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Human Capital and Poverty: A Theoretical Modeling of the Transmission Channels of the Link

Abotome B. Roger[1] , Koto P. Bien-Aimé[2] & Liwono M. Dickens[3]

[1]Faculty of Economics and Management, University of Bas-Uele

[1]Department of Economics, University of Kinshasa,

[1]Department of Economics, University of Kinshasa,

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Abstract

Drawing inspiration from human capital theories and hypotheses emerging from work in the economics of education and health, the objective of this article is to show, through theoretical microeconomic modelling, the transmission channels of the link between human capital and poverty. The mathematical formalization thus applied has made it possible to establish the relationships between human capital and poverty by emphasizing in particular the mechanisms underlying the relationships linking the two. To this end, this study paves the way for empirical evaluation.

Keywords: Human capital, Poverty, Education, Health.

1. Introduction

The economic literature emphasizes that the seminal research of Schultz (1961) and Becker (1964) on the concept of human capital gave rise to several works and lines of research, particularly empirical. While from a largely theoretical perspective, health and education have been shown to be important components of human capital (Kamala et al, 2017; Zamo-Akono, 2007); education has been and remains the most analyzed component. Taking health or some of its dimensions into account dates only from the end of the 1950s, with the pioneering work of Winslow in 1951 (Audibert, 2006) and Leibenstein (1957). In order to verify the theoretical predictions in relation to the benefits of said capital, Empirical work has focused much more on the effect of human capital on productivity, measured directly or through wages, thereby limiting the analysis to returns expressed by the market. However, well-being being associated with many more parameters than salary, such confinement would have many limits. It does not, for example, make it possible to determine at what level human capital would be correlated with the status of poor or its change over time (Kamala, 2013).

Indeed, while the supposed relationship between human capital and poverty is relevant to know, it remains complex to establish because of the difficulty in defining the meaning of causality; the latter resulting, itself, from the insufficiency of information necessary to the determination of the mechanisms which are underlying it.

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The link between human capital and poverty has long been considered through the prism of growth theory. However, two main elements justified a change of direction towards a direct analysis of the said link (Kamala, 2013). First, the virtuous effect of human capital as an unconditional engine of economic growth quickly aroused strong controversy among economists. If the latter are unanimous on the importance of human investment, they are not so on the extent of its effect on growth and on the direction of causality between the two (Pritchett, 2001; Benhabib and Spiegel, 1994; Knowles and Owen, 1995; Bills and Klenow, 2001). Second, growth has many sources (Barro and Sala-I-Martin, 2004) and these affect the poor differently; consequently, its ultimate impact on the poor is quite different depending on its main source (Thurlow and Wobst, 2006 and Loayza and Raddatz, 2006).
Thus, if we cannot decide on the effect of human capital on growth, we cannot predict its effect on poverty. Moreover, as an aggregate phenomenon, the process of economic growth pushes some households into poverty at the same time as it pushes others out of poverty. Therefore, even in an environment characterized by sustainable growth, not all the population benefits equally (Woolard and Klasen, 2005; Jalan and Ravallion, 2002; Balisacan et al, 2003). Only individuals or households with a certain number of characteristics, observed or not, take better advantage of the benefit generated by growth.

The objective of this article is to present, through the use of microeconomic modeling, the different transmission channels of the supposed theoretical link between human capital and poverty. The rest of the study is presented as follows: in the second point, we proceed to the conceptual and theoretical tracing of the notion of human capital, highlighting its variants and characteristics. In the third point, it is a question of implementing the modeling of the link between these two components and finally the fourth point concludes the study.

