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# Process of accumulation of Italian human capital

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ABSTRACT

Human capital (HC), from the economical point of view, is defined as a stock variable that represents the capacity of an individual generated by investment in education and work experience to produce a sustained flow of income throughout the life span.

The proposed approaches that consider HC as unidimensional latent variable are recent and start from the economic theory specified in Dagum's recursive model [Dagum, C., 1994. Human capital, income and wealth distribution models and their applications to the USA. In: Proceedings of the American Statistical Association, pp. 253–258] which purports to explain the determination and the distribution of income, wealth, debt and HC.

The aim of the present article is to generalize the previous approaches to the case of human capital conceived as a latent variable, composed by two main dimensions (Education HC and Work experience HC), underlying the process of determination of earned and capital income. The model is applied to the estimate of Italian household human capital in 2000 and compared with the US household human capital.



## 1. Human capital specified in age-earning profiles

The concept of human capital is very old; it was formally introduced and quantified by Petty (1690) and Cantillon (1755) and conceptually analyzed by Smith (1776).

Human capital (HC), also called human resources, is a concept that refers to the productive capacity of an individual (household, nation) as determined by indicators such as years of schooling, formal postschool training, ability, driving force, health, and socioeconomic and home environment.

Over the last 50 years, the concept of HC has been systematically developed in a broad swath of the human capital literature (School of Chicago, Becker, 1964). Particularly noteworthy are the pioneering efforts of Theodore Schultz, Jacob Mincer and Gary Becker to analyze earnings functions, summarized in Eq. (1).

Eq. (1), defined in various ways (*age-earning profile*, *human capital production function* or *Mincerian wage equation*), specifies that the investments in schooling $s_i$ (usually in units of years completed) and in work experience or on-the-job training, furthering job skills and acquiring job-related information ($j_i$), determine, for the $i$th economic unity, the level and distribution of the life cycle earnings ($y_i$), controlling for a set of other variables ($Z_i$), plus a random disturbance ($u_i$):

$$y_i = f(s_i, j_i, Z_i) + u_i \tag{1}$$

Nevertheless, model (1), where human capital coincides with schooling and work experience, is based on unrealistic assumptions. Firstly, the model assumes that ability, acquired by the worker through education and on-the-job formation, which influence his productivity, constitutes an homogeneous stock of human capital (independent by the kind of job and by

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employers ability), secondly, it assumes that every worker possesses the same internal rate of return of education and, third, that everyone invests the same fraction of their capability to earn in formation.

Various contributions in literature, starting from Griliches (1977), have discussed several problems affecting the estimates of the basic Mincerian wage equation, in particular the ability omission and selectivity bias. Many authors believe that, in Mincerian equation, the ability, having an important impact on productive potential and therefore earnings, is not perfectly described by the specified covariates. Several empirical investigations indicate that there exists indeed such a problem. The return of schooling appears to be underestimated because of this omitted variable bias (Blackburn and Neumark, 1993, 1995). Many authors (among others Griliches, 1977; Chamberlain and Griliches, 1975; Willis, 1986; Card, 1994) consider, under different hypothesis and with different methods, the ability component. What seems to emerge from the comparison of methodologies and results is that the proxy variables used to explain the omitted components, are often disputable. To resolve the difficulties caused by unobserved characteristics many authors propose instrumental-variable (IV) estimation which includes additional variables (instruments) that affect the years of schooling, but are not correlated with omitted determinants of wages.

Considering the second aspect, because individuals can choose for a particular level of education on their own and that this choice will depend, among other things, on the wage they expect to earn on the labour market, this aspect poses a problem of endogeneity of the schooling in the Mincerian equation. Because typically schooling and thus the economic success is affected by unobservable characteristics of individuals, such as ability, motivation or familial background reflecting non-cognitive skills (Heckman et al., 2003), Eq. (1) suffers of schooling endogeneity, typically affected by omitted variable bias. The same arguments apply also to the correlation between work experience and wages, likely to be due to latent, unrecorded individual characteristics (attitude towards job searching, employability). This problem of self-selectivity, leading to an underestimate of the rate of return of education if estimated by OLS, has been the object of research in many empirical contributions to the literature (Willis and Rosen, 1979; Garen, 1984; Harmon and Walker, 1995; Heckman et al., 1998). Two alternative estimation techniques are proposed to overcome the problem of endogeneity of schooling and labour market participation: the instrumental variables estimation technique or the simultaneous equations which model both wages and years of schooling (and labour participation) as endogenous variables. Heckman (1979) provides the archetype two-step estimation technique for this type of model; Heckman two steps estimation procedure consists in a Probit analysis to estimate participating equation by means of a set of covariates on the first step and an OLS to estimate the Mincerian equation on the second step, inserting among covariates a proxy variable for the probability of participation. In other applications, the procedure *à la Heckman* has been applied to eliminate any sample selection bias in the identification of unobserved factors that simultaneously influence sector choice and earning incomes (Glewwe, 1996; Heckman and Sedlacek, 1985).

Finally, other authors note that classical estimation methods such as linear models or Path Analysis, presuming that exogenous variables are non-stochastic and measured without error, yield underestimated parameters – e.g., the rate of return of education in Eq. (1) – making it preferable to use methodologies that keep track of the latent nature of human capital (Griliches, 1977).

### 1.1. Human capital as a unidimensional latent variable

Although most basic theories considers human capital to be generated by education and labour market experience, nevertheless, Human capital is frequently discussed, but poorly measured. A great part of existing literature *de facto* uses education, especially years of schooling, work experience, as proxies for the underlying human capital. Also previous cited authors, however, did not engage in any quantitative estimation of it. Heckman, for example, models the human capital production function as part of a standard income maximization problem, identifying the length of the schooling period as a measure of the quantity of human capital. The fact that the amount of schooling and work experience should be considered as endogenous variables affected by many factors (also unobservable) which together make up human capital is consistent with the consideration that only one variable cannot adequately describes the personal human capital.

Instead, HC should be considered as a complex, multifaceted concept with various intangible dimensions that are not directly observable and that cannot be measured with precision by a single attribute, a set of attributes, or their combined sum (Le et al., 2003).

In the "Encyclopedia of Statistical Sciences", Human capital is defined "as a stock latent (i.e. non-observable) variable that represents the capacity of an individual (household, nation) to generate a sustained flow of earned income" (Dagum, 2004).

The present article characterises human capital as a latent variable whose distribution has to be estimated at disaggregated micro unit level, departing from existing literature which uses observable indicators as proxies for the unobservable human capital.

Other approaches, although if they neglect its latent nature, have been proposed with the aim of a quantitative estimation of HC: the prospective methods (Petty, 1690; Farr, 1853; Dublin and Lotka, 1930; Jorgenson and Fraumeni, 1989) or retrospective (Cantillon, 1755; Engel, 1883; Kendrick, 1976; Eisner, 1985). The income-based approach (prospective method) measures the stock of human capital by summing the total discounted values of all the future income streams that all individuals belonging to the population in question expect to earn throughout their lifetime, whereas the retrospective approach deals with costs of production. However, the former ignores the amount of investment in education, job training or health and the latter ignores the effects of the investment in HC on earned income. Recognising that no single approach to measuring