Education and Intergenerational Mobility in Occupations: a Comparative Study[†]

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Abstract

The problem of measurement and welfare implications of intergenerational transmission of inequality is studied. A possible decomposition between educational attainments and other factors is proposed and applied to three individual data sets regarding Germany, Italy and United States. The main result is that educational attainment is responsible of almost half of observed immobility. Whether increasing equality of opportunity in entering the educational system can result in less inequality in income distribution is considered.

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I. The intergenerational dynamics of incomes

Some recent economic literature recognizes that inequality analysis must be considered in a dynamic framework. Formal models (as for example those proposed by Galor-Zeira 1993 and Banerjee-Newman 1993) obtain persistent inequality at equilibrium outcomes. The proposed stories go as follows: investing in human capital is worth undertaking (i.e. returns to schooling are sufficiently high) but requires personal wealth, since financial markets are imperfect. As a consequence the poorest segment of the population is discriminated against, does not gain access to education and remain poor in subsequent generations. These results contradict the standard predictions of neoclassical models, where the decreasing (marginal) productivity of capital leads to long run equalization of incomes (Stiglitz 1969, Barro-Sala-i-Martin 1993). But the transitional dynamics is relevant as well. Independently on whether long run allocation is more or less unequal, will equality occur and how soon ? Since income (or wealth) distribution evolves through subsequent generations, the intergenerational evolution of income or wealth distribution has to be looked at.

In the empirical literature there are two basic approaches to the problem of measurement of this evolution. On one side, the *speed of mean regression* is taken as an indicator of the degree of independence from inherited conditions.[1] Defining y_{it} as the *social status achievement* (be it income, wealth or social prestige) of individual *i* belonging to the generation that is working in period *t*, a process of social mobility (at the individual level) can be represented as

$$y_{it} = f(y_{it-1}, x_{it}) \ , \ \ \forall i = 1, 2, \ldots, n \qquad [1]$$

where x_{it} are individual characteristics of individual *i* (thus sex, age and exogenous events - for example policy reforms or wars), which are uncorrelated with $y_{it\text{-}1}$ (the social status of his/her parents), and *n* is the number of families (a more proper term would be dynasties). Abstracting from population growth and inter dynastic marriages, an *equilibrium social status for dynasty i* can be defined as

$$\bar{y}_{it} = f(\bar{y}_i, x_{it}) = g(x_{it}) \ , \ \ \forall i = 1, 2, \ldots, n \qquad [2]$$

Equation [1] can be empirically estimated invoking the linearity assumption and the existence of a common dynamic process across dynasties. The parameter $\beta = \dfrac{\partial y_{it}}{\partial y_{it-1}}$, obtained by regressing the achievements of one generation onto the achievements of the previous one (controlling for individual characteristics), provides information on the speed of adjustment of each dynasty to its "equilibrium" position in the society. From mathematical theory of dynamic systems we know that :

i) for $|\hat{\beta}| < 1$ we can speak of a stable process, and for $\hat{\beta} > 0$ (< 0) we have a monotone convergence (divergence).[2]

ii) the higher is $\hat{\beta}$, the lower is the speed of adjustment to the individual equilibrium value defined by x_{it} . In facts, by linearizing equations [1] and [2], subtracting the latter from the former and assuming that dynastic features are time invariant we obtain

$$y_{it} = \beta y_{it-1} + \gamma x_i \qquad [3.1]$$

$$\bar{y}_i = \frac{\gamma}{1-\beta} x_i \qquad [3.2]$$

$$y_{it} - \bar{y} = \beta \left(y_{it-1} - \bar{y}_i \right) \qquad [3.3]$$

It is easy to recognise that when a generation deviates from its equilibrium social status, the following one will persist longer in the deviation the higher is the coefficient β.

Apart from econometric problems in obtaining information on the true β from the estimated $\hat{\beta}$, we are left with the problem of interpretation of the results.[3] Taken by itself β is just a measure of the time length required to reach the equilibrium status, and should not be confounded with the notion of convergence, which requires the additional assumption that all dynasties are characterized by the same long run (equilibrium) social status.[4] However, conditional on the previous assumption (implying $x_i = \bar{x}, \ \forall i = 1, \ldots$) and the additional assumption that the equilibrium social status is a desirable allocation of each dynasty in the society, some ordering of alternative societies may be inferred from $\hat{\beta}$. A higher β implies greater dispersion around this desirable distribution. As an example, let us suppose that social welfare is maximized under an equalitarian distribution of social status (for example incomes). In this case social welfare will be negatively correlated with any measure of dispersion (for example the variance of incomes). But from equation [3.3] we get that

$$Var\left(y_{it} \right) = \beta^2 Var\left(y_{it-1} \right) \qquad [4]$$

In this case, for given inequality (dispersion) of income distribution in the previous generation, the income inequality of current generation will be higher the greater is the β coefficient. The main limitation of this approach is that it does not provide information about possible rank reversal of dynasties during the process. In other words, a same estimated value for $\hat{\beta}$ can be associated with totally different situations.[5]

For this reason, some authors prefer an alternative approach.[6] In this case, mobility is measured in terms of *chance opportunity open to each dynasty in the passage from one generation to the following*.[5] In this case define $\mathbf{Y}_t$ as a $(1 \times k)$ row vector representing the (marginal) distribution of the generation t across k pre-defined categories (that can be thought as classes, or income percentile, or wealth categories). $\mathbf{P}$ is a $(k \times k)$ transition matrix whose element

$[p_{ij}]$ gives the probability for an individual with initial conditions in category *i* to end up in category *j*. In this case the evolution of status distribution across generations can be represented as

$$\mathbf{Y}_t = \mathbf{Y}_{t-1} \cdot \mathbf{P} \qquad [5]$$

In principle, equation [5] is the matrix counterpart of scalar representation described by equation [1]. However, when interpreted as a Markov process, it can be read in probabilistic terms: it tells us how the (marginal) distribution of current generation evolves conditional on the (marginal) distribution of previous generation only. Thus the present distribution is the only information necessary to predict the future evolution of the same distribution. There are several measures that can be obtained from the analysis of matrix **P** (Shorrock 1978). The closest analogous to the autoregression coefficient β is the second highest eigenvalue λ_2.[7] In this case the higher is λ_2 the slower is the convergence to the invariant distribution of incomes (that is the distribution that replicates itself fro infinite repetitions of the transition).[8]

II. Interpretations of the dynamic process

Under both approaches (the estimation of either the β coefficient or the transition matrix **P**) we do not have convincing interpretations of these measures in terms of welfare, that is it is difficult to impose some ordering among alternative situations. A commonly shared point of view claims that the higher is the *independence from initial conditions*, the greater is the equality of opportunity. In terms of previous measures, the lower are the estimated $\hat{\beta}$ (or the corresponding measure associated to the transition matrix **P**), the more egalitarian is a society. But we know that equality of opportunity does not necessarily corresponds to equality of final outcomes, and therefore this interpretation does not seem granted. However in the literature we find possible interpretations (in terms of welfare) of the statistical measures previously referred at.

Assuming a model of intergenerational (genetic) transmission of intelligence, Becker-Tomes (1986) show that in the absence of liquidity constraints the income correlation between fathers and sons (the β coefficient) measures the degree of "natural" linkage across generations. It is natural in the sense that it acts mechanically, independently of rational choices by the agents. When the parameter $\hat{\beta}$ estimated on incomes converges to the genetic β, the society as a whole approximates an intergenerational efficient allocation of resources. One may like or dislike the story of genetic transmission of talent, the true problem is how one can measure income transmission in the absence of liquidity constraints. Becker-Tomes (1986) suggest the use of data referred to the upper tail of income distribution (namely the richest portion of the population), but this procedure is unconvincing because it is based on the assumption that

parents know the talent of their sons perfectly at birth. Moreover, Cooper et al. (1993) have shown that mean regression is not constant across the income distribution, being higher at both tails. In accordance with all "natural" theories, the underlying idea is that the convergence to an unequal distribution of incomes reflecting an unequal distribution of talents is good in itself just for it is based on "original" distribution of resources. Pareto (1896) was probably the first author to investigate systematically the distribution of income/wealth. After his discovery of the "iron law of incomes" (to be named the 2-parameter Pareto distribution), for several years he sought the causes of the surprising stability of this empirically derived distribution, across both countries and historical periods. His main explanation of the persictence of this shape was based on the human nature, and on the different degree of natural abilities received by any individual at birth :

> "*Some people receive capitals as inheritance or as a gift. These capitals allow them reaching a social class that may be different from what could have been predicted from original abilities being scarce or abundant. Eventually, the portion of talented people could be the main cause of the actual shape of income distribution."*[9]

Sen (1973) strongly argues against this proposition, stressing that there is no personal merit in being born with a better endowment of natural ability, and therefore it does not deserve rewards. He is against a desert theory of distribution on the ground that natural ability has an inelastic supply, and therefore there is no need to offer incentive in terms of income differentials:

> "*It is difficult to justly rewarding talent on grounds of efficiency. We find here two alternative concepts of desert locked in combat with each other. One demands - on ground of 'merit' - a higher reward of natural ability and does not accept the claims of acquired competence which reflects social arrangements. The other points towards rewarding acquired ability - on ground of 'incentives' - but provides no case for rewarding natural talents. Both of course conflict with the notion of needs*".[10]

On the whole, the interpretation of the correlation of father and son incomes based on inheritance of natural abilities is based on shaky evidence, both on biological ground and on economic measures.[11]

If one wishes to pursue the study of mobility by means of transition matrices, a suggested interpretation is to impose some regularity assumption on intertemporal individual utilities and social welfare functions and to study the evolution of the (expected) intertemporal social welfare function under alternative assumptions regarding the dynamic process. This is the route proposed by Atkinson (1981) and Dardanoni (1993) with respect to mobility matrices. The former proposes a partial ordering criterion (analogous to Lorenz dominance[12]) based on the difference in cumulative probability with respect to the main diagonal (diagonalizing transformation). The intuitive idea is that the higher is the dependence from original conditions, the higher is the variance of individual intertemporal utility functions, and consequently higher is the variance of the (aggregated) social welfare function. The latter introduces the decreasing utility of income and therefore weighs higher the mobility changes of the lower tail of income distribution. In both authors the reference point in terms of welfare evaluation is the *independence from original conditions*, which is

justified on the ground of equality of opportunity and, in the absence of any other source of intergenerational linkage, speeds up the convergence to an egalitarian distribution of incomes. The actual problem in implementing these measures is their partial ordering nature, and/or the reliance on the axiomatic approach to welfare evaluation.[13]

In this case on avoids assuming inheritability of natural abilities and/or giving support to the idea of an "optimal" distribution of incomes. On the expectation of a wider consensus to the "independence from initial condition" than to "optimal (intergenerational) transmission of resources" as a reference point for social welfare evaluations, the present paper follows the former lead and takes the independence of social achievements from family backgrounds as a relevant criterion against which to compare alternative situations.

