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# Determinants of early child development in Chile: Health, cognitive and demographic factors

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ABSTRACT

International evidence shows that intervention in the early childhood years has positive effects on individuals' long-term outcomes. Through the use of an education production function, this article estimates the effect of variables related to health status, cognitive abilities, and demographic factors of Chilean mothers and children on the children's psychomotor development. We use the Early Childhood Longitudinal Survey, which provides measures of children's biopsychosocial development through the application of a psychomotor development test (TEPSI) and the Peabody Picture Vocabulary Test (TVIP). In turn, the application of the Wechsler Adult Intelligence Scale (WAIS) test to the mother allows an estimation of the role that her cognitive ability plays in the psychomotor development of the child. The results show that health, cognitive, and demographic variables are important factors in a child's biopsychosocial development. In the general model, the measures of cognitive ability have a greater impact than the other variables and, in all specific models, they are significant. Additionally, demographic variables and those related to the family environment have a greater impact than health variables. The child's attendance at preschool has a positive impact on psychomotor development, as measured by the TEPSI, and is even more important than the mother's employment status.



## 1. Introduction

In early childhood[1] the brain develops quickly through the processes of neurogenesis, the growth of axons and dendrites, synaptogenesis, synaptic pruning, myelination, andglycogensis. These ontogenic events occur at different times and build upon each other, therefore small disturbances to them can have long-term effects on a child's brainstructure and capacity (Grantham-McGregor et al., 2007). For this reason, factors related to health status, cognitive ability, and demographics are important determinants in a child's development.

Studies show that providing intellectual stimulation during the first few years of life has a positive impact on individuals' future development and productivity. Different experiments carried out in the United States – including Perry Preschool, Abecedarian Project and the Chicago Child–Parent Center – have found evidence that early intervention translates into lower rates of juvenile delinquency, adolescent pregnancy, and single motherhood. Additionally, there is evidence that children in these treatment groups have slightly higher cognitive abilities than those in the control groups. Although the impact varies according to the type of program implemented and the age of the child, the results are positive and support the idea that public policies focused on early childhood produce benefits not only for the individual but for society as a whole (Heckman and Masterov, 2007).

International evidence also shows that more vulnerable children who have been exposed to less stimulation display a significant gap in their performance compared to children from high socioeconomic backgrounds. Carneiro and Heckman (2003) show that early childhood interventions have a higher rate of return than those carried out at other stages of life. Education has been identified as one of the most important tools for reducing the gap between different segments of the population. It raises the quality and skill level of human capital, which drives productivity and the national growth. This translates into better opportunities for employment and welfare conditions.

Furthermore, the intergenerational effect must also be considered. Currie and Moretti (2003) analyze the effect of the mother's education on the health of the child, using birth weight and gestation age. They analyze four channels through which the mother's education is transmitted into observable results in the child: mothers with more education are less likely to smoke,

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[1] This corresponds to the pre-school period, extending from birth to 4 or 5 years of age (source: www.crececontigo.cl).

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0738-0593/

more likely to be married to a man with a high income, to delay motherhood, and to obtain better prenatal care. Their results demonstrate that each additional year of education for the mother reduces the consequences of her child being born both underweight and prematurely. For their part, Carneiro et al. (2007) analyze the impact of the mother's educational level on the cognitive development of the child, using ability test performance. They found that the mother's education increased the mathematics and reading scores of 7–8 year-old children, but found no effect on children 12–14 years-of-age. These studies demonstrate that the failure to take intergenerational effects into account will lead to underestimation of the benefits of education.

In summary, investing in children's first stage of life as a public policy helps to decrease the disadvantages experienced by children born in deprived conditions, while increasing productivity and equity in society as a whole. Identifying the factors that influence psychomotor development in the first few years of life is important precisely because it can enable the focalization of public resources on policies that have the greatest impact and efficiency.

This paper presents evidence on the determinants of children's psychosocial development in Chile. The analysis is made for children at ages between 2 and 4. It considers relevant variables such as health status (including pregnancy), measurements of mothers' cognitive development, and assessments of children's psychosocial development, making an important contribution to the literature.

We use the first round of a study designed especially to examine these determinants. The *Encuesta Longitudinal de Primera Infancia* (Early Childhood Longitudinal Survey, ELPI) is a representative survey of the Chilean population and was intended for gathering information about children in the first few years of life for the purpose of designing and assessing different public policy programs. The variables studied are classified primarily into three categories: health, cognitive, and demographic.[2]

The group of health variables includes nutritional status of and use of pharmaceuticals by the mother during pregnancy. This category also includes variables such as premature birth, birth weight, APGAR scores,[3] breastfeeding duration, and current nutritional status of the child. Variables in the cognitive ability category include the mother's educational level and performance on the Wechsler Adult Intelligence Scale (WAIS) intelligence test, while the child's psychomotor development is measured by the psychomotor development test (TEPSI)[4] and the Peabody Picture Vocabulary Test (TVIP).[5] For TEPSI we also include the analysis of the three dimension of the test: coordination, language and motor skills.

Demographic variables include the child's area of residence and indigenous/non-indigenous status. Other child variables include age, gender, preschool attendance, and whether or not the child lives with both parents. Regarding the mother, additional variables include age, number of children, employment status during the first year of the child's life, number of hours currently works per month, and the per capita income of the household.

This article is organized as follows. Section 2 presents a descriptive analysis of the ELPI database, with emphasis on measures of children's psychosocial ability and maternal cognitive ability in the sample analyzed. Section 3 describes the methodology. Section 4 presents the results. Lastly, Section 5 offers conclusions and implications from a public policy perspective.

## 2. Data

This study uses data from the first round of the 2010 Early Childhood Longitudinal Survey[6] (ELPI). The survey is a sample of 15,175 children (boys and girls) born between January 1, 2006 and August 31, 2009, and is considered representative of children between 6 months and 5 years-of-age. The survey consisted of two information-gathering visits. The first was a household sociodemographic survey for each child included in the survey. On the second visit, three instruments were applied to evaluate cognitive, socioemotional, and physical aspects.

An important aspect of the survey is that it does not just provide information required to characterize the family environment of the children studied. It also enables a profile of mothers to be built that includes prenatal care, cognitive ability, and employment status. Additionally, the survey enables the identification of factors that are important in the psychomotor development of children up to 5 years-of-age, such as preschool education, health status, and environment.

Because of its design, the ELPI can be used to analyze factors that are not considered by other surveys but that are relevant to children's physical and psychomotor development: health factors during the mother's pregnancy and in the first few years of the child's life. By applying the Psychomotor Development Test (TEPSI) and the Peabody Picture Vocabulary Test (TVIP), a measure of a child's biopsychosocial status can be obtained. In addition, the application of the WAIS[7] digit span and vocabulary subtests provided a measure of the mother's cognitive ability. Using this information, it was possible to identify the effect, in terms of direction and magnitude, of maternal cognitive development on the child's biopsychosocial development.

The study was conducted with a sample of children whose mothers reported being the primary caregiver.[8] The TEPSI consisted of 8342 children ranging from 2 to 4 years, while the TVIP included a sample of 6397 children from 30 months to 4 years.

The average age of those taking the TEPSI was 2.72 and 49.8% were female. Fig. 1 shows that the distribution of the girls' scores slopes slightly to the right, averaging 56 points, while the boys subsample shows a distribution of around 52.4 points. Meanwhile, those taking the TVIP had an average age of 2.91 and 49.4% were female. Fig. 2 displays the distribution of the scores, with boys having a mean of 105.4 points and girls 106.3 points.

When analyzing the scores by income quintile, as shown in Figs. 3 and 4, a significant gap can be observed in the TEPSI and TVIP. Children from the lower quintile obtain, on average, a score of 50.8 points on the TEPSI and 100.6 points on the TVIP. In contrast, children from the upper quintile obtained an average of 57.7 points and 111.8 points respectively. These gaps are significant at the 95% confidence interval.

Lastly, the results of the TEPSI showed that 4-year old children perform better than 2 and 3 year-olds; in the TVIP older children also perform better. These results are significant for a 95% confidence interval.

### 2.1. Test of psychomotor development (TEPSI)

This test is used internationally to provide a rough assessment of psychomotor development among children 2–5 years-old. It is

[2] The second round of the survey (panel data) will be available in 2013.

[3] A neonatal clinical exam applied to study the vitality of a newborn child.

[4] Test to assess psychomotor development in children 2 to 5 years-of-age (Haeussler and Marchant, 2007). See Section 2.1 for more details.

[5] A psychometric test that measures an individual's receptive or auditory vocabulary (Dunn et al., 1986). See Section 2.2 for more details.

[6] The ELPI was commissioned by the Ministry of Education and implemented by the Centro de Microdatos in the Department of Economics of the Universidad de Chile. www.elpi.cl.

[7] Test that measures the overall intelligence of individuals 16–64 years of age (Apfelbeck and Hermosilla, 2000). See Section 2.3 for more details.

[8] See Annex 1 for a descriptive analysis of the variables.

intended to provide this assesment by observing children's conduct in the areas of coordination, language, and motor skills. The score obtained in the test corresponds to a development coefficient, which determines the child's profile, ranging from normal to at risk and delayed, by means of a statistical norm established for each age group.[9] Although the test has not been recently standardized for the Chilean population, it possesses good general psychometric characteristics.

The coordination subtest consists of a set of activities such as the recognition and manipulation of geometric objects, which measures a child's ability to interact with objects and to draw. The language subtest measures the capacity to name and verbalize actions and is used to build a profile of the child's level of comprehension and expression. Lastly, the motor skills subtest is applied in order to measure the child's ability to control his or her own body. Results in Section 4 decompose the anlysis according the dimensions of this test.

The standardized scores fall on a scale of 19–80 points. Children obtaining scores of 29 points or below display a level of psychosocial development classified as at risk, while children who score 30–49 points are classified as developmentally delayed. Lastly, children with scores above 50 points fall into the psychosocial development category of normal[10] (Haeussler and Marchant (2007).

### 2.2. Peabody Picture Vocabulary Test (TVIP)

The test corresponds to an adaptation of the *Peabody Picture Vocabulary Test* that was designed for Spanish-speaking children. It offers a measure of auditory vocabulary that is internally valid and consistent and has been used in several international studies.

This psychometric test is intended to measure the auditory reception capacity of children between 30 and 60 months old. It is easy to apply and, as it requires no reading or writing skills, it can be given to preschool-aged children. The test contains 125 laminated sheets, each of which contains four pictures. The examiner shows the child each of the sheets and says a word out loud. After hearing the word, the child must select the image that best illustrates its meaning. The test is applied until it is possible to identify a basal and a ceiling in the responses obtained. The basal is the highest set and is established when a child has eight consecutive correct responses, while the ceiling is the lowest set and is established when a child incorrectly identifies six out of eight consecutive items. The results are then standardized according to the age group of those interviewed to standards for Mexico or Puerto Rico. The standardized scale of the test ranges from 55 to 145 points, with scores ranging from *extremely low* to *extremely high*[11] (Dunn et al., 1986).

### 2.3. Wechsler Adult Intelligence Scale (WAIS)

The Wechsler Adult Intelligence Scale (WAIS) is designed to measure the overall intelligence of individuals 16–64 years-old, regardless of their educational level, socioeconomic status, or reading level. In the test, two scales are applied – vocabulary and digit span – and the individual's scores are compared with average scores obtained for the subject's age group.

It has been demonstrated that the test provides highly accurate measurements and has a high predictive capacity regarding the future behavior of an individual. It is updated every 10 years to compensate for the intellectual coefficient increase observed in many countries, e.g. the "Flynn effect."

The WAIS test was applied to the sample in two subtests. The *digit span* subtest measures working memory, processing speed, and short-term auditory memory. A high score on this subtest implies rapid adaptation to the demands of stimuli and flexibility in cognitive adaptation. The *vocabulary* subtest evaluates cultural level in relation to early childhood environment and education and serves as an indicator of a subject's capacity to receive new information, store it, and use it properly (Apfelbeck and Hermosilla, 2000). When the test was applied as part of the early childhood longitudinal survey (ELPI), it had a scale of 0–19 points, with scoring categories ranging from extremely reduced to excellent.[12]

## 3. Methodology

### 3.1. Estimation strategy

To model the psychomotor development of children in Chile, an education production function was used that takes into account characteristics of the mother, household, and child, as key factors. Making use of Ordinary Least Squares (OLS), the association of health, cognitive ability, and demographic variables on the child's biopsychosocial development is estimated. To achieve this, the standardized score of the TEPSI[13] and TVIP are used as an approximate measure of psychomotor development.

$$\text{TEST}_i = \alpha_0 + \beta_1 M + \beta_2 H + \beta_3 D + \beta_4 C + \mu_i \quad (1)$$

The $M$ matrix contains information on the health variables of the mother and child, such as the mother's nutritional status and use of pharmaceuticals while pregnant. It takes into account APGAR scores, whether the child was born prematurely or underweight, the duration of breastfeeding, and the child's current nutritional status. For its part, the $H$ matrix groups ability variables, including maternal educational level and WAIS performance. The $D$ matrix addresses demographic factors such as the child's area of residence and indigenous/non-indigenous status. Lastly, $C$ includes other controls such as age, gender, preschool experience, and whether or not the child lives with both parents. The mother's age, number of children, employment status during the first year of the child's life, average number of hours she works monthly, and household per capita income are also taken into account.

It is important to note that, given the characteristics of the model, problems of multicollinearity and endogeneity may arise. In the last case, for example, while preschool attendance can enhance children's psychomotor development, it also could be the case that children with greater biopsychosocial development are precisely those that receive preschool education. In this case, the explanatory variable would be endogenous and the OLS estimator would be biased and inconsistent. Given the complexity of using instrumental variables in this case, a sensitivity analysis is undertaken in Section 4.1 to identify how the sign and magnitude of the estimated coefficients vary.

The analysis is extended for different ages and income quintiles, as there is evidence that psychosocial development does not occur in a linear fashion. In other words, children do not necessarily move from one stage of knowledge to another at the same age. The theory of Jean Piaget[14] posits that a child's development follows a sequence of predetermined stages but that the age associated with each period varies slightly for each child. In Figs. 3 and 4, a

[9] The TEPSI has construct validity, analyzing the progression of scores by age group, with these being significant ($F = 397.600$, $p < 0.000$). (Haeussler and Marchant, 2007).

[10] See Annex 2, Table 1.

[11] See Annex 2, Table 2.

[12] See Annex 2, Table 3.

[13] The results related to the overall score and the three dimensions of TEPSI are presented in Table 1A.

[14] Jean Piaget was a Swiss psychologist whose contributions include the theory of cognitive development.

**Table 1**
Linear regression model for children's test scores.

| Variables | OLS–TEPSI score | | | OLS–TVIP score | | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (1) | (2) | (3) |
| Mother | | | | | | |
| Poor nutrition during pregnancy = 1 | −0.017 | −0.019* | −0.017 | −0.031** | −0.035*** | −0.031** |
| No pharmaceuticals during pregnancy = 1 | 0.023** | 0.020* | 0.022** | 0.014 | 0.013 | 0.016 |
| Preterm birth = 1 | −0.051*** | −0.024** | −0.025** | −0.039*** | −0.025* | −0.024* |
| WAIS digit span subtest | 0.098*** | 0.094*** | 0.091*** | 0.123*** | 0.125*** | 0.120*** |
| WAIS vocabulary subtest | 0.112*** | 0.106*** | 0.100*** | 0.153*** | 0.149*** | 0.144*** |
| Number of children | −0.069*** | −0.075*** | −0.075*** | −0.108*** | −0.117*** | −0.116*** |
| Years of schooling | 0.125*** | 0.121*** | 0.112*** | 0.145*** | 0.141*** | 0.129*** |
| Age | 0.044*** | 0.030** | 0.028** | 0.100*** | 0.082*** | 0.079*** |
| Worked during first year of child's life = 1 | −0.023* | −0.021* | −0.021* | −0.005 | −0.001 | −0.003 |
| Average hours worked per month | 0.067*** | 0.049*** | 0.047*** | 0.021 | 0.017 | 0.016 |
| Child | | | | | | |
| Lives with both parents | | 0.025** | 0.027** | | 0.062*** | 0.062*** |
| Low birthweight = 1 | | −0.052*** | −0.052*** | | −0.031** | −0.030** |
| Months breastfed | | 0.010 | 0.011 | | −0.013 | −0.010 |
| Poor nutrition = 1 | | −0.016 | −0.013 | | −0.001 | −0.000 |
| Male child = 1 | | −0.140*** | −0.142*** | | −0.029** | −0.031** |
| Attends preschool = 1 | | 0.081*** | 0.076*** | | 0.027* | 0.020 |
| Age | | 0.089*** | 0.093*** | | 0.077*** | 0.081*** |
| APGAR score | | 0.110 | 0.134* | | 0.002 | 0.012 |
| Other | | | | | | |
| Urban = 1 | | | 0.042*** | | | 0.048*** |
| Indigenous descent = 1 | | | −0.045*** | | | −0.040*** |
| Per capita family income | | | 0.015* | | | 0.028*** |
| Observations | 8414 | 8373 | 8342 | 6452 | 6420 | 6397 |
| *R*-squared | 0.096 | 0.139 | 0.143 | 0.145 | 0.159 | 0.164 |

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

significant difference can be observed between the average test scores of children of different ages. In this regard, it is interesting to analyze the role of health, cognitive, and demographic variables on biopsychosocial development in each age group.

Three models are estimated and the standardized scores of the TEPSI and TVIP are considered as dependent variables. In the first and fourth column of Table 1, the impact of the mother's cognitive ability on her child's psychomotor development is estimated, controlling for health characteristics during pregnancy and those related to the family environment. In columns two and five, the control variables used include the child's health characteristics, household enviroment, and preschool education. Lastly, columns three and six take into account the child's area of residence (urban or rural), indigenous status, and per capital income variables. Table 1A, estimate the same model (last colum for each test) by separating TEPSI in the three dimensions: coordination, language and motor skills. Table 2 shows the results of the analysis by income quintiles. Children from families in lower socioeconomic status receive less intellectual resources and emotional stimulation in the home. They also have less opportunity to attend any kind of high-quality preschool, which creates a significant gap in the abilities they develop compared to children from higher socioeconomic levels. Bradley and Corwyn (2002) studies the relation between socioeconomic status and a variety of outcomes in children. Meanwhile Bradley et al., 1993 studies how the home environment affect the relation between maternal and child IQ. Figs. 3 and 4 show the significant gap that exists among scores obtained by children from different socioeconomic levels. Lastly, Table 3 shows the results of the estimation by age.

## 4. Results

Psychomotor development in the first few years of life is affected by multiple child and environmental factors. Tables 1 and 1A analyze the impact of health, cognitive, and demographic variables on the child's biopsychosocial development, using TEPSI (overall score and the three dimensions)[15] and TVIP scores respectively, as measures of that development. The results are presented on the basis of normalized coefficients.

The results show that the poor nutrition of a mother during pregnancy has a negative correlation with a child's performance on the TEPSI (only significant at 10%). However, this parameter is not significant when controlling for demographic characteristics. Additionally, children of mothers who did not take pharmaceuticals during the nine months of pregnancy scored 0.022 higher compared to those whose mothers did take such substances. When the TVIP is used as a measure, poor maternal nutrition reduces the score obtained by 0.031 points, while the ingestion of pharmaceuticals has a positive but not significant impact.

Characteristics of the child at birth, such as the duration of gestation, birth weight, and duration of breastfeeding all influence his later growth and development. Children born prior to 37 weeks have not completely developed and display pulmonary immaturity, which exposes them to more illnesses and even increases their risk of mortality. Currie and Hyson (1999) shows that the effects of low birth weight are long-term, influencing academic and employment outcomes as well as those related to health. A study of how these factors influence developmental measurements shows that children born prematurely had lower test scores, close to 0.025 points lower than those who are born at term (not

[15] The evidence indicates robust results by comparing TVIP and TEPSI in the language dimension. This results provides a picture in which the apparent differences in some models between overall TEPSI and TVIP are explained by the Coordination and Motor skills dimensions. Given that TVIP is a test which mostly capture vocabulary development the relevant comparison should be made with TEPSI language. We also estimate the models by age and income quintiles using the three dimensions of TEPSI. These Tables are available upon request to the authors.

**Table 1A**
Linear regression model for children's test scores and TEPSI dimensions.

| Variables | TEPSI score | TEPSI dimension | | | TVIP score |
|---|---|---|---|---|---|
| | | Coordination | Language | Motor skills | |
| Mother | | | | | |
| Poor nutrition during pregnancy = 1 | −0.017 | −0.017 | −0.017 | −0.004 | −0.031** |
| No pharmaceuticals during pregnancy = 1 | 0.022** | 0.033*** | 0.010 | 0.014 | 0.016 |
| Preterm birth = 1 | −0.025** | −0.027** | −0.025** | −0.014 | −0.024* |
| WAIS digit span subtest | 0.091*** | 0.073*** | 0.090*** | 0.055*** | 0.120*** |
| WAIS vocabulary subtest | 0.099*** | 0.077*** | