Campino A.C.C.[1], *Machado F.M.S.*[2] **Intergenarational Transmission of Human Capital in Brazil: Differences According to Race and Region**

ABSTRACT

The main objective of this study is to analyze the relationship between human capital formation, and processes of economic growth and social development by exploring the use of the population's nutritional and health variables to assess the quality of human capital and the mechanisms through which this capital is transmitted between generations among people of different races living in different regions of Brazil.; special emphasis is given to the consideration of the differences between the poorest Metropolitan Region – Fortaleza – and the richest one – São Paulo. This research includes considerations on recent advances in the economic growth theory that relates health, human capital, and long-term economic growth (see Fogel, R.W. "The Impact of Nutrition on Economic Growth", July/2001.) The evidence is obtained from the analysis of an important Brazilian database, "Pesquisa de Padrão de Vida", the Brazilian version of the World Bank´s "Living Standard Measurement Survey", conducted between 1996 and 1997, for the Northeast and Southeast Regions.

The model we developed comprises two phases. In phase one, we took into account the factors which explain the differences in human capital formation between races, using the region and the area where the person lived as control variables. This part of the study focuses on information pertaining to economically active individuals (people between 19 and 59 years-old, both genders)with the purpose of analyzing the connection between individuals' health variables, such as height and health status, and socioeconomic variables, like income and educational attainment, In phase two, the factors that explain the differences in the intergenerational transmission of human capital between races, were determined; area (urban vs. ~~x~~ rural) and region were used as control variables. This part of the study focuses on information pertaining to individuals belonging to the same group, with at least one child to raise (2 to 21 years-old, both genders) in order to evaluate the intergenerational transmission of human capital. Results lead to the conclusion that relevant investments in human capital formation, such as educational attainment, create better

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opportunities to the individual in terms of employment and income. Beyond these primary effects, however, there are secondary effects, mainly based on the transmission of human capital formation through generations, which result in population lifestyle changes, economic growth and development.

1 - INTRODUCTION

The main objective of this study is to analyze the relationship between human capital formation , and processes of economic growth, and social development. It uses the nutrition status variables to assess the formation of human capital and uses the population's health variables to assess the quality of this human capital. Special importance is given to the study of the mechanisms through which human capital is transmitted between generations between people of different races living in different regions of Brazil.; emphasis is also given to the differences between the poorest Metropolitan Region – Fortaleza – and the richest one – São Paulo.

Height of the individual will be used as a proxy for human capital investment made on this individual by his family and by the government, as expressed by Fogel (2001). Population data regarding adults in the 19 to 59 years old age bracket will be used, because this is an age group on the prime of its economic activity. People older than 60 will not be included, since the precise assessment of height in this age group is more difficult.

The source of the data analyzed is the "Living Standards Measurement Survey", (Pesquisa de Padrão de Vida (PPV), a household survey conducted between 1996 and 1997 in both the Southeast and Northeast Regions of Brazil.

The PPV survey was carried out by the "Brazilian Institute of Geography and Statistics (IBGE)" in association with the World Bank. It is the Brazilian version of the LSMS and consists of a pilot project of multitheme research to fulfill information needs which: (a) qualify and indicate the determinants of social welfare of different social groups, and (b) allow for the identification of the effects of government policy on household living standards. The main objective of PPV being that of providing adequate information for the planning, following up, and analysis of economic policies and social programs vis-à-vis their impacts on household living standards, especially among low-income populations. (IBGE, 1998).

PPV includes data on age, height, weight, self-reported health status, education, and income of the population. The PPV achievements are very important, moreover since this has been the first socioeconomic and demographic survey conducted ~~carried out~~ in Brazil following the introduction on July 1994 of the stabilization plan known as the "Real Plan".

The PPV sample design was discussed with World Bank officials while sample size has been determined by the available budget. In accordance to its pilot-research configuration, it was decided that it would only cover the Southeast and Northeastern Regions of Brazil, taking into consideration 10 geographic strata, namely: Fortaleza, Recife, and Salvador Metropolitan areas; the remaining urban areas of the Northeast; the remaining rural areas of the Northeast; Belo Horizonte, Rio de Janeiro, and Sao Paulo Metropolitan areas; the remaining urban areas of the Southeast; and the remaining rural areas of the Southeast (IBGE, 1998).

2. THEORETICAL BACKGROUND

Economic development textbooks define economic growth as growth in income per capita and economic development as a process that implies transformations in social structure, such as education, health, nutrition, access to housing and sanitation that, on their turn, imply growth in per capita income.

Human capital "is the most fundamental source of economic growth. It is a source of both increased productivity and technological advance".[3] Investment in human capital, as defined by the founding father of the human capital theory, Gary Becker, is the imbedding of resources in people that influence future real income.[4]

Therefore, the investment in human capital has an important impact on the economic development of a country. One of the forms of investment in human capital is the expenditure in education. It has been proved that expenditures in education are important in explaining the rate of growth experienced by a country. One of the earliest studies in this area, conducted by Edward F. Dennison, has shown that 40% of the rate of growth of the United States in the period 1929-1957 could be attributed to expenditures in education.[5]

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[3] Parkin, Michael Macroeconomics 5th ed. 2000 Addison-Wesley Publishing Co.Inc. p.230.

[4] Becker, Gary S. "Investment in Human Capital: A Theoretical Analysis" chapter 3 in Febrero, Ramon and Schwartz, Pedro S. The Essence of Becker Hoover Institution Press Stanford University Stanford California 1995 p.36.

