the section 7 of chapter 6 of the present volume for a definition of attenuation bias in the context of estimating of the return to education.

[55] Analogous procedure, also followed by Checchi, Ichino and Rustichini 1999 because of lack of data, takes the economic approach close to the sociological approach to class mobility, since class belonging are typically defined according to occupations. Alternative strategies have been based on multi-year averages when data were available (Solon 1992), or using instrumental variables (like parental education or social prestige associated to occupations - Zimmerman 1992). In all cases, the estimated coefficients under these procedures are higher than single year estimates. This is confirmed by the estimates provided by Blanden et al. 2004 with reference to the UK case.

A second aspect drawing the attention of scholars was that the intergenerational elasticity estimate would have not provided a correct measure of the actual correlation, at least during transition phases when substantial structural mobility was occurring.[56]

Current consensus is that the intergenerational elasticity is in the order of 0.40, and that Nordic countries experience more mobility than the Anglo-Saxons ones.[57] Beyond the issue of correctly measure the intergenerational elasticity, the real policy issue regards the possibility to decompose this persistence into constituent channels. Only such decomposition allows the evaluation of how much in observed mobility can be altered by appropriate policies. If most of parental resources is passed from one generation to the following through the educational attainment of children,[58] the understanding of what governs educational choices become crucial not only for education economists, but also for politicians, since intergenerational mobility shapes long run inequality. In this respect some results have been obtained.

Solon (1999) reviews several studies on income correlation across siblings (including twins), arguing that this correlation provides information on the relative importance of family and community factors in shaping individual destinies.[59] Even if we may reasonably expect a decline of the direct impact of parental income, the overall effect of family background has not.[60] Ermisch and Francesconi (2001) have drawn attention on the differential role played by mothers and fathers in shaping educational

---

[56] In a regression like $y_{t+1} = \alpha + \beta y_t + \omega_t$, the least square estimate of the β coefficient is $\hat{\beta}_{LS} = \frac{\sigma_{t+1}}{\sigma_t}\rho$ where ρ is the true correlation coefficient and σ_t is the (log) standard deviation of parents' incomes. Therefore, if children were experiencing a historical phase of rising inequality, this would be incorrectly perceived as reduced mobility, which is not occurring in the data generating process. Grawe 2004 calls for attention to the variation of income dispersion over the life cycle, showing that the measured mobility varies according the age distance between parents and children. Following Grawe 2004, Blanden et al. 2004 estimate the underlying intergenerational correlation using the formula $\hat{\rho} = \frac{\sigma_t}{\sigma_{t+1}}\hat{\beta}_{OLS}$, using a correction factor of approximately 1.1.

[57] See Solon 2002 and Aaberge et al. 2002. However the UK ranking is still controversial. Dearden, Machin and Reed 1997, using NCDS data (National Child Development Survey, a longitudinal sample of a cohort of individuals born in 1958) provide an estimate as high as 0.57-0.59 for sons and 0.64-0.70 for daughters. Blanden et al. 2004 use NCDS and BCS data (British Cohort Survey, a longitudinal sample of individuals born in 1970) to show that, if any, mobility in UK has declined between the first and the second cohort. On the contrary, Ermisch and Francesconi 2004 make use of BHPS (British Household Population Survey, a panel sample on British families) surveys conducted between 1991 and 1999, producing a much lower estimate using occupational prestige (between 0.15 and 0.30, which more than double when potential measurement errors are taken into account).

[58] This claim has been recently challenged by Charles and Hurst 2003, where they provide estimates of intergenerational elasticity in wealth, and show that asset ownership explains about two thirds of intergenerational mobility. The different degrees of skewedness of wealth and income distribution suggest a non-linear relationship between intergenerational incomes, an issue explored among others by Grawe 2004 (using quantile regressions) and Couch and Lillard 2004 (finding more persistence at the extremes of income distribution). A calibrated model able to replicate these asymmetries has been proposed by DeNardi 2004.

[59] "In that sense, the sibling correlation is an index to the extent to which permanent earnings inequality arises from disparities in families and community backgrounds." (Solon 1999, p.1767). And again: "The empirical literature on sibling correlations in earnings, mostly focused on brothers in the United States, suggest that somewhere around 40% of the variance in the permanent component of the earnings is generated by variation in the family and community background factors shared by siblings" (p.1775).

[60] With respect to US experience, Mayer and Lopoo 2004 conclude that "…the decline in the effect of parental income on son's income and wages is steeper when we control parent's education and marital status and son's race, suggesting that some of the correlates of parental income may have become more important to children's economic success at the same time that parental income was becoming less important." This is in accordance with the findings of Shea 2000, whereas Maurin 2002 finds still strong effects in French data.

attainments of children. Since mothers have lower outside options (given existing discrimination in the labour market), they are more likely to take responsibility for supportive activities for children.[61] The crucial role of mothers in education achieving does not necessarily imply that increasing female participation in the labour market should contribute to lowering educational attainment in the children generation.[62] As Esping-Andersen 2004a and 2004b has forcefully shown, the impact of family backgrounds attenuates in countries characterised by extensive pre-school day care; in addition, additional incomes provided by second-earners may contribute to boosting educational attainments in children.[63] So far, most of the economic analysis has focussed on the impact of the family income, testing what has been defined the "*money*→*investment*→*money*" model (Esping-Andersen 2004a), but educational choices are still a black box from the point of view of intergenerational persistence analysis. For these reasons, we expect that the economics of education will provide fruitful insight on this very same issue.

[61] Ermisch and Francesconi 2001 use BHPS data on UK to study the impact of parental education on educational choices of the children, and use financial transfer as identifying treatment. "Thus, if parents do not make gifts or bequests, the correlation between parent s and child's education is likely to represent primarily a causal effect of parent education. This is because human capital investment is not carried to the point at which the marginal return from education equals its marginal cost" (p.140). They find that mothers' gradient is higher than fathers' one.

[62] Increased female participation in the labour market exerts an ambiguous effect, since on one side it reduces the attention paid to children, but at the same time increases available income. Ruhm 2004 finds an overall negative impact of working mother condition onto cognitive abilities of children measured at the age of 5 and 6.

[63] Heckman 2000 also expresses similar opinions, where he stresses the importance of pre-school children care for its complementary role in favouring further educational achievements.

References

Aaberge, R., A.Björklund, M.Jäntti, M.Palme, P.Pedersen, N.Smith and T.Wennemo. 2002. Income inequality and income mobility in the Scandinavian Countries compared to the United States, *Review of Income and Wealth*, 48 (4): 443-470.

Atkinson, A. 1981. On Intergenerational Income Mobility in Britain. *Journal of Post Keynesian Economics*, 3: 194-218.

Banerjee, A., and A.Newman. 1993. Occupational choice and the process of development. *Journal of Political Economy* 101(2): 274-98.

Becker, G. 1993. *Human capital: a theoretical and empirical analysis, with special reference to education.* University of Chicago Press, Chicago (first edition: 1964).

Becker, G. and N.Tomes 1986. Human capital and the rise and fall of families, *Journal of Labor Economics*, 4: S1-S39.

Benabou, R. 1993. Working of a city: location, education and production. *Quarterly Journal of Economics* 108(3): 619-52.

Bertola, G. and D.Coen Pirani. 1998. Market failures, education and macroeconomics, in G.Barba Navaretti, P.Dasgupta, K-G. Maler, D.Siniscalco (eds), *Creation and Transfer of Knowledge: Institutions and Incentives*, Berlin: Springer-Verlag.

Blanden, J., A. Goodman, P. Gregg and S. Machin. 2004. Changes in intergenerational mobility in Britain. in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press

Bowles, S. and H.Gintis. 2002. The inheritance of inequality. *Journal of Economic Perspectives* 16(3): 3-30.

Charles, K., and E.Hurst. 2003. The correlation f wealth across generations. *Journal of Political Economy*. 111(6): 1155-82.

Checchi, D. 1997. Education and intergenerational mobility in occupations. *American Journal of Economics and Sociology*, 56(3): 331-352.

Checchi, D., A.Ichino and A.Rustichini. 1999. More equal but less mobile ? Intergenerational mobility and inequality in Italy and in the US. *Journal of Public Economics* 74: 351-393.

Checchi, D., and V.Dardanoni. 2002. Mobility Comparisons: Does using different measures matter ? *Research on Inequality* 9: 113-145.

Cobalti, A., and A.Schizzerotto. 1994. *La mobilità sociale in Italia*. Mulino, Bologna

Cooper, S., S. Durlauf and P. Johnson 1994. On the Evolution of Economic Status Across Generations. *American Statistical Association, Business and Economics Section,* Papers and Proceedings 50-58.

Couch, K. and D. Lillard. 2004. Nonlinear patterns of intergenerational mobility in Germany and the United States. in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press.

Dardanoni, V. 1993. Measuring Social Mobility. *Journal of Economic Theory*: .372-394

Dearden, L., S. Machin and H. Reed. 1997. Intergenerational Mobility in Britain. *Economic Journal*, 107: 47-66.

De Nardi, C. 2004. Wealth inequalities and intergenerational links. *Review of Economic Studies* 71: 743-68.

Eeckhout, J. 1999. Educational Mobility: The Effect on Efficiency and Distribution. *Economica*. 66 (263): 317-33

Erikson, R., and J.Goldthorpe. 1992. *The constant flux*. Oxford, Claredon Press.

Erikson, R., and J.Goldthorpe. 2002. Intergenerational inequality: a sociological perspective. *Journal of Economic Perspectives* 16(3): 31-44.

Ermisch, J. and M. Francesconi. 2001. Family matters: impact of family background on educational attainments. *Economica* 68: 137-56.

Ermisch, J. and M. Francesconi. 2002. Intergenerational social mobility and assortative mating in Britain. IZA Discussion Paper n.465.

Ermisch, J. and M. Francesconi. 2004. Intergenerational mobility in Britain: new evidence from the British household panel survey in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press
Esping-Andersen, G. 2004a. Unequal opportunities and the mechanisms of social inheritance in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press
Esping-Andersen, G. 2004b. Untying the Gordian knot of social inheritance. mimeo
Esping-Andersen, G. 2004c. Income mobility, human capital and fertility. mimeo
Fields, G. 2000. Income Mobility: Concepts and Measures. in N.Birdsall and C.Graham (eds), *New markets, new opportunities? Economic and social mobility in a changing world.* Washington, D.C.: Carnegie Endowment for International Peace; Washington, D.C.: Brookings Institution Press (101-32)
Galor, O. and J.Zeira 1993. Income distribution and macroeconomics. *Review of Economic Studies* 60: 35-52.
Grawe, N. 2004. Intergenerational mobility for whom? The experience of high and low earning sons in international perspective in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press
Grawe, N., and C.Mulligan. 2002. Economic interpretations of intergenerational correlations. *Journal of Economic Perspectives* 16(3): 45-58.
Hassler, J., J.Rodriguez Mora and J.Zeira. 2003. Inequality and mobility. mimeo
Hauser, R., J.Warren, M.Hsiung and W.Carter. 2000. Occupational status, education and social mobility in meritocracy.
Heckman, J. 2000. Policies to Foster Human Capital. *Research in Economics*. 54(1): 3-56.
Iyigun, M. 1999. Public education and intergenerational economic mobility. *International Economic Review* 40(3): 697-710.
Loury, G. 1981. Intergenerational transfers and the distribution of earnings. *Econometrica* 49(4): 843-67.
Maoz, Y. and O.Moav. 1999. Intergenerational mobility and the process of development. *Economic Journal* 109: 677-97.
Mayer, S. and L. Lopoo 2004. Trends in the intergenerational economic mobility of sons and daughters in the United States in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press
Maurin, E. 2002. The impact of parental income on early schooling transitions. A re-examination using data over three generations. *Journal of Public Economics*. 85: 301-332.
Montgomery, J. 1991. Social networks and labor market outcomes: towards an economic analysis. *American Economic Review* 81(5): 1408-18.
Mulligan, C. 1997. *Parental Priorities and Economic Inequality.* Chicago: University of Chicago Press.
Mulligan, C. 1999. Galton versus the human capital approach to inheritance. *Journal of Political Economy* 107(6): S184-S224.
Owen, A. and D.Weil. 1998. Intergenerational Earnings Mobility, Inequality, and Growth, *Journal of Monetary Economics* 41: 71-104.
Picketty, T. 2000. Theories of Persistent Inequality and Intergenerational Mobility. in A.B.Atkinson and F.Bourguignon (eds). *Handbook of Income Distribution*, North Holland.
Piketty, T. 1997. The Dynamics of the Wealth Distribution and the Interest Rate with Credit-Rationing, *Review of Economic Studies* 64: 173-89.
Plug, E. 2004. Estimating the effect of mother's schooling on children's schooling using a sample of adoptees. *American Economic Review* 94(1): 358-68.
Ruhm, J. 2004. Parental Employment and Child Cognitive Development. *Journal of Human Resources*, 39(1): 155-92.
Schnepf, S.V. 2002. A sorting hat that fails ? The transition from primary to secondary school in Germany. Unicef Innocenti Working Papers n.92.
Shavit, Y., and H.Blossfeld. 1993(eds). *Persistent Inequality: Changing Educational Stratification in Thirteen Countries.* Boulder, Westview Press.
Shea, J. 2000. Does Parents' Money Matter?. *Journal of Public Economics.* 77(2): 155-84.
Shorrock, A. 1978. The measurement of mobility. *Econometrica* 46(5): 1013-24.

Solon, G. 1992. Intergenerational income mobility in the United States. *American Economic Review*, 82: 393-408.
Solon, G. 1999. Intergenerational mobility in the labor market. in O.Ashenfelter and D.Card. *Handbook of labor economics*. vol.3. North Holland.
Solon, G. 2002. Cross-country differences in intergenerational earnings mobility. *Journal of Economic Perspectives* 16(3): 59-66.
Solon, G. 2004. A model of intergenerational mobility variation over time and place, in M.Corak (ed). *Generational Income Mobility in North America and Europe*. Cambridge University Press
Woessman, L. 2004. How equal are educational opportunities ? Family background and student achievement in Europe and in the United States. Cesifo wp.1162.
Zimmerman, D. 1992. Regression towards mediocrity in economic stature. *American Economic Review* 82: 409-29.