Occupational Mobility between Generations: a Theoretical Model with an Application to Italy

Irene Brunetti - Davide Fiaschi *

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Abstract

Family background, labour market and social prestige of occupations all determine children's socio-economic status. Our simple theoretical model describes how these factors affect occupational mobility.

The empirical application of the proposed model to a sample of Italian families describes Italy as a less mobile country, and in particular we show that occupational mobility decreases for children born between 1966 and 1976. This result is due to the worsening of opportunities, nonetheless the increase of incentives for children to change their occupational class in respect to that of their fathers. The estimate of three synthetic indexes confirms the decease of mobility.

Keywords: Occupational Mobility, Opportunities, Mobility Indexes.
JEL Classification Numbers: C01; C22; J60; J62

*Irene Brunetti, Department of Economics and Management, University of Pisa, e-mail: ireneb@ec.unipi.it; Davide Fiaschi, Department of Economics and Management, University of Pisa, e-mail: dfiaschi@ec.unipi.it.

1 Introduction

Intergenerational mobility refers to the correlation between parents and children's socio-economic status, and it has emerged as one the stylized fact both in economics and sociology. High correlation means low mobility, and, in general, low mobility is associated to higher inefficiency (most talented individuals are not allocated in the best positions) and higher injustice (initial positions and not individual efforts decide your welfare).

Socio-economic status is captured by different measures, the most common are social class, occupational status and income (see, e.g., Erikson and Goldthorpe (1992), Schizzerotto and Cobalti (1994), Checci et al. (1999), Solon (2002), Piraino (2007), Bjorklund and Jantti (2009), Franzini et al. (2013) and Corak (2013)). In this paper as the main proxy of socio-economic status we use the occupational status defined as the highest occupation got by parents and children[1]. This choice allows to take into account both several key aspects of background, i.e. individual position in the social scale, his or her prestige, relation capital and the capacity to influence important economic decisions, and the changes in the occupational structure (Prais (1955), Erikson and Goldthorpe (1992), Breen (2004), Granovetter (2005) and Long and Ferrie (2013)).

The measurement of occupational mobility is widely debated but less attention is dedicated to the identification of the main determinants of occupational mobility. In this paper we propose a simple theoretical model to identify these determinants and we provide an application to Italy.

In our analysis the occupational status of each individual is the result of the interaction between three different channels: the *incentives*, the *opportunities* and the *occupational structure*. The incentives are the set of characteristics of each occupational class which determines the individual will to move to a particular class. Dardanoni et al. (2006) discuss that all actions of the individual that affect his or her occupational status represent the *effort*, and the equality of opportunity holds if the occupational status of children depends only on their own efforts. Regarding the opportunities, they are factors reflecting both individual skills and family background, i.e. his or her native abilities, education, but also parents' education and social connection. Dardanoni et al. (2006) denote them as *circumstances*. The last channel that affect children's occupational status are the changes of the occupational structure, that is exogenous changes, related to circumstances, in the labour market that necessarily generate mobility (Prais (1955) and Bjorklund and Jantti (2000)).

In our theoretical model, considering an economy with only two occupational classes (*Work-*

[1]Bjorklund and Jantti (2000) summarize some of the relative merits of occupation for the measurement of intergenerational mobility, and discuss scenarios in which it provides very different results from those where intergenerational mobility is measured by income.

ing and Lower Middle and *Upper Middle Capitalist* class), we discuss how each determinant affects occupational mobility. We assume that occupational mobility can be described by a *Markov* matrix and we deduce three synthetic indexes to measure the overall occupational mobility, that propose by Shorrocks (1978), the opportunities, and the incentives for children to not change their occupational class respectively.

In literature the majority of the studies to measure mobility use an index, the intergenerational elasticity β, or the closely associated correlation coefficient (Bjorklund and Jantti (2009)). These indexes are synthetic measures of the correlation between socio-economic status of two subsequent generations. Therefore, they do not provide any information on the processes lying behind such correlations (Franzini et al. (2013)). The use of *Markov matrix* permits to overcome these limits. In fact, the value of *Markov matrix*, and then of the transition matrix, is that it offers a more detailed depiction of intergenerational mobility. It provides a picture of the movement of individuals among the specified occupational classes, and it can thus be quite telling at times. Moreover, transition matrix lets one develop easily interpretable mobility measures (see Shorrocks (1978) and Formby et al. (2004)).

From an empirical point of view, the model is estimated on occupational data available from the Survey on Household Income and Wealth (SHIW) carried on by the Bank of Italy. We partition the sample into three Cohorts on the base of year of birth of the head of household ($1947-56$, $1957-66$ and $1967-76$). We show that occupational mobility decreases over time, in particular occupational mobility is low for the youngest cohort, and the changes in the occupational structure seems to lead to an increase in the downward mobility. Finally the estimate of the parameters of the model suggests that the decrease of occupational mobility is due to the decrease of opportunities for the Working and Lower Middle class, nonetheless the increase of the incentives.

The paper is organized as follows. Section 2 presents the theoretical model for occupational mobility analysing the three determinants and discusses the synthetic mobility indexes. The empirical analysis on Italy is in Section 3. Section 4 concludes.