III. The decomposition of intergenerational dynamics

Even rejecting the idea of genetic transmission of talents, the existence of a "cultural environment" must be recognized in which children are raised and which differs from family to family.[14] As in the case of genetic transmission, even in this case cultural endowment is transmitted at low cost for the society. Let us take the example of verbal ability. Everyone will agree on the fact that children raised in families who speak good English will (probably) speak good English themselves. Most of the transmission occurs as an unconscious process, and therefore does not represent an intentional investment (of time or other resources) by parents in the verbal ability of their children. Moreover, it is not easily interveneable from a public policy point of view without altering social attitudes.[15] More than measuring in an abstract way, from a political point of view regarding potential policies the interst here is in decomposing observed mobility (or immobility) into single components which may or may not be modified by economic and social policies, in the direction of getting closer to our ideal situation of independence from origins.

A growing theoretical literature points out that indivisibility of investment in human capital combined with imperfect financial markets produces persistent inequality (Galor-Zeira 1993, Banerjee-Newman 1993). Since human capital cannot be collateralized and the credit market is segmented, the poor will face a higher cost of credit which will prevent them from accessing to more education and consequently more income (Piketty 1992, Glomm-Ravikumar 1992). Once that inherited wealth is a function of family income, inequality within one generation is transmitted to the following one. A companion literature introduces externalities from the environment: while originally intended to the analysis of ghettos' formation, it helps us to enlightening another potential channel of inequality transmission. Since local school funding is proportional to (average) local income, sons raised in richer environments tend to acquire better quality human capitals (Benabou 1993 and 1994).

For all these reasons in the sequel a decomposition of observed mobility into two channels is proposed: "education acquisition" (henceforth EA) and "other factors" (henceforth OF). The first channel takes into account that educational attainment is conditional on family income and that there are returns to education. If this were the only existing channel for inequality transmission, by conditioning sons' earned incomes on their educational achievements, and their educational achievements on their family incomes, it should be possible to replicate observed patterns of mobility almost exactly.[16] On the contrary, if there is cultural transmission, family networking, or even genetic transmission, then observed immobility will be higher than that implied by EA. The main difference between EA and OF is the possibility of policy intervention. EA can be reduced in two ways: increasing equality of opportunity in educational achievements (by making educational attainment independent from family income) and/or reducing income differentials based on education (i.e. reducing the return to education through an equalizing income or taxation policy). On the contrary, OF can take place rather independently from existing incentive structure, and therefore is more difficult to be modified. In graphical terms it is represented in Figure 1: solid lines represent the EA and OF channels; dashed lines represent additional links that are ignored by assumption (and therefore will be incorporated in the OF measure). The decomposition of observed mobility can be performed with alternative techniques. Sociologists prefer path analysis, but econometricians object on the ground of (econometric) identification. Economists are more familiar with regressions, but the exact estimation of returns to schooling is troublesome (Card 1994). An alternative technique is proposed here: the transition matrix (father's income → son's income) is compared with the (matrix) product of two other transition matrices (father's income → son's education and son's education → son's income). The joint product of these two matrices is interpreted as the contribution of the EA channel to intergenerational mobility. As better shown later, the difference with the actually observed mobility is taken as evidence of the relative contribution of the OF channel.

[Figure 1 about here]

IV. Empirical analysis

In the Data Appendix data on intergenerational income mobility are presented for three countries, Germany, Italy and United States. For each country a representative sample of individuals is considered, containing information regarding income and education for both the interviewee and his/her parents. The sample are of comparable sizes, all exceeding one thousand of cases. Given the differences in activity rates for women in the three countries, only information about fathers and sons are retained. Occupational income as a proxy of social status enjoyed by an individual in a society. Economists speak of permanent income, and in some case take multi-year averages to proxy this concept. Sociologists make use of status or social prestige indices (like the Duncan index) associated with

occupations. An intermediate position suggests the use of the median income associated to each occupation as a better proxy of the social status. While showing sufficient correlation with the corresponding prestige index,[17] the occupational income has the advantage of inducing a cardinal ordering among the occupations. In addition it avoids the effect of individual fortunes, that mainly represent outliers in the social process of status transmission which is analyzed here. Thus it is more appropriate to speak of occupational income mobility than earned income mobility. If we accept the idea that a society should be more concerned with "permanent" inequality (i.e. the inequality attributable to structural factors like the occupational structure) than with "transitory" inequality (i.e. the inequality measured on transitory incomes), then considering occupational incomes seems more coherent with this concern. Tables 1 to 3 report intergenerational mobility matrices based on income quartiles (respectively for Germany, Italy and the United States).

[Tables 1-2-3 about here]

While observing that the numbers on the main diagonal represent the percentage of dynasties that are almost immobile in terms of occupational income mobility, it is easy to notice that the three countries look rather similar, especially when considering the relative mobility of intermediate quartile. If we take synthetic measures (like the second eigenvalue or the distance from a *perfect mobility matrix* - i.e. a matrix exhibiting 25% in each cell, implying total independence from origins), we observe that Germany could represent the most mobile country, with US coming second and Italy third. Using the measures proposed in the first approach, based on the speed of mean regression, we do not obtain greater clarification in terms of country ranking and, even worse, in terms of explaining the observed differences among countries (see Table 4).

[Table 4 about here]

While the case of Germany being more mobile than United States does not come as a surprise, one remains unclear about the country ranking not being univocal. Looking at Table 5 it can be seen that the ordering of different societies in terms of relative occupational mobility depends on the index we choose. In most cases Italy ranks as the most immobile and Germany as the most mobile, but there are a few cases of order reversal. But these comparisons are of little significance if we are not able to interpret these differences.