[5] See Dennison, E.F. Why growth rates differ; postwar experience in nine western countries Edward F. Denison, assisted by Jean-Pierre Poullier. Washington, Brookings Institution [1967], 494 and also Dennison, E.F. Accounting for United States economic growth, 1929-1969` Washington, Brookings Institution [1974], 355p.

A number of studies in developing countries have shown that there is an important relationship between education and health of the next generation, measured in terms of life expectancy; the mechanism by which this relationship is revealed resides in improvements in infant and child survival rates (Le Vine, 1987 quoted by McMahon, 1999:82). The hypothesis is that the knowledge and increased earnings potential gained through education enable parents to provide a healthier environment for their families, although the mechanisms through which this occurs are still unclear (Eisemon, 1988, referred by McMahon, p. 83). The regressions run by McMahon show that infant mortality rates are dependent on female gross enrollment rates, lagged 20 years (McMahon, p. 84).

Becker and Tomes assumed a different position, on the paper "Human Capital and the Rise and Fall of Families" (Becker and Tomes, 1986), developing a theoretical model of the transmission of earnings, assets and consumption from parents to descendants. Becker and Tomes depart from a simple model of the relation between the parents' and children's incomes.

$$I_{t+1} = \alpha + b\, I_t + \varepsilon_{t+1}$$

where I_t is the income of the parents, I_{t+1} is the income of children, α and b are constants and the stochastic forces affecting the income of the children ε_{t+1} are assumed to be independent of the income of parents[6].

The second hypothesis is that the endowments of a family are inherited from their parents, but only partially so. This relation is expressed as

$$E_{i\,t} = \alpha_t + h\, E_{i\,t-1} + \upsilon_{I\,t}$$

where $E_{i\ t}$ is the endowment of the ith family in the tth generation, h is the degree of inheritability of these endowments, and $\upsilon_{I\,t}$ measures unsystematic components of luck in the transmission process[7].

[6] Acc.Becker and Tomes, p.344.
[7] Becker and Tomes, p.347.

Having specified relationships for the transmission of income and of endowments from one generation to the other, the authors elaborate on the relation between earnings and human capital. They assume that adult earnings depend on human capital (H) and market luck (L):

$$Y_t = \gamma\,(T_t, f_t)\,H + L$$

where Y_t stands for earnings, and the earnings of one unit of human capital γ is determined by equilibrium in factor markets. It depends positively on technological knowledge (T_t) and negatively on the ratio of the amount of human capital to nonhuman capital f_t.

This equation allows for the transformation of investments in human capital during childhood in earnings received during adulthood.

The study by Becker and Tomes is theoretical, they have not conducted any estimates of their own, probably due to the difficulty in obtaining data. But they have examined about a dozen empirical studies relating the earnings, income and assets of parents and children. They observe that the point estimates for most of the studies indicate that a 10 percent increase in parents' earnings (or income) increases the children's earnings by less than 2% (Becker and Tomes, 1986:366). They also concluded that: "Almost all earnings advantages and disadvantages of ancestors are wiped out in three generations. Poverty would not seem to be a "culture" that persists for several generations" (Becker and Tomes, 1986:373).

The analysis by Becker and Tomes gives interesting insights, but it does have a shortfall. It does not elaborate on what measure or measures of investment in human capital ought to be taken (like expenditures in health and in education), how they should be combined. Also it does not elaborate on the mechanism by which inheritance of endowments and human capital results in inheritance of a given income level.

A leap forward was given by Fogel (1992, 1994) who linked "aggregate movements in adult height to long-run changes in standards of living, including income, mortality, and …morbidity" (Strauss and Duncan, 1998:768). The insight Fogel had was the use of height, and variations in height, as measures of previous investments in human capital. Fogel suggested a simple yet precise way of measuring past investments in human capital by its

outcome. If the family (and the state) had invested in the child, he/she would have grown, if this investment were not made the child would not have grown.

Fogel is using a property very well known to the specialists on nutrition who work with anthropometry. If by any reason there is a significant reduction in the availability of food for a child, he/she will stop growing either in terms of weight or height. When availability of food is resestablished to the child, he/she will resume growth and will in due course recover weight, at the normal pace for his/her age. As far as height is concerned, however, the situation is different. The child may resume his/her rate of growth, but will never recover the height lost during the period of reduction of the normal availability of food.

Based on the case made by Fogel, Strauss and Thomas (1998) observed that:

- ✓ the income generating capacity of the poorest could be enhanced by some health sector investment (p.767),
- √ there are "correlations between health and labor outcomes",
- √ "health varies over the lifetime and is the outcome of behavioral choices both during childhood and in later life" (p. 768).
- √ health (measured by height) and productivity are correlated at the individual level (p. 772).
- √ "... in recent years, substantial progress has been made in documenting the existence of a causal impact of health on wages and productivity in low-income settings...."
- √ "health has a larger return at very low levels of health and (perhaps) in jobs requiring more strength. With economic development …one might expect the labor market impact of improved health to decline, especially relative to the impact of education and skill acquisition."