2 A Model of Occupational Mobility

In the following we propose a simple model of occupational choice to identify three crucial determinants of the occupational mobility of a society: i) the social prestige and/or income **incentives** to choose one occupation instead of another (see, e.g., Corak (2013)); ii) the different **opportunities** generally related to family background and socio-economic environment of individuals (see, e.g., Becker and Tomes (1979) and Cap. 3 in Corak (2004)); and, finally, iii) the **occupational structure**, i.e. the possibility of occupation given by the production side of economy (see, e.g., Prais (1955)).

Consider an economy with two classes of occupations denoted by the *Working and Lower Middle* (**WLM**) class, and the *Upper Middle and Capitalist* (**UMC**) class[2].

The life-time (indirect) utility of individual i, U_i, only depends on her occupation, i.e.:

$$U_i = \begin{cases} W_i, & \text{if individual belongs to WLM class;} \\ \Pi_i, & \text{if individual belongs to UMC class.} \end{cases} \tag{1}$$

Assume that life-time utility in each class has a stochastic component; in particular:

$$\log W_i \sim \mathcal{N}\left(\mu_{WLM}; \sigma^2_{WLM}\right); \tag{2}$$

$$\log \Pi_i \sim \mathcal{N}\left(2\theta_i \mu_{UMC}; \sigma^2_{UMC}\right), \tag{3}$$

where $\mathcal{N}(\cdot)$ is the Gaussian distribution, with $0 \leq \mu_{WLM} \leq \mu_{UMC}$, $\sigma^2_{WLM} \leq \sigma^2_{UMC}$, and $\theta_i \in [0, 1]$. θ_i is an idiosyncratic factor that reflects both individual skills and family background, i.e. her native abilities, education, but also parents' education and social connections (the "circumstances" in Dardanoni et al. (2006)).

An individual decides to belong to UMC class *if and only if*:

$$\mathbf{E}\left[\Pi_i\right] \geq \mathbf{E}\left[W_i\right] + \sigma^{RP}, \tag{4}$$

where σ^{RP} is the risk premium depending on the attitude towards risk of individual i. Assuming that individual i is risk-adverse or risk-neutral, $\sigma^{RP} \geq 0$, and not decreasing in $\sigma^2_{UMC}/\sigma^2_{WLM}$, Condition (4) becomes:

$$2\theta_i \mu_{UMC} \geq \mu_{WLM} + \sigma^{RP}\left(\frac{\sigma^2_{UMC}}{\sigma^2_{WLM}}\right) \Rightarrow \theta_i \geq \frac{\mu_{WLM} + \sigma^{RP}\left(\frac{\sigma^2_{UMC}}{\sigma^2_{WLM}}\right)}{2\mu_{UMC}} \equiv \lambda; \tag{5}$$

given θ_i λ is the threshold, which determines the **incentives** for individual i to move to class UMC (higher λ means *less* incentives to move to UMC class). θ_i is assumed to be known by individual i[3].

As regards the **opportunities** determined by family background and social environment of individual i, we assume that if her parents belong to WLM class, the probability distribution of θ_i is giving by:

$$f(\theta_i|WLM) \sim \mathcal{U}\left(0, \theta^{\max}\right), \tag{6}$$

[2] We limit the theoretical model only to two classes for simplicity reasons. The extension to more than two classes is straightforward from the theoretical point of view, but it does not add any additional insights of the phenomenon, and the increase in the model's parameters make the results of the empirical application less clear.

[3] This assumption on θ_i makes irrelevant to know the probability distribution of it.

where $\mathcal{U}(0, \theta^{\max})$ means a uniformly distributed random variable in the range $[0, \theta^{\max}]$, with $\theta^{\max} \leq 1$; otherwise if her parents belong to UMC class, the probability distribution of θ_i is giving by:

$$f(\theta_i|UMC) \sim \mathcal{U}\left(\theta^{\min}, 1\right), \tag{7}$$

with $\theta^{\min} \geq 0$.

Figure 1: **A Comparison between opportunities of individuals whose parents belong to different occupational classes.**

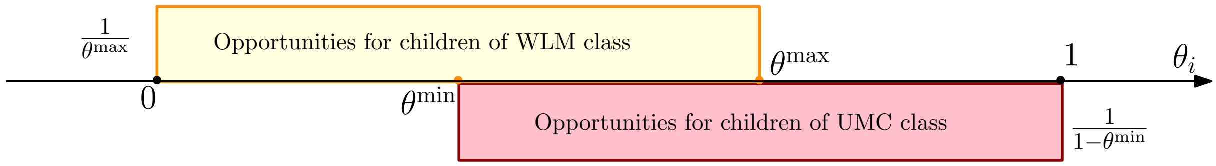

Figure 1 shows the different opportunities for individuals whose parents belong to different occupational classes. A higher $\theta^{\max}$ tends to favour a change in occupational class for individuals whose parents are in WLM class. The same applies with a lower $\theta^{\min}$ for individuals whose parents are in UMC class.

