The Journal of Economic Inequality
https://doi.org/10.1007/s10888-023-09568-8

Occupational mobility: theory and estimation for Italy

Irene Brunetti[1] · **Davide Fiaschi**[2]

Received: 5 April 2021 / Accepted: 12 February 2023

Abstract
This paper presents a model considering intergenerational occupational mobility as the joint outcome of three main determinants: income incentives, equality of opportunity and changes in the composition of occupations. The model, rationalising the use of transition matrices to measure occupational mobility, allows for identifying asymmetric mobility patterns and constructing a specific mobility index for each determinant. The empirical application of our model to Italy suggests that intergenerational mobility increased from the cohort of children born in the period 1940-1951 to the one born in the period 1952-1965, then to remain at the same level for the cohort of children born in the period 1966-1977. This steady mobility, however, hides i) lower structural mobility, caused by a declining trend in the composition of occupations in favour of upper-middle classes; ii) less upward mobility for those whose fathers were in the lower class; and iii) higher downward mobility from upper-middle classes, both caused by a decrease in the income incentives. Equality of opportunity is low and constant for those born after 1951.

Keywords Income incentives · Equality of opportunities · Composition of occupations · Mobility indexes

JEL Classification C51 · D63 · J62

1 Introduction

The downward trend in intergenerational mobility, characterising several major countries, is a very debated issue (Corak 2013; Dobbs et al. 2016). A society with a high intergenerational mobility is considered both more *just* in terms of equality of opportunity, since individual efforts, and not initial positions, decide individual achievements (Atkinson 1980; Kanbur and

✉ Davide Fiaschi
davide.fiaschi@unipi.it

Irene Brunetti
i.brunetti@inapp.org

[1] INAPP - Istituto Nazionale per l'Analisi delle Politiche Pubbliche, Rome, Italy

[2] Dipartimento di Economia e Management, University of Pisa, Pisa, Italy

Published online: 09 May 2023

Stiglitz 2016), and more *efficient*, i.e. able to attain "the largest possible value of advantages given a production possibility set" (Bourguignon et al. 2007).

Intergenerational mobility is, however, a multifaceted phenomenon for which it is difficult to formulate a unifying framework. Sorokin (1927), Prais (1955) Blau and Duncan (1967), Boudon (1973) and Thurow (1976) argue that intergenerational mobility is the joint outcome of several factors which interact among themselves: *social origin* (family background, school, etc.), *individual's motivations*, *differential demographic dynamics* among different strata of population (birth, death, in- and out-migration) and shifts in the *occupational structure*. Cunha et al. (2010), Heckman et al. (2014), and Fox (2016) highlight the importance of complementarity between these different factors in deciding children's outcomes. In particular, they argue that wealthy parents, having greater educational access, wider occupational networks, and more neighbourhood choices, invest more in the human capital of their offspring than poorer ones; this results in a better outcomes of their children, and thus in a persistent difference in the economic status across generations.

In this paper, we address the issue of (absolute) mobility by focusing on occupations. The choice to focus on occupations instead of income (or wealth) is based on several considerations. Firstly, occupations better reflect the socioeconomic status of individuals, as their social prestige, and more appropriately encompass several critical aspects of socioeconomic characteristics of individuals, such as their position on the social scale (Ganzeboom and Treiman 1996; Barone 2012; Raitano and Vona 2015). Secondly, a better understanding of the occupational linkage across generations is essential to contrast social inequalities and complements the studies on intergenerational income or wealth mobility. Finally, as discussed by Erikson and Goldthorpe (2002), occupations are less affected by measurement error, and they are better predictors of life chances and lifetime earnings when compared to snapshot measures of income (Atkinson 1980).[1]

This paper contributes both to the theoretical and empirical literature on intergenerational mobility. As regards theory, it provides a model that, rationalising the use of transition matrices for measuring intergenerational mobility, allows identifying three possible determinants of occupational mobility: i) *income incentives* that capture the individual's choice to carry out a specific occupation based on its different characteristics (*expected return*, *return risk*, and *cost of access*); ii) *equality of opportunity*, that is occupation possibility set available to each individual in society; and iii) *occupational shifts* representing the structural changes in the composition of occupations induced by the technological changes (Shorrocks 1978). The micro-foundation of the elements of transition matrices enables to highlight of possible *asymmetric patterns* across the distribution of occupations (e.g., the higher downward mobility at the top than at the middle of the distribution) (Fields and Ok 1999; Jantti et al. 2006). Moreover, we can estimate specific *mobility indexes* to determine if the observed mobility is the outcome of a "true mobility", i.e. of the unconstrained choices of individuals, or a "structural mobility", i.e. of changes in the composition of occupations. Our approach complements Lo Bello and Morchio (2022), who decompose occupational persistence into three different sources: i) imperfect inheritance of comparative advantage; ii) imperfect inheritance of preferences, and iii) parental networks. They find that the last one account for the bulk of occupational persistence in the U.K.

From the empirical point of view, we estimate the absolute intergenerational occupational mobility by defining three occupational classes (Working, Middle and Upper) based on the

[1] Bjorklund and Jantti (2000) summarise some of the relative merits of the use of occupations to estimate intergenerational mobility and discuss the scenarios in which it provides different results from those where intergenerational mobility is estimated by individual income.

social ranking of the occupations proposed by Goldthorpe and Hope (1974) for a sample of Italian heads of households born in the period 1940-1977. We therefore add more recent estimates on occupational mobility in Italy, complementing previous analyses (Schizzerotto and Cobalti 1994; Checchi 1997; Checchi et al. 1999; Pisati 2000). Our findings suggest that Italian children born in 1940-1951 had lower mobility than those born in 1952-1977. The steady mobility for children born after 1952 is the outcome of lower structural mobility, caused by a declining trend in the composition of occupations in favour of upper-middle classes, balanced by higher downward mobility from upper-middle classes, caused by a decrease in the income incentives. Equality of opportunity is low and constant for those born after 1951. Our evidence complements Acciari et al. (2022), who show that, for a sample of children born between 1979 and 1983, the probability that a child reaches the top quintile of the national income distribution starting from a family in the bottom quintile is 0.11.

The paper is organised as follows. Section 2 presents the model, Section 3 presents some social mobility indexes; Section 4 is devoted to the empirical analysis on Italy. Section 5 concludes.

2 A model of occupational mobility

Our model of intergenerational occupational mobility encompasses three key determinants of occupational mobility, i.e.: i) the *income incentives* of different occupations (see, e.g., Corak 2013); ii) the *opportunities* deriving from family cultural and genetic attributes and socio-economic environment (the concept of "inherited endowments" proposed by Becker and Tomes 1986, and Corak 2004); and, finally, iii) the *occupational shifts*, i.e. the changes in occupational possibility set determined by the production side of economy (Prais 1955 and Thurow 1976).

In particular, the observed occupational mobility can be considered as the outcome of two distinct phenomena: i) the choices of individuals, which are driven by income and social incentives and individual opportunities (Prais 1955 denotes it as *true mobility*); and ii) the *occupational shifts*, deriving from the changes in the occupational structure caused both by the mutations in the production side of the economy (for example because of technology), and by the differences in the fertility rates among occupational classes (denoted by Prais 1955 as *structural mobility*). Therefore, Prais (1955) assumes that the observed mobility can be represented by transition matrix $\mathbf{P}$, where the initial states are the parents' occupations, and the final states are the children's occupations. Moreover, Matrix $\mathbf{P}$ can be expressed as the result of the product of two transition matrices: $\mathbf{Q}$, representing the mobility driven by social and individual opportunities, i.e. *true mobility*, and $\mathbf{R}$, representing the mobility due to shifts in the occupations' distribution made available by the industrial system and fertility rates, i.e. *structural mobility*, i.e.:

$$\mathbf{P} = \mathbf{QR}. \tag{1}$$

Section 2.1 provides a micro-foundation of the elements of matrix $\mathbf{Q}$ starting from the idea that individuals choose their occupations for maximizing their lifetime utility on the base of their income (and social) incentives and origins (opportunities). The main results are summarized in Proposition 1. Section 2.2, instead, discusses the determination of the element of matrix $\mathbf{R}$ by comparing the vector of the real shares of individuals in each occupational class with the one of shares that would be observed in absence both of constraints on the production side and of no difference in fertility rates, under the identification assumption of minimum occupational mobility. The main results are summarized in Proposition 3.

2.1 The choice of occupation

Individual occupational attainment is associated both with his/her motivations and with his/her social origin (Blau and Duncan 1967). Individual motivation depends on the characteristics of occupations, such as their income or social prestige, that constitute what we refer to as *income* (and social) *incentives*. Social origin, which we denote as *opportunities*, can be instead identified as: "[. . .] the aspects of the environments of individuals that affect their achievement of the objective, and for which the society in question, or the policymaker, does not wish to hold individuals responsible." Roemer (1998) and Dardanoni et al. (2006) includes social origin into the broader concept of "circumstances".

Consider an economy with only three classes of occupations: Working class (*Wc*), Middle class (*Mc*) and Upper class (*Uc*). This three-partition of society has a long tradition that starts from the rise of the Middle Class at the end of the 19-*th* century in most developed countries, and that is well discussed in the literature on social classes (Goldthorpe and Hope 1974). In particular, Giddens and Sutton (2013) argue that blue-collars are the most representative of Wc, clericals, teachers, and artisan of Mc, while managers, members of the profession, self-employment and entrepreneurs of Uc.[2]

Assume that the (log of) lifetime (indirect) utility of individual i, U_i, is given by:

$$\log U_i = V_i + \epsilon_i, \tag{2}$$

where V_i is the systematic component of utility, and ϵ_i is a random component. Both components depend on the occupational class of individual i. In particular, for the systematic component, we assume that:[3]

$$V_i = \begin{cases} \mu_W & \text{if } i \in \text{Wc;} \\ 2\theta_i \mu_M & \text{if } i \in \text{Mc; and} \\ 2\theta_i \mu_U & \text{if } i \in \text{Uc.} \end{cases} \tag{3}$$

Parameter $\theta_i \in [0, 1]$ represents "the endowment" of individuals (in Becker and Tomes (1986), "cultural and genetic attributes [...] transmitted from parents to children"), or "the child's luck variable" as in Goldberger (1989, 507): "the capital that child receives automatically and effortlessly from his parents-genes, reputation, culture, learning, skill and goals that his parents provided at no cost".

At the time of the choice of occupational class, θ_i is assumed to be known by individual i, but it has a stochastic nature. We assume that:

$$\epsilon_i \sim N\left(0, \sigma_i^2\right), \tag{4}$$

where:

$$\sigma_i^2 = \begin{cases} \sigma_W^2 & \text{if } i \in \text{Wc;} \\ \sigma_M^2 & \text{if } i \in \text{Mc; and} \\ \sigma_U^2 & \text{if } i \in \text{Uc.} \end{cases} \tag{5}$$

To reflect the different lifetime utilities associated with the three classes, we assume:

$$\mu_W \leq \mu_M \leq \mu_U, \tag{6}$$

[2] The classification of occupations used in the analysis, therefore, derives from a multidimensional evaluation which combines material aspects, such as working conditions, economic returns, duties and skills; normative aspects, such as the social utility of occupations; and, finally, more symbolic values, such as power and prestige (Goldthorpe and Hope 1974).

[3] Parameter θ_i is multiplied by 2 because if $i \in$ Mc (Uc) then $E\left[V_i\right] = \mu_M$ (μ_U), under the assumption of uniform distribution of θ_i on the range [0, 1] which will take in Section 2.1.2.

while no restrictions are imposed on the value of σ_W^2, σ_M^2, and σ_U^2. On the one hand, the dispersion of lifetime utility is expected to be higher in Uc than in Mc and Wc because of the importance individuals attribute to income. On the other hand, the types of occupations in Wc, i.e. low-skilled jobs, make individuals in this class more subject to unemployment risk.

Equations 2–5 summarise the substantial differences in the three occupational classes: lifetime utility of individuals belonging to Wc is assumed to be independent of individual attributes and lower than the one of Mc and Uc. On the contrary, an individual belonging to Mc and Uc should exploit her specific attributes to increase her lifetime utility; Mc and Uc should therefore include all individuals undertaking an entrepreneurial or professional activity based on their abilities.

2.1.1 Income incentives

To consider that most occupations in Mc and Uc require an adequate level of skills, we assume that access to Mc and Uc requires to bear a cost $\tilde{c}_e$ (expressed in units of utility). Since such skills can be acquired by formal education and by benefiting from a favourable social environment, we allow that $\tilde{c}_e$ can negatively depend on individual attributes θ_i.[4]

$$\tilde{c}_s^e = (1 - \delta\theta_i)\, c_s^e, \tag{7}$$

where $s \in M, U$ is the cost to bear to access Mc (Uc) for $s = M(U)$ and $\delta \in [0, 1]$ measures the magnitude of the negative impact of individual attributes on the cost of meeting the required skills to access to Mc and Uc. To reflect the hierarchy among different occupational classes, we assume that:

$$c_U^e > c_M^e. \tag{8}$$

Individual i prefers to belong to Mc instead of Wc if and only if her net expected utility in Mc is higher than in Wc (with a slight abuse of notation):

$$\text{Mc} \gtrsim \text{Wc} \iff \mathbf{E}\left[\log U_M\right] - \tilde{c}_M^e \geq \mathbf{E}\left[\log U_W\right] + \sigma_{WM}^{RP}, \tag{9}$$

where σ_{WM}^{RP} is the *risk premium* of belonging to Wc instead of Mc deriving from the different variance of the expected utility of belonging to Mc instead of Wc. We assume that individual i is risk-averse or risk-neutral, i.e.:

$$\sigma_{WM}^{RP} = \sigma^{RP}\left(\frac{\sigma_M^2}{\sigma_W^2}\right), \text{ with } \frac{\partial \sigma^{RP}}{\partial \sigma_M^2/\sigma_W^2} \geq 0 \text{ and } \sigma^{RP}(1) = 0; \tag{10}$$

this implies that $\sigma_{WM}^{RP} > 0$ only in the case the variance of the lifetime utility of belonging to Mc (σ_M^2) is higher than the one of belonging to Wc (σ_W^2).

Given Eqs. 2, 4, 7 and 10, Condition (9) can be written as:

$$\text{Mc} \gtrsim \text{Wc} \iff \theta_i \geq \lambda_M \equiv \underbrace{\frac{\mu_W}{2\mu_M + \delta c_M^e}}_{\text{Return premium}} + \underbrace{\frac{\sigma^{RP}\left(\sigma_M^2/\sigma_W^2\right)}{2\mu_M + \delta c_M^e}}_{\text{Risk premium}} + \underbrace{\frac{c_M^e}{2\mu_M + \delta c_M^e}}_{\text{Cost of access}}. \tag{11}$$

On the base of (individual) *income incentives* a high level of λ_M means a *lower* probability for individual i to belong to Mc (we use "probability" because θ_i has a random component,

[4] A cost of education negatively depending on individual talent is generally assumed in the theory of signalling (see, e.g., Weiss 1995).

see below); at *aggregate level* λ_M instead measures the probability mass of individuals that decide to belong to Wc.

In the same fashion, individual i prefers to belong to Uc instead of Mc if and only if her net expected lifetime utility in Uc is higher than in Mc, which can be expressed as:

$$\text{Uc} \gtrsim \text{Mc} \Longleftrightarrow \theta_i \geq \lambda_U \equiv \frac{\mu_M}{2\mu_U + \delta c_U^e} + \frac{\sigma^{RP}\left(\sigma_U^2/\sigma_M^2\right)}{2\mu_U + \delta c_U^e} + \frac{c_U^e}{2\mu_U + \delta c_U^e}; \tag{12}$$

and individual i prefers to belong to Uc instead of Wc if and only if her net expected utility in Uc is higher than in Wc, which can be expressed as:

$$\text{Uc} \gtrsim \text{Wc} \Longleftrightarrow \theta_i \geq \lambda_U^W \equiv \frac{\mu_W}{2\mu_U + \delta c_U^e} + \frac{\sigma^{RP}\left(\sigma_U^2/\sigma_W^2\right)}{2\mu_U + \delta c_U^e} + \frac{c_U^e}{2\mu_U + \delta c_U^e}. \tag{13}$$

Finally, to reflect the different status of occupational classes, assume that:

$$\lambda_U > \lambda_U^W > \lambda_M. \tag{14}$$

To summarize, the choice of individual i hinges on the relationship between θ_i and λs; in particular, if $\theta_i \in \left[0, \min\left(\lambda_M, \lambda_U^W\right)\right) = [0, \lambda_M)$ individual i chooses to belong to Wc; if $\theta_i \in \left[\min\left(\lambda_M, \lambda_U^W\right), \max\left(\lambda_U^W, \lambda_U\right)\right) = [\lambda_M, \lambda_U)$ to belong to Mc; and, finally, if $\theta_i \in \left[\max\left(\lambda_U^W, \lambda_U\right), 1\right] = [\lambda_U, 1]\, t$ to belong to Uc.

2.1.2 Equality of opportunity

To introduce the equality of opportunity, we assume that the expected level of θ_i is decided by the parental occupational class of individual i (POC_i). In particular, assume that the probability distribution of θ_i conditioned to the fact that individual i's parents belong to Wc is:

$$f(\theta_i | POC_i \in \text{Wc}) \sim \mathcal{U}\left(0, \theta^{\max}\right), \tag{15}$$

where $\mathcal{U}(0, \theta^{\max})$ is a uniformly distributed random variable in the range $\left[0, \theta^{\max}\right]$, with $\theta^{\max} \in (0, 1]$. If her parents instead belong to Mc, the probability distribution of θ_i is:

$$f(\theta_i | POC_i \in \text{Mc}) \sim \mathcal{U}\left(\theta_M^{\min}, \theta_M^{\max}\right), \tag{16}$$

with $\theta_M^{\min} \in [0, 1)$, $\theta_M^{\max} \in (0, 1]$, and $\theta_M^{\min} < \theta_M^{\max}$. Finally, if her parents belong to Uc, the probability distribution of θ_i is:

$$f(\theta_i | POC_i \in \text{Uc}) \sim \mathcal{U}\left(\theta^{\min}, 1\right), \tag{17}$$

with $\theta^{\min} \in [0, 1)$. An intuitive way to catch the meaning of parameters $\theta^{\min}$, $\theta_M^{\min}$, $\theta_M^{\max}$, and $\theta^{\max}$ is to assume that individual attributes θ_i are the product of *genetic attributes* g_i and *cultural/social attributes* $c\&s_i$, i.e.:

$$\theta_i = g_i \times c\&s_i.$$

Moreover, assume that g_i are drawn from a uniform distribution in the range [0, 1] (i.e. no genetic class effectis present) and $c\&s_i$ is a non random factor. Since for children with

parents in Wc θ_i must satisfy (15), then $\theta_i = g_i\theta^{\max}$; $\theta^{\max} < 1$ proxies for the cultural/social attributes of individual i and *reduces* the impact of genetic attributes on her θ_i. To the opposite, children with parents in Uc must satisfy (17) and hence $\theta_i = \theta^{\min} + g_i\left(1 - \theta^{\min}\right)$; $\theta^{\min} > 0$ proxies for cultural/social attributes of individual i and *puts a lower bound* on the value of θ_i independent of the genetic attributes of individual i. It is straightforward to conduct the same reasoning for individuals in Mc.

In a related paper, Peng (2021) proposes that parental influence on the job market opportunities of children goes through a cost of (education) effort, which is decreasing in their level of the bequest. The effort, jointly with individual talent, is critical in determining children's income. Differently, in our model, the children with fathers in the upper classes have a favourable bias in the determination of their level of θ_i. The latter, in turn, both decreases the cost of education and increases the probability of getting a better job (conditioned to the level of education). In Peng (2021), the persistence in social mobility is determined by the incentive of individuals with low talent but high bequest to produce a high effort in the search for a high-return job. Instead, in our model, persistence is caused by the higher expected return for the occupations in MC and Uc for children with fathers in the upper classes.

2.1.3 The transition probabilities between occupational classes

The conditional distribution of θs and λs are the base for the computation of the (transition) probability of a child with a parent in social class i to belong to social class j, denoted by q_{ij}. For example, a child with a parent in Wc will remain in Wc if her θ_i is lower than λ_M; this implies that the mass of probability of not changing her social class is equal to $q_{WcWc} = \lambda_M/\theta^{\max}$ (see the top panel in Fig. 1).

Proposition 1 *Under the assumptions*

$$\theta^{\max} \geq \lambda_U;\ \theta_M^{\max} \geq \lambda_U \geq \lambda_M \geq \theta_M^{\min};\ \textit{and} \lambda_M \geq \theta^{\min},$$

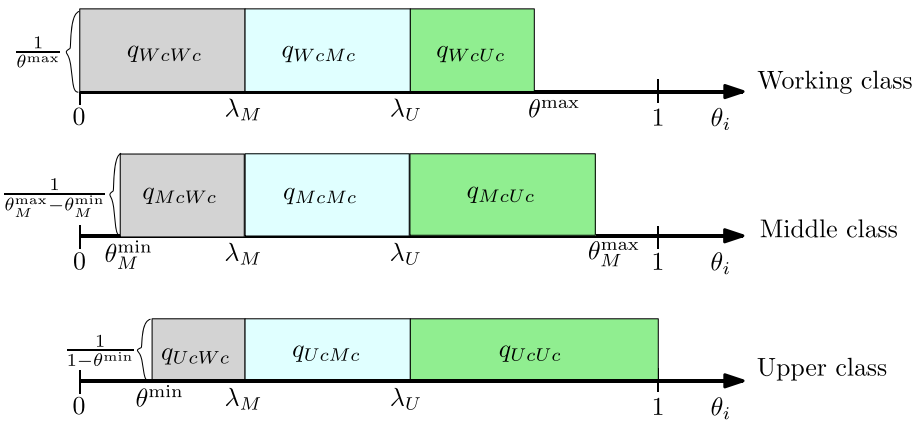

Fig. 1 The distribution of θs, the value of parameters λ_M and λ_U, and the transition probabilities of children with parents in different occupational classes

the occupational mobility of a society attributable to income incentives and opportunity, i.e. the true occupational mobility, is completely described by the transition matrix $\mathbf{Q}$ *defined by:*

$$\mathbf{Q} \equiv \begin{array}{c} \\ Wc\ (Parents) \\ Mc\ (Parents) \\ Uc\ (Parents) \end{array} \begin{array}{c} \begin{array}{ccc} Wc\ (Children) & Mc\ (Children) & Uc\ (Children) \end{array} \\ \begin{bmatrix} \frac{\lambda_M}{\theta^{\max}} & \frac{\lambda_U - \lambda_M}{\theta^{\max}} & \frac{\theta^{\max} - \lambda_U}{\theta^{\max}} \\ \frac{\lambda_M - \theta_M^{\min}}{\theta_M^{\max} - \theta_M^{\min}} & \frac{\lambda_U - \lambda_M}{\theta_M^{\max} - \theta_M^{\min}} & \frac{\theta_M^{\max} - \lambda_U}{\theta_M^{\max} - \theta_M^{\min}} \\ \frac{\lambda_M - \theta^{\min}}{1 - \theta^{\min}} & \frac{\lambda_U - \lambda_M}{1 - \theta^{\min}} & \frac{1 - \lambda_U}{1 - \theta^{\min}} \end{bmatrix} \end{array} \tag{18}$$

The first element in the main diagonal of $\mathbf{Q}$ represents the probability of children with parents in Wc belonging to Wc, i.e.:

$$q_{WcWc} \equiv \mathbf{Pr}\left[\theta_i \leq \lambda_M | POC_i \in \text{Wc}\right] = \frac{\lambda_M}{\theta^{\max}},$$

calculated on the base of conditional probability distribution (15) of θ_i and the children's incentives to belong to Wc given by Condition (11). We can calculate all other elements in the same manner. The constraints on the model's parameters ensure that all probability masses are non-negative.

Matrix $\mathbf{Q}$ in Proposition 1 allows us to identify two polar cases of societies, already discussed in Prais (1955): the Perfect Mobile Society (PMS) and the Perfect Immobile Society (PIS). In PMS, the probability of belonging to an occupational class is independent of the class of own parents. This happens when all conditioned distributions of θ_i are the same and not biased, i.e. for $\theta^{\max} = \theta_M^{\max} = 1$ and $\theta^{\min} = \theta_M^{\min} = 0$, and hence:

$$\mathbf{Q_{PMS}} = \begin{bmatrix} \lambda_M & \lambda_U - \lambda_M & 1 - \lambda_U \\ \lambda_M & \lambda_U - \lambda_M & 1 - \lambda_U \\ \lambda_M & \lambda_U - \lambda_M & 1 - \lambda_U \end{bmatrix}.$$

In PIS, where no movements between classes take place, this happens when $\theta^{\max} \leq \lambda_M$, $\theta_M^{\min} \geq \lambda_M$, $\theta_M^{\max} \leq \lambda_U$, $\theta^{\min} \geq \lambda_U$, i.e.:

$$\mathbf{Q_{PIS}} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}.$$

2.1.4 The identification of mobility and equality of opportunity

The micro-foundation of the transition matrix allows circumventing the key limitation in identifying mobility and equality of opportunity generally due to the lack of data (Roemer and Trannoy 2016).

Proposition 2 *Assume that all the elements of Matrix* $\mathbf{Q}$ *are observed. Then, all six parameters of the model can be calculated as follows:*

$$\begin{cases} \lambda_M = \dfrac{q_{32}/q_{33}}{(1+q_{12}/q_{11})(1+q_{32}/q_{33})-1}; \\ \lambda_U = \lambda_M (1+q_{12}/q_{11}); \\ \theta^{\max} = \dfrac{\lambda_M}{q_{11}}; \\ \theta^{\min} = 1 - \dfrac{1-\lambda_U}{q_{33}}; \\ \theta_M^{\min} = \lambda_M - (\lambda_U - \lambda_M)\left(\dfrac{q_{21}}{q_{22}}\right); \text{ and} \\ \theta_M^{\max} = \theta_M^{\min} + \dfrac{\lambda_U - \lambda_M}{q_{22}}. \end{cases} \tag{19}$$

The simple inspection of Matrix $\mathbf{Q}$ in Proposition 1 is sufficient to verify the proposition. To appreciate the importance of Proposition 2 consider that in our model a higher persistence in Wc class, i.e. a higher $\lambda_M/\theta^{\max}$ (see Proposition 1), can be the outcome of two possible dynamics: i) a decline in income incentive to move to higher classes, i.e. a higher λ_M; and ii) a decline in the equality of opportunity, i.e. a lower $\theta^{\max}$. However, while the individual element is not sufficient to determine the true cause of the higher persistence, identification is possible considering all elements of $\mathbf{Q}$, since the latter has six independent elements, the same number of model's parameters. In other words, the system of equations directly derived by the definition of the transition matrix elements is sufficient to estimate the equality of opportunity and income incentives with the information set corresponding to the case of *poor dataset* of Roemer and Trannoy (2016).

2.2 Occupational shifts

Following Prais (1955), the meaning of structural mobility represented by transition matrix $\mathbf{R}$ can be appreciated by denoting with s_t the vector of the shares of individuals in each occupational class at period t; in the case of *unconstrained occupational mobility* the dynamics of these shares is given by:

$$s_{t+1,UN} = \mathbf{Q}^\top s_t, \tag{20}$$

where $s_{t+1,UN}$ is the vector of shares in *absence of constraints on the production side* and *no difference in fertility rates* among occupational classes. The difference between $s_{t+1,U.N.}$ and s_{t+1} can be expressed by a transition matrix $\mathbf{R}$, which proxies the importance of occupational shifts in the observed occupational mobility, i.e.:

$$s_{t+1} = \mathbf{R}^\top s_{t+1,UN}, \tag{21}$$

which, substituted from Eq. 20 for $s_{t+1,UN}$, yields:

$$s_{t+1} = \mathbf{R}^\top \mathbf{Q}^\top s_t = \mathbf{P}^\top s_t, \tag{22}$$

where the last equality explains our starting point of the analysis, i.e. Eq. 1.

In case of no occupational shifts $\mathbf{R} = \mathbf{I}$ where $\mathbf{I}$ is the identity matrix, the individual choices do not face any constraint from the production side and by differential fertility rates among occupational classes. Differently, if $s_{t+1,Wc} > s_{t,Wc}$ and $s_{t+1,Mc} < s_{t,Mc}$ and $s_{t+1,Uc} < s_{t,Uc}$, some children who would like to belong to Mc and Uc are constrained in their choice to Wc (increasing occupational mobility) because production and

fertility are favouring occupations in Wc at the expense of occupations in Mc and Uc, as highlighted by the literature on good and bad jobs (Kalleberg 2011). On the contrary, in an economy with a structural change benefiting knowledge-intensive industries (e.g. financial and information and technology sectors), the dynamics would turn to be the opposite (White 1991; Breen 1997).

To estimate **Q**, we must know **R** and **P**, but only **P** can be directly estimated from data. The estimate of **R** is possible only by imposing some identifying assumptions. In particular, Prais (1955) proposes a criterion of *individually minimum occupational mobility* to identify **R**. He implements such criterion by an algorithm starting from the bottom class of parents (our Wc) and *sequentially* arriving at the top one (our Uc), allocating children in each class, minimising the change between their occupational class and one of their parents. As stated in Proposition 3, we instead estimate **R** under the criterion of *globally minimum occupational mobility*, where occupational mobility is measured by the opposite of the trace of **R**.

Proposition 3 *Assume that social mobility is estimated under the criterion of globally minimum occupational mobility measured by the trace of* **R**. *Then, the elements of R must satisfy:*

$$\min_{\mathbf{R}} -\operatorname{tr}(\mathbf{R})$$
$$s.\,t. \begin{cases} s_{t+1} = \boldsymbol{R}^{\top} s_t \\ \sum_{j=1}^{k} r_{ij} = 1 & \forall i = 1, \ldots, k \\ r_{ij} \geq 0 & \forall i, j. \end{cases}$$

Occupational mobility reaches its minimum when all children remain in the same class of their parents, which implies that each element of the main diagonal R should be equal to 1. However, such minimum is not feasible when $s_{t+1} \neq s_t$. Proposition 3 therefore defines a criterion of global minimum occupational mobility based on the minimum of the trace, but constrained by the observed occupational shares and the feasible range of the elements of **R**.

We prefer our criterion with respect to the one proposed by Prais (1955) because it is more coherent with our measure of occupational mobility based on the trace of transition matrix discussed in Section 3.[5] Finally, we observe that Proposition 3 provides an estimate of **R** which tends to positively bias the estimate of **Q**.

3 Indexes of occupational mobility

In this section, we illustrate how the different types of mobility discussed so far, true versus structural mobility, and synthetic indexes of mobility can measure the decomposition between income incentive and equality of opportunity.

In agreement with Eq. 1, we assume that:

$$I_{OBS} = I_{TRUE} \times I_{OS},$$

[5] In the procedure for the calculation of r_{ij} we need that $q_{ij} \geq 0\ \forall i, j$. The following procedure allows to satisfy the latter constrains: 1) calculate **R** on the base of Algorithm (3); 2) calculate $\mathbf{Q}' = \mathbf{P}\mathbf{R}^{-1}$; 3) setting $q''_{ij} = q'_{ij}$ if $q'_{ij} \geq 0$ or $q''_{ij} = 0$ if $q'_{ij} < 0$; 3) row normalizing the resulting matrix, i.e. $q'''_{ij} = q''_{ij} / \sum_{j=1}^{k} q''_{ij}$ (this amounts to proportionally decrease the excessive mass of non null elements of $\mathbf{Q}'$); 4) calculate $\mathbf{R}' = \mathbf{Q}'''^{-1}\mathbf{P}$; 5) calculate $\mathbf{R}''$ by row-normalizing $\mathbf{R}'$ in order to satisfy $\sum_{j=1}^{k} r_{ij} = 1\ \forall i = 1, \ldots, k$; and, finally, 6) calculate $\mathbf{Q}'''' = \mathbf{P}\mathbf{R}''^{-1}$.

that is, the index of observed mobility (I_{OBS}) is expressed as the product of an index of true mobility (I_{TRUE}) and an index of occupational shifts (I_{OS}). Moreover, inspired by the results of Section 2.1, I_{TRUE} is assumed to be the difference between an index of the equality of opportunity (I_{OPP}) and an index of lack of incentives to exploit these opportunities (I_{LOI}):

$$I_{TRUE} = I_{OPP} - I_{LOI}.$$

I_{TRUE} represents a novelty for the existing literature where equality of opportunity is generally related to ex-post inequality and not to the choice set of individuals (see, e.g., Checchi and Peragine 2010 and Brunori et al. 2013). Checchi and Peragine (2010), for instance, propose an index of inequality as the sum of an index of opportunity and an index of effort where their index of opportunity is *inversely* related to our I_{OPP}.

3.1 Observed, true, and structural mobility

Inspired by Shorrocks (1978) and based on the intuition that a lower value of trace corresponds to higher occupational mobility, as an index of observed occupational mobility, we take the complement to 3 of the trace of transition matrix among different occupations:[6]

$$I_{OBS} \equiv 1 - \frac{\text{tr}\,(\mathbf{P})}{3},$$

with $I_{OBS} \in [0, 1]$. It measures the intensity of the *observed* occupational mobility (0 minimum and one maximum mobility). In the same fashion, we propose as an index of true occupational mobility:

$$I_{TRUE} \equiv 1 - \frac{\text{tr}\,(\mathbf{Q})}{3},$$

which, given Proposition 1, is equal to:

$$I_{TRUE} = 1 - \left(\frac{1}{3}\right)\left[\frac{\lambda_M}{\theta^{\max}} + \frac{\lambda_U - \lambda_M}{\theta_M^{\max} - \theta_M^{\min}} + \frac{1 - \lambda_U}{1 - \theta^{\min}}\right].$$

As expected $I_{TRUE} \in [0, 1]$, it is a positive function of $\theta^{\max}$ and $\theta_M^{\max}$ and a negative function of $\theta_M^{\min}$ and $\theta^{\min}$. The impact of λ_M and λ_U instead is ambiguous: an increase in λ_M (λ_U) causes both an increase in the probability of remaining in the same class for children with parents in Wc (Mc) and at the same time, a decrease in the same probability for children with a parent in Mc (Uc).

Finally, from Eq. 23:

$$I_{OS} \equiv \frac{I_{OBS}}{I_{TRUE}}.$$

3.2 Equality of opportunity and lack of incentives

Calculating the equality of opportunity's index requires additional reasoning with the help of Fig. 2.

