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**Wealth and the Construction of Non-Cognitive Skills
The Case of Colombia ***

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The purpose of this article is to identify to what extent there is a causal relationship between wealth and non-cognitive skills for children in Colombia. This article contributes to the existing literature of skills formation in three ways. First, methodological shortcomings of previous works are addressed. Second, variables that have been omitted in earlier studies are included in this analysis. Third, this is first article with such objective in the context of Colombia. One of the major conclusions of the literature of skills formation, in the context of a developed economy is that income has a limited impact in this process. The results of this study suggest that might not be the case in developing countries.

Key Words: Health, Education, and Welfare: General; Children; Skills; Human Development

JEL Classification: I00; J13; J24; O150

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**La riqueza de los hogares y la producción de habilidades no cognitivas:
El caso colombiano***

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El objetivo de este artículo es identificar hasta qué punto existe una relación causal entre la riqueza de los hogares y la producción de habilidades no cognitivas de los niños en Colombia. El artículo contribuye a la literatura en tres puntos. Primero, se desarrollan algunas de las limitaciones metodológicas de la literatura. Segundo, se incluyen variables que han sido omitidas en el pasado. Tercero, es el primer artículo con este objetivo en Colombia. Una de las principales conclusiones de la literatura indica que no hay relación entre el ingreso y la producción de habilidades no cognitivas en el contexto de una economía desarrollada. Los resultados de este artículo sugieren que este podría no ser el caso en economías en desarrollo.

Key Words: Health, Education, and Welfare: General; Children; Skills; Human Development

JEL Classification: I00; J13; J24; O150

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I Introduction

The complex problems faced by Colombian society can be most appreciated by looking at the high levels of poverty and inequality¹. For this reason, many studies and policies have been implemented in order to improve the material conditions of people living in poor households². Most of these policies and studies have been designed in order to accomplish the United Nations Millennium Development Goals (MDGs). Surprisingly, there is no reference to psychosocial development in the MDGs, although literature pointing out its importance is abundant (Cunha & Heckman, 2007; Heckman, Stixrud & Urza, 2006, and Bowels, Gintis & Osborne, 2001.)

Psychosocial development in early childhood is defined as a process in which the child incorporates his interaction with the physical and social environment to accomplish increasingly complex levels of movements and actions, thoughts, language, emotions and feelings, and relationships with others (UNICEF, 2004.) A child with an adequate psychosocial development performs pro-social and cooperative acts and does not report high levels of anti-social or non-cooperative behavior. The economic literature has often used the term *non-cognitive skills* to refer to the aforementioned process³.

The purpose of this study is to identify the extent to which wealth has an impact on the construction of non-cognitive skills during early childhood. There is a series of limitations in the literature on psychosocial development which will be solved in the article. First, although the study of non-cognitive skills is currently receiving a great deal of attention in Economics, there are not many studies in the context of a developing country and there is not a single one for the case of Colombia. This is a matter of great importance because the conclusions of studies based on developed economies can not be applied to developing countries given the vast economic and social disparities.

One of the biggest limitations of studies based on developing economies (e.g. Camfield et al., 2009; Anselmi et al., 2004, and Dercon & Krishnan, 2009) is ignoring the unobserved heterogeneity between households' wealth and the stock of non-cognitive skills: it is reasonable to assume that richer households are systematically different to poorer ones in non-observable characteristics (innate cognitive development and social capital, among many others.) Thus, it is plausible that OLS estimates are biased. To deal with this endogenous relationship we use information on home ownership and wage-payment frequency as instruments for wealth.

A further drawback in many studies on non-cognitive skills in developing economies is to omit the simultaneous determination between cognitive and psychosocial development. When a

¹In 2008, 46% of the population lived under the national poverty line and the Gini coefficient was 0.59. (DNP 2009.) In 1996, such indicators were 50.9% and 0.57 respectively. In 2005, Colombia was considered the 15th country with the worst income distribution in the world (World Bank 2009.)

²Some of these policies are: Hogares Comunitarios de Bienestar, Familias en Acción, Comedores Comunitarios and Familias Guardabosques.

³Even though non-cognitive skills include a great number of features (psychosocial development, inhibitory skill, cognitive flexibility, functional memory), the economic literature uses it to refer to children's psychosocial development. See, for example, Cunha & Heckman (2007), Cunha, Heckman & Schennach (2010), Heckman, Stixrud & Urzúa (2006) and López (2009.)

child has a higher stock of non-cognitive skills, his or her cognitive skills are enhanced. These skills, in turn, foster psychosocial development (Cunha, Heckman & Schennach, 2010). Studies that have been successful in overcoming this limitation do so using panel data, as the process of skill formation is dynamic. However, the information available for this article is cross-sectional. To deal with the simultaneous relationship between the two processes a numerical simulation is performed.

Finally, using the data collected for the impact evaluation of the *Hogares Comunitarios de Bienestar* childcare program (Bernal et al. 2009) we take into account in the econometric analysis various features that can affect the process of psychosocial development but that have been omitted in most of previous studies. It is reasonable to assume, for instance, that social capital, child abuse, age of mother at the time of pregnancy, among others can have serious implications in the production of non-cognitive skills. To do so, we will estimate a psychosocial development production function as proposed in Todd & Wolpin (2006).

The article has the following structure: Section II contains a brief review of the literature on the importance of studying the determinants of non-cognitive skills. Section III presents a literature review on the determinants of psychosocial development. Section IV summarizes the methodology applied in this study. Section V provides a brief description of the data. In Section VI, the results of the study are discussed. Section VII concludes.

2 The importance of studying the determinants of Psychosocial Development

Herrnstein & Murray (1994) and Jensen (1998) state that non-cognitive skills do not determine the performance of individuals in the labor market. The authors claim that cognitive skills are the sole ability recognized in the labor market. In addition, they state that large part of cognitive skills is predetermined by genetics. If this were true, the scope for any policy aimed at improving the job performance of individuals would be limited.

However, these results have been challenged by overwhelming evidence. Among the studies stressing the importance of non-cognitive skills in the labor market are Heckman, Stixrud & Urzua's (2006), who find that a movement from the first decile to the last one in non-cognitive skills increases wage in the same proportion as a symmetric movement in cognitive abilities would. Bowels, Gintis & Osborne (2001) find that a significant fraction of the wage gap unexplained by a standard Mincer equation is due to non-cognitive skills omitted in this type of analyses, but recognized in the labor market. In addition to highlighting the importance of non-cognitive skills as determinants of a person's job performance, Bowels & Nelson (1994) and Borghans et al. (2008) argue that part of the relevance of such skills lie in the fact that these are much more malleable than cognitive ones⁴.

⁴Other works with similar results include Gould, Lavy & Paserman (2009); Carneiro, Hansen & Heckman (2003); Cunha, Heckman & Navarro (2005); Heckman, Lochner & Todd (2006); Murnane & Levy (1996); Cunha & Heckman (2007); Cunha, Heckman & Schennach (2010.) Non-cognitive skills are more malleable than cognitive skills because the prefrontal cortex, the brain's area in control of social interaction, closes completely at age 20. In contrast, cognitive skills are stabilized at about age 10 (Hopkins & Bracht, 1975.)

In addition to significantly influence job performance, having an inadequate psychosocial profile may increase the incidence of disease in adulthood. Having an inappropriate psychosocial development increases the likelihood of any type of coronary artery disease (Strike & Steptoe, 2004 and Cohen, 1988), sexual impotence (Levy, 1994), recurrence of genital herpes (McLarnon & Kaloupek, 1988), lower back problems (Schultz et al., 2004), and alcohol or psychoactive substances abuse (Machado, 2005 and Cohen, 1988). In addition to health, crime is also associated with an inadequate psychosocial profile⁵.

Studying how wealth determines the construction of non-cognitive skills in children under six years of age in Colombia is, therefore, extremely important as an increase in these kinds of skills should be understood as a private and social gain. The reason why this paper focuses on early childhood is because this is the period when cognitive and non-cognitive skills are more malleable. Partly because of that, investments in human capital, understood as improvements in any kind of skills, find greater profitability in this period (Heckman, 2006, Cunha & Heckman, 2007, and Bernal & Camacho, 2010 for the Colombian case; see Graph 1.)

3 Literature review

Korenman, Miller & Sjaastad (1994) and Duncan, Klebanov & Brooks-Gun (1994), through OLS estimates, using city fixed effects, find a positive relationship between wealth and psychosocial development. Berger, Paxson & Waldfogel (2009), using nonparametric methods, find that children located in the lowest part of the distribution of wealth report more behavioral and aggression problems, two facts associated with having a poor psychosocial profile. The authors suggest that this relationship can arise due to physical conditions: poorest households tend to have substandard housing (e.g. inadequate roof, wall and floor materials, among others), which can significantly affect the development of cognitive and non-cognitive skills in children. Many studies on psychology have arrived to similar conclusions (Mayer, 1997.)