[Table 5 about here]

We start with noticing that the ranking in terms of income mobility is quite similar to the ranking in terms of educational mobility. It is legitimate to suspect that the mobility ranking, and especially the German dominance, is related to the functioning of the educational system. In order to obtain a deeper insight on this issue, let us introduce

the following decomposition. Define w_s as the income rank achieved by the son and w_f the income rank of the corresponding father. Also define e_s the educational achievement of the son (for example "compulsory education completed") and e_f the educational achievement of his father. Therefore the intergenerational mobility matrices reported in Tables 1-3 present the probability distribution of income ranking for sons conditional on fathers' income rankings. In symbols, this corresponds to $prob(w_s|w_f)$. If e is a binary variable (and assuming this is the case for simplicity - things are a bit more complicated when e can take more than two values) it is possible to show[18] that

$$\begin{aligned} &prob(w_s|w_f) = prob(w_s, e_s|w_f) + prob(w_s, \bar{e}_s|w_f) = \\ &= prob(w_s|e_s, w_f) \cdot prob(e_s|w_f) + prob(w_s|\bar{e}_s, w_f) \cdot prob(\bar{e}_s|w_f) \end{aligned} \qquad [6]$$

The first addend corresponds to the product of the two matrices reported in Tables 6-7-8 (i.e. the status acquisition of the son conditional on his educational achievement and his father status), and is intended to capture the *education acquisition* channel mentioned above. The second addend takes into account all the other factors affecting the income achievement of the son conditioning on *non obtaining* education *and* father income; it corresponds to the *other factors* channel. Therefore, when we take the (matrix) product of each couple of matrices reported in Tables 6-7-8 we get the hypothetical mobility that we would have observed if intergenerational mobility were dependent on educational achievements only. The difference with actually observed mobility gives us a measure of all the other factors related with intergenerational transmission (genetic or cultural inheritance, family networking, and so on). Using a distance measure (for example the Euclidean distance, defined as the mean square distance from 0.25 - the matrix describing the independence from family conditions - for each cell of the matrix) we get a measure of the relative contribution of education acquisition to the observed patterns of intergenerational mobility. When we compare Tables 6-7-8 we also find evidence of some well known facts. Rank correlation indices indicate that United States is the country where educational attainment is most independent of family background, while Italy and Germany share a second position. And when we move from constraints (family income) to incentives (returns to education) we find that the former country keeps the leadership: education pays more in US than in Germany, and it pays more in Germany than in Italy. Thus Italy seems to present the worst of possible worlds: highest dependence from initial conditions, combined with lowest incentives to educational attainments. Germany would present an intermediate situation, and US would represent the prototype of a so-called *open society*: low conditioning on origin and high incentive to mobility. However this is only part of the story, because the overall mobility that characterises each country depends on additional factors: entry barriers to internal labour markets, imperfection in financial markets, costs of geographical mobility, to mention some of them.

When we consider the ranking of the three countries according to the EA channel, we notice that if mobility were just a matter of educational attainment, United States would be the most mobile society in terms of occupation, Italy would rank second and Germany third. But this is just part of the story, because the three countries present different overall mobility. And when we take the ratio between immobility accounted through educational attainment and overall immobility, we find that not only Germany is the country with lower overall immobility, but it is also the country where the educational achievement channel helps more in equalizing individual opportunities. Probably the German apprentship system, that operates at the end of compulsory education, has a strong equalizing effect in opening high income possibilities for sons who did not get higher education (Soskice 1994). United States exhibits a greater overall immobility than Germany and a lower contribution of the educational system: an evidence that other factors of immobility (the OF channel) are more effective in the former than in the latter. Finally, Italy scores third, notwithstanding the presence of a widely public educational system: the two matrices clearly show that in this country getting a degree is heavily dependent on father's income, and that the access to the top quartile is almost impossible if a son does not pass the threshold of compulsory education.

As a general conclusion one can infer from previous calculations a rather general statement: the EA contribution to immobility is in the order of 40 to 50%, i.e. granting equality of opportunity in educational attainments would reduce observed immobility of the same amount. In addition, it should appear clear that aggregate indicators of mobility/immobility (and the relative ordering that can be derived from them) can obscure the actual mechanisms underlying the phenomenon.

V. Conclusions

Let us now move to a crucial question from a policy point of view. Let us assume that the "thumb rule" previously obtained (reduce EA channel to zero and obtain a halving of intergenerational inequality transmission) has some reliability.[19] Then would it be worth undertaking from an equalitarian point of view ? If we look to the Social Justice report for the British Labour party (Commission for Social Justice 1994), one gets the impression that current social democratic alliances maintain two joint propositions:

a) increasing total access to education will increase total domestic income;

b) increasing equality of opportunity in accessing education will induce income distribution equality.

While discussing proposition *a* is not a goal of this paper,[20] our previous discussion seems to provide support to proposition *b*. However our previous analysis has a stricter implication: increasing equality of opportunity reduces

inequality transmission, which does not necessarily prevent the strengthening of other inequality generating devices within one generation. In other words, there is a contradiction between the socialization role and the selection function (Shavit-Blossfeld 1993). As a thought experiment, think of extending compulsory education up to 24 years. Human capital accumulation will definitively increase, but educational attainment will not signal anything to the labor market. To be effective, the compulsory school will necessarily become more selective through marks, test scores, alternative programs and other devices. Individuals will go to the market with different "labels", and if the school system has been efficient, the labels will be a better proxy of their "natural" ability than previous educational attainment. Greater inequality of rewards (now reflecting distribution of different abilities) could be predicted, and now even more easily justified. The paradoxical conclusion being that increasing equality of opportunity in educational access could yield increased inequality in income distribution.

Obviously we may claim that extending the access to education is a good thing in itself, for it gives more content to citizenship rights (Okun 1975) and it creates the fabric of a society (Checchi-Salvati 1995). However, when considering the possibility of increasing the access to education, one should take into account not only the constraint side, but the incentive structure as well. We could almost certainly obtain an increase in efficiency and equity, but at the expense of equality. And the last value is more familiar to the progressive heritage than the other twos (Cohen 1994).

Footnotes

(1) Recent examples of this procedure can be found in Becker-Tomes 1986, Zimmerman 1992 and Solon 1992. Becker-Tomes 1986 have a model where altruistic parents care about children welfare, given a genetic transmission of natural endowments.

(2) Here *convergence* only means that the distance from the equilibrium position declines with time. In the growth literature this corresponds to the concept of β-convergence, to be non confounded with σ-convergence (a decline in the cross-country - or cross-individuals - dispersion). β-convergence is a necessary condition for σ-convergence. It becomes also sufficient when the steady state equilibrium is identical across state (or across individuals). See Barro-Sala-i-Martin 1991 and 1992.

(3) Quah has shown in several papers that when working with random fields (i.e. panel data where the number of individuals and the number of observations for each individual are of comparable order) there are problems in obtaining consistent estimates of autoregression coefficients (like β), especially when the random walk hypothesis cannot be excluded. In Quah 1994b he proves that short sample distribution of the same parameter is neither normal nor standard Dickey-Fuller. In Quah 1993b, 1993c and 1994a he proposes the alternative strategy of directly modeling the dynamics of the evolving cross-section distributions.

(4) Both Friedman 1992 and Quah 1993a criticize the convergence interpretation of negative correlation between initial conditions and growth rates (which substantiate most of the empirical results of growth literature) claiming that this is nothing more than mean regression (or Galton's fallacy).

(5) Take two extreme cases, one where the process described by equation [1] is completely deterministic, and the other where a white noise is added to the same equation. In the former case, intergenerational mobility will be zero (absence of rank reversal), whereas in the latter case some mobility will be observed. Obviously the econometric estimate in the latter case will be less efficient.

(6) This is the approach preferred by the sociological analysis, which explores class mobility. Among recent examples Erikson-Goldthorpe 1992 and Cobalti-Schizzerotto 1994.

(7) Given the linear dependence of one row/column, the first eigenvalue is always equal to unity.

(8) More formally, the invariant distribution is given by the (second) eigenvector associated to the (second) eigenvalue obtained from the characteristic equation system $\overline{\mathbf{Y}}\left[\mathbf{I} - \lambda\mathbf{P} = \mathbf{0}\right]$, where $\overline{\mathbf{Y}}$ is the eigenvector matrix and $\mathbf{I}$ is the identity matrix.

(9) Pareto 1964, p.371 (my translation). While looking for an endogenous explanation of income distribution, Pareto was at the same time contending with socialist authors (like Lassalle) about social justice. Therefore invoking difference natural abilities across individuals was an easy escape to legitimate an unequal distribution of incomes. (see for example Pareto 1964, p.350). In reality, the so-called *natural* explanation of income distribution is not free of contradictions: as Edgeworth pointed out (1926 edition of Palgrave Dictionary) natural abilities should be normally distributed, whereas incomes are not normally distributed. Therefore a proper endogenous theory should explain how abilities are translated into incomes. Pareto never came to this point.

(10) Sen 1973, p.103-4. A lengthier discussion of this issue in connection with the problem of efficiency is in Checchi-Ichino-Rustichini 1994.

(11) In the 60's the works by Bowles 1972 and Bowles-Nelson 1974 were able to prove that measured IQ at the age of 14 was the mere reflection of cultural and socio-economic background. Not to speak of the enormous literature on returns to schooling, which attempted (without success) to measure the relative contribution of natural abilities. New spurts of interest in the theory of genetic differences is signaled by the publication of Herrnstein-Murray 1994; see also Goldberger-Manski 1995.

(12) For a formal definition of Lorenz dominance and its properties see Fields-Fei 1978.

(13) For example, the three matrices reported in Table 2 cannot be ordered according to Atkinson criterion.

(14) Gramsci was well aware of the relevance of this channel: " *In many families, especially among intellectuals, children receive from the family a training which integrates (formal) education. In other words they 'breath from the air' knowledge and model roles that facilitate their educational achievements."* (Gramsci 1975, p.131 - my translation). Analogously: "*Consequently selection in school favors children from those families that already possess dominant cultural advantages*" (Shavit-Blossfeld 1993, p.).

(15) With respect to the Italian case, an example is offered by the passage from half-day to full-day primary school, which was intended as a cultural compensatory device, but was made possible - and made in turn possible - women full-time jobs.

(16) We do not forget that educational achievements is endogenous in the process and has to be instrumented in order to be used as a regressor. See Card 1993.

(17) The correlation coefficient between Duncan index and median occupational index for United States in the PSID sample is 0.86, whereas the correlation coefficient between the prestige index developed by DeLillo-Schizzerotto 1985 and median occupational index in the Italian sample is 0.66. See Table A.1.

(18) See theorems 25 and 31, p.35-37 in Mood-Graybill-Boes 1974.

(19) Obviously it does not, as any counterfactual experiment: one could easily argue that families could react against excessive equalization of outcomes and would invent other devices to transmit inequality.

(20) See for example Reich 1992.