In the case of Brazil, results of several researches conducted by Monteiro and cols.(1993) with data surveyed in the National Study of Household Expenditures (Estudo Nacional de Despesa Familiar (ENDEF), and the National Research on Health and Nutrition, (Pesquisa Nacional de Saúde e Nutrição (PNSN), showed that:

- There was an increase in height of young adults (21-22 years of age), when we compare persons born in 1966-1968 to those born in 1951-53. The increase was of 1.3 cm for males and 1.0 cm for females;
- There was an increase in height of children (7 years of age ± 12 months), comparing children born in 1981-1983 to those born in 1966-68. The increase was of 3.6 cm for males and 3.7 cm for females;
- Height of young Brazilian adults and children was below heights presented in the NCHSI/WHO standard, but the deficit is being reduced. It was reduced in 15% for young adults, both male and female, born between 1951/1953 and 1966/1968; and it was reduced in 50% for children, both male and female, born between 1966-1968 and 1982-1983.

Strauss and Thomas (1998) have studied the variations in the long run of the investment in human capital, assessed by the average height of the individuals, among countries with different levels of development. They chose to study the cases of the United States, a developed country, Brazil, a developing country and a less developed country, VietNam, torn by war. Their important conclusion is that countries with different levels of development will present different profiles of evolution of human capital formation: the United States had achieved its maximum level of height (a proxy for human capital formation) around 1935, Brazil around 1960 and the VietNam had its process stalled by the war.

What happened to countries in their process of economic development also might have occurred to regions of a country,. That is the reason why we intend to study differences in the formation of human capital in Brazil comparing a less developed region – the Northeast – with a more developed one – the Southeast and comparing the poorest metropolitan area – Fortaleza- with the richest metropolitan area – São Paulo.

Regarding race our bibliographical research showed that there are no significant theoretical advances that explain why persons of different races present differences in the access to education and health care. The theoretical studies belong to the area of labor economics and deal with the subject of why people belonging to different races receive different wages. In this area one important development was the study done by Gary Becker "The Economics of Discrimination". In this book, on Chapter 2, entitled "Effective

Discrimination", Becker presents a model of wage discrimination, and discusses interesting topics like "discrimination and capitalists", "discrimination and segregation" and "discrimination by minorities". In the other chapters other dimensions of discrimination are discussed, comprising all possible sources of discrimination, employers, employees, consumers and the government. A relevant variable used through all his book is the "market discrimination coefficient" based on the equilibrium wages of whites and negroes.

Besides labor market discrimination there are other dimensions to discrimination. Hoffman, E. P. in the Introduction to the book she is editor, Essays on the Economics of Discrimination says that prelabor market discrimination "is unequal treatment based on irrelevant criteria in such areas as type and amount of education and training and career aspirations" (p.2).[8] Regardind discrimination within the family, Taubman, P.J. concludes that "parents care equally for sons and daughters" and therefore if there are differences in earnings between males and females "they are not arising because of parents favoring boys" (Taubman, in Hoffman, op cit pg. 38) [9]. Studying discrimination among age groups, Wolfe, B.L. finds that federal government income-transfer programs according to the age of the recipient "discriminate against children and in favor of the elderly" (Hoffman, p. 5) [10].

But in the studies on prelabor discrimination little is said about race, which is mentioned as a lesser issue .

In the ´90s and afterward economists and sociologists started being interested in pre labor market discrimination. A significant literature was written about the consequences of differences in access to education and access to schools of good quality by different races, consequences stated in terms of rates of return.

In Differences in retrurns to education: An analysis by race (1994) , Ashraf found returns to black college graduates much higher than those for white college graduates, although the returns across race were much closer to each other in the case of high school

[8] Hoffman defines discrimination as "unequal treatment based on irrelevant criteria" (p.2). So, "economic discrimination is unequal treatment based on criteria irrelevant to the activity involved" and labor market discrimination "is unequal treatment in the labor market based on irrelevant criteria" (Hoffman, p.2) Still remains the question of what is the relevant criteria, or who defines the relevant criteria.

[9] See Taubman, P.J. "Discrimination within the family: The treatment of daughters and sons" in Hoffman, op cit. p. 25-42

[10] See Wolfe, B.L. "The Deteriorating Economic Circunstances of Children" in Hoffman, op. cit. p.43-66

graduates; in many years the returns were higher for whites than for blacks in this latter category.

The rate of return is calculated from data on incremental benefits and incremental costs of a specific educational level. The incremental benefits are expressed in terms of incremental wages. Another way of expressing the advantages of studying at hiher levels of education is to calculate the educational wage premium – the degree to which highly educated workers are paid more than less educated workers.. In Education and wages in the 1980s and 1990s: Are all groups moving up together? (2002), Katharine L Bradbury observed that after controlling for a variety of observable differences, wage disparities by race, Hispanic origin, and sex remain. Black men, black women, and Hispanic women did not present an increase in the educational wage premium similar to the one received by nonblacks or nonHispanics counterparts. At the end of the 1990s, blacks earned lower wages at each education level and realized less of a payoff for additional education than otherwise similar nonblacks. Hispanics, too, earned below average wages at each education level.

In an interesting study on School Quality and Black-White Relative Earnings: a Direct Assessment (1992), Card and Krueger found a strong relationship between school quality and the economic return to additional years of schooling for black and white workers. It was estimated that measures of school quality could explain 15%-25% of the convergence in relative rates of return to schooling for Southern-born black workers between 1960 and 1980. A direct relationship was found between the relative quality of schools for black and white students from a particular state and cohort and their relative earnings later in life.

The importance of prelabor market discrimination is also present in Brazil.

In a book on Raça e Gênero nos Sistemas de Ensino: Os limites das políticas universalistas na educação (2002) (Race and Gender in the Education Systems: limits to the blanket approach in education) Henriques, using data from the PPV (Pesquisa Padrão de Vida), 1996/97 – the same survey we are using in this study – calculated that 58% of the wage differential between blacks and whites is related to education ; in part this difference

is generated inside the educational system (27%) an din part it is derived from the discrimination in educational opportunities faced by the parents of the students.

TABLE 1

DETERMINANTS OF WAGE DIFFERENTIAL BETWEEN WHITES AND BLACKS

DETERMINANT	%
WAGE DISCRIMINATION	16
EDUCATIONAL DISCRIMINATION	27
DIRECT IMPACT OF PARENTS´ SCHOOLING	9
INDIRECT IMPACT OF PARENTS´SCHOOLING	22
OTHER FACTORS	26

SOURCE: HENRIQUES, 2002 (P. 30)

Discrimination in terms of access to school is being reduced, but still exists. The percentage of negros who didn´t have access to school in 1999, for the 7 to 14 age group, was comparable to that prevailing for whites in 1992.

Henrique´s (2002) findings are consistent with the one´s presented by Okediji (2004) who, using cross sectional analyses, showed that race/color and educational attainment determine earnings potential in Brazil. This characteristic of the brazilian situation is also found in many developing nations, as stated by Becker and Becker (1997), p. 67 "The social problems from unequal education are often compounded by racial differences: In Brazil, Mexico, and many other nations, wealth, education, and occupation are polarized along racial lines".

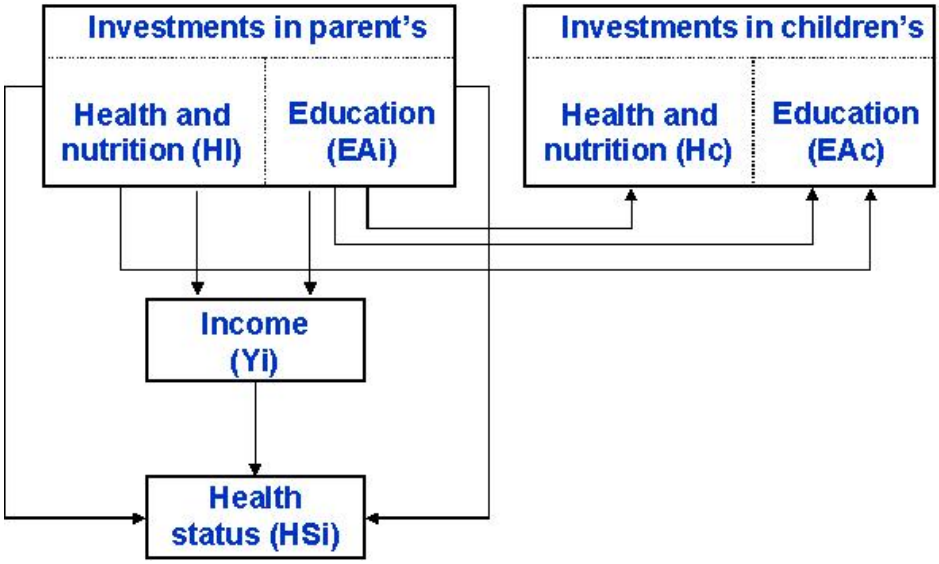
3. METHODOLOGY

Methodological lines to be followed in this study are the ones developed by Fogel (2001) and Barro (1996).

As the first line of analysis, we chose identifying the impact of human capital investment at two privileged points in time: (a) during childhood, involving investments in individuals in terms of health and nutrition; (b) during school age, involving investments on

formal education. As outcome of this investment in human capital, we used people's income and their health status. This line of analysis is expressed on the left column of Diagram 1.

DIAGRAM 1: IMPACT OF THE INVESTMENT IN HUMAN CAPITAL ON AN INDIVIDUAL´S INCOME AND HEALTH STATUS, AND THE INTERGENERATIONAL TRANSMISSION OF THIS INVESTMENT



Our survey population, pertaining to this main line, consists of all 20 to 59 year-old adults who had been surveyed by PPV. For indicator of the investment in human capital during childhood, made either by family and/or by state (per lines of Fogel 2001), we used the final height reached by the individual, a measurement which, in societies such as ours, reflects outstandingly well the prevailing health and nutrition status of the individual during the first two years of his/her life. As for investments on formal education, we used the number of school years of the individual as indicator. The outcome indicators regarding health and nutrition investments made during childhood were: (a) the income (productivity) he/she earned from work; and (b) the overall status of health (self-referred scale).

On a second line of analysis, we pursued the study of the intergenerational transmission of investments in health, nutrition and education. This second line of analysis is expressed on the right column of Diagram 1. We studied household units formed by

father and mother in the age group of 19 through 59, and their children between 2 and 7 years old or 15 through 21 years old.

The direct transmission of the investments on nutrition and health from parents to child cannot be investigated in view of the impossibility of controlling the genetic fraction of height transmission. We may, however, study the transmission of these investments on nutrition and health made by parents, in terms of their investments in the child's education.

As to investments made in the parents' education, we will investigate their transmission in the form of investments made in their children's education, and investments in their children's health and nutrition.

Whatever the case, we must control the family income. The income control enables us to affirm if those investments made in nutrition and health or in education are transmitted independently from the family income, i.e. if individuals of identical income but on whom more investments in education were made (either by parents' or by state) are more likely to invest more in the education (or on nutrition) of their children than those individuals on whom less investments in education have been made.