When $\theta^{\max} < \lambda$ and $\theta^{\min} > \lambda$ no changes in occupational classes should be observed. When $\theta^{\max} < \lambda$ and $\theta^{\min} < \lambda$, only individuals whose parents belong to UMC class change their class; hence in the long run all individuals will be doomed to belong to WLM class. The opposite happens when $\theta^{\max} > \lambda$ and $\theta^{\min} > \lambda$, with all individuals in the UMC class in the long run.

The condition to observe a change for both classes are therefore given by:

$$\theta^{\max} > \lambda; \tag{8}$$

and

$$\theta^{\min} < \lambda, \tag{9}$$

Under Assumptions (8) and (9) the occupational mobility of a society is completely described by the following *Markov matrix* $\mathbf{Q}$[4]:

Fathers\Children	WLM	UMC
WLM	$\dfrac{\lambda}{\theta^{\max}}$	$\dfrac{\theta^{\max} - \lambda}{\theta^{\max}}$
UMC	$\dfrac{\lambda - \theta^{\min}}{1 - \theta^{\min}}$	$\dfrac{1 - \lambda}{1 - \theta^{\min}}$

[4] $\dfrac{\lambda}{\theta^{\max}} > \dfrac{1 - \lambda}{1 - \theta^{\min}}$ guarantees that $\mathbf{Q}$ is a monotone Markov transition matrix (see Dardanoni (1995))

The first element in the main diagonal of $\mathbf{Q}$, $\lambda/\theta^{\max}$, represents the probability of a child with a father in WLM class to belong to WLM class given the probability distribution (6) and her incentives to belong to WLM class reported in Condition (5), i.e.:

$$\mathbf{Pr}\left[\theta_i \leq \lambda | WLM\right] = \frac{\lambda}{\theta^{\max}}. \tag{10}$$

Similarly the second element of the main diagonal of $\mathbf{Q}$, $(1-\lambda)/\left(1-\theta^{\min}\right)$, represents the probability of a child with a father in UMC class to belong to UMC class given the probability distribution (7) and her incentives to belong to UMC class reported in Condition (5).
The first out-of-diagonal element, $\left(\theta^{\max}-\lambda\right)/\theta^{\max}$, is given by:

$$\mathbf{Pr}\left[\theta_i > \lambda | WLM\right] = 1 - \mathbf{Pr}\left[\theta_i \leq \lambda | WLM\right] = 1 - \frac{\lambda}{\theta^{\max}} = \frac{\theta^{\max}-\lambda}{\theta^{\max}}. \tag{11}$$

Social mobility, measured by $\mathbf{Q}$, determines also the shares of individuals in the two classes in the long run. In particular, the equilibrium distribution implied by $\mathbf{Q}$ is given by[5]:

$$\pi_{\mathbf{Q}} = \left[\ \frac{1}{1+\gamma(\theta^{\min},\theta^{\max},\lambda)}, \frac{\gamma(\theta^{\min},\theta^{\max},\lambda)}{1+\gamma(\theta^{\min},\theta^{\max},\lambda)}\ \right]. \tag{12}$$

where

$$\gamma = \frac{(\theta^{\max}-\lambda)(1-\theta^{\min})}{\theta^{\max}(\lambda-\theta^{\min})}; \tag{13}$$

the first (second) element of $\pi_{\mathbf{Q}}$ represents the equilibrium probability masses of WLM (UMC) class. Higher $\theta^{\min}$ and/or $\theta^{\max}$ results in a lower equilibrium mass of WLM class ($\partial\gamma/\partial\theta^{\min} > 0$ and $\partial\gamma/\partial\theta^{\max} > 0$), while a higher λ leads to the opposite outcome, a higher equilibrium mass of WLM class ($\partial\gamma/\partial\lambda < 0$)[6].

[5] See Bartholomew (1973) for more details.

[6] To identify $\lambda, \theta^{\max}$ and $\theta^{\min}$ we have to solve the following system of three equations (notice that we have three parameters and three independent equation because the sum of the elements in each row is equal to one):

$$\begin{cases} \dfrac{\lambda}{\theta^{\max}} = q_{11} \\[2ex] \dfrac{1-\lambda}{1-\theta^{\min}} = q_{22} \\[2ex] \dfrac{(\theta^{\max}-\lambda)(1-\theta^{\min})}{\theta^{\max}(\lambda-\theta^{\min})} = \pi_1 \end{cases} \tag{14}$$

from which we get:

$$\theta^{min} = \frac{(1-q_{11})\pi_1 - (1-q_{22})\pi_2}{q_{22}\pi_2 - \pi_1 q_{11}}, \qquad \theta^{\max} = (q_{11}\theta^{\min} + 1 + q_{11})\frac{\pi_1}{(1-\pi_1)q_{11}} \qquad and \qquad \lambda = q_{11}\theta^{\max}. \tag{15}$$

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2.1 A Measure of Occupational Mobility

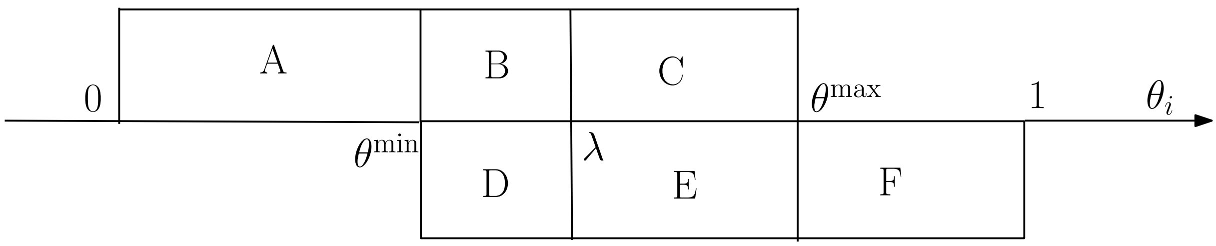
Heuristically the complement to 2 of the trace of $\mathbf{Q}$ defines a measure of occupational mobility (a lower trace corresponding to a higher mobility)[7]. Under Assumptions (8) and (9) we have:

$$I_S = 2 - \mathrm{tr}(\mathbf{Q}) = 2 - \frac{\lambda(1-\theta^{\min}-\theta^{\max})+\theta^{\max}}{\theta^{\max}(1-\theta^{\min})}; \tag{16}$$

where $I_S \in [0,2]$ (0 minimum social mobility, and 2 maximum). As expected $\partial I_S/\partial\theta^{\max} > 0$ and $\partial I_S/\partial\theta^{\min} < 0$, i.e. occupational mobility increases with $\theta^{\max}$ and decreases with $\theta^{\min}$.

Instead occupational mobility has an ambiguous relationship with λ. Higher λ means less (upward) mobility for WLM children and higher (downward) mobility for UMC children. Under the condition $\theta^{\min}+\theta^{\max} < 1$ the first effect prevails on the second and I_S decreases with λ. This should be the most plausible case because this would mean that the less upward mobility of lower social occupational class WLM more than compensate the higher downward mobility of higher social occupational class UMC (this is the case for Italy, see Section 3). Under the Assumptions (8) and (9) the occupational mobility can be decomposed into two components, the first related to incentives, and the second to opportunities.

Figure 2: **Disentangle the occupational mobility due to incentives and opportunities.**



In Figure 2 I_S is measured by area (C+D)[8]. Area (B+C) measures the probability to move upward for children with parents in WLM class independent of incentives (i.e. the level of λ). Likewise Area (D+E) measures the probability to move downward. Area (B+C+D+E) can therefore proxy for the socio-economic opportunities of individuals, that is:

$$I_{OPP} = 2 - \frac{\theta^{\min}(1-\theta^{\min})+\theta^{\max}(1-\theta^{\max})}{\theta^{\max}(1-\theta^{\min})}. \tag{17}$$

I_{OPP} reaches the highest value equal to 2 for $\theta^{\min}=0$ and $\theta^{\max}=1$.

[7] A simple intuition of I_S is to see it as the sum of the out of diagonal element of $\mathbf{Q}$.

[8] Area C is equal to $\left(1-\frac{\lambda}{\theta^{\max}}\right)$, while area D is equal to $\left(1-\frac{1-\lambda}{1-\theta^{\min}}\right)$.

The difference $I_{INC} \equiv I_{OPP} - I_S$, i.e. area (B+E) in Figure 2, measures the incentives for children to **not** change their occupational class with respect their parents; in particular

$$I_{INC} = \frac{\lambda - \theta^{\min}}{\theta^{\max}} + \frac{\theta^{\max} - \lambda}{1 - \theta^{\min}}; \tag{18}$$

I_{INC} is in the range $[0, 1)$. Eqs.(16)-(18) therefore allows to disentangle the part of occupational mobility due to incentives and to opportunities.

2.2 Three Types of Societies

In this section we discuss three extreme types of Markov matrix, $\mathbf{Q}$, corresponding to three extreme cases of society.

1 *Perfect Mobile Society* (see Prais (1955)): the probability of entering a particular class is independent of the class of one's parents. In our model this means $\theta^{\min} = 0$ and $\theta^{\max} = 1$, from which:

$$\mathbf{Q_{PMS}} = \begin{bmatrix} \lambda & 1-\lambda \\ \lambda & 1-\lambda \end{bmatrix}, \tag{19}$$

and

$$\pi_{\mathbf{Q_{PMS}}} = \left[\ \lambda, 1-\lambda\ \right]. \tag{20}$$

It is worth noting that *Perfect Mobile Society* does not imply the symmetric mobility between classes; with $\lambda = 1/2$

$$\mathbf{Q_{PMS}} = \begin{bmatrix} 1/2 & 1/2 \\ 1/2 & 1/2 \end{bmatrix}, \tag{21}$$

while with $\lambda = 0$

$$\mathbf{Q_{PMS}} = \begin{bmatrix} 0 & 1 \\ 0 & 1 \end{bmatrix}; \tag{22}$$

however Q_{PMS} reported in (21) shows both downward and upward mobility, while Q_{PMS} reported in (22) just upward mobility (notice that $I_S = 1$ for both Q_{PMS}).
Accordingly in a *Perfect Mobile Society* $I_{OPP} = 2$ and $I_{INC} = 1$. A comparison between Q_{PMS} in (21) and (22) highlights how between socio-economic mobility and social welfare there is not a perfect correspondence: Q_{PMS} in (21) appears to be Pareto-dominated by Q_{PMS} in (22) since the second one has the same mobility, but all individuals are in UMC class in the equilibrium distribution.

2 *Perfect Immobile Society*: no movements between classes take place. In our model this means $\theta^{\min} > \lambda$ and $\theta^{\max} < \lambda$:

$$\mathbf{Q_{PIS}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}. \tag{23}$$

In this case $I_S = 0$ and $I_{OPP} = I_{INC} = 0$ by definition.

3 *Ex-Post-Minimum Inequality Society*: class WLM is the absorbing class in the equilibrium distribution. In our model this means $\theta^{\min} < \lambda$ and $\theta^{\max} < \lambda$, from which:

$$\mathbf{Q_{EPMIS}} = \begin{bmatrix} 1 & 0 \\ \dfrac{\lambda - \theta^{\min}}{1 - \theta^{\min}} & \dfrac{1 - \lambda}{1 - \theta^{\min}} \end{bmatrix}, \tag{24}$$

with

$$\pi_{\mathbf{Q_{EPMIS}}} = \begin{bmatrix} 1, 0 \end{bmatrix}. \tag{25}$$

Since $I_S = 1 - \dfrac{1 - \lambda}{1 - \theta^{\min}}$ we observe that a decrease in λ leads to an increase in mobility but ex-post inequality is the same. We refer to this case as *Ex-Post-Minimum Inequality Society* because all observations in the long-run will be concentrated in the WLM class characterized by minimum variance. If $\theta^{\min} > \lambda$ and $\theta^{\max} > \lambda$, from which:

$$\mathbf{Q} = \begin{bmatrix} \dfrac{\lambda}{\theta^{\max}} & \dfrac{\theta^{\max} - \lambda}{\theta^{\max}} \\ 0 & 1 \end{bmatrix}, \tag{26}$$

with

$$\pi_{\mathbf{Q}} = \begin{bmatrix} 0, 1 \end{bmatrix}. \tag{27}$$

with $I_S = 1 - \dfrac{\lambda}{\theta^{\max}}$. We can not refer to this case as *Ex-Post-Minimum Inequality Society* since UMC class, where all observations will be concentrated in the long-run, shows higher variance and then a higher level of inequality.

2.3 A Decomposition of the Observed Occupational Mobility

Prais (1955) discusses how the observed occupational mobility can be traces to two types of forces related to i) **occupational mobility** due to the choices of individuals (Prais denotes it as "true" occupational mobility); and ii) the occupational mobility due to **occupational shifts**, changes in the occupational structure caused both by changes in the supply side and in differences in the reproduction rates within each occupational class. Prais (1955) assumes that *observed* transition matrix $\mathbf{P}$ is the result of the product of two Markov transition matrices $\mathbf{Q}^\top$ representing the true occupational mobility, and $\mathbf{R}^\top$ representing the occupational shifts.

Given the choices of individuals and the shares of observations at period t, $s_{t+1}^{UN} = \mathbf{Q}^\top s_t$ would be the vectors of allocations of individuals to each occupational class if there were not any constraints from the supply side of economy or different reproduction rates in each classes. The observed vector at period $t+1$ is generally different from s_{t+1}^{UN}. $\mathbf{R}$ reflects these possible differences due to occupational shifts, i.e.:

$$s_{t+1} = \mathbf{R}^\top s_{t+1}^{UN} = \mathbf{R}^\top \mathbf{Q}^\top s_t = \mathbf{P}^\top s_t \tag{28}$$

In particular in our framework with just two classes:

$$\mathbf{R}^\top = \begin{bmatrix} r_{11} & r_{21} \\ r_{12} & r_{22} \end{bmatrix}; \tag{29}$$

where r_{11} can be meant as the probability for individual i, who would aim to belong to WLM class, to be in WLM class; r_{21} is the probability for individual i, who would aim to belong to UMC class, to belong to WLM class because of the occupational structure; r_{12} is the probability for individual i, who would aim to belong to WLM class, to belong to UMC class, and r_{22} is the probability for individual i, who would aim to belong to UMC class, to be in that class.
We observe two extreme situations:

1 *No occupational shifts* happened, i.e. $s_{t+1,WLM} = s_{t,WLM}$ and $s_{t+1,UMC} = s_{t,UMC}$; then:

$$\mathbf{R_{NOS}} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}; \tag{30}$$

where no constraints are present in the individual choices.

2 *Maximum occupational shifts* happened, then:

$$\mathbf{R_{MOS}} = \begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}; \tag{31}$$

where maximum constraints are present in the individual choices.

In general we observe $\mathbf{P}$, then to estimate $\mathbf{Q}$ from $\mathbf{P}$ we need $\mathbf{R}$, and the estimate of $\mathbf{R}$ is possible only imposing some identifying assumptions. Prais (1955) follows a criterion of *minimum* occupational mobility to identify $\mathbf{R}$: he proposes an algorithm starting from the first class of fathers, and *sequentially* arriving to the top one, which allocates children in each class minimizing the changes between occupational classes with respect to their fathers class[9]. We instead estimate $\mathbf{R}$ under the criterion of the *jointly minimum* occupational mobility, measured by the opposite of the trace of $\mathbf{R}$, subject to the observed occupational shifts, i.e.:

$$\max_{\mathbf{R}} \quad \mathrm{tr}(\mathbf{R}) \qquad \text{subject to} \begin{cases} s_{t+1} = \mathbf{R}^\top s_t, \\ \sum_{j=1}^{k} r_{ij} = 1 & \forall i = 1...k, \\ r_{ij} \geq 0 & \forall ij \end{cases} \tag{32}$$

Therefore we assume that individuals are able to realise their optimal choice conditioned to the occupational structure. In addition to the situation where no occupational shifts happened we have two other solutions to Problem 32:

3 *Occupational shifts* happened in favour of WLM class, i.e. $s_{t+1,WLM} > s_{t,WLM}$ and $s_{t+1,UMC} < s_{t,UMC}$; then:

$$\mathbf{R}^*_{\mathbf{WLM}} = \begin{bmatrix} 1 & 0 \\ \dfrac{s_{t,UMC} - s_{t+1,UMC}}{s_{t,UMC}} & \dfrac{s_{t+1,UMC}}{s_{t,UMC}} \end{bmatrix}; \tag{33}$$

where some individuals choosing UMC class are constrained to belong to WLM class.

4 *Occupational shifts* happened in favour of UMC class, i.e. $s_{t+1,WLM} < s_{t,WLM}$ and $s_{t+1,UMC} > s_{t,UMC}$; then:

$$\mathbf{R}^*_{\mathbf{UMC}} = \begin{bmatrix} \dfrac{s_{t+1,WLM}}{s_{t,WLM}} & \dfrac{s_{t,WLM} - s_{t+1,WLM}}{s_{t,WLM}} \\ 0 & 1 \end{bmatrix}; \tag{34}$$

where some individuals choosing WLM class are constrained to belong to UMC class.

3 An Estimate of Occupational Mobility in Italy

Now we estimate the theoretical model presented in Section 2 and the indexes of mobility for a sample of heads of household born in the period 1947 – 1976. In particular we partition the sample into three cohorts on the base of the year of birth: the first cohort includes those heads of household born in the period 1947 – 1956 (Cohort I), the second one those born between 1957 and 1966 (Cohort II) and the third one those born between 1967 and 1976 (Cohort III).

Section 3.1 describes the dataset in more details, and Section 3.2 contains the estimates.

[9] See Appendix A for a numerical example.

3.1 The Dataset

The dataset is build from a a nationally representative household survey carried on by the Bank of Italy, the *"Survey on Household Income and Wealth"* (*SHIW*).

In particular we consider the last eight waves conducted in the period 1998-2012, selecting all heads of household aged from 22 up to 65 (i.e born between 1947 and 1976). We focus on these waves because all heads of household are asked to recall some characteristics of their parents, among which year of birth and occupational status, indicatively referred to the same current age of the respondent[10]. Following the standard approach in literature we measure occupational mobility comparing occupational status of children and their fathers (see, Checchi (1997) and Piraino (2007)). We removed those heads of household not giving informations on their fathers and the repeated observations due to longitudinal component (panel) present in the waves (about 30% of households persists from a wave and the next one). We get a sample of 11,807 observations divided into 4,015 in Cohort I, 4,848 in Cohort II and 2,944 in Cohort III.

3.2 The Estimate of Italian Occupational Mobility

In accordance to the theoretical model we define two occupational classes: the *Working* and *Lower Middle* (**WLM**) class and the *Upper Middle* and *Capitalist* (**UMC**) class. Following a large sociological literature we rank occupational classes according to their social prestige, such as the Hope-Goldthorpe scale (see, e.g., Goldthorpe and Hope (1974), and more recently Cap.12 in Giddens and Sutton (2013)). Hope-Goldthorpe scale mainly reflects the average income paid by each occupation, but a number of other social criteria enter into its construction (see Giddens and Sutton (2013) for more details).

The eight socio-economic classes of Hope-Goldthorpe scale are pooled into WLM class which includes blue-collars, clericals and teachers; and UMC class which consists of managers, member of profession, entrepreneurs and self-employment workers (see Cap.12 in Giddens and Sutton (2013))[11]. According to the nine ISCO classes, for both children and fathers, our two occupational classes correspond respectively to: the first class (WLM) includes ISCO categories from 3 to 7 excepted the 6 category; the second class (UMC) concerns ISCO categories from 1 to 2

[10] Asking to the respondent the occupational status of his or her parents at the same current age we control for the life cycle component.

[11] In the questionnaire of Bank of Italy for children we refer to card B01: the first occupational class corresponds to the answers 1 2, 3 and 12 (Blue-collar, Office worker, Teacher and Unemployed), the second class corresponds to the answers 4, 5, 6, 7 and 8 (Junior and senior Middle Manager/Official/School Head and Magistrate, Member of Professions, Small Employer and Own Account Worker). As regards fathers we refer to card A25 with the same classification.

and the 6^{th} [12].