For children with parents in Wc, Area G is a proxy for the lower probability of moving from the class of their parents due to the bias in the distribution of θ_i. This suggests measuring the contribution of Wc to the overall index of the equality of opportunity I_{OPP} by 1-G (G goes to zero, i.e. max equality of opportunities, as $\theta^{\max}$ goes to 1). Moreover, since the contribution of

[6] The original Shorrocks index is defined as $(k - \text{tr}\,(Q))/(k - 1)$.

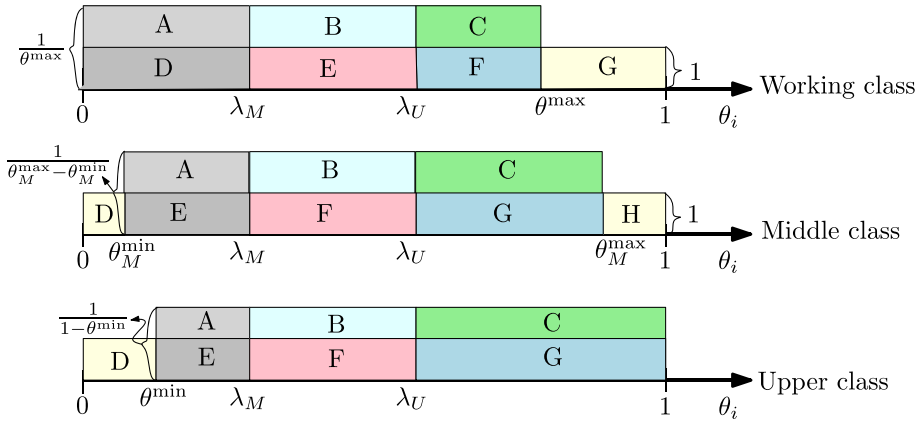

Fig. 2 The decomposition of true mobility's index I_{TRUE}

Wc to true mobility index I_{TRUE} is given by Areas B+C+E+F=1-A-D, then the contribution of Wc to the overall index of the lack of incentive to exploit these opportunities I_{LOI} is given by Areas D+A-G. By making the same reasoning for Mc and Uc, averaging the contributions of each class, and calculating the areas on the base of our theoretical model, we get that:

$$I_{OPP} = \frac{1 + \theta^{\max} + \theta_M^{\max} - \theta^{\min} - \theta_M^{\min}}{3}$$

and

$$I_{LOI} = \left(\frac{1}{3}\right)\left[1 + \theta^{\max} + \theta_M^{\max} - \theta^{\min} - \theta_M^{\min} + \frac{\lambda_M}{\theta^{\max}} + \frac{\lambda_U - \lambda_M}{\theta_M^{\max} - \theta_M^{\min}} + \frac{1 - \lambda_U}{1 - \theta^{\min}}\right] - 1.$$

I_{OPP} reaches the maximum value of 1 for $\theta^{\max} = \theta_M^{\max} = 1$ and $\theta^{\min} = \theta_M^{\min} = 0$, i.e. where no bias are present in the distribution of θ_i. In particular, $I_{OPP} = 1$ for each true mobility matrix corresponding to a Perfect Mobile Society, i.e. $Q = Q_{PMS}$.

4 An estimate of occupational mobility in Italy

In this section, we apply our theoretical model to a sample of Italian heads of households born in the period 1940-1976. Section 4.1 describes the dataset whereas Section 4.2 contains the estimates and a discussion of the main findings.[7]

4.1 The dataset

The dataset is built from a nationally representative household survey by the Bank of Italy called the "*Survey on Household Income and Wealth*" (SHIW). We pool the nine waves

[7] Dataset and codes are available at Davide Fiaschi's website https://people.unipi.it/davide_fiaschi/ricerca/.

conducted in 1995-2012, selecting all heads of household aged from 35 up to 65 (i.e. born between 1940 and 1977). In all these waves, the heads of the household are asked to recall some characteristics of their parents, among which the occupation, indicatively referred to the same current age of the respondent, which allows controlling for the *life cycle component* of occupational mobility.

We measure occupational mobility comparing occupational status of children with those of their *fathers* (see Checchi 1997 and Piraino 2007). We removed the heads of households not giving information on their fathers (about 15% of the sample) and the repeated observations due to the longitudinal component (panel) of the waves (about 30% of households persist from a wave to the next one). Overall, the sample consists of 14,037 observations.

To study the dynamics of occupational mobility over time, we partition the sample into three cohorts based on the year of birth of the heads of the household. The first cohort includes 4,166 observations of the heads of household born in the period 1940-1951 (Cohort I); the second 7,696 observations of those born between 1952 and 1965 (Cohort II); and the third 2,175 observations of those born between 1966 and 1977 (Cohort III). The ratio of this division into three cohorts is exposed in Fig. 3.

Cohort I includes children who chose education and occupation in the aftermath of the II World War (between 1955 and 1966) in a poor but fast-growing economy, with a robust structural change favouring manufacturing sectors. This environment encouraged occupational mobility, mainly thanks to the production side and favourable economic prospects, while credit constraints and cultural/social were the main braking factors. Cohort II collects children taking their choices in the period (between 1966 and 1980) with the highest growth rate of income in the last century, with increasing maturity and awareness of educational and working decisions. All these factors are conducive to higher occupational mobility toward Mc and Uc. Finally, Cohort III gathers children who took their choices more freely, but also in a period (post-1992) where the occupational structure was stable, and expectations about the economy were gloomy. Occupational mobility toward Mc and Uc should have been negatively affected.

Concerning the definition of occupational classes, in the SHIW dataset, the occupational class of children is coded by the APQUAL variable. Children whose answers are: i) 1 or 20 (blue-collar and atypical workers, respectively) are assigned to Wc; ii) 2, 3, 4, or 8 (clerk, teacher, office worker, junior manager, small employer, own account worker respectively) are assigned to Wc; and iii) 5, 6, 7, or 10 (senior manager, official, school head, professor, magistrate, member of professions, entrepreneur, administrator respectively) constitute the Uc. Unemployed children are assigned to the class of their last job if available. The label CONPCF codes the occupational class of fathers, and we use the same reclassification of children. Regarding ISCO classification, Wc corresponds to ISCO major groups 6-9, Mc to 3-5, and Uc to 1-2, the same partition used by Franzini et al. (2013).

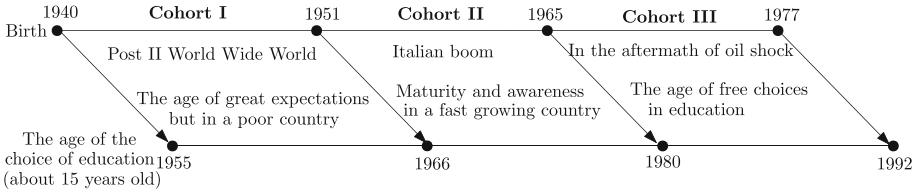

Fig. 3 Socioeconomic conditions of Italy when children within each cohort took their choices on education and occupation (assumed at about 15 years old)

Table 1 The estimate of matrices **P** (observed mobility), **R** (structural mobility), and **Q** (true mobility) for children in Cohorts I, II and III

	Matrix P			Matrix R			Matrix Q		
	Wc	Mc	Uc	Wc	Mc	Uc	Wc	Mc	Uc
Cohort I									
Wc	0.49	0.42	0.09	0.74	0.15	0.10	0.67	0.33	0
Mc	0.22	0.60	0.18	0	0.95	0.05	0.29	0.59	0.12
Uc	0.08	0.35	0.57	0.01	0.01	0.99	0.10	0.35	0.55
Obs.	1307	1847	591	1307	1847	591	1307	1847	591
Cohort II									
Wc	0.52	0.41	0.07	0.72	0.19	0.09	0.72	0.28	0
Mc	0.22	0.61	0.17	0	0.97	0.03	0.31	0.56	0.13
Uc	0.10	0.49	0.41	0.01	0.01	0.98	0.14	0.47	0.39
Obs.	3104	4120	1101	3104	4120	1101	3104	4120	1101
Cohort III									
Wc	0.60	0.35	0.05	0.84	0.12	0.04	0.72	0.26	0.02
Mc	0.28	0.60	0.12	0	1	0	0.33	0.56	0.11
Uc	0.13	0.55	0.32	0	0	1	0.15	0.53	0.31
Obs.	1451	1542	326	1451	1542	326	1451	1542	326

Source: Our elaborations on SHIW dataset (Bank of Italy)

4.2 The estimate of occupational mobility and its determinants

Table 1 reports the estimate of **P**, **R** and **Q** for each cohort.[8] The observed occupational mobility generally appears low for all three classes with respect to other developed countries (Jonsson (2004) for Sweden, Muller and Pollak (2004) for Germany, Ganzeboom and Luijkx (2004) for the Netherlands, Chetty et al. (2017) for the U.S., and Berman (2022) for a cross country comparison): between 52% and 60% of children of Cohorts II and III with fathers in Wc and Mc remain in the same parent's class (see the elements along the main diagonal of estimated **P**). This evidence further supports the results of Schizzerotto and Cobalti (1994), Pisati (2000), Di Pietro and Urwin (2003), and of more recent contribution by Raitano and Vona (2015), which suggests high persistence in the lowest occupational classes in Italy. In particular, we find a still worse picture of the phenomenon in the youngest cohort, with an estimated probability of persisting in Wc equal to 60% against one of 51% found in Pisati (2000). Moreover, the high and steady persistence in Mc, about 60% in all three cohorts, is the result of increased downward mobility (from 22% to 28% from Mc to Wc) and a corresponding decreased upward mobility (from 18% to 12% from Mc to Uc). A decreased upward mobility is also experimented by children with fathers in Wc (from 42% to 35% from Wc to Mc and from 9% to 5% from Wc to Uc), as opposed to the increased downward mobility by children with fathers in Uc (from 35% to 55% from Uc to Mc and from 8% to 13% from Uc to Wc). In summary, the overall picture of Italian occupational mobility is disappointing: a high persistence in the low occupational classes Wc and Uc is associated with increasing downward mobility and decreasing upward mobility.