It is worth mentioning that the aforementioned articles conclude that wealth affects the development of non-cognitive skills in children while ignoring the endogeneity between wealth and the psychosocial profile: richer households may differ systematically in unobserved characteristics from their poorer counterparts, characteristics that may, in turn, alter the process of skills formation. Blau (1999), for instance, notes that studies aimed at identifying the role of income as a determinant of children's skills should be aware of this fact. The author states that, once the appropriate econometric techniques are applied, there are three major facts on how wealth affects the process of skill formation:

1. The impact of current income on child development is low;
2. The effect of permanent income on child development is larger than that of the current income, but its impact is significantly reduced as more variables are included in the analysis;
3. The impact of permanent income on child development is quite low compared to other characteristics, such as gender and household and mother's characteristics.

⁵See for example Rexford (1959); Losel & Beelman (2003); Rutter, Giller & Hagel (1998); Barylnik (2004) and Cunha & Heckman (2007.)

The author reaches the above cited conclusions based on a review of the existing literature and through his own estimates, using longitudinal data for children in the United States. Mayer (1997) draws the same conclusions using previous income as an instrument for current income. Additionally, after a comprehensive literature review, she notes that articles in psychology declaring that income affects psychosocial development do not deal properly with unobserved heterogeneity.

Dahl & Lockner (2008) use variations in the Earned Income Tax Credit (EITC) legislation as an instrument for current income. The EITC is a monetary subsidy granted to lower-income households in the United States. Since each state is autonomous in its implementation, there have been many changes throughout the country. The authors take this exogenous variation in income as an instrument for wealth and solve, at least partially, the problem of unobserved heterogeneity. They conclude that the impact of income on children's cognitive and non-cognitive skills is limited.

Dooley & Stewart (2007) use a similar strategy. Their objective is to identify the impact of current income on the cognitive and psychosocial development of children. The authors implemented three strategies: OLS estimates, Fixed Effects estimates and Instrumental Variables (IV) estimates. In the first case, the authors find that an increase in monthly income of \$1,000 Canadian dollars improves the score of the behavioral test used (BPI) by 0.15 standard deviations. The authors consider this to be a reduced impact. In the IV specification, the authors, as well as Dahl & Lochkner (2008), use different income shocks as instruments for current income. In this case, and in the fixed effects estimates, the authors find that there is no relationship between household income and production of non-cognitive skills. Their main conclusion is that there is virtually no relationship between current income and children's psychosocial development.

Phipps, Burton & Curtis (2002) develop a structural model where there is a simultaneous interaction between children's behavior and parental care practices. This an econometric model where a variable of children's behavioral problems is used as the dependent variable and a dichotomous variable indicating whether the child lives in a low-income household or not is used, among many others, as an independent variable. The authors find that there is no significant impact of income on children's psychosocial development. A potential problem with this study is that poverty is defined using monthly income rather than permanent income, as used in Blau (1999) and Dahl & Lockner (2008). Also, the authors use the proportion of neighbors without high school diploma as an instrument for poverty status. While it is likely that this instrument is relevant, it might not be orthogonal: it is reasonable to assume that living in a more educated environment benefits the psychosocial development of children. For example, college-educated parents are more aware and have more information about appropriate parenting practices (Durlauf, 1996.)

The aforementioned studies conclude that wealth determines psychosocial development in a very limited scope. However, it is worth noting that these studies arrive to this conclusion solely in the context of a developed economy, which is the case of the U.S. and Canada. These results may not apply to a developing economy such as Colombia, given the social and economic disparities. Anselmi et al. (2004), for example, analyze the determinants of cognitive and psychosocial development of children in Brazil through variance decomposition analysis and various OLS specifications.

In both cases, they find that the quality of the physical environment has a significant impact on the production of skills of children, explaining about 28% of the variance in the test used to measure cognitive and non-cognitive skills in children.

Dercon & Krishnan (2009), through OLS, find that there is a strong relationship between households' material conditions and psychosocial development in the cases of Ethiopia, India, Peru and Vietnam. The authors do not use a measure of current income, but rather of monthly consumption per capita. They find that this consumption variable have the most predictive power on social and emotional development test results.

Camfield et al. (2009) summarize the results of qualitative studies in developing countries. The major part of these studies are based on analysis of individual cases through interviews with qualified experts. The authors find that in the analyzed studies –where Ethiopia, Peru, Vietnam, India, Bangladesh, Thailand and South Africa are included-it is common to find children with traumatic experiences, affecting negatively psychosocial profile of children. The authors claim that most of the people link this experience with the fact of coming from a poor family.

Several hypotheses have been laid on the mechanism in which wealth can affect non-cognitive skills in children. Grantham-McGregor et al. (2007) sustain that poverty undermines the development of cognitive and non-cognitive skills of children in two different ways. First by not having enough resources, impoverished children have a high probability of having nutritional deficiencies, leading to chronic malnutrition. Thus, the child's biological capacity to develop the full potential of his motor, social and cognitive skills is reduced. Second, members of poor households have lower levels of education and higher levels of stress. These circumstances modifies the type of care received by children.

Saxena, S. Jané-Llopis, & E. Hosman, C. (2006) mention a number of factors related with poverty that might have a negative impact on the process of non-cognitive skills formation. These include chronic insomnia, alcohol abuse, consumption of hallucinogenics, high rates of exposure to violence and stress. Although they do not present empirical evidence, the authors consider improvement of household quality as a valid policy to pick up the stock of non-cognitive skills of children. Camfield (2010), in a qualitative study in Ethiopia, finds that another way poverty can affect children's psychosocial development is by lack of access to cultural goods.

In summary, we know that the impact of transient income on the development of different types of skills in children is quite small in developed economies. However, the impact of permanent income or household wealth is greater than that of transient income, but still of reduced magnitude if compared with other household or mother's characteristics. In developing economies, it seems that wealth plays a more substantial role in determining the cognitive and non-cognitive skills of children than in the case of developed economies. There is econometric, biological and sociological evidence supporting this fact. However, the econometric evidence, which quantifies the impact, does not deal adequately with unobserved heterogeneity. Furthermore, Cunha & Heckman (2007) and Cunha, Heckman & Schennach (2010) claim that cognitive and non-cognitive skills are somehow determined simultaneously, as higher levels of cognitive skills enhance non-cognitive

development and vice versa. This fact is ignored in all the studies revised focused in developing economies.

The main contribution of this paper is the attempt to identify how wealth determines the construction of non-cognitive skills, dealing with the problem of unobserved heterogeneity the simultaneous determination between cognitive abilities and not cognitive ones.

4 Data

The data used for this study is a survey developed to perform an impact evaluation of the Hogares Comunitarios de Bienestar (HCB) childcare program. Created in 1986, HCB provide, among other services, childcare and food supply for children ages 1 to 6, living in poverty.⁶

The database was developed to assess HCB's impact on different characteristics of the children and their families. Data was collected in 2007 from 12,925 HCB beneficiaries and 14,545 non-beneficiaries, totaling 27,470. The study's target population was constituted by children no older than 7 living in zones 1 and 2 according to SISBEN ⁷ in both rural and urban areas.

Individuals targeted in the study were selected from 70 municipalities coming from the 32 departments of Colombia and Bogotá. Data was collected from children participating in the HCB (44.8% of the sample) and non-participants. Children in the latter group were not beneficiaries either because they live in towns where the program is not offered (10.6% of the sample) or because they are not eligible for different reasons (44.6 %).⁸

In order to establish the level of children's psychosocial development the Early Development Instrument (EDI) is used⁹. This is an instrument of maternal report that allows identification of physical, social and emotional competency and level of cognitive and language development¹⁰. The level of psychosocial development is derived from 26 items related to the following areas: competency and cooperation when interacting with other children, ability to remember and follow instructions, curiosity and enthusiasm, and problem-fixing manner (Janus & Offord 2007.) Each item has three possible answers related to the quality or frequency of specific activities performed by children. The responses range from 1 to 3, with 1 being very good or always, 2 normal or sometimes, and 3 bad or never. The questions include the frequency in which a child follows instructions; shows respect for others and their possessions; gets involved in physical fights; accepts responsibility for his actions; looks fearful, anxious, sad, depressed or preoccupied. The average

⁶The requirements to participate in an HCB include being younger than seven and being considered poor and vulnerable to poverty. However, these requirements are not very strict, and consequently, they are considered to be "informal" (Bernal et al. 2006.)