2. Human capital: concept, variants and characteristics

All of an individual's productive capacities and aptitudes constitute his human capital (Becker, 1964). This includes an innate part and another acquired from activities that take the form of investment and that are recognized in the literature as human investments (Greffe et al, 2002). Although being a capital like other forms of capital, because it can improve or depreciate over time in addition to lasting a long time like a machine, human capital is a particular good. Indeed, it is on the one hand intrinsically linked to an individual and, on the other hand, it influences both the wealth and the well-being of the person who holds it (Schultz, 1961). Thus, as globally perceived, human capital comprises three components:

- **Education and training in the broad sense**: this component integrates formal education, vocational training, informal education acquired within the family during early childhood, on-the-job training;

- **Health**: this is one of the key elements in the development and physical and mental well-being of individuals. In this regard, it plays a key role in maintaining, even increasing human capital and;

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- **All the factors that increase the productive capacities of an individual**: it is in this category that elements such as migration and access to information fall.

The first two of these three components are generally perceived as the most important because they can generate large benefits, both in the household and in the labor market. We therefore understand the importance they can play in determining well-being and poverty.

2.1. Education as human capital

By emphasizing the economic role of education in his analysis, Behrman (2010)defines education as the acquisition of knowledge and skills through various design experiences, continuously throughout the life cycle, and which allow the increase of productivity defined in the broadest way. This definition takes up the same salient elements found in others such as those of Page (1975) who, in the notion of competence, clearly specifies that they can be manual or intellectual. From this definition, it is possible to deduce the most remarkable features of education, that is to say those from which it is perceived in the analysis of human capital. From this point of view, education is perceived not only as a consumer good, but also and simultaneously as a domestic and market production good and, finally, as a public good (Kamala,

Perceiving education as a production good refers to two aspects. On the one hand, it is perceived as a domestic production good and, on the other hand, as a market production good. The conception of education as a domestic production good was formalized by Becker (1964) who extended the notion of production to domestic activities. The starting point here is that education improves productivity even within the household through the capacity it offers to those who acquire it to grasp information in general, on the economic and social environment, and especially to make it a very good treatment. The model specified for this purpose establishes that the household seeks to maximize a utility function of the form:

$$U = U(S_1, S_2, \dots, S_n) \quad (1)$$

or$U$represents the well-being of household members, andS_i the various elements such as meals, leisure and health, etc. Seeking to derive the maximum utility from production, the household uses the total available time of all its members, as well as other market goods, falls within the traditional analysis of consumer behavior. Thus, the production of these services can be translated by the following function:$T\ X$

$$S_i = f_i(T_i, X_i) \quad (2)$$

The household is subject to constraints. The purchase of goods at the priceP_x, requires a purchasing power that is assumed to be equal to labor income, itself the product of the wage rate, and the number of hours of work,wT_w. This gives rise to the following constraint:

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$$\sum P_{x_i} X_i = w\, T_w \qquad (3)$$

The total number of hours, to be distributed among the various service productions and the work is limited; which results in a second constraint:

$$\sum T_i + T_w = T \qquad (4)$$

Equations (2), (3) and (4) can be grouped within a single constraint, where the quantities of services () are valued at their implicit priceS_i, $P_i$incorporating the cost of goods and the value of the time needed to produce them, and that of total income, defined as the product of the wage rate and the total number of hours available:R_t

$$\sum P_i\, S_i = wT = R_t \qquad (5)$$

In this configuration, education modifies domestic practices. It improves information and makes the production of health services more efficient, for example (Grossman, 1972).

Furthermore, as a market production good, education should be conceived within the strict framework of the theory of human capital. Indeed, this assumes that there is a link between training and productivity on the one hand and, on the other hand, between productivity and remuneration. The essence of training being to transmit knowledge, these will increase the productive efficiency of the individual who acquires them; the market remunerating the worker at his marginal productivity, this acquisition of knowledge will be sanctioned by a better remuneration. This last link is based on the traditional neoclassical model which assumes that the company maximizes its profit in a competitive framework, by equalizing real remuneration and marginal productivity.

2.2. Health as human capital

In economic analysis, health is considered as a component of human capital, which in recent literature is called human capital-health to distinguish it from human capital-education (Lopez-Casasnovas et al, 2005). From a microeconomic point of view and by its characteristics, health is a durable good and integrated into a pattern of household consumption and investment (Mwisha, 2018). This human capital is an integral part of human well-being and is not easily measured.

The definition of the World Health Organization illustrates well the conceptual nature of health and the difficulty implicit in measuring it: "a state of complete physical, mental and social well-being, and not merely the absence of disease and disability" (WHO, 2001, 2006). Another characteristic of healthy human capital is that it is positively correlated with other forms of human capital. Healthy individuals, for example, are on average better fed and better educated than people in poor health. However, although health and education increase labor productivity, health has an additional feature: by reducing the time spent in illness, it increases the total time available to produce money income and goods,

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Indeed, according to Grossman, health capital comprises two components. The first is a "duration" component which is measured over time either by the probability of dying in, or by life expectancy at age. The second component relates to "quality" and is measured by a relative index between 0, for death, and 1 for perfect health, called QUALY (Quality Adjusted Life Years). Thus, each individual is born with a potential for life and health which decreases with age, at an increasing rate, until death. But, it is possible to fight against this depreciation by preventive attitudes, which require time and income. There are two sub-models. The first considers health as an investment that increases production and earning capacity. The second sub-model considers health as a consumption: it improves the utility drawn from life and from other consumptions. In the following formalization (equation 6), the two aspects are integrated.ttt

Consider an individual who has a planning horizon of two periods (0.1) and during each period experiences a non-negative amountt^s sickness time, which is inversely proportional to the initial stock of health, In other words, the time spent in good health constitutes a non-market return on the unobservable stock of health. Indeed, the health capital is valued by the consumer both because being in good health provides a certain positive utility and also because the disease eats away at the time to be devoted to other activities, both commercial and non-market. The individual derives positive utility from consumption of (consumer) goods and disutility from sick time$HXt^s(H)$. The utility function defined on the basis of these arguments is assumed to be independent of time, ie the marginal rate of substitution between sickness time and consumption does not change with age.

Thus, the individual maximizes discounted utility:u

$$u = U(t^s(H_0), X_0) + \beta(t^s(H_1), X_1) \quad (6)$$

$$\text{with,} \frac{\partial U}{\partial t^s} < 0 \frac{\partial^2 U}{\partial (t^s)^2} > 0, \ \frac{\partial U}{\partial X} > 0, \ \frac{\partial^2 U}{\partial X^2} < 0, \ \frac{\partial t^s}{\partial H} < 0$$

An increase in sick time decreases utility but at an increasing rate. On the other hand, an increase in the consumption of goods increases utility but at a decreasing rate. Also, increasing health stock decreases sick time.

The crucial component of Grossman's model is given by equation (7) which defines the change in the stock of health over time. For one thing, health can depreciate, at a rate. On the other hand, this depreciation can be offset by investment in health; which involves the purchase of medical inputs at a rate or the use of units of time devoted to prevention efforts. In sum, we have: $\delta It^I M_0$

$$H_1 = (1 - \delta_t)H_0 + I(M_0, t^I) \quad (7)$$

Thus, the health investment function is given by:

$$I(M_0, t^I) = H_1 - (1 - \delta_t)H_0 \tag{8}$$

$$\text{with.} \frac{\partial I}{\partial M} > 0, \frac{\partial^2 I}{\partial M^2} < 0, \frac{\partial I}{\partial t^I} > 0, \frac{\partial^2 I}{\partial (t^I)^2} < 0$$

An increase in units of time devoted to prevention efforts increases investment in health, but at a decreasing rate. Similarly, an increase in the rate of purchase of medical inputs increases investment in health, but at a decreasing rate.

The equation (8)is the constraint that will enter the individual maximization problem. It gives a very simplified expression because overall, the state of health depends on five factors: genetics, chance, the environment or living environment, individual behavior and the health care system. However, it's not just health that changes over time, it's also wealth.[1]and abilities or skills.

Disregarding the existence of health insurance, price-valued health expenditure must be financed from labor income and/or the initial stock of wealth. Thus, the budget constraint after discounting is given by:$p\ (pM)$

$$A_0 + w_0(1 - t^s(H_0) - t^I) + \frac{w_1(1 - t_1^s(H_1))}{R} = pM + cX_0 + \frac{cX_1}{R} \tag{9}$$

withw_0 the initial period wage rate.