[8] We first estimate **P**; then, on the base of the observed occupational shifts and the solution of Problem (3) in Section 2.2 (amended to prevent negative elements in **Q**), **R**. Finally, by Eq. 22 we get the estimate of **Q**.

Table 2 The occupational structure of fathers and children for Cohort I, II and III

	Cohort I			Cohort II			Cohort III		
	Wc	Mc	Uc	Wc	Mc	Uc	Wc	Mc	Uc
Fathers	0.51	0.44	0.06	0.53	0.40	0.06	0.52	0.40	0.08
Children	0.35	0.49	0.16	0.37	0.49	0.13	0.44	0.46	0.10

Source: Our elaborations on SHIW dataset (Bank of Italy)

As occupational shifts, the estimate of **R** in Table 1 highlights the critical but declining role of the production side in favouring the escape from Wc in favour of Mc and Uc, and Mc in favour of Uc. More precisely, the share of children with fathers in Wc who moves from Wc because of the Italian economy's change in the occupational structure goes from 26% of Cohort I to 16% of Cohort III. In contrast, the share of children with fathers in Mc who move from Uc goes from 5% of Cohort I to 0 of Cohort III. The comparison between the occupational structure of children and fathers for the three cohorts reported in Table 2 further confirms that occupational shifts less and less favour upward mobility over time (for example, in Cohort I 51% of fathers belong to Wc versus 35% of children, while in Cohort III 52% versus 44% of children).

The true occupational mobility as estimated by **Q** in Table 1 appears lower than observed mobility: the persistence in Wc is much higher, peaking at 72% for Cohort III, and it is almost the same in Mc and Uc (56% and 31% in Cohort III respectively). Moreover, upward mobility from Wc is decreasing from Cohort I to Cohort III, while is increasing the downward mobility from Uc, peaking at 53% to Mc and 15% to Wc for Cohorts III. Overall, we find the same picture of observed mobility: high persistence in Wc and Uc is associated with increasing downward mobility.

The estimates of the indexes reported in Table 3 calculated on the base of Eqs. 3.1-3.1 depict growing occupational mobility, raised from 0.45 for Cohort I to 0.49 for Cohort III, which is mainly ascribable to increasing downward mobility, especially in Uc, declining structural mobility (from 1.11 for Cohort I to 1.05 for Cohort III), due to the fading structural changes in favour of middle and upper classes; and, finally, rising true mobility climbed by 0.4 for Cohort I to 0.46 for Cohort III, primarily caused by the increased downward mobility in Uc.[9] In summary, observed occupational mobility is increased from Cohort I to Cohort III, but unfortunately for "bad" reasons, i.e. increased downward mobility, especially from Uc. Occupational shifts, which favoured the escape from Wc, faded over time, making the true occupational mobility lower, but, again, for "wrong" reasons, as a result of higher persistence in Wc and higher downward mobility in both Mc and Uc.

Our results are in line with the evidence discussed by other empirical studies. Goldberger (2016), analysing social mobility in Britain over the period from the end of the Second World War down to the early 21st century, highlights that the total occupational mobility has remained stable but, distinguishing between upward and downward mobility, the former is decreased, whereas the latter is increased. Moreover, the U.S. and four European countries (Germany, France, Sweden and Netherlands) Breen (2019) find a pattern of increasing downward mobility and decreasing upward mobility for those individuals born between 1960 and 1980.

[9] All the differences are statistically significant at usual 5% significance level.

Table 3 Estimated indexes of observed, structural and true occupational mobility for Cohort I, II and III

	I_{OBS}	I_{OS}	I_{TRUE}
Cohort I	0.45	1.11	0.40
	(0.012)	(0.049)	(0.013)
Cohort II	0.49	1.10	0.44
	(0.008)	(0.03)	(0.009)
Cohort III	0.49	1.05	0.47
	(0.014)	(0.045)	(0.015)

Notes: standard errors of estimates, reported between brackets, are computed via a bootstrap procedure with 1,000 bootstraps (see Appendix A)
Source: computations using SHIW dataset (Bank of Italy)

4.2.1 Disentangling the effects of equality of opportunities from the lack of incentives on mobility

The estimates of model's parameters of Eq. 19 reported in Table 4 suggest that income incentives and (in)equality of opportunities played an important role for the mobility for all three cohorts: $\theta^{\max}$ and $\theta_M^{\max}$ are largely under 1, while $\theta^{\min}$ and $\theta_M^{\min}$ are above 0. Checchi (2003) finds a similar crucial role of family background for educational attainments.

For children in Wc, incentives to change their class have been decreasing over time (λ_M rose from 0.44 to 0.64), while opportunities have been expanding ($\theta^{\max}$ jumped from 0.66 to 0.89). Therefore, the increased overall persistence in Wc (from 67% to 72%, see Table 1) covers two opposite phenomena, with the impact of declining incentives prevailing on the higher opportunities. For children in Uc, the incentives to change their class have been increasing over time (λ_U rose from 0.66 to 0.87), and opportunities to fall behind have been reducing ($\theta^{\min}$ climbed from 0.38 to 0.58). As a consequence, the decreased overall persistence in Uc (from 55% to 31%, see Table 1) again covers two opposite phenomena, with the impact of increasing incentives to move prevailing on the lower (opportunities) possibilities of sliding down. Finally, for children in Mc, as in Wc, opportunities to move upward have increased ($\theta_M^{\max}$ increased from 0.71 to 0.91). In contrast, opportunities to move downward have been declining ($\theta_M^{\min}$ increased from 0.33 to 0.51). Income incentives have been working in the same directions, i.e. the increased λ_M favoured the outflow toward Wc, while the increase in λ_U discouraged any upward movement toward Uc. The slightly declined persistence over time is the result of these competing forces.

Table 4 Estimate of the model's parameters and the indexes of equality of opportunities I_{OPP} and lack of incentives I_{LOI}

	λ_M	λ_U	$\theta^{\max}$	$\theta^{\min}$	$\theta_M^{\max}$	$\theta_M^{\min}$	I_{TRUE}	I_{OPP}	I_{LOI}
Cohort I	0.44	0.66	0.66	0.38	0.71	0.33	0.40	0.55	0.15
	(0.027)	(0.036)	(0.036)	(0.035)	(0.038)	(0.025)	(0.014)	(0.013)	(0.003)
Cohort II	0.58	0.81	0.81	0.52	0.86	0.46	0.44	0.57	0.12
	(0.017)	(0.017)	(0.017)	(0.022)	(0.018)	(0.019)	(0.009)	(0.009)	(0.005)
Cohort III	0.64	0.87	0.89	0.58	0.91	0.51	0.47	0.57	0.10
	(0.025)	(0.022)	(0.023)	(0.033)	(0.023)	(0.031)	(0.015)	(0.015)	(0.011)

Notes: standard errors of estimates, reported between brackets, are computed via a bootstrap procedure with 1,000 bootstraps (see Appendix A)
Source: Our computations using SHIW dataset (Bank of Italy)

Overall, equality of opportunity as measured by I_{OPP} calculated by Eq. 3.2 is slightly increased from Cohort I to Cohort II (from 0.55 to 0.57), but steady from Cohort II to Cohort III. However, from the estimated parameters, we know that the outcome is the sum of increasing opportunities to move upward (both $\theta^{\max}$ and $\theta_M^{\max}$ increased over time) and declining opportunities to move downward (both $\theta^{\min}$ and $\theta_M^{\min}$ increased as well). Finally, income incentives as measured by I_{LOI} calculated by Eq. 3.2 shows a positive trend (from 0.15 to 0.10). This trend is the outcome of opposing forces, with the increased income incentives to move downward for children with fathers in Mc and Uc and the lower income incentives to move upward from Wc and Mc. From another perspective, the increased importance of income incentives can be appreciated by observing that in Cohort I, children exploited 0.40/0.55 = 73% of opportunities, while in Cohort III, this value raised to 0.47/0.57 = 82%.

4.2.2 The determinants of income incentives

From the policy perspective it would be crucial to identify the contribution of (occupational) *return premium*, *risk premium* and the *cost of access* (see Eqs. 11 and 12), to the increasing trend in λ_M and λ_U reported in Table 4. Unfortunately, as we will discuss below, the available information only allows for a limited investigation of this issue.

Assume that the log of income can be taken as a proxy for the utility of children and that, at the moment in which children took their occupational decision, their expected utility and its standard deviation can be proxied by the observed mean, and the standard deviation of the distribution of the log of income of their working life, i.e. income differentials among occupations are assumed to be steady along working life.[10]

Table 5 reports the ratios between sample means (a proxy for return premium) and standard deviations (a proxy for risk premium) of the log of incomes for Cohorts I, II and III in 1995-2012.[11] As expected, on average incomes are higher in Uc and lower in Wc, and therefore Condition (6) is respected. Instead, the picture of the standard deviation of the distribution of incomes is more complex: in all three cohorts, Wc displays the highest values (essentially caused by the highest unemployment rate in Wc), while Uc has higher values than Mc for the first two cohorts, while the opposite holds for Cohort III. Overall, figures reported in Table 5 support Assumption (14), excluding the higher value of standard deviation in Mc than Uc in Cohort III. The decline in the return premium belonging to Mc instead of Wc (i.e. μ_M/μ_W) and the increase in risk premium σ_M^2/σ_W^2 can contribute to explaining the estimated increase in λ_M. Similarly, the decline in the return premium of belonging to Uc instead of Mc (i.e. μ_U/μ_M) can explain the estimated increase in λ_U; however, the decline in risk premium σ_U^2/σ_M^2 tends to push upward λ_U.

Our model points to an increasing cost of meeting the required skill to access Mc c_M^e and Uc c_U^e as other explanatory causes of the upward trend of λ_M and λ_U. Unfortunately, we have no specific information on the level of tuition fees and financial support to Italian students, the most likely determinants of c_M^e and c_U^e. In particular, we have no data for tertiary

[10] We consider as individual income the net total available income of individuals, coded by label Y in SHIW, expressed in constant prices by the consumer price index with the base year 2013 provided by ISTAT.

[11] In particular, we calculate the mean and standard deviation of the distribution of the log of incomes for each wave and each cohort. We then calculate their weighted mean over all nine waves, with weights proportional to the number of observations in each wave, and finally, we calculate the ratios. Since the values reported in Table 5 refer to the ratio between means of the log of incomes, the ratio between the means of incomes is much higher; for example, the ratio of the means of the log of income of Mc with respect to Wc equal to 1.055 in Cohort I, implies that to an income of 1000 in Wc would correspond to an income of $1000^{1.055} = 1462.18$ in Mc, i.e. 46.2% higher (and not just 5.5%).

Table 5 Ratios between sample means (a proxy for return premium) and standard deviations (a proxy for risk premium) of the log of incomes for Cohorts I, II and III

Return premium	μ_M/μ_W	μ_U/μ_M
Cohort I	1.055	1.048
	(0.004)	(0.004)
Cohort II	1.049	1.041
	(0.002)	(0.003)
Cohort III	1.047	1.026
	(0.004)	(0.006)
Risk premium	σ^2_M/σ^2_W	σ^2_U/σ^2_M
Cohort I	0.480	1.105
	(0.089)	(0.140)
Cohort II	0.486	1.088
	(0.059)	(0.087)
Cohort III	0.832	0.783
	(0.133)	(0.135)

Notes: standard errors of estimates, reported between brackets, are computed via a bootstrap procedure with 1,000 bootstraps (see Appendix A)
Source: Our computations using SHIW dataset (Bank of Italy)

education, which is the most likely type of education to access Uc (see, e.g., Checchi 1997 for Italy and Hauser et al. (2000) for the U.S.). However, there exists a common view in the literature that from the end of the 1980s, the tuition fees in Italian universities started increasing. At the same time, the restrictions on the public budget curbed financial support to students. At the beginning of the 2000s, OECD (2006) ranks Italy at the ninth highest position for tuition fees among European countries. It also points to the very low percentage of Italian students with a scholarship. For the same period, Istat (2005) confirms that in Italy the access to tertiary education is checked by the high and increasing tuition fees, highlighting the growing accommodation cost for students.

5 Concluding remarks

Corak (2013) discusses how the observed downward trend in mobility in most western countries is generally perceived as a source of declining efficiency and justice (Gilbert 2011; Stiglitz 2012). On the contrary, we have documented that Italian children born in 1952-1965 experienced growing occupational mobility with respect to children born in 1940-1951, while those born after 1966 showed no changes in mobility. However, the picture is still gloomy because this steady mobility is unfortunately largely ascribable to higher downward mobility from upper-middle occupational classes, contrasted by the fading structural mobility in favour of upper-middle occupational classes present just after II World War in Italy. We also find that equality of opportunities is far from perfection and steady for those born after 1951. Changes in income incentives play a significant role, favouring higher downward mobility from upper-middle occupational classes and lower upward mobility from a lower class. This estimated trend in income incentives could be (partially) explained by the observed trend in differential returns and riskiness of occupations, together with anecdotal evidence of the increasing cost of education in Italy.

Our analysis has two main theoretical limitations. First, we have assumed that individuals know their ability (proxied by θ in the model) when deciding their occupation. However,

the uncertainty on the level of own ability can induce risk-averse individuals not to educate, mainly if they are poor. Second, we have adopted a definition of equality of opportunity strictly related to the conception of "level the playing field"; Roemer (1998) advances another conception which he calls the "non-discrimination or merit principle". In his words, it holds when "in the competition for the position in society, all individuals who possess the attributes relevant for the performance of duties of the position in question should be included in the pool of eligible candidates, and that an individual's possible occupancy of the position should be judged only with respect to those relevant attributes" (Roemer 2000, p.17). For example, race and sex should not affect the competition for a position, but it is likely to be in the real world. In this regard, another limitation of our model is its inability to identify the individual contribution to social (im)mobility of genes, cultural traits and family background, which is the subject of an intense debate in the literature (Arrow and Bowles 2000; Heckman et al. 2014).

Future research should first aim to tackle the two limitations discussed above. The most promising directions of research regarding the impact of credit market imperfections on socioeconomic mobility and the identification of the contribution (if any) to observed (im)mobility of the transmission of cultural traits and family background as opposed to genes (see, e.g., Bjorklund and Jantti 2009). From the empirical side, the class of latent Markov models could represent a robustness check to our findings by allowing us to analyse the dynamics of the unobservable individual social status based on the dynamics of its observable proxies such as wealth and income (Bavaro and Tullio 2019). Finally, our model could be extended to investigate a possible (negative) relationship between inequality and intergenerational mobility (the so-called "Great Gatsby Curve"), which recent empirical literature has found in U.S. data (Krueger 2012; Corak 2013; Durlauf et al. 2022).

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s10888-023-09568-8.

Funding Open access funding provided by Università di Pisa within the CRUI-CARE Agreement. This research has benefited from the financial support of the Italian Ministry of University and Research as part of the PRIN 2009 programme (grant protocol number 2009H8WPX5.

Data Availability Data, materials and code availability: dataset and codes used during the current study are fully available at Davide Fiaschi's website https://people.unipi.it/davide_fiaschi/ricerca/.

Declarations

Conflicts of interest None.

References

Acciari, P., Polo, A., Violante, G.L.: And Yet It Moves: Intergenerational Mobility in Italy. American Economic Journal: Applied Economics **14**(3), 118–63 (2022)

Arrow, K., Bowles, S.: and S. Meritocracy and Economic Inequality, Princeton University Press, Durlauf (2000)
Atkinson, A.B.: On intergenerational income mobility in Britain. Journal of Post Keynesian Economics **3**, 194–218 (1980)
Barone, C.: Le trappole della meritocrazia. Il Mulino, Bologna (2012)
Bavaro, M., and Tullio, F. (2019). Intergenerational mobility measurement with latent transition matrices. *Mimeo*
Becker, G.S. and N. Tomes, "Human Capital and the Rise and Fall of Families", *Journal of Labor Economics*, 4, 1986
Berman, Y.: The Long-Run Evolution of Absolute Intergenerational Mobility. American Economic Journal: Applied Economics **14**(3), 61–83 (2022)
Bjorklund, A. and M. Jantti, "Intergenerational Mobility of Socio-Economic Status in Comparative Perspective", *Nordic Journal of Political Economy*, 26, 2000
Bjorklund, A., Jantti, M.: Intergenerational Income Mobility and the Role of Family Background. In: Nolan, B., Salverda, W., Smeeding, T.M. (eds.) The Oxford Handbook of Economic Inequality. Oxford University Press, Oxford (2009)
Blau, P., Duncan, D.: The American Occupational Structure. Wiley, New York (1967)
Boudon R., *Mathematical Structure of Social Mobility*, Elsevier Scientific Publishing Company, 1973
Bourguignon, F., Ferreira, F., Walton, M.: Equity, efficiency and inequality traps: A research agenda. The Journal of Economic Inequality **5**(2), 235–256 (2007)
Breen, R.: Risk, recommodification and stratification. Sociology **31**(3), 473–489 (1997)
Breen, R.: Education and intergenerational social mobility in the U.S. and four European countries. Oxford Review of Economic Policy **35**, 445–466 (2019)
Brunori, P., Ferreira, F., Peragine, V.: Inequality of Opportunity, Income Inequality and Economic Mobility: Some International Comparisons. In: Paus, Eva (ed.) Getting Development Right. Palgrave Macmillan, New York, NY (2013)
Checchi, D.: Education and Intergenerational Mobility in Occupations: a Comparative Study. American Journal of Economics and Sociology **56**, 331–351 (1997)
Checchi, D., "The Italian Educational System: Family Background and Social Stratification", *ISAE Annual Report on Monitoring Italy*, 2003
Checchi, D., Ichino, A., Rustichini, A.: More Equal but Less Mobile? Education Financing and Intergenerational Mobility in Italy and U.S. Journal of Public Economics **74**, 351–393 (1999)
Checchi, D., Peragine, V.: Inequality of Opportunity in Italy. Journal of Economic Inequality **8**, 429–450 (2010)
Chetty, R., Grusky, D., Hell, M., Hendren, N., Manduca, R., Narang, J.: The Fading American Dream: Trends in Absolute Income Mobility Since 1940. Science **356**(6336), 398–406 (2017)
Corak, M.: Generational Income Mobility in North America and Europe. Cambridge University Press, Cambridge (2004)
Corak, M., "Income Inequality, Equality of Opportunity and Intergenerational Mobility", *Journal of Economic Perspective*, 27, 2013
Cunha, F., J.J. Heckman, and S.M. Schennach, "Estimating the Technology of Cognitive and Non-cognitive Skill Formation", *Econometrica*, 78, (3): 883-931
Dardanoni, V., H. Fields, J.E. Roemer, and M.L. Sanchez Puerta, "How Demanding Should Equality of Opportunity Be, and How Much Have We Achieved?", *ILR Collection*, 2006
Di Pietro, G., Urwin, P.: Intergenerational Mobility and Occupational Status in Italy. Applied Economic Letters **10**, 793–797 (2003)
Dobbs, R. A. Madgavkar J. Manyika J. Woetzel J. Bughin E. Labaye P. Kashyap, "Poorer than their parents? A new perspective on income inequality", McKinsey Global Institute, 2016
Durlauf, S.N. A. Kourtellos T. Chih Ming, "The Great Gatsby Curve", *Annual Review of Economics*, 14, (1), 571-605, 2022
Efron, B. and Tibshirani, R.J., "*An Introduction to the Bootstrap*", Chapman and Hall-CRC, 1993
Erikson, R. and J. Goldthorpe, "Intergenerational Inequality: A Sociological Perspective", *Journal of Economic Perspective*, 16, 2002
Fields, G.S. and E.A. Ok, "The measurement of income mobility: an introduction to the literature", in J. Silber (ed.), *Handbook of income inequality measurement*, 557-598, Springer, 1999
Fox, L.E., "Parental Wealth and the Black-White Mobility Gap in the U.S.", *The Review of Income and Wealth*, 4, 2016
Franzini, M., M. Raitano, and F. Vona, "The Channels of Intergenerational Transmission of Inequality: a Cross-Country Comparison", *Rivista Italiana degli Economisti*, 2, 2013

Ganzeboom, H., Treiman, D.: Internationally comparable measures of occupational status for the 1988 International Standard Classification of Occupations. Social Science Research **25**, 201–239 (1996)
Ganzeboom, H., Luijkx, R.: Recent Trends in Intergenerational Occupational Class Reproduction in the Netherlands 1970–99. In: Breen, R. (ed.) Social Mobility in Europe. Oxford University Press, Oxford (2004)
Giddens, A., Sutton, P.W.: Sociology. Polity Press, Cambridge (2013)
Gilbert, D.: The American Class Structure in an Age of Growing Inequality. Pine Forge Press, SAGE Publication, London (2011)
Goldberger, A., "Economic and Mechanical Models of Intergenerational Transmission", *American Economic Review*, 79, 1989
Goldberger, A.: Social class mobility in modern Britain: changing structure, constant process. Journal of the British Academy **4**, 89–111 (2016)
Goldthorpe, J., Hope, K.: The Social Grading of Occupations. Oxford University Press, Oxford (1974)
Hauser, R. M., J. R. Warren, M. Huang, and W. Y. Carter. "Occupational status, education, and social mobility in the meritocracy", in K. Arrow, S. Bowles, and S. Durlauf. (ed.) *Meritocracy and Economic Inequality*, Princeton University Press, 2000
Heckman, J. J., and S. Mosso. "The Economics of Human Development and Social Mobility." *Annual Review of Economics*, 6, 2014
Istat, *Le spese delle Famiglie per l'Istruzione e la Formazione Professionale*, 2005
Jantti, M., B. Bratsberg, K. Roed, O. Raaum, R. Naylor, E. Osterbacka, A. Bjorklund and T. Eriksson, "American Exceptionalism in a New Light: A Comparison of Intergenerational Earnings Mobility in the Nordic Countries, the United Kingdom and the United States", *IZA Discussion Paper*, 1938, 2006
Jonsson, J.O.: Equality at a Halt? Social Mobility in Sweden, 1976–99. In: Breen, R. (ed.) Social Mobility in Europe. Oxford University Press, Oxford (2004)
Kalleberg, A. L. *Good jobs, bad jobs: The rise of polarized and precarious employment systems in the United States, 1970s-2000s*, Russell Sage Foundation, 2011
Kanbur, R., Stiglitz, J.E.: Dynastic inequality, mobility and equality of opportunity. The Journal of Economic Inequality **14**(4), 419–434 (2016)
Krueger A., "The Rise and Consequences of Inequality in the United States", *Council of Economic Advisers*, 2012
Lo Bello S. and I. Morchio, "Like father, like son: Occupational choice, intergenerational persistence and misallocation", *Quantitative Economics*, 13, 629-679, 2022
Muller, W., Pollak, R.: Social Mobility in West Germany: The Long Arms of History Discovered? In: Breen, R. (ed.) Social Mobility in Europe. Oxford University Press, Oxford (2004)
Peng, B.: Positional competition: A theory of the Great Gatsby curve and the Easterlin paradox. Journal of Economic Behavior and Organization **186**, 562–575 (2021)
Piraino, P., "Comparable Estimates of Intergenerational Income Mobility in Italy", *The B.E. Journal of Economic Analysis & Policy*, 7, 2007
Pisati, M., *La Mobilitá Sociale*, Il Mulino, 2000
Prais, S.J.: Measuring Social Mobility. Journal of the Royal Statistical Society **118**, 56–66 (1955)
OECD, "Education at a Glance", 2006
Raitano, M., Vona, F.: Measuring the link between intergenerational occupational mobility and earnings: Evidence from 8 European countries. The Journal of Economic Inequality **13**, 83–102 (2015)
Roemer, J.E.: Equality of Opportunity. Harvard University Press, Cambridge (1998)
Roemer, J.E. "Equality of Opportunity", in K. Arrow, S. Bowles, and S. Durlauf. (ed.) *Meritocracy and Economic Inequality*, Princeton University Press, 2000
Roemer, J.E and A. Trannoy, "Equality of Opportunity: Theory and Measurement", *Journal of Economic Literature*, 54, 2016
Schizzerotto, A. and A. Cobalti, *La Mobilitá Sociale in Italia*, Il Mulino, 1994
Shorrocks, A.F.: The Measurement of Mobility. Econometrica **46**, 1013–1024 (1978)
Sorokin, P.: Social Mobility, New The Free Press of Glencoe, Glencoe (1927)
Stiglitz, J. E., *The price of inequality: How today's divided society endangers our future*. WW Norton & Company, 2012
Thurow L., *Generating Inequality*, Macmillan London, 1976
Weiss, A., "Human Capital vs. Signalling Explanations of Wages", *The Journal of Economic Perspectives*, 9, 1995
White, M.: Against Unemployment. Policy Studies Institute, London (1991)