⁷SISBENi (the selection system of social programs' beneficiaries) scores households according to their socio-economical features to identify the beneficiaries of each kind of program. The population with a score of 1 is the most vulnerable group in socio-economical terms, followed by the population with a score of 2.

⁸Among the reasons for non-participation are the distance, unavailability of spots or lack of information about the programs.

⁹The spanish version of this instrument has been validated and used Colombia (Bernal et al., 2009); Chile (UNICEF, 2010) and Mexico (Naudeau et al. 2010)

¹⁰Although based on the mother's account (subjective), the results of these reports do correlate to professional reports (Janus & Offord, 2007.)

score is computed in such way that the higher the EDI, the weaker the socio-emotional profile.

In order to identify the level of cognitive development of children, EDI's subscale on cognitive development is used. The subscale has 12 items and each one has three different responses: yes, no, do not know. The questions ask, for example, if the child is able to count to 20, sort numbers, read simple sentences with or without help, and solve math problems.

In addition to this information, the database also reports information on variables whose impact on psychosocial development has not yet been analyzed. Some of these variables are: information on pregnancy intentions, general nutritional status, household features, educational resources at home, and characteristics of the child's community, among others.

In order to define the set of variables included in the econometric specification I take into account the characteristics that previous studies have found as relevant for the process of non-cognitive skills. However, I also include a set of variables that have not yet been analyzed by the literature but that might have an impact on psychosocial development such as household's social capital. The variables included are reported in Table 1A, depending on whether they are at the individual or household level. On Table 1B, their statistics are reported.

5 Methodology

Todd & Wolpin (2006), TW hereinafter, summarize the economic models of skill formation depending on the data available and the assumptions made by the researcher. These methodologies aim to estimate a production function of skill γ for an individual i living in household j at the age of a :

$$\gamma_{ija} = \sum_{m=1}^a [\theta_{ij(a-m+1)}\alpha_m + \phi_{j(a-m+1)}\beta_m + \vartheta_{ij(a-m+1)}\rho_m] + \pi_j + \varepsilon_{ija} \quad (1)$$

where θ_{ijm} are inputs available for the individual at age m , ϕ_{jm} are inputs available at the household, ϑ_{ijm} are non-observable inputs, ε_{ija} is the error term π_j is the household fixed effect. The variables used for the econometric specification are presented in Table 1A. The advantage of this methodology lies in the fact that all inputs affecting an individual since birth have been taken into account. However, HCB survey does not include inputs available for every specific age, and consequently, adjustments proposed by the authors for this kind of situations are necessary. Given the available information, it is important to make two assumptions. First, we assume that only current inputs matter, instead of cumulative investments since birth (*S1*.) A consequence of this assumption is that the impact of past experiences on the child is not taken into account. For instance, it is not possible to account for a change in household material conditions. If, in the past the family enjoyed better quality goods and services than what they have now, this fact will be ignored in the model. Nevertheless, this current input assumption is common in the economic literature when using this kind of data (Dercon & Krishnan, 2009 and Phipps, Burton & Curtis, 2002.)

Assumption 1

Current inputs are the only ones effecting children's psychosocial development

$$\theta_{ijk} = 0; \quad \forall k \neq a \quad \forall i, j \quad (S1)$$

It is also necessary to assume that the impact of current inputs is independent of the individual's age (S2). For example, having access to potable water impacts a six year old the same as a three year old. Such assumption is very common not only in literature on cognitive and psychosocial development (Dercon & Krishnan, 2009 and Phipps, Burton & Curtis, 2002.) but also in literature on returns to education¹¹

Assumption 2

The impact of inputs on psychosocial development is orthogonal to the age

$$\begin{aligned} \alpha &= \alpha_k = \alpha_l; \quad k, l = 1, 2 \dots m \\ \beta &= \beta_k = \beta_l; \quad k, l = 1, 2 \dots m \end{aligned} \quad (S2)$$

Taking into account (S1) and (S2), equation (1) results in:

$$\gamma_{ija} = \theta_{ij}\alpha + \phi_j\beta + \vartheta_{ij}\rho + \pi_j + \varepsilon_{ij} \quad (2)$$

The main assumption to obtain consistent estimators through OLS is the conditional independency of non-observables and covariates.

Assumption 3

Non-observables are independent to covariates in equation (2)

$$E[\varepsilon_{ij}|\theta_{ij}, \phi_j] = E[\pi_j|\theta_{ij}, \phi_j] = E[\vartheta_{ij}|\theta_{ij}, \phi_j] = 0 \quad (S3)$$

In the case that (S3) does not hold, TW suggest an IV or a fixed effects estimation. As Variance-Covariance matrix may have different forms, equation (2) is estimated through OLS, OLS random effects at the household level and by fixed effects among siblings.¹²

For the wealth index, Principal Component Analysis of several household's characteristics was used. Following Blau's (1999) suggestion, this index reports a much more structural level of wealth than a measurement of current income, since physical characteristics of the household and access to several public services are taken into account. This group of variables includes access to natural gas, water, sewage, trash collection, electricity, and exclusive use of a toilet. Durable goods such as TV, refrigerator, blender, stereo, washing machine, stove, water heater, and car are also

¹¹See for instance Blinder (1976).

¹²For the fixed effects estimates sample size is significantly reduced. Also, through Hausman's test the null hypothesis of having consistent estimates through random effects can not be rejected. Furthermore, many of the variables do not vary among siblings (e.g. wealth level)

taken into account. Finally, specific characteristics such as number of bedrooms, exclusive use of kitchen, flooring material, and walls material are considered. This wealth index has been previously used (Bernal et al. 2009). To facilitate the interpretation of this index, it is scaled between 0 – 100.

6 Results

Tables 2A and 2B report descriptive statistics on standardized EDI scores depending on children and households' characteristics. On table 2A individuals are divided between those whose value is above or below the mean for each variable and average EDI is computed for both groups. It is important to note that EDI differs significantly between those above and below the mean for every variable reported. Table 2B reports differences between groups generated by a dichotomous variable. As in Table 2A, all variables seem to affect children's psychosocial development with the exception of displacement by violent causes, caretaker's gender and pregnancy intentions.

Table 3 reports estimation results of equation (2). Although all variables reported on Table 1A were included in the econometric specification, this table reports the coefficients of variables with some statistical relevance. Besides variables reported in Table 1A, a fixed effect for municipality was included in the specification. First column reports OLS estimates of (2) . As Breusch-Pagan test brings some evidence on the existence of a non-observable household fixed effect (π_j), a random effects model was estimated and reported in column (2). In addition to this, a fixed effects model of differences among siblings is reported in column (3) in case (S3) does not hold¹³. The order in which variables are presented depend on the magnitude of their standardized coefficients, reported on column (4) .

There seems to be a correlation between wealth and non-cognitive skills. According to estimates on columns (1) and (2), a 1% increase in wealth level reduces EDI score in 0.01 standard deviations¹⁴. As mentioned before, studies on the determinants of psychosocial development in developed economies find that, in case there is a relationship between wealth and psychosocial development its magnitude is negligible. However, results on Table 3 suggest this might not be the case in Colombia as wealth has a large impact on psychosocial development, compared with most of the variables included in the analysis.

An interesting feature that can be seen in Figure 2 is that gaps on psychosocial development associated with socioeconomic status emerge at 36 months of age. However, as can be seen in Figures 3 and 4, gaps on cognitive development appear after 3 years of age (Paxson & Schady, 2007.) This suggests that, contrary to cognitive skills, programs and policies intended to improve non-cognitive abilities should have an important component on ages before 3¹⁵.

Dealing with Unobserved Heterogeneity

¹³From (2) it is evident that the error term can be decomposed in a idiosyncratic term ε_{ija} and a household term (π_j). Null hypothesis of zero variance of the term (π_j) is rejected. $\chi^2 = 99.56$ P-value=0.00. When comparing random and fixed effects estimates-through Hausman test- we cannot say that these two estimates are different.

¹⁴It is worth noting that a reduction in EDI score implies an improvement in psychosocial profile.

¹⁵In Colombia, there is evidence suggesting that these gaps are much more evident in rural than in urban zones.

Dahl & Lockner (2008), Blau (1999), Burton et al. (2002), Cunha & Heckman (2007) and Cunha, Heckman & Schennach (2010) argue that OLS estimates might be biased due to unobserved heterogeneity. Wealthier households could systematically differ to the poorer ones in non-observable characteristics and (S3). will no longer hold. On one hand, wealthier households have a higher level of innate cognitive skills and, consequently, OLS estimates could overestimate the impact of wealth on non-cognitive skills. On the other hand, as wealth increases, the number of at-home mothers decreases as well as the time the primary caregiver spends with the child while mother's participation on labor market increases (see Figure 5.) There is evidence pointing out the negative impact of these facts on psychosocial development (Bernal, 2008). The direction of the OLS bias, thus, is not evident. Richer households display a higher level of innate cognitive skills, but at the same time, they show an inferior resource allocation (particularly amount and quality of time) in the development of non-cognitive skills in children.

Articles trying to deal with wealth this endogenous relation report estimates through IV (Burton et al., 2002 and Dahl and Lockner, 2008) and those with proper data available, estimate such equations through individual fixed effects over time (Blau, 1999; Cunha & Heckman, 2007; Cunha, Heckman & Schennach, 2010.) Given that information used for this study is cross-sectional, one way to get unbiased estimates would be through IV using instruments varying along with wealth and orthogonal to non-observable characteristics. The instruments used in this article are house tenancy characteristics and the frequency with which household's head receives his/her wage.

Relevance of house tenancy is straightforward as richer families are more likely to own the place of residence while poorer ones must look for alternatives (Nuñez and Espinosa, 2005.) Among these alternatives, people can rent a place, live with relatives or usufruct a place (people occupying someone else's house without paying rent, but with owner's authorization are called usufructuaries.) It is much more common to find these types of arrangements in poorest families, as is reported in Table 4. The relationship between house tenancy and wealth level is evident: wealthier families are more likely to own their place of residence while the proportion of households being usufructuaries increases as income decreases.

On the validity of this instrument, the impact of house tenancy on children's cognitive and psychosocial development has been analyzed in Haurin, Parcel & Haurin (2002.) This paper finds two different channels through which house tenancy could affect production of skills in children. On one hand, families living in their own house have more incentives to invest in improvements and maintenance (e.g. flooring material, roof, and walls among others.) On the other hand, owning a house reduces incentives to migration and, as migration affects negatively the production of skills in children, owning a house improves indirectly psychosocial development in children. Green & White (1997) study possible systematic differences between families who are homeowners and those who are not. The authors find that, besides wealth itself, there are no systematic differences that might affect children's development. Given the fact that house tenancy affects the production of skills indirectly, through wealth (the variable instrumented) and incentives to migrate, if we

include a variable indicating migration status of households, we can consider house tenancy as being orthogonal to non-observables determining production of non-cognitive skills. Two dichotomous variables will be used as instrument of household wealth. One is whether the household owns a house and pays mortgage, and the other, whether the household is usufructuarie or not.

As a robustness check on the main results, the frequency with which the head of household receives payment for his work is also used as instrument for wealth. Two dichotomous variables are used to indicate whether the head of household receives its payment monthly and another one indicating whether the frequency is weekly or not. Table 5 shows there is an inverse relationship between the wealth and this frequency. In the richest quintile, 39.6% of heads of household receive monthly payment and 16.1% weekly payment. In the lowest wealth quintile the numbers are 47% and 12.2% respectively. However, when using frequency as instrument, the number of observations declines substantially as seen on Table 6. This is due to the fact that those who report frequency are mostly employees while those not reporting frequency are mostly self-employed or employers. Taking this into account, it is important to emphasize that we are not working with the general population, but a limited group. Such limitation does not jeopardize the validity of the estimations, but interpretation on the results should be done at the local level and could not be extrapolated to the general population.

Table 5 reports the results of the two stages. It is evident that the instruments chosen are relevant as these are statistically significant at 1% level in the different specifications. The relevance of the instruments is supported by the results reported on Table 6. Results of first stage estimates show that these instruments are relevant not only because of the increase in the R-squared but also because of the results for the Anderson and Cragg-Donald tests.

Table 7 reports the results of different tests used to identify to what extent these instruments are exogenous. The first test was a simple OLS regression using EDI score as dependent variable and variables in Table 1A as independent ones. It is worth noting that there is not a substantial increase in the R-squared (although not reported, adjusted R-squared remains constant for all estimations) and in none of the specifications the coefficients associated to the instruments are statistically significant. Sargan's exogeneity test also gives some evidence on the exogeneity of the instruments (Hansen's test also but it is not reported).

Sargan and Hansen test exogeneity in every instrument assuming that at least one of them is orthogonal to the unobserved term. The C test is similar to a Sargan test but there is a set of specific instruments excluded from the orthogonality assumption. In order to guarantee the exogeneity of the instruments, this test was done 1,000 times where random placebo instruments were generated from a uniform distribution between zero and one. In all of these repetitions the real instruments were excluded from the orthogonality assumption. The placebo instruments are obviously exogenous. In 97% of the cases the test shows that the real instruments are exogenous.

The validity of the instruments relies on the fact that there are no differences between owners and usufructuaries households in non-observable characteristics that may affect the development of non-cognitive abilities in children. Besides wealth, the only difference between these two types

of households is the incentive to move, according to Haurin, Parcel & Haurin (2002.) In order to guarantee the validity of this instrument, the number of years a child has lived in a house is incorporated as explanatory variable. Including this variable in the regressions does not modify the main results. If homeownership and quality of time devoted to children are correlated, this should be reflected in differences in childcare practices. However, there are no differences in the amount and quality of time (quality measured using the index developed in Bernal, Fernández & Peña) associated with home ownership characteristics.

It is also reasonable to assume that holding everything else constant, the fact that the frequency of payment to the household head is changed from monthly to weekly should not affect the construction of socio-emotional skills in children. Even though it is not reported in this article different categories of house tenancy were used (categories such as, de facto resident among others) and different instruments suggested by Burton et al. (2002.)¹⁶. In all these cases, the impact of wealth on psychosocial development is the same as the one estimated using the two categories for house tenancy as instrument of wealth level.

Estimates using house tenancy and frequency of payment as instruments for wealth show that an increase of one unit in the wealth index improves the EDI test of psychosocial development by 0.02 standard deviations. These results are found using each set of instruments separately and using them altogether. While it is true that wealthier households have better innate cognitive skills than their poorer counterparts, it is also true that the richer ones spend less time on childcare. This is evident in the high indexes of maternal work, in the few hours that care takers spend with children, and the small number of stay-at-home mothers. It has been observed that an increase in maternal labor supply (by increasing the number of work hours or by returning to work) and the delegation of child care, affect negatively the construction of skills in children (Bernal, 2008.) Taking these findings into account, it is not surprising to see that the results of OLS underestimate the impact of wealth on children's psychosocial development.

In addition to the estimated results, monthly income for the household head (in hundreds of thousands of pesos) is used to evaluate whether or not monetary income affects psychosocial development to the same extent as wealth does. This estimates show that the effect of monetary income on psychosocial development is not statistically significant. The results are consistent with evidence findings from Blau (1999), Dahl & Lochner (2008) and Dooley & Stewart (2007) in the sense that it is structural and long-term wealth, not current monetary income, the one that has impacts on the construction of skills. However, and contrary to the results of the previously cited articles, in Colombia wealth does happen to be one of the main determinants of psychosocial development due to the magnitude of its coefficient. As shown on Table 3, when estimating through instrumental variables, wealth maintains its magnitude. This is possible because wealth might affect psychosocial development only until some specific threshold. In developed economies, most households surpass the threshold while in underdeveloped economies, many do not.

¹⁶Among the instruments suggested by Burton et al. (2002) are average years of education of head of households within the neighborhood and category of employment of the person economically responsible of the child. Estimates results using these instruments do not change dramatically. However, these are not included in the article as the exogeneity of the instruments might be hard to prove. This, particularly because of the externalities on human capital.

Wealth and Psychosocial Development in a Scenario of Simultaneous Determination between Cognitive and Non-Cognitive Skills

Cunha & Heckman (2007) find a positive relationship between cognitive and non-cognitive skills. An increase in either of these type of skills translates into an improvement of the other. An extension proposed in this paper is to analyze the process of skill formation under this scenario. The structural model of cognitive and non-cognitive formation is determined by equation (5):

$$Y\Gamma = \Theta A + \Phi B + E \quad (3)$$

where Y contains the information on psychosocial and cognitive development –the variables determined simultaneously—for the n are the individuals:

$$Y = \begin{bmatrix} y'_1 \\ \vdots \\ y'_n \end{bmatrix} \quad (4)$$

$$y'_i = \begin{bmatrix} \gamma_{ija}^P & \gamma_{ija}^C \end{bmatrix} \quad (5)$$

Where γ_{ija}^h is a measure of psychosocial (P) or cognitive (C). Matrix $\Gamma_{2 \times 2}$ reveals the structure of the mutual-determination between psychosocial and cognitive development. Matrix $\Gamma_{2 \times 2}$ has the following structure:

$$\Gamma = \begin{bmatrix} 1 & -\rho_{CP} \\ -\rho_{CP} & 1 \end{bmatrix} \quad (6)$$

where ρ_{PC} is the coefficient indicating to what extent is psychosocial development determined by its cognitive counterpart. ρ_{CP} is defined the other way around. Matrix $\Gamma_{2 \times 2}$ has the following property: for all non-null vector $z \in \mathbf{R}^2$, $z'\Gamma z > 0$ must hold (positive-definite). This property is based on the assumption that $\rho_{CP}, \rho_{PC} < 1$: it is not reasonable to assume that a change in cognitive (non-cognitive) skills may affect non-cognitive (cognitive) skills in a higher magnitude. Furthermore, we assume that $\rho_{CP}, \rho_{PC} \geq 0$, this is: the process of simultaneous determination of skills, in case there is any, should be positive (Cunha & Heckman, 2007 and Cunha, Heckman & Schennach, 2010.) Matrixes Θ and Φ contain the information on independent variables:

$$\Theta = \begin{bmatrix} \theta'_1 \\ \vdots \\ \theta'_n \end{bmatrix} \quad (7)$$

and vector θ'_i is a row vector containing the information on k independent variables for individual i :

$$\theta'_i = \left[\theta_i^1 \quad \theta_i^2 \quad \dots \quad \theta_i^k \right] \quad (8)$$

Matrix Φ is defined similarly. Matrix A and B contain the coefficients indicating how variables in Θ and Φ alter psychosocial and cognitive development respectively:

$$A = \begin{bmatrix} \alpha_1^P & \alpha_1^C \\ \vdots & \vdots \\ \alpha_k^P & \alpha_k^C \end{bmatrix} \quad (9)$$

and in an analogous way, matrix B is defined. Finally, matrix E contains the non-observables.

By ignoring the double determination between psychosocial and cognitive development, we get estimates for:

$$YI_2 = \tilde{A} + \Phi\tilde{B} + \tilde{E} \quad (10)$$

Where OLS estimates of \tilde{A} and \tilde{B} are reduced form estimates of A and B . Estimates of \tilde{A} and \tilde{B} through OLS could be biased because of the simultaneous determination of cognitive and non-cognitive skills. However, given that Γ is a full-rank matrix, equations (5) and (11) can be used to get the following expression:

$$Y = Y\Gamma\Gamma^{-1} = \Theta A\Gamma^{-1} + \Phi B\Gamma^{-1} + E\Gamma^{-1} = \Theta\tilde{A} + \Phi\tilde{B} + \tilde{E} \quad (11)$$

This takes us to equation (12), which determines the relationship between structural and reduced form coefficients:

$$\begin{bmatrix} A \\ B \end{bmatrix} \Gamma^{-1} = \begin{bmatrix} \tilde{A} \\ \tilde{B} \end{bmatrix} \quad (12)$$

Now, we are taking into account the possibility of a simultaneous determination between psychosocial and cognitive development. Consequently, it is necessary to take this into account when quantifying the impact of wealth on psychosocial development. Even though it is not clear yet how a type of skill affects the other, Cunha, Heckman & Schechman (2010) perform some exercises in order to get estimates for ρ_{CP} and ρ_{PC} . They find that, on one scenario, an increase of one standard deviation on cognitive skills leads to an improvement of 0.208 standard deviations in psychosocial development and the same for the other way around ($\rho_{CP} = \rho_{PC} \approx 0.208$). However, the authors consider an alternative scenario where an increase of one standard deviation in the cognitive skills does not improve psychosocial development at all while an increase of one standard deviation in the non-cognitive skills improves the cognitive ones by 0.4 standard deviations.

It is still necessary to go deeper in the analysis of how psychosocial and cognitive skills are mutually correlated. Nonetheless, on Figure 6, the impact of wealth level on psychosocial development is plotted for different possible correlations between the two skills. On the first panel, we

see how wealth impacts the EDI standardized score assuming a symmetric impact: $\rho_{CP} = \rho_{PC}$. We see that in the case where there is not determination between psychosocial and cognitive development ($\rho_{CP} = \rho_{PC} = 0$), the impact of wealth on psychosocial development coincides with IV estimates (an improvement of 0.02 standard deviations on EDI.) However, as the value of the mutual determination increases, the impact of wealth on psychosocial development increases substantially, going from an impact of 0.03 standard deviations (for $\rho = 0.208$ the parameter found by Cunha and Heckman, (2007) to 1.57 for $\rho = 0.8$). To understand why wealth impact escalates as ρ increases, it is necessary to understand the two channels through which wealth affects psychosocial development. On one hand there is a direct channel: The greater the wealth the better the psychosocial development. On the other hand, a greater wealth level leads to a higher stock of cognitive skills which, in turn, improves non-cognitive skills. The channel through which wealth affects psychosocial development via cognitive skills will be called as the “indirect” effect. On the second panel, the impact of wealth on psychosocial development is presented for different levels of ρ_{CP} assuming that $\rho_{PC} = \frac{\rho_{CP}}{2}$. Finally, on the third panel, the case in which cognitive development does not affect psychosocial development is presented. It is evident that as ρ_{CP} decreases, the indirect channel through which wealth affect psychosocial development also diminishes.

7 Conclusions

Adequate psychosocial development can, and should, be understood as an improvement in general well being, not only for its indirect effects (labor market performance, disease incidence and criminality reduction), but also because adequate development is good in itself. A large part of inequalities faced during adulthood is determined at infancy and, when explaining these inequalities non-cognitive skills have been found to be as relevant as cognitive ones. Taking this into account, analyzing the process of construction of non-cognitive skills during infancy is a key issue for policy-making. The value of such research articles aiming at understanding the process of skill formation may be higher in the context of a developing economy, such as is Colombia, where the incidence of poverty has much more serious consequences.

This is the first, to the author’s knowledge, trying to identify the extent to which wealth affects the production process of psychosocial development in Colombia. The main issues on unobserved heterogeneity and simultaneous determination of cognitive and non-cognitive skills are partially solved. Such issues are not addressed in many articles aiming at understanding the process of skill formation in developing economies.

Through the exercise of literature review the existence of a consensus on the reduced impact of wealth on psychosocial development is evident, at least in the case of developed economies. However, this might not be the case for developing economies, or at least, this paper presents evidence suggesting this might not apply to Colombia. Going from naïve OLS estimates to IV taking into account simultaneous determination between cognitive and non-cognitive skills, wealth seems to be one of the key factors in the process of non-cognitive skills formation. Wealth’s impact on psychosocial development is of great importance as the magnitude of its coefficient is the second

non-biological largest one after routine's productivity. A possible explanation is that while poor households in underdeveloped economies cannot cover the basic needs (e.g. drinking-water access, exclusive use of toilets, good quality roofing, flooring, and walls, among others) it might not be the case in developed economies. Taking this into account, an improvement in the material conditions has a multiplicative effect: it enhances the material conditions of poor families and fosters productivity of non-cognitive skills. It is necessary for future research to investigate specific channels through which wealth modifies the production of non-cognitive. Specifically, an answer to what is the channel through which material circumstances modify children's psychosocial development will be of great value.

Young mothers, given their lack of readiness or experience in childbearing, have children with serious disadvantages when it comes to non-cognitive skills. The same happens to children born from an unwanted pregnancy and to those who live in households with an absent parent. For this reason, specific policies for non-planned pregnancies should be strengthened, specifically in the case of youth-single mothers. Also, the prevalence of illnesses (DAD), even though considered short term, should be considered of great importance. This should be an indicator of a plausible channel between general health status and skill formation. A strong connection is also found between child abuse, attendance to child care centers, and weaning.

Many questions arise for future research projects. Among them, birth order. While the confluence theory argues that the importance of birth order is based on the distribution of resources among more children, its coefficient is still statistically significant even when controlling by the number of people and the fraction of children under seven in the household. Behrman and Taubman (1986) suggest that a possible explanation is offered by the differential in the learning process between older and younger siblings. Older children learn more by teaching than the younger ones by paying attention. It is necessary to understand why having been displaced because of violence does not appear to have a negative effect on children. A possible explanation could lie in the nature of such migration, whether preventive or reactive, the endogeneity, or the length of the displacement. As suggested by Blau (1999), the possible existence of non-linear effects of wealth over psychosocial development should be evaluated.

It is important for future research to evaluate the regional pattern of psychosocial development in Colombia. As seen on Figure 1, the least favorable region for children in Colombia-at least in terms of non-cognitive skills- is the Caribbean Coast. In the central zone, children have a higher level of non-cognitive skills. A possible explanation for this is associated with child-rearing differences in each region. As shown in Graphs 9 and 10, in the Caribbean Coast the intensity of discipline, both physical and that based on incentives, exceeds that of the rest of the country.

The availability of a longitudinal information source will maximize the chances of studying cognitive and psychosocial development in children. With this information, it will not be necessary to assume (S1) and (S2) to obtain consistent results. It will also be possible to have an additional tool to deal with income endogeneity, since past income or unexpected shocks on income will be able to be used as an instrument of current wealth, as suggested by Dahl & Lockner (2008) and Cunha & Heckman (2007), respectively.

8 References

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Figure 1

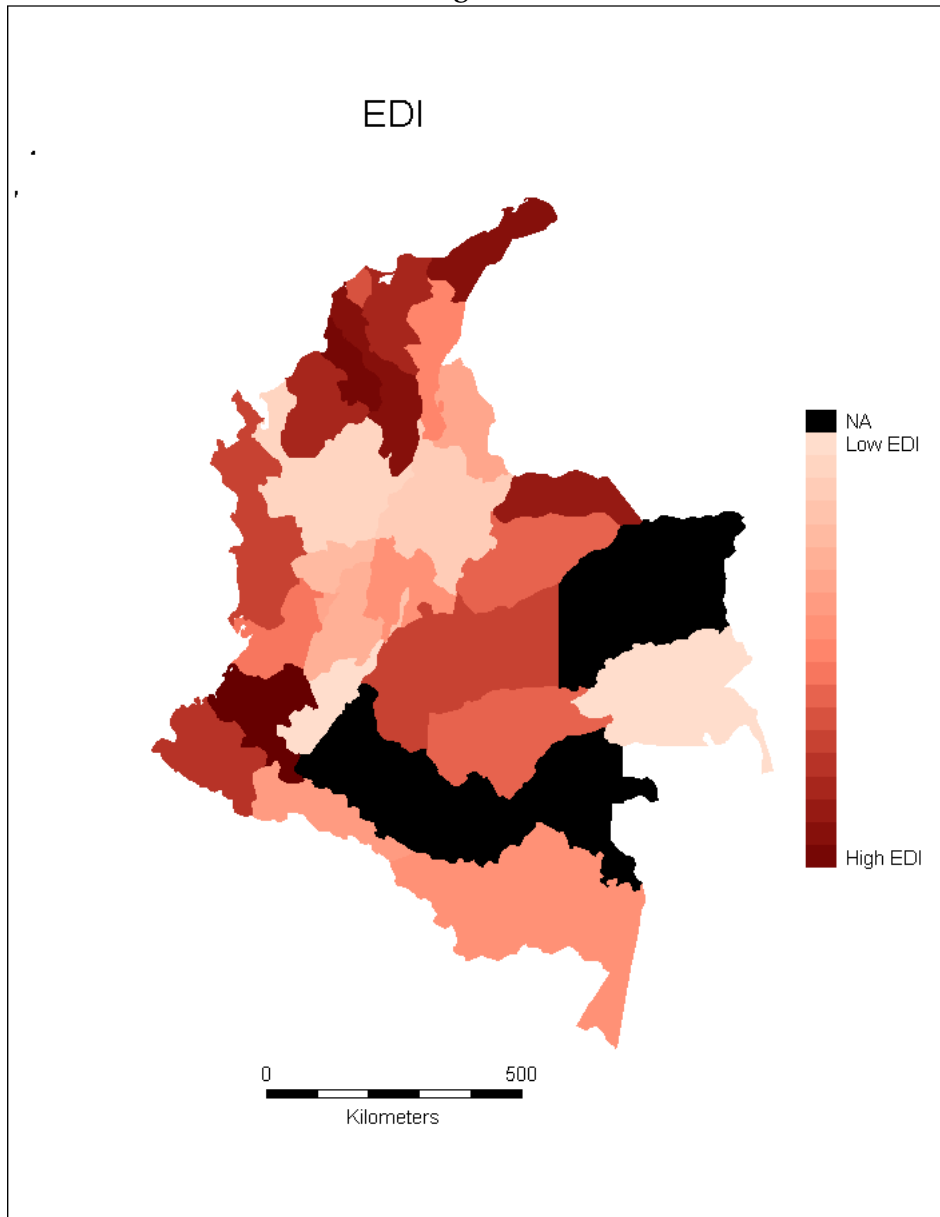


Figure 2. EDI-socio emotional

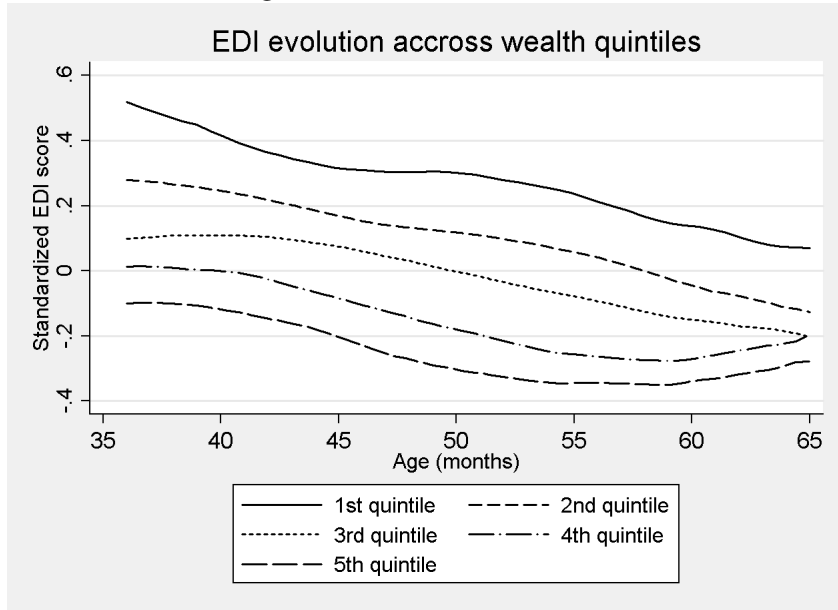


Figure 3. EDI-cognitive

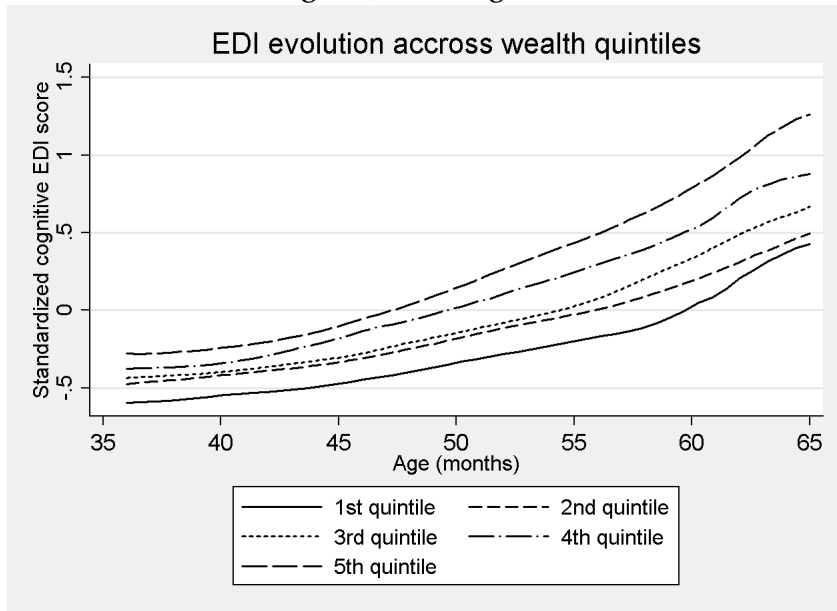


Figure 4. TVIP

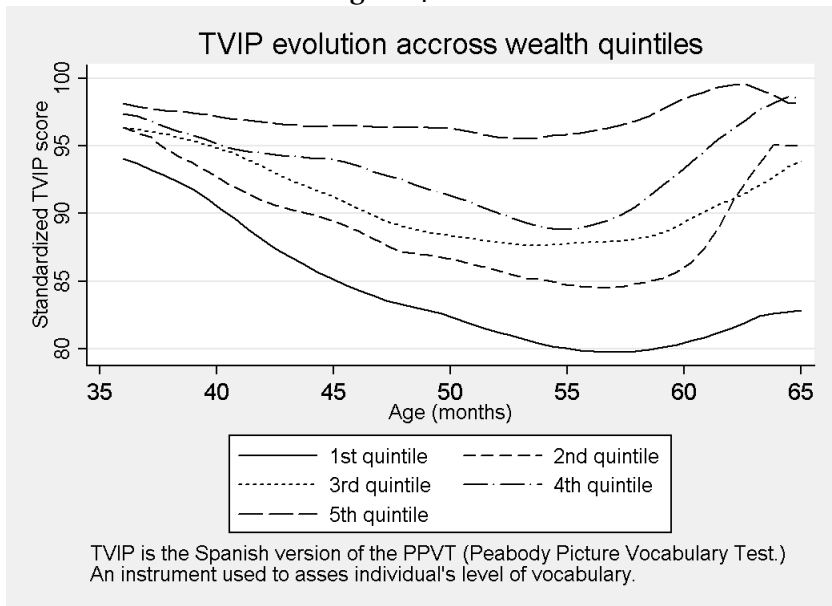


Figure 5

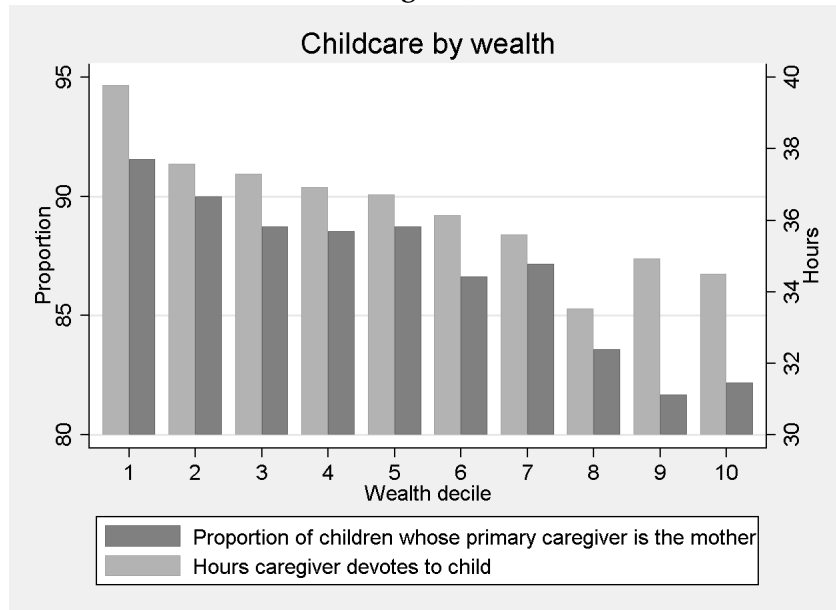


Figure 6

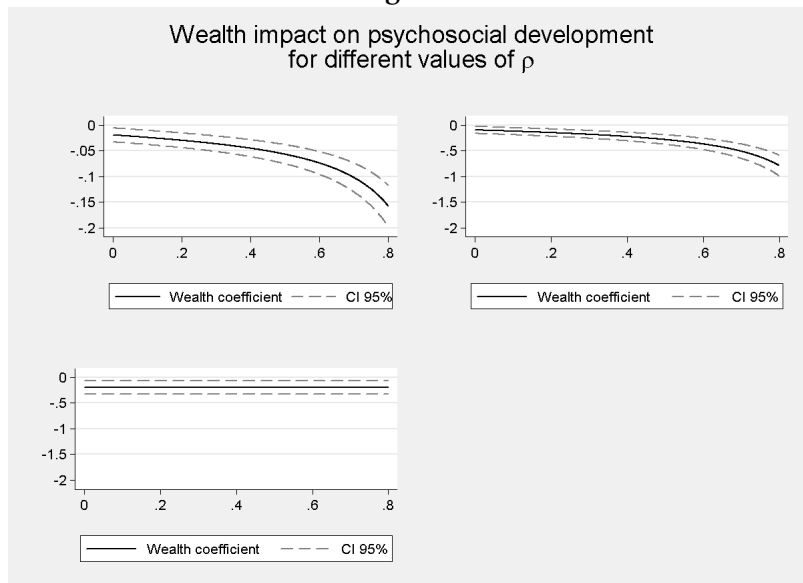


Table 1A. Variables included in the model¹

Child (θ_{ij})	Household (ϕ_j)
Hours spent with child (PG ²)	Migration status ³
Mother lives in household	Social capital
Hours worked in weekdays (PG)	Household's head has permanent job
Attends to ECD services	Program beneficiary ⁴
Birth weight (Kg)	Money spent on children's caregiving (Monthly)
Household's head gender	Money spent on children's educational materials (Monthly)
Age of child (years)	Money spent on children's education (Monthly)
Birth order	Amount of recreational resources at home ⁵
Undesired pregnancy (1) ⁶	Migration due to violence
Undesired pregnancy (2) ⁷	Wealth index
Physical abuse	Number of people in household
Sexual abuse	Proportion of younger than 7 y in household
Psychological abuse	
Gender	
Primary caregiver gender	
Father lives in household	
Age of breastfeeding interruption	
ADD ⁸	
ARI ⁹	

1. These variables are included in the estimates of table 3 except for cognitive EDI.

2. Primary caregiver.

3. Household members left municipality due to violence among illegal armed groups, natural disasters, poverty, job opportunities, education or health.

4. A household member is beneficiary of *Familias en acción*, *Acción nutricional* or *Desayunos Infantiles*

5. Puzzles, musical instruments, children's books, among others.

6. Mother didn't want to have any child

7. Mother wanted to have children but at a different time.

8. Acute Diarrheic Disease

9. Acute Respiratory Infection

Table 1B. Descriptive statistics¹

Variable	Average SD	Variable	Average SD
Household size	5.14 2.08	Displaced household ²	13.27% 0.339