To solve this maximization problem, we consider the following Lagrangian:

$$\begin{aligned} L(H_1, t^I, M, X_0, X_1) = {} & U\left[t^S(H_0), X_0\right] + \beta\left[t^S(H_1), X_1\right] + \mu\left[H_0(1-\delta) + I(M_0, t^I) - H_1\right] \\ & + \lambda\left[A_0 + w_0(1 - t^s(H_0) - t^I) + \frac{w_1(1 - t_1^s(H_1))}{R} - pM - cX_0 - \frac{cX_1}{R}\right]. \end{aligned} \tag{10}$$

avec les multiplicateurs de la lagrange $\mu, \lambda > 0$

After substituting the various first-order conditions, we obtain:

$$-\beta \frac{\partial t^S}{\partial H_1}\left[\frac{w_1}{c}\frac{\partial U}{\partial X_1} - \frac{\partial U}{\partial t^S}\right] = \frac{\partial U/\partial X_0}{\partial I/\partial M}\frac{p}{c} \tag{11}$$

Equations (6), (8) and (11) give the simplified format of the Grossman model. Condition (5) requires that the marginal utility of an investment in health be equal to its marginal cost. The left member suggests three aspects of health as capital:

[1]In particular, the savings made during the first period S_0 is available for consumption in the second period. Savings generate interest, so that during this second period, the individual, with.$rRS_0R \equiv 1 + r$

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- The condition of efficiency: for an investment in health to generate a positive gain, it must reduce the time of illness. A negative value of, in combination with positive values of the large parenthesis would result in a positive value of the entire left-hand side, thereby indicating positive marginal utility.$\partial t^s/\partial H_1$
- Valuing health as a consumer good: reducing time ill, or alternatively increasing time spent in good health, directly increases utility given that.$\partial U/\partial t^s < 0$
- The valuation of health as an investment good: the reduction of sickness time has an immediate impact on wealth through and the real wage rate. Even if sick time is avoided for what it is, investment in health has a return in terms of additional work income or wealth.$-\beta(\partial t^s/\partial H_1)w_1/c$

2.3. Concept of poverty: definition and measurement

We can distinguish three main forms of poverty according to the approach taken. The three main streams of analysis are: the (welfarist) welfare stream (Greer, Foster and Thorbecke, 1984), the Basic Essential Needs School (Streeten, 1984) and the capabilities approach (Sen, 1992 and 1998). The first approach makes it possible to define monetary poverty, that which results from an insufficiency of resources and results in insufficient consumption. The second defines poverty of living conditions; that which refers to the difficulty for an individual or a household to satisfy a certain number of basic needs. The broadening of this approach makes it possible to define poverty through the potentialities or capacities of individuals. Finally,

Moreover, the measurement of poverty involves three stages: the definition of a well-being indicator; the establishment of a minimum acceptable threshold for this indicator so as to separate the poor from the non-poor (the poverty line) and the generation of one or more statistics that aggregate(s) the information from the distribution of the well-being indicator relative to the poverty line. Thus, the literature on poverty presents several indices of poverty[2](Haughton and Khandker, 2009). Among these different measures of poverty, those of the family of decomposable indices developed by Foster et al. (1984), and known as FGT[3], are the most used.

3. Microeconomic formalization of the link between human capital and poverty

The link between human capital, in its various forms, and poverty at the level of an individual or a household can be well understood through the notion of household model as developed by Singh, Squire and Strauss (1986). Indeed, this model offers a recursive analytical tool where the maximization of profit and that of utility are identified in the same framework. However, as the Beckerian model suggests, the analysis of elements relating to the behavior of rural households should take into account the interdependence of production and consumption decisions.

Specifically, each household is assumed to maximize a utility function of the form:

[2]These include the indices of: Sen (1976), Thon (1979), Kakwani (1980), Cark, Hemmig and Ulph (1981) and that of Shorrocks (1995). See Zheng (1997) for a discussion of the strengths and weaknesses of each.

[3]Greer, Foster and Thorbecke.