Table 1 contains the estimate of **P** (the *observed* total mobility), **R** and **Q** matrices for each cohort. The overall persistence in occupational status between generations, estimated by **P**, increased for WLM class and decreased for UMC class (from Cohort I to Cohort III the probability to remain in WLM class increased from 0.74 to 0.86, while the probability to remain in UMC class decreased from 0.48 to 0.37)[13]. Accordingly the probability to move upward decreased from Cohort I to Cohort III (the probability to move upward fom WLM class decreases from 0.26 to 0.14), while the probability to move downward increased from 0.52 to 0.63[14]. The high persistence in the first class is also found by Pisati (2000) and Di Pietro and Urwin (2003) even if our estimates give a even worse picture of this phenomenon (0.85 vs 0.51 in Pisati (2000)). This higher persistence is mainly due to our inclusion in WLM class of blue-collar and office workers.

Looking at **Q** we observe that, also in this case, Cohort I and II are similar, but Cohort III shows an increase of the persistence for WLM class. The comparison between **P** and **Q** highlights that occupational shifts played a role only for Cohort III. In particular the *true* persistence in UMC class is higher (0.37 vs 0.45), and at the same time, the probability to move downward is lower (0.55 vs 0.63). This result is due to the shifts in the occupational structure stressed by **R** ($r_{22} << 1$). In particular, for Cohort I **R** shows a small upward bias for children whose fathers are in WLM class suggesting that some of them are constrained to move towards to the upper class (0.02%); for Cohort II holds the opposite, children whose fathers are in UMC class are constrained to move downward. For Cohort III the constraint to mobility employed by occupational structure is more evident: 0.24% of children with a father in UMC class are obliged to move downward. Therefore the occupational shifts lead to an increase in the downward mobility for the youngest cohort.

Table 2 reports the estimate of the parameters of the theoretical model presented in Section 2. From Cohort I to Cohort III $\hat{\lambda}$ increases (0.52 vs 0.56) suggesting less incentives for an individual in WLM class to move to UMC class, and higher incentives for an individual in UMC class to access to WLM class. From Cohort I to Cohort III both $\theta^{\min}$ and $\theta^{\max}$ decreases showing that increases the opportunities for UMC individuals to move downward and decreases the opportunities to move upward for WLM individuals.

[12] Franzini et al. (2013) develop an analysis of occupational mobility using three categories using the ISCO classes: managers, classes from 1 to 2, white-collars, classes from 3 to 5, and blue-collars, classes from 6 to 9

[13] We can reject the null hypothesis of equality between all these transition probabilities at the usual confidence level of 5%.

[14] We can reject the null hypothesis of equality between all these transition probabilities at the usual confidence level of 5%.

As expected $\theta^{\min} + \theta^{\max} < 1$ for all cohorts implying that I_S is decreasing in λ (remind that higher λ means less incentives to upward mobility for children with WLM parents). Moreover from Cohort I to Cohort III I_{OPP} decreases confirming the reduction of opportunities to change occupational class, and, finally, I_{INC} increases highlighting an increase of the incentives for children to remain in the same class of their fathers[15].

Table 1: **Estimate of Markov matrices of socio-economic mobility for Cohort I, II and III ($1947-56$, $1957-66$ and $1967-76$).**

	P				**R**				**Q**		
Cohort I	**WLM**	**UMC**	**N.Obs**	**Cohort I**	**WLM**	**UMC**	**N.Obs**	**Cohort I**	**WLM**	**UMC**	**N.Obs**
WLM	0.74	0.26	2742	**WLM**	0.98	0.02	2742	**WLM**	0.74	0.26	2742
UMC	0.52	0.48	1273	**UMC**	0	1	1273	**UMC**	0.52	0.48	1273
N.Obs	2713	1302	4015	**N.Obs**	2713	1302	4015	**N.Obs**	2713	1302	4015
Cohort II	**WLM**	**UMC**	**N.Obs**	**Cohort II**	**WLM**	**UMC**	**N.Obs**	**Cohort II**	**WLM**	**UMC**	**N.Obs**
WLM	0.77	0.23	3406	**WLM**	1	0	3406	**WLM**	0.77	0.23	3406
UMC	0.55	0.45	1442	**UMC**	0.02	0.98	1442	**UMC**	0.55	0.45	1442
N.Obs	3435	1413	4848	**N.Obs**	3435	1413	4848	**N.Obs**	3435	1413	4848
Cohort III	**WLM**	**UMC**	**N.Obs**	**Cohort III**	**WLM**	**UMC**	**N.Obs**	**Cohort III**	**WLM**	**UMC**	**N.Obs**
WLM	0.86	0.14	2112	**WLM**	1	0	2112	**WLM**	0.85	0.15	2112
UMC	0.63	0.37	832	**UMC**	0.24	0.76	832	**UMC**	0.55	0.45	832
N.Obs	2308	636	2944	**N.Obs**	2308	636	2944	**N.Obs**	2308	636	2944

Notes: Columns 2-4 report the estimate of **P**; columns 6-8 report the estimate of **R**; and columns 10-12 report the estimate of **Q** respectively.

Source: Our calculations based on SHIW (Bank of Italy).

Table 2: **Estimate of λ, $\theta^{\min}$, $\theta^{\max}$, I_S, I_{OPP} and I_{INC}.**

Cohort	$\hat{\lambda}$	$\hat{\theta}^{\min}$	$\hat{\theta}^{\max}$	I_S	I_{OPP}	I_{NIC}
I	**0.52** (0.013)	**0.010** (0.001)	**0.70** (0.02)	**0.78** (0.01)	*1.68* (0.02)	**0.90** (0.04)
II	0.55 (0.013)	0.008 (0.002)	0.71 (0.019)	0.78 (0.003)	1.71 (0.005)	0.93 (0.002)
III	**0.56** (0.03)	**0.001** (0.003)	**0.67** (0.003)	**0.72** (0.01)	**1.67** (0.006)	**0.95** (0.004)

Notes: Standard errors are reported in parenthesis; they are computed via a bootstrap procedure with 1000 bootstraps (see Efron and Tibshirani (1993)).

[15] We can reject the null hypothesis of equality between the two values of each parameter at the usual confidence level of 5%.

4 Concluding Remarks

In this paper we propose a simple theoretical model to identify the main determinants of occupational mobility. We also provide an application to Italy using data from the Survey on Household Income and Wealth (SHIW) for the period $1979-2008$.

The theoretical model identifies three main determinants: the **incentives**, a set of characteristics of each occupational class which induces the individual will to move to a particular class (its social prestige and/or income), the **opportunities** related to his or her native abilities, education, family background and to the socio-economic environment, and the **c** in the *occupational structure*, exogenous factors related to the supply side of the labour market. The latter represents a constraint to the individual choice to change own occupational class.

The application to our sample describes Italy as a less mobile society in particular occupational mobility decreases for individuals born between $1967-1976$. The estimate of the model's parameters suggests that the decrease of mobility is mainly due to the decrease of opportunities for children with a father in the Working and Lower Middle class, nonetheless the increase of incentives to change own occupational class.

Future research should be take into account the possibility to assume that θ_i, the parameter measuring the opportunities, is not known by individual i. Individual has only beliefs on θ_i depending on the socio-economic status of the past generations and also on the genetic transmission of abilities.

Another important extension of the analysis should be try to obtain a theoretical relationship between inequality (measured by the variance of the life-time utility) and intergenerational mobility (measured by I_S), a relationship that has been called "Great Gatsby Curve" (see Krueger (2012) and Corak (2013)).

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A The Numerical Example for the Decomposition of Observed Occupational Mobility.

To identify $\mathbf{R}$ (and therefore $\mathbf{Q}$) we can make different assumption on the allocation of children on each occupational class. We follow the criterion of *minimum occupational mobility* as in Prais (1955), but we measured it in terms of the trace of the $\mathbf{R}$ matrix. Consider for example the following Markov and transition matrices:

$$\mathbf{M} = \left[\begin{array}{ccc|c} 15 & 33 & 35 & 83 \\ 33 & 55 & 17 & 105 \\ 58 & 0 & 54 & 112 \\ \hline 106 & 88 & 106 & 300 \end{array}\right] \qquad \mathbf{P} = \left[\begin{array}{ccc|c} 0.18 & 0.40 & 0.42 & 83 \\ 0.32 & 0.52 & 0.16 & 105 \\ 0.52 & 0 & 0.48 & 112 \\ \hline 106 & 88 & 106 & 300 \end{array}\right]$$

The actual distribution of fathers (s_t) is written in the extreme right-hand column and the distribution of children (s_{t+1}) is written down in the bottom row.
Tables below show the two approaches (Prais and ours respectively) to obtain the matrix representing the changes of the occupational structure:

$$\mathbf{C}^{\mathbf{PRAIS}} = \left[\begin{array}{ccc|c} 83 & 0 & 0 & 83 \\ 23 & 82 & 0 & 105 \\ 0 & 6 & 106 & 112 \\ \hline 106 & 88 & 106 & 300 \end{array}\right] \qquad \mathbf{C}^{\mathbf{OURS}} = \left[\begin{array}{ccc|c} 83 & 0 & 0 & 83 \\ 11 & 88 & 6 & 105 \\ 12 & 0 & 100 & 112 \\ \hline 106 & 88 & 106 & 300 \end{array}\right]$$

The matrix $\mathbf{R}$ is than derived by dividing each row by the sum of the element in it, i.e.:

$$\mathbf{R}^{\mathbf{PRAIS}} = \begin{bmatrix} 1 & 0 & 0 \\ 0.22 & 0.78 & 0 \\ 0 & 0.05 & 0.95 \end{bmatrix} \qquad \mathbf{R}^{\mathbf{OURS}} = \begin{bmatrix} 1 & 0 & 0 \\ 0.10 & 0.84 & 0.06 \\ 0.11 & 0 & 0.89 \end{bmatrix}$$

We interpret $\mathbf{R}$ as the matrix of the constraints to individual occupational choice deriving from the occupational structure. Prais (1955) assumes that, if a child can not remain in the same class of her father, she moves downward in a lower occupational class with respect to that of her father. Unlike Prais, we assume that, if the occupational structure limits individual choices, then individual can move both downward and upward but minimizing the overall mobility.