Data Appendix

[Table A.1 about here]

Notes to Table A.1:

(a) In each sample retained observations refer to matches father-(first)son aged more than 25, both working full-time, both native in the reference country. Therefore women, unemployed and part-time-workers were excluded.

(b) Since only information about occupation and occupational prestige are available for the Italian sample, incomes are estimated in the following way:

i) information on sons' occupations are collected in 1985; fathers' occupations refer to the year when the corresponding sons were 14;

ii) an earning function is estimated on a different sample for 1987, after computing gross incomes from self-declared net incomes (Bank of Italy family incomes survey); regressors include age, age squared, school degree, birth region, sector and qualification, and interactions among variables;

iii) using the estimated earning function on original sample, an estimated income is computed for each individual.

(c) In order to approximate the idea of permanent income (socially available), only median labor incomes for each occupation are attributed to each individual. Germany considers 78 occupations, Italy considers 93 occupations and United States considers 96 occupations. All countries refer to pre-tax incomes.

[Table A.2 about here]

Notes to Table A.2:

(d) In general primary (ISCED 1) and lower secondary (ISCED 2) education have been considered as corresponding to the concept of *compulsory education*, and upper secondary (ISCED 3) or tertiary (ISCED 5) as corresponding to the concept of *more than compulsory education*. The class *university degree* include graduate (ISCED 6) and postgraduate (ISCED 7) education (OECD 1993, Caroli 1994). However, since the educational systems of each country have undergone significant changes in last decades, the definition of "compulsory education" has been adapted to each generation:

i) In order to take into account the 1964 reform (that unified primary education and created the existing tripartite system), for German fathers compulsory education is equivalent to *general school leaving certificate* (*hauptschulen* - corresponding to 7 years of schooling). For German sons uncompleted compulsory education is equivalent to either nothing or hauptschulen without further apprentship education - corresponding to 7 years of schooling); for them compulsory education is equivalent to *general school leaving certificate* (*realschulen* or *gymnasium* stage 1 - corresponding to 10 years of schooling).

ii) In order to take into account the 1962 reform (that unified the lower secondary school and raised compulsory education from 5 to 8 years of schooling), for both Italian fathers and sons compulsory education is defined as *completed primary school* (*scuola elementare* providing *licenza elementare* degree - it corresponds to 5 years of schooling) if born before 1952, and as *completed lower secondary school* (*scuola media inferiore* providing *licenza media* degree - it corresponds to 8 years of schooling) if born later.

iii) without a specific school reform at the federal level, I relied on Bowles-Gintis 1976 (claiming that 1930 is the turning point for secondary school to become a mass institution) and set compulsory education equal to *completed lower secondary school* (*junior high school* - grade 8 - corresponds to 8 years of schooling) if born before 1918, and *completed upper secondary school* (*senior high school* - grade 12 - corresponds to 12 years of schooling) if born afterwards.

Data sources:

The data used in this study for Germany 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 come from the data set developed by A.DeLillo and others, whose results are published in DeLillo 1988, Cobalti 1988 and Cobalti-Schizzerotto 1994. The data for US come from the PSID (Panel Study of Income Dynamics) panel developed by the University of Michigan.

References

Atkinson A. 1981, On intergenerational income mobility in Britain, *Journal of Post Keynesian Economics* Winter v.3, 194-218

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

Barro R.-Sala-i-Martin X. 1991, Convergence across states and regions, *Brooking Paper on Economic Activity* v.1, 107-82

Barro R.-Sala-i-Martin X. 1992, Convergence, *Journal of Political Economy,* v.100, 223-51

Becker G.-Tomes N. 1986, Human capital and the rise and fall of families, *Journal of Labor Economics,* v.4, S1-39

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

Benabou R. 1994, Education, income distribution and growth: the local connection, CEPR working paper n.995

Bowles S.-Gintis H. 1976, *Schooling in capitalist America*, Routledge & Kegan, London

Card D. 1994, Earnings, schooling and ability revisited, NBER Working Paper n.4832, August

Caroli E 1994, *Niveau de qualifications et rapport de formation dans cinq pays de l'OCDE*, chapitre 3, Ph.D. dissertation, University of Paris

Checchi D.-Ichino A.-Rustichini A. 1994, Social mobility and efficiency - a re-examination of the problem of intergenerational mobility in Italy, WP #94.11, Dipartimento di Economia Politica, Università degli Studi di Milano

Checchi D.-Salvati M. 1995, Giustizia sociale oggi: una discussione di *Social Justice - strategies for national renewal*, *Politica economica*, agosto 1995

Cobalti A. 1988, Mobili e diseguali, *Polis-*πολισ, v.1 53-82

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

Cohen G. 1994, Back to socialist basics, *New Left Review*, v.204, 3-16

Commission for Social Justice 1994, *Social justice - Strategies for national renewal*, Vintage 1994

Cooper S.-Durlauf S.-Johnson P. 1993, On the evolution of economics status across generation, *Proceedings of the American Statistical Association*, v.83, 50-58

Dardanoni V. 1993, Measuring social mobility, *Journal of Economic Theory*, v.61, 372-394

DeLillo A. 1988, La mobilità sociale assoluta, *Polis-*πολισ, v.1, 19-52

DeLillo A.-Schizzerotto A. 1985, *La valutazione sociale delle occupazioni*, Il Mulino

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

Fields G.-Fei J. 1978, On inequality comaprisons, *Econometrica*, v.46/2, 303-16

Friedman M.1992, Communication: Do old fallacies ever die ?, *Journal of Economic Literature*, v.30, 2129-32