We also controlled for the child's age due to: (a) possible variations in the child's nutritional status according to age; (b) the association of age and education derived from the expected positive secular trend in education.

The main variables utilized in this study, which are part of the PPV survey, have the definitions expressed below:

- √ Height (measured in centimeters), an indicator of the individual's linear growth and indirectly of health conditions and nutritional status during childhood and adolescence;
- √ Self-reported health status (HS), scaled from 1 to 5 (from 1, excellent health status, till 5, poor health status) intends to investigate the individual's health history. Based on additional data collected in the PPV questionnaire that registered presence of chronic and/or acute illness, self-reported health status could be validated as a consistent variable to measure an individual's actual health conditions, showing that individuals with poorer self-reported health

status tend to report much more often chronic and/or acute diseases than individuals with better self-reported status;

- √ Data on income represent total income from working activities only (measured in units of Brazilian currency: real), excluding financial and other non-productive sources of profits. Given the standard hypothesis about the utility of income, the variable income was constructed as the logarithm of total income (plus one)
- √ Age of the individual was measured in months;
- √ Education is expressed in years of schooling. We investigated the effects of mother´s education (EAm) and father´s education (EAp);
- √ Gender, of course, refers to the sex of the individual, male or female (0 for men, one for women);
- √ Data on race were arranged in two groups , Negroes (blacks and "pardos") and Whites.[11]

We want to compare the impact on the overall status of health of the adult individual and his income, of investments in human capital made during his childhood and also to compare the intergenerational transmission of human capital, between the richest Region of Brazil – Southeast – and the poorest – Northeast. We also intend to investigate if we obtain better results working with region broadly defined or with region narrowly defined, as is the case with a metropolitan region – where the variance of access to education and health services is smaller. For this reason we also compare the reachest metropolitan region – São Paulo – with the poorest metropolitan region - Fortaleza.

.Table 2 presents relevant data on the mean of the variables income, father´s and mother´s education and health status of negroes and whites, the Regions and Metropolitan Regions being considered.

[11] The group of whites also comprises people form the yellow race, mainly Japanese descendants, which are mainly concentrated in the State of São Paulo, where they represent 3.5% of the total population

TABLE 2

MEAN VALUES OF INCOME, EDUCATION AND HEALTH STATUS, ACCORDING TO RACE, AND REGION

Mean Values	HS	EAp	EAm	Y
Northeast Region	2,73	4,54	4,76	289,22
SoutheastRegion	2,54	5,60	5,55	504,89
Fortaleza Metr. Region	2,50	5,19	5,45	372,82
São Paulo Metr. Region	2,32	6,74	6,52	708,64
Negroes	2,76	4,07	4,22	264,63
Whites	2,51	6,14	6,15	531,43

Source: PPV, 1996/1997

4. MODELS

The model of the impact of the investment in human capital on the individual's income and health status will investigate the impact of health and nutrition investments and of investments in education made during childhood on the overall status of health of the individual and the income (productivity) he/she earns from work.This was done using the following equations:

$$(1)\ HSi = f(Hi, EAp, EAm, Ypc)$$

This equation measures the contribution to health status (HSi) of the human capital investment during infancy (Hi) and from infancy to adulthood (EAp, EAm) , using as control variables the family´s per capita income (Ypc), Race (C) , Gender (S), rural/urban area (A), Region (R) and Metropolitan Region (RM).

The control variables were specified as *dummy* variables, and for all regressions had the following values:

C – Race = 0 for whites and 1 for negroes;

R – Region = 0 for the Southeast and 1 for the Northeast;

A – Area = 0 for urban area and 1 for rural area;

S – Gender = 0 for males and 1 for females;

RM – Metropolitan Region = 0 for São Paulo and 1 for Fortaleza.

Since HS varies from 1 = excellent, to 5 = poor, a reduction in HS means an improvement in health status it is expected that the coefficients of the variables in the regression (Hi, EAp, EAm,Yi)will be negative..

(2) Ypc = f (Hi, EAp, EAm, HSi)

This equation shows the following important determinants of family´s per capita income:

(a) The human capital investment this individual benefited from as a child (Hi);

(b) The human capital investment this individual benefited from infancy to adulthood (EAip,EAm;

(c) His/her present health status (HSi).

The coefficients of all these three variables are expected to be positive.

(3) EAi = f (Hi)

The third step is to examine the relation between educational attainment (EA) and height (H) of an individual , to analyze how good a predictor of educational attainment height is. It is expected that the bigger the investment made in health and nutrition during infancy, the higher the possibility of the individual having a better educational attainment from infancy to adulthood, so the coefficient of the variable Hi is expected to be positive.

The second phase of the study consists in estimating a group of regressions based on models which allow the analysis of the main mechanisms that determine intergenerational transmission of human capital.

(3) Hc = f (EAp, EAm)

(4) EAc = f (EAp, EAm)

where Hc and EAc are, respectively, the height and the educational attainment of a child c; Equations (3) and (4) indicates the impact of the human capital investment:

√ On the investment made in the development of the child's human capital (Hc) in the two first years, and

√ On the investment made in the formation of human capital of the child (EAc) during adolescence.

Data on children's educational attainment were converted in an educational attainment adequacy index (EAc). The 15 to 21 years old children's educational attainment adequacy index is derived from the comparison between the ideal number of school years calculated for each age group and the individual's actual number of school years at that age. The following scale of school years was considered ideal, since in the case of Brazil a child should start his first year of schooling at age 7.