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$$U = U(C_a, C_m, C_l) \quad (12)$$

where the variables include agricultural commodities (), market products () and leisure (). Utility is maximized under the current income constraint: $C_a\ C_m\ C_l$

$$p_m\ C_m = p_a(Q_a - C_a) - w(L - L^f) - w_x X + E \quad (13)$$

where and are respectively the prices of market products and agricultural commodities; is the agricultural production of the household; the prevailing market wage rate; the total volume of work; family labor (so that if is positive, the household is recruiting, meaning that the volume of household labor alone is not enough to cover its agricultural labor needs; if it is negative then part of the labor is released work for off-field activities); is a variable input; the market price of the variable input; and is income of any origin other than labor (exogenous income) or non-agricultural activity such as transfers received for example. $p_m\ p_a\ Q_a\ wLL^f L - L^f\ X\ w_x E$

Every household also faces a time constraint; he cannot allocate more time than () to leisure, agricultural and non-agricultural production. Welch (1971) suggests that a household's field management skills or competencies should be translated firstly through technical efficiency in the production process and secondly through efficiency in the production process. the allocation of inputs or the decision to produce (allocative efficiency). As a result, the total stock of household time available for agricultural production () is shared between field and household management () and field work. In the vein of Ulimwengu (2009a), efficiency in field and household management is given by:$TL^f\ M\ F$

$$M^e(I, M) = m(I)M, \quad \partial m/\partial I < 0 \quad (14)$$

where is the health impairment index and taken as an exponent represents the effectiveness of the term with which it is associated.Ie

Worsening health impairment decreases efficiency in field and household management. We can note at this level the fact that the rare applications of this framework only consider the effect of the disease on productivity (Ulimwengu, 2009b). However, it can well be extended to all human capital without modifying its foundations or mathematical development. For this purpose, the expression (14) can be rewritten as:

$$M^e(KH, M) = m(KH)M \quad (15)$$

orKH is human capital and or depending on whether the stock of human capital is depreciating or appreciating, or whether it is low or high.$\partial m/\partial KH < 0\ \partial m/\partial KH > 0$

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Similarly, effective family labor is then given by, together with recruited labor. The household faces a production constraint or a production technology that associates inputs and outputs as follows:$L^e = F^e + H^e H^e$

$$Q_a = Q(X, L^e, M^e, Z) \tag{16}$$

where represents fixed inputs such as land and capital.Z

After allocating the available time, each household is assumed to choose and in such a way as to maximize net returns. The maximization program is specified as follows:$X, H^e, FM\ \pi$

$$\pi = p_a Q(X, L^e, M^e, Z) - w_x X - wH^e \tag{17}$$

under the constraint of:

$$\begin{cases} T = F + M, \\ L^e = F^e + H^e, \end{cases} \tag{18}$$

The first constraint stipulates that the total time is shared between the management of the field and the household and the field work . The second constraint relates that effective family work is given by family work and recruited work..

So the production is given by:

$$Q_a = Q[X, F^e(KH, F) + H^e, M^e(KH, M), Z] \tag{19}$$

so that the overall effect of the change (improvement or depreciation) in human capital is given by:

$$\frac{\partial Q_a}{\partial KH} = \frac{\partial Q}{\partial M^e}\frac{\partial M^e}{\partial KH} + \frac{\partial Q}{\partial F^e}\frac{\partial F^e}{\partial KH} \tag{20}$$

Thus, theoretically, the variation in production would be due to changes in the level of managerial efficiency and in the volume of the effective work of the household. However, as Ulimwengu (2009b) points out, the comparative static analysis of the effect of these variations on current family work, and, and on other inputs does not, a priori, suggest any obvious result. Indeed, there may well exist a compensation resulting from the substitution of family labor by some of its inputs or by recruited labor. Also, the allocation of family labor to management and field work depends on the marginal productivities of these two allocations and the relative impact of human capital (or its variation) on the ability to undertake field work or to perform management tasks. And as for income,$M^e F^e$

Despite their relevance, Pitt and Rosenzeig (1986), who focus on the specific case of health, relativize these considerations. Indeed, these authors note that performance in production is independent of variations in the health status of farmers only in the case where the input market is perfect and there is no missing market for any of the inputs. goods consumed or used in the production of health.

But this difficulty in predicting variations in income as a consequence of changes in human capital implies that changes in the level of poverty induced by said capital cannot be accurately predicted a priori. Formally, it can be deduced by taking inspiration from the formalization of poverty adopted by Besley and Kanbur (1988).

This starts from the following representation of the FGT poverty indices:

$$P_{\propto} = \int_0^z \left[\frac{z - y_T(\blacksquare)}{z}\right]^{\alpha} f(y)dy \qquad (21)$$

where is the poverty line, is the household income or any indicator of well-being; is the density function of this welfare indicator. Thus, the marginal effect of the change in human capital on the poverty index can be derived as follows: $zy_T(\blacksquare) = y_T[X, F^e(KH, F), H^e, M^e(KH, M), Z]f(y)KH$

$$\frac{\partial P_{\propto}}{\partial KH} = \frac{\partial P_{\propto}}{\partial y_T}\frac{\partial y_T}{\partial KH} = \left(\frac{\propto}{z}\right)\left(\frac{\partial y_T}{\partial KH}\right)\int_0^z \left[\frac{z - y_T(\blacksquare)}{z}\right]^{\propto - 1} f(y)dy \qquad (22)$$

Expression (21) can be simply written as:

$$\frac{\partial P_{\propto}}{\partial KH} = \frac{\partial P_{\propto}}{\partial y_T}\frac{\partial y_T}{\partial KH} = \left(\frac{\propto}{z}\right)\left(\frac{\partial y_T}{\partial KH}\right)P_{\propto - 1} \qquad (23)$$

From (23) we can then deduce the following different effects:

$$\frac{\partial P_{\propto}}{\partial KH} = \begin{cases} < 0, si\ \partial y_T(\blacksquare)/\partial KH < 0, \\ = 0, si\ \partial y_T(\blacksquare)/\partial KH = 0, \\ > 0, si\ \partial y_T(\blacksquare)/\partial KH > 0. \end{cases} \qquad (24)$$

It emerges from (24) that one cannot, a priori, predict the effect of human capital on poverty. The net effect is a function of the impact of human capital on efficiency. Although such a framework offers the possibility of examining the impact of human capital on poverty, it does not integrate, at least not in a direct way, the relationship in the opposite direction, that is to say, that which can go from poverty to human capital. Taking these two aspects into account in the same framework is essentially a matter of analyzes of poverty traps (Mayer, 2008).

4. Conclusion

Although the concept of human capital is a concept with variable geometry, and covers a much broader field than the two components (education and health) retained within the framework of this study, given the importance which they represent in the all the components of human capital,

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the objective of this article was to show through a theoretical microeconomic modeling, the transmission channels of the link between human capital and poverty. Several studies have highlighted the relationship between human capital and growth. The human capital theory predicts that investment in education contributes to strengthening the productive potential of individuals, which ultimately translates into an improvement in individual incomes. Don't we say that a well-educated, well-trained, healthy individual is a more qualified workforce capable of greater productivity, greater output, and therefore higher income. The link between growth and poverty has given rise to controversy; growth has several sources that affect the poor differently.

In order to properly model the relationship between human capital and poverty, he began with a presentation of the theoretical foundations of the perception of education and health as (human) capital on the one hand and, on the other, that of the conception of poverty. A number of models have reported household behavior following changes in education and health variables.

Drawing inspiration from human capital theories and hypotheses emerging from work in the economics of education and health, the initial model offers a recursive analytical tool where profit maximization and utility maximization are identified. in the same frame. The mathematical formalization thus applied has made it possible to establish the relationships between human capital and poverty by emphasizing in particular the mechanisms underlying the relationships linking the two. The net effect of human capital on poverty is a function of the impact of human capital on efficiency. This framework does not integrate, at least not directly, the impact of poverty on human capital.

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