Galor O.-Zeira J. 1993, Income distribution and macroeconomics, *Review of Economic Studies* v.60, 35-52

Glomm G.-Ravikumar B. 1992, Public versus private investment in human capital: endogenous growth and income inequality, *Journal of Political Economy*, v.100/4, 818-34

Goldberger A.-Manski C. 1995, Review article: The *Bell Curve* by Herrnstein and Murray, *Journal of Economic Literature*, v.33, 762-76

Gramsci A. 1975, *Quaderni dal carcere - Gli intellettuali*, Editori Riuniti

Herrnstein R.-Murray C. 1994, *The Bell Curve: intelligence and class structure in American life*, Free Press

Mood A.-Graybill F.-Boes D. 1974, *Introduction to the theory of statistics*, McGrawHill

OECD 1993, *Education at a glance* - OECD indicators, Paris

Okun A. 1975, *Equality and efficiency - the big trade-off*, The Brooking Institutions

Pareto V. 1964 (first published 1896-97), *Cours d'economie politique*, Droz, Geneve 1964

Piketty T. 1992, Imperfect capital markets and persistence of initial wealth inequalities, STICERD LSE Discussion Paper #TE/92/255

Quah D. 1993a, Galton's fallacy and test of the convergence hypothesis, *Scandinavian Journal of Economics*, v.4/95, 427-44

Quah D. 1993b, One Business Cycle and one trend from (many,) many disaggregates, Institute of International Economic Studies, Stockholm Seminar Papers n. 550, October

Quah D. 1993c, Empirical cross-section dynamics in economic growth, *European Economic Review* v.37, 2/3, 426-34

Quah D. 1994a, Convergence Empirics Across Economies with (some) capital mobility, STICERD - LSE Discussion Paper EM/94/275, April

Quah D. 1994b, Exploiting cross section variation for unit root inference in dynamic data, *Economics Letters* v.44, 9-19

Reich R. 1992, *The work of nations*, Random House

Sen A. 1973, *On economic inequality*, Claredon Press, Oxford

Sen A. 1992, *Inequality reexamined*, Oxford University Press

Shavit Y.-Blossfeld H. 1993, *Persistent inequality: changing educational stratification in thirteen countries*, Westview Press

Shorrock A. 1978, The measurement of mobility, *Econometrica* v.46/5, 1013-1024

Solon G. 1992, Intergenerational income mobility in the United States, *American Economic Review*, v.82, 393-408

Soskice D. 1994, Reconciling markets and institutions: the German apprentship system, in Lynch L (ed), *Training and the private sector*, University of Chicago Press

Stiglitz J. 1969, Distribution of income and wealth among individuals, *Econometrica*, v.37/3, 382-97

Zimmerman D. 1992, Regression towards mediocrity in economic stature, *American Economic Review*, v.82, 409-29

Figure 1

LINKAGES BETWEEN GENERATIONS

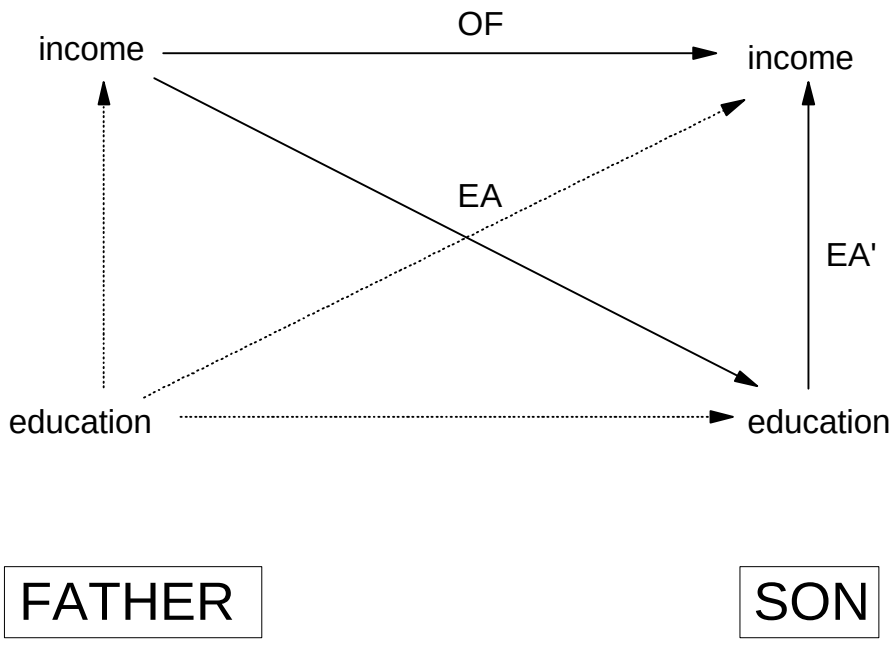

Table 1

Intergenerational Income Mobility - Germany

	I quartile son	*II quartile son*	*III quartile son*	*IV quartile son*
I quartile father	37.98	24.93	22.85	14.24
II quartile father	30.77	29.29	23.67	16.27
III quartile father	19.53	28.99	25.44	26.04
IV quartile father	11.54	16.86	28.11	43.49
Associated eigenvalues	**1**	**0.307**	**0.055**	**- 0.0017**
Distance from perfect mobility		**0.1493**		

Table 2

Intergenerational Income Mobility - Italy

	I quartile son	*II quartile son*	*III quartile son*	*IV quartile son*
I quartile father	40.20	25.81	19.35	14.64
II quartile father	26.73	37.87	17.33	18.07
III quartile father	22.52	26.98	28.71	21.78
IV quartile father	10.40	9.65	34.41	45.54
Associated eigenvalues	**1**	**0.333**	**0.094 + 0.015 *i***	**0.094 - 0.015 *i***
Distance from perfect mobility		**0.1816**		