Table 3

Ideal Number of School Years For Individuals in the 15 to 21 Age Bracket (Brazil)

Age (Ic)	Ideal number of school years (EA*)
15 years	8
16 years	9
17 years	10
18 years	11
19 years	12
20 years	13
21 years	14

Thus, the educational adequacy level of the child (EAc) was calculated according to the relation between the ideal educational attainment to his/her age (EA*) and the effectively attended years of school declared (EAr) by the child c of the age group Ic:

$$EAc = \frac{EAr}{EA^*}$$

5. RESULTS

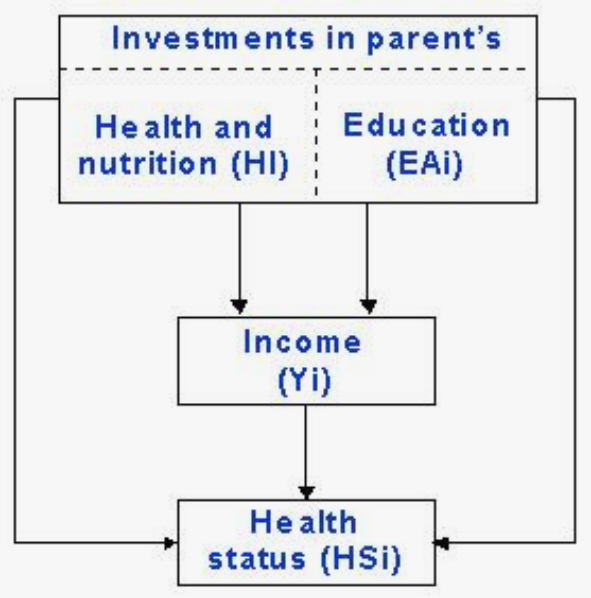
Results are presented for each model described in the section on methodology. Regressions which included self-reported health status as dependent variable were run

using the method ordered logit in order to fulfill the requirements of self-reported health status as a discrete variable with cardinal classification.

5.1 Impact of the Investment in Human Capital on an Individual's Income and Health Status

Diagram 2 will help us to remember the relationships we are estimating in the first phase of this study. In this phase, we worked with adults in the age bracket 19 to 59 years of age, that is, we excluded from the sample adults with ages lesser than 228 months (19 years old) and adults with ages equal or superior to 720 months (60 years old). Also excluded were registers that did not inform the individual's height.

DIAGRAM 2: IMPACT OF THE INVESTMENT IN HUMAN CAPITAL ON AN INDIVIDUAL´S INCOME AND HEALTH STATUS



1. Relations among an Individual's Health Status, Height, Educational Attainment, and Family Income.

Dependent Variable: Self-reported Health Status (HSi).

Independent Variables: Height (Hi) as proxy for human capital investment made in the individual at childhood, Educational Attainment of father´s (EAp) and mother´s (EAm)

as proxy for human capital investment made in the individual from childhood to adulthood and Income per capita (Ypc). [12]

Control Variables: Age (I);Age Squared (I^2); Gender (S); Region (R) Metropolitan Region (RM). And Race (C)

HSi = f (Hi, EAp,,EAm Ypc)

Dep.Var.	HEALTH STATUS		HEALTH STATUS	
Pseudo-R^2	0,04669		0,05967	
	β	Sig.	β	Sig.
H	-0,0058	(0,214)	-0,0076	(0,000)
EAp	0,0026	(0,891)	-0,0175	(0,041)
EAm	-0,0506	(0,007)	-0,0279	(0,002)
Ypc	-0,3111	(0,033)	-0,4625	(0,000)
I	0,0012	(0,458)	0,0011	(0,133)
I^2	0,0000	(0,127)	0,0000	(0,001)
C	0,1082	(0,122)	0,1580	(0,000)
S	0,1689	(0,163)	0,2541	(0,000)
A	-0,8179	(0,013)	0,2709	(0,000)
RM	0,2526	(0,059)		
R			0,1461	(0,006)

Sample size: 1737 observations. Values in parentesis are the *p´*s

The signal of the coefficients of the regression should be interpreted carefully. The health status varies from 1 = excellent to 5 = very poor. Therefore a negative signal means an improvement in health status. We will comment on the results obtained using the variable region, since they were much better than the ones using metropolitan region; Height, educational attainment of father´s and mother´s and income per capita presented a negative sign, meaning that they had a positive impact on the level of self-reported health status. All coefficients were significantly different from zero. With a high degree of statistical significance, we can state that human capital investment made in an individual when he was an infant, and from childhood through adulthood, captured by the variable Educational Attainment and the individual's family per capita income have a positive impact on the level of self-reported health status. The variable income should be interpreted with caution. It is the present income received by the individual, from different sources. It

[12] As the effects of income increase at decreasing rates, we preferred to use the logarithm of income (Ln); as for some observations the income could be zero, we took the logarithm of income plus one.

reflects his ability to work, in the case of wages, but it also could reflect the wealth inherited by this individual, in the case of rents. In every case, the present (family per capita)income is here being used as a measure of the individual's capacity of acquiring goods and services; among which only the access to health and sanitation services and to educational services are relevant to the present study, with positive impacts on the health status.

Race, Gender, Area and Region, all presented very significant and positive coefficients. As an increase in the value of the variable health status maeans that we are moving towards a worse health status, these results indicate that the health status of negroes is worse than that of whites, women and people living in rural areas and people living in Fortaleza have a worse health status than men, people living in urban areas and people living in São Paulo.

2. Relations among an Individual's Family income and His Health Status, Height and Educational Attainment

Dependent Variable: Family per capita income (Ypc).

Independent Variables: Self-reported Health Status (HS) as current health and nutritional status indicator, Height (H) as proxy for human capital investment made in an individual during childhood, Educational Attainment of father´s (EAp) and mother´s (EAm) as proxy for human capital investment made in an individual from childhood through adulthood.

Control Variables: Age(I); Age Squared (I^2); Race (C), Gender (S); Metropolitan Region (RM) and Region.

Ypc = f (Hi, EAp, EAm, HSi)

Dep.Var.	Ypc Income per capita			
R^2	0,39481		0,51843	
	β	Sig.	β	Sig.
α	1,8215	(0,000)	1,7689	(0,000)
H	0,0023	(0,018)	0,0026	(0,000)
EAp	0,0357	(0,000)	0,0330	(0,000)
EAm	0,0285	(0,000)	0,0365	(0,000)
HS	-0,0227	(0,056)	-0,0332	(0,000)
I	-0,0007	(0,045)	-0,0009	(0,000)
I^2	0,0000	(0,006)	0,0000	(0,000)
C	-0,0255	(0,373)	-0,0288	(0,005)
S	-0,0056	(0,825)	0,0192	(0,062)
A	-0,1959	(0,003)	-0,1651	(0,000)
RM	-0,1285	(0,000)		
R			-0,1608	(0,000)

Discussing the determinants of income per capita, when we define region in a more narrower way, we observe that the coefficients for height and education were positive, meaning that human capital investment made in an individual during childhood, and human capital investment made in an individual from childhood through adulthood. have a positive impact on the family´s per capita income. The same happens with the current health and nutritional status indicator (HS) (though the signal of the coefficient is negative, for the reasons already explained).

In what respect the control variables, Race had a negative but non significant coefficient. The coefficients for Gender, Area and Metropolitan Region were negative and significant, meaning that women, persons living in the rural areas and persons living in Fortaleza presented lower family income per capita. The coefficient for age ws negative and significan, meaning that older people tend to receive lower incomes.

The results obtained when we worked with a broader definition of Region were better, in terms of R square and of the significance of the coefficients. Again we observe that the coefficients for height and education were positive, meaning that human capital investment made in an individual during childhood, and human capital investment made in

an individual from childhood through adulthood. have a positive impact on the family´s per capita incomeand the same happens with the current health and nutritional status indicator (HS).

In what respect the control variables, Race, Area and Region presented negative and significant coefficients, meaning that negroes, persons living in the rural areas and persons living in the Northeast presented lower family income per capita. The coefficient for gender was positive and significant, therefore women tended to have higher incomes. Age presented a negative and significant coefficient , meaning that older people tend to receive lower incomes.

3. Relations among an Individual's Educational Attainment (EA) and his/her Height (H).

EAi = f(Hi)

Dep.Var.	Educational Attainment (EAi)			
R^2	0,11653		0,21754	
	β	Sig.	β	Sig.
α	4,2152	(0,000)	5,5939	(0,000)
H	0,0239	(0,007)	0,0164	(0,000)
I	-0,0016	(0,620)	-0,0012	(0,368)
I^2	0,0000	(0,977)	0,0000	(0,710)
C	-2,4002	(0,000)	-1,8132	(0,000)
S	-0,1297	(0,587)	-0,0133	(0,892)
A	-4,1903	(0,000)	-3,6646	(0,000)
RM	0,8271	(0,001)		
R			0,0153	(0,873)

This regression intend to verify the relationship between investment in human capital made during infancy, captured by the variable H, with investment in human capital made in an individual from childhood through adulthood, captured by the variable Educational Attainment (EA).

In both specifications the coefficient for height is positive and significantly different from zero, indicating that investment in human capital made during infancy is an important determinant of investment in human capital made from childhood through adulthood.

This characteristic does not differ among Regions, it is as important in the Southeast as it is in the Northeast (the coefficient for Region is not statistically significant different from zero). It does differ by race and area, that is, given the level of investment during infancy, white persons men and persons living in urban areas tend to have more years of schooling.

The coefficients for age are not statistically significant.

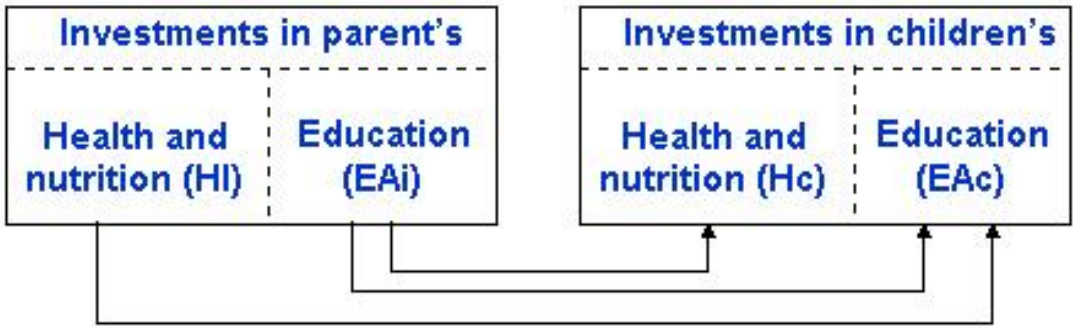
The regression were a narrower definition of region was used presented similar results. It just merits to be emphasized that, surprisingly the coefficient for metropolitan region was positive and significant, what was not expected, since the means presented in an earlier table showed that mena and women living in Fortaleza had less years of study than their counterparts living in São Paulo.

5.2 Intergenerational Transmission of Human Capital

Diagram 3 has been taken from Diagram 1 and will remind us of the relationships we are estimating on this second phase of our study.

DIAGRAM 3

IMPACT OF THE INVESTMENT IN HUMAN CAPITAL ON THE INTERGENERATIONAL TRANSMISSION OF THIS INVESTMENT.



The regressions for which children´s height is the dependent variable, refer to children in the age bracket 2 years (24 months) to 7 years (84 months) old. The regressions for which Educational Attainment Adequacy of the child is the dependent variable, refer to children in the age bracket 15 years (l80 months) to 21 years (252 months) old.

1. Relationship between the Child's Height (Hc) and Parents' Educational Attainment (EAp, EAm)

A child's height is a proxy of investments on health and nutrition made in children of the age bracket 2 to 7 and the parents' Educational Attainment is a proxy of the investment in human capital made in parents at a younger age.

Dependent Variable: Child's Height (Hc).

Independent Variables: Father´s Educational Attainment (EAp).and Mother´s Educational Attainment (EAm)

Control Variables:; Child's Age (Ic), Race (C) , Gender (S) Metropolitan Region (RM), Region (R)

Hc = f (EAi)

FAMILIES WITH YOUNGEST CHILD IN THE 2-7 AGE BRACKET

Dep.Var.	Height of Child (Hc)			
R^2	0,14601		0,12797	
	β	Sig.	β	Sig.
α	0,9521	(0,002)	0,5746	(0,000)
H				
EAp	0,0619	(0,037)	0,0522	(0,000)
EAm	-0,0157	(0,605)	0,0084	(0,518)
I	-0,0094	(0,000)	-0,0076	(0,000)
I^2	0,0000	(0,001)	0,0000	(0,000)
C	-0,1197	(0,588)	-0,0164	(0,835)
S	0,2101	(0,263)	0,1290	(0,084)
A	0,4206	(0,327)	-0,1681	(0,060)
RM	-0,5187	(0,014)		
R			-0,2223	(0,004)

Results show a positive impact from the father´s Educational Attainment - a proxy of the investment in human capital made in father´s at a younger age - .on the child's height - a proxy of investments on health and nutrition made in children of the age bracket 2 to 7 One should bear in mind that the father´s Educational Attainment has a two-fold role. It acts directly on the intergenerational transmission of human capital and acts also indirectly, since better educated father´s tend to have a higher family income and as a consequence are more efficient in the transmission of human capital to their children in the first two years of their lives. The results for the mother´s educational attainment were not significant , regardless of how we define region.

Discussing the results obtained when we used a narrower definition of region, we observed that the coefficient for race (C) was not significantly different from zero, as well the coefficients for gender and area. The coefficient for metropolitan region was negative and significant, therefore children living in Fortaleza tended to have a lower height, that is lower investments on health and nutrition were made in children of the age bracket 2 to 7 living in Fortaleza.

The results obtained using a broader definition of region also presented results for race not significantly different from zero.The coefficient for gender was positive and significant, meaning that girls tended to have higher investments on health and nutrition , the coefficients for area and region were negative and significant, meaning that children living in rural areas and in the Northeast tended to have lower investments on health and nutrition .

3. Relationship between the Educational Attainment (EAc) of individuals in the age bracket 15 to 21 and Parents' Educational Attainment (EAp, EAm)

Educational attainment of individuals in the age bracket 15 to 21 can be considered a measure of the outcome of investments in human capital made in parents when they were younger.

Dependent Variable: Child's Educational Attainment (EAc).

Independent Variable: Father´s Educational Attainment (EAp), Mother´s Educational Attainment (EAm).

Control Variables: Race (C), Gender (S), Metropolitan Region (RM), Region (R).

EAc = f (EAp, EAm)

FAMILIES WITH CHILDREN BETWEEN 15 AND 21

Dep.Var.	Child Education Index (EAc)			
R^2	0,59229		0,59975	
	β	Sig.	β	Sig.
α	34,9201	(0,138)	6,4410	(0,455)
H				
EAp	0,0124	(0,454)	0,0180	(0,011)
EAm	0,0263	(0,136)	0,0159	(0,030)
I	-0,2912	(0,143)	-0,0485	(0,502)
I^2	0,0006	(0,142)	0,0001	(0,513)
C	-0,0086	(0,936)	-0,0500	(0,299)
S	0,0364	(0,742)	0,1122	(0,026)
A			-0,2314	(0,000)
RM	-0,1068	(0,387)		
R			-0,0346	(0,464)

The results for Region were much better than the ones obtained for metropolitan region, so we will comment only the latter. Parents' education (father and mother) – a measure of the investment in human capital made in parent's when they were younger - bears a significantly positive influence on the child's educational attainment adequacy. The coefficient for race is not significant. The coefficient for gender is significant and positive, meaning that given the educational attainment of parent's, girls had a high educational attainment adequacy. The coefficient of the *dummy* variables for area and Region were negative and significant, therefore given the educational attainment of parent's and gender of the children, children living in urban areas and in São Paulo had a higher educational attainment adequacy .

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