Younger than 7 in household (%)	35% 0.14	Mother lives with child	93.66% 0.243
Father lives with child (%)	62.29% 0.48	Social Capital (%) ³	9.33% 0.29
Caregiver years of education (%)	7.76 3.58	Birth weight (kg)	2.09 0.42
Household head has permanent job (%)	64.19% 0.48	Hours caregiver devotes to child	36.31 21.14
Household's head is male (%)	72.60% 0.45	Hours worked/week (caregiver) ¹⁷	18.13 25.06
Age of child (years)	3.69 0.76	Beneficiary of social programs ⁴	21.00% 0.41
Birth order	1.11 0.33	Child in ECD services ⁵	59.63% 0.49
Undesired pregnancy (1) ⁶	26.33% 0.44	Undesired pregnancy (2) ⁷	26.66% 0.44
ADD ⁸ (%)	15.00% 0.35	Child victim of abandonment	0.53% 0.07
ARI ⁹ (%)	5.54% 0.23	Money spent in child caregiving services (monthly)	\$24,091 \$73,019
Money spent in children's education (monthly)	\$12,275 \$64,468	Money spent in educational materials (monthly)	\$13,509 \$90,127
Amount of educational resources in household ¹⁰	4.72 18.74	Physical maltreatment (%)	2.01% 0.14
Psychological maltreatment (%)	0.36% 0.06	Sexual abuse (%)	0.35% 0.06
Child is male (%)	51.26% 0.5	Displaced household (%)	1.47% 0.12
Mother's age at birth	25.17 6.58	Socioemotional EDI	1.52 0.24
Cognitive EDI ¹¹	0.35 0.27	Wealth index (PCF)	72.99 14.14
Productive Routines Index	46.11 0.11		

Table 2A. Non cognitive standardized EDI mean differences¹

		Group		<i>t</i> -statistic
		Inf.	Sup.	
Household Size	Average EDI	0.00	0.15	-8.79***
	Observations	11,535	5,726	
(%) Younger than 7	Average EDI	-0.01	0.15	-9.68***
	Observations	10,624	6,637	
PG years of education	Average EDI	0.18	-0.05	14.75***
	Observations	7,842	9,419	
Money spent on children's education	Average EDI	0.08	-0.08	7.95***
	Observations	13,653	3,607	
Birth weight	Average EDI	-0.01	0.17	-9.68***
	Observations	13,199	4,062	
Hours spent with child (PG-weekly)	Average EDI	0.01	0.11	-6.32***
	Observations	9,833	7,428	
Age of child	Average EDI	0.22	0.01	10.83***
	Observations	3,655	13,606	
Breastfeeding interruption	Average EDI	0.10	0.04	3.53***
	Observations	7,401	6,407	
Wealth index	Average EDI	0.26	-0.08	22.16***
	Observations	7,385	9,875	
Money spent in educational inputs	Average EDI	0.08	-0.04	6.96***
	Observations	13,464	3,794	
Stock of educational inputs	Average EDI	0.04	0.08	-1.91*
	Observations	15,569	1,691	
Age of mother at birth	Average EDI	0.08	-0.04	7.96***
	Observations	8,364	8,869	

1. Sample is divided in two groups: those with a value above and below the mean for each variable. We compare average EDI score between these groups for every variable

Table 2B. Non cognitive standardized EDI mean differences¹

Variable	Group	Average	Difference	t statistic	Observations
Father lives in household	No	0.12	0.03***	6.71	6,625
	Yes	0.01			10,635
Mother lives household	No	0.12	0.02***	2.63	1,279
	Yes	0.05			15,981
Household's head type of job	Permanent	0.13	0.03***	8.00	5,345
	Temporary	-0.01			9,520
Gender of child	Male	-0.08	-0.03***	-16.81	8,857
	Female	0.16			8,403
Household's head gender	Male	0.04	0.02***	-3.58	4,761
	Female	0.10			12,498
Birth order	Other	0.14	0.03***	4.79	2,531
	First	0.04			14,729
Attendance to caregiving centers	No	0.17	0.04***	10.99	5,874
	Yes	-0.01			11,386
Beneficiary of social programs	No	0.02	-0.03***	-6.59	13,419
	Yes	0.15			3,841
Child victim of abandonment	No	0.05	-0.06***	-2.46	17,153
	Yes	0.29			107
Child victim of sexual abuse	No	0.05	-0.09***	-2.81	17,190
	Yes	0.39			70
Child victim of psychological maltreatment	No	0.05	-0.07***	-2.20	17,187
	Yes	0.31			73
Child victim of physical maltreatment	No	0.05	-0.07***	-4.27	16,892
	Yes	0.27			368
Social Capital	No	0.05	-0.07***	3.89	16,892
	Yes	0.27			368
ARI	No	0.05	-0.03***	-2.34	16,455
	Yes	0.13			805
ADD	No	0.04	-0.04***	-6.38	15,442
	Yes	0.19			1,818
Migration in the past five years	No	0.04	-0.02***	-3.79	14,711
	Yes	0.12			2,545
Undesired pregnancy (1)	No	0.01	-0.04***	-8.15	12,644
	Yes	0.16			4,616
Undesired pregnancy (2)	No	0.05	0	-0.60	12,863
	Yes	0.06			4,397
Gender of PG	Male	-0.03	0.02	-1.61	16,728
	Female	0.05			350
Displaced household	Yes	0.04	-0.01	-0.81	314
	No	0.08			16,946

Table 3. OLS Estimates

Variables	(1) EDI	(2) EDI	(3) EDI	(4) EDI
Age of mother at birth	-0.03*** (-3.57)	-0.03*** (-3.60)	0.35 (0.45)	-0.21
Age of mother at birth ²	0.00*** (2.34)	0.00*** (2.36)	-0.00 (-0.23)	0.14
Male	0.23*** (11.65)	0.23*** (11.77)	0.56 (4.22)	0.12
Wealth	0.23*** (11.65)	0.23*** (11.77)		-0.08
Undesired pregnancy (1)	0.13*** (4.85)	0.13*** (4.89)	0.15 (0.61)	0.06
Attendance to caregiving centers	-0.12*** (-4.94)	-0.12*** (-4.99)	-0.60 (-1.33)	0.06
Attendance to caregiving centers	-0.12*** (-4.94)	-0.12*** (-4.99)	-0.60 (-1.33)	0.06
Father or mother absent in household	0.13*** (4.16)	0.13*** (4.13)		0.06
Number of people in household	0.02*** (2.96)	0.02*** (2.92)		0.04
Household's head is male	0.09*** (2.72)	0.09*** (2.72)		0.04
Household's head years of schooling	-0.01*** (-3.58)	-0.01*** (-3.59)		-0.04
Expenditure in education	-0.51** (-2.11)	-0.51** (-2.10)		-0.03
Social Capital	-0.09** (-2.73)	-0.09** (-2.72)		-0.03
% of younger than 7 years in household	0.23** (2.55)	0.23** (2.58)		0.03

Table 3. OLS Estimates (Continued)

Variables	(1) EDI	(2) EDI	(3) EDI	(4) EDI
% of younger than 7 years in household	0.23** (2.55)	0.23** (2.58)		0.03
Hours spent with child (PG-weekly)	-0.00*** (-2.62)	-0.00*** (-2.73)	0.02* (1.77)	-0.03
Age at breastfeeding interruption	-0.00*** (-2.99)	-0.00*** (-2.96)	0.01 (1.60)	-0.03
Birth order	0.11*** (3.11)	0.10*** (3.00)	0.09 (0.60)	0.03
Physical maltreatment	0.20*** (2.48)	0.20*** (2.59)	0.46*** (2.62)	0.03
Non-violent migration	0.08*** (2.56)	0.08*** (2.56)		0.03
ADD	0.06* (1.85)	0.06* (1.88)	0.23 (0.96)	0.02
Migration due to violence	-0.11 (-1.09)	-0.11 (-1.09)		-0.01
PG is male	-0.02 (-10.30)	-0.03 (-0.32)	-0.79*** (-2.62)	0.01
Constant	1.62*** (2.89)	1.61*** (2.88)	-8.72 (-0.62)	—
Number of observations	8,403	8,403	1,364	
R-squared	0.12	0.12	0.12	

(1) OLS estimates

(2) Random Effects estimates

(3) Fixed Effects estimates (4) Standardized coefficient in (1)

Table 4
Instrument Z1: Frequency of labor earnings

	Q1	Q2	Q3	Q4	Q5	Total
Monthly	3.57%	4.03%	5.00%	5.79%	7.76%	42.71%
Weekly	20.81%	12.44%	10.20%	8.90%	6.23%	11.91%

Instrument Z2: Household ownership status

	Q1	Q2	Q3	Q4	Q5	Total
Own	39.63%	42.72%	46.79%	51.81%	54.00%	42.71%
Usufruct	16.13%	15.86%	14.16%	9.54%	6.00%	12.22%

Table 5
First Stage. Using Wealth index as dependent variable¹

Variables	(1)	(2)	(3)
Own house	2.30** (4.15)		2.25*** (4.08)
Usufruct	-2.52*** (-6.18)		-2.42*** (-5.98)
Monthly payment		1.31*** (4.66)	1.24*** (4.47)
Weekly payment		-1.71*** (-3.93)	-1.67*** (-3.87)
Constant	64.18*** (9.48)	66.34*** (9.79)	64.87*** (9.62)
Observations	5,419	5,413	5,413
R-squared	0.42	0.42	0.43
Significance joint test	29.81 (0.00)	26.56 (0.00)	27.50 (0.00)
Instruments used	Z1	Z2	Z1 + Z2

Table 6. Power of Instruments

Instruments	R^2 -restricted ¹	R^2 -unrestricted ²	R^2 Increase ³	Cragg-Donald ⁴	Anderson ⁴
Z ₁	0.41	0.4201	0.0101	26.56 (0.00)	53.63 (0.00)
Z ₂	0.41	0.42	0.01	29.81 (0.00)	60.11 (0.00)
Z ₁ +Z ₂	0.41	0.425	0.015	27.50 (0.00)	109.9 (0.00)

1. R^2 -restricted corresponds to first stage estimation including every exogenous covariate and excluding the instruments: $Wealth = XB$.
2. R^2 -unrestricted corresponds to first stage estimation including the set of instruments instruments specified (Z₁, Z₂, or Z₁ and Z₂.) $Wealth = XB + Z\Gamma$.
3. This value represents the increase in the R^2 due to the inclusion of the set of instruments specified.
4. In every test, the null hypothesis of having a weak set of instruments is rejected.

Table 7. Validity of Instruments

Instruments	R^2 -restricted ¹	R^2 -unrestricted ²	R^2 Increase ³	Significance test ⁴	Sargan test ⁴
Z ₁	0.1231	0.1234	0.0003	1.11 (0.33)	0.01 (0.92)
Z ₂	0.1231	0.1232	0.0001	0.53 (0.59)	0.17 (0.68)
Z ₁ +Z ₂	0.1231	0.1236	0.0005	0.82 (0.51)	2.03 ⁵ (0.57)

1. R^2 -restricted corresponds to OLS estimates having EDI as dependent variable and variables in Table 1 as covariates: $EDI = XB$.
2. R^2 -unrestricted corresponds to OLS estimates of EDI including variables in Table 1 and instruments Z₁, Z₂, or Z₁ and Z₂ as covariates $EDI = XB + Z\Gamma$.
3. This value represents the increase in the R^2 due to the inclusion of the set of instruments specified.
4. In every case, the null hypothesis of having exogenous instruments is rejected. Although not reported, Jansen's test has the same null hypothesis and is never rejected.
5. Sargan's test requires the model to be overspecified and assumes that at least one instrument is orthogonal to non-observables. C test is also performed to exclude the orthogonality assumption on a specific set of instruments. Whenever Z₁ or Z₂ is excluded from this assumption, the null hypothesis is never rejected.