Table 3

Intergenerational income mobility - United States

	I quartile son	*II quartile son*	*III quartile son*	*IV quartile son*
I quartile father	37.60	26.36	23.64	12.40
II quartile father	35.14	27.03	21.62	16.22
III quartile father	15.71	30.65	25.29	28.35
IV quartile father	11.20	16.22	29.34	43.24
Associated eigenvalues	**1**	**0.329**	**0.001 + 0.047 *i***	**0.001 - 0.047 *i***
Distance from perfect mobility		**0.1704**		

Table 4

Sample Correlation between Incomes of Different Generations

	GERMANY	ITALY	USA
Sample correlation between father and son incomes	0.33	0.35	0.37
Rank correlation between father and son incomes	0.32	0.37	0.35
Regression coefficient between father and son incomes *	0.447 (13.34)	0.364 (15.03)	0.388 (13.25)

* OLS regression including also age and age squared; t statistics in parenthesis.

Table 5

Immobility Ranking According to Different Indicators

	GERMANY	ITALY	USA
Sample correlation between father and son incomes	3	2	1
Rank correlation between father and son incomes	3	1	2
Regression coefficient between father and son incomes	1	3	2
Second eigenvalue associated to the intergenerational transition matrix	3	1	2
Distance from perfect mobility	3	1	2
Rank correlation between father and son educational attainments	3	1	2

Table 6

Family Income-Son Education and Return to Schooling - Germany

→ son education ↓ family income	*uncompleted compulsory*	*completed compulsory*	*more than compulsory*	*university degree*
I quartile father	0.13	0.72	0.11	0.04
II quartile father	0.06	0.77	0.12	0.05
III quartile father	0.09	0.64	0.18	0.09
IV quartile father	0.02	0.44	0.28	0.26

Spearman rank correlation	**0.32**

→ son income ↓ son education	*I quartile son*	*II quartile son*	*III quartile son*	*IV quartile son*
uncompleted compulsory	0.48	0.35	0.15	0.02
completed compulsory	0.30	0.30	0.27	0.13
more than compulsory	0.12	0.16	0.29	0.43
university degree	0.00	0.05	0.13	0.83

Spearman rank correlation	**0.50**

Distance from perfect mobility of the product of the two matrices above: 0.0843
Ratio with the distance of observed mobility: 0.564

Table 7

Family Income-Son Education and Return to Schooling - Italy

→ son education ↓ family income	*uncompleted compulsory*	*completed compulsory*	*more than compulsory*	*university degree*
I quartile father	0.17	0.49	0.29	0.04
II quartile father	0.14	0.50	0.32	0.03
III quartile father	0.06	0.37	0.51	0.06
IV quartile father	0.05	0.22	0.52	0.20

Spearman rank correlation	**0.33**

→ son income ↓ son education	*I quartile son*	*II quartile son*	*III quartile son*	*IV quartile son*
uncompleted compulsory	0.49	0.31	0.10	0.09
completed compulsory	0.35	0.34	0.17	0.14
more than compulsory	0.14	0.19	0.36	0.31
university degree	0.00	0.01	0.27	0.72

Spearman rank correlation	**0.47**

Distance from perfect mobility of the product of the two matrices above: 0.0791
Ratio with the distance of observed mobility: 0.435

Table 8

Family Income-Son Education and Return to Schooling - USA

→ son education ↓ family income	*uncompleted compulsory*	*completed compulsory*	*more than compulsory*	*university degree*
I quartile father	0.22	0.26	0.35	0.17
II quartile father	0.17	0.31	0.36	0.17
III quartile father	0.10	0.20	0.38	0.31
IV quartile father	0.07	0.14	0.36	0.44

Spearman rank correlation **0.27**

→ son income ↓ son education	*I quartile son*	*II quartile son*	*III quartile son*	*IV quartile son*
uncompleted compulsory	0.48	0.36	0.12	0.05
completed compulsory	0.42	0.28	0.20	0.10
more than compulsory	0.21	0.32	0.31	0.16
university degree	0.04	0.08	0.28	0.60

Spearman rank correlation **0.54**

Distance from perfect mobility of the product of the two matrices above: 0.0758
Ratio with the distance of observed mobility: 0.445

Table A.1

Sample Compositions

	GERMANY		ITALY		USA	
	father	*son*	*father*	*son*	*father*	*son*
number of cases [a]	1351	1351	1615	1615	1037	1037
reference year for incomes	son's age = 15	1986	son's age = 14	1987	1974	1990
average yearly income [b, c]	40009 DM	45200 DM	17794960 Lit	20356200 Lit	24498 $	26185 $
average age	N/A.	42.5	46.7	43.6	46.0	32.3

Table A.2

Sample Distribution According to Educational Classification

	GERMANY		ITALY		USA	
	father	*son*	*father*	*son*	*father*	*son*
Educational attainments (%):						
uncompleted compulsory [d]	17.54	7.55	47.72	10.84	42.04	13.98
completed compulsory [d]	64.17	64.03	41.36	39.63	18.61	36.55
more than compulsory [d]	14.36	17.32	12.88	41.24	23.24	36.16
university degree	3.92	11.10	3.03	8.30	16.10	27.29
Kolmogoroff dissimilarity index for educational attainments	**0.10**		**0.34**		**0.28**	
Rank correlation between father and son educational attainments	**0.38**		**0.53**		**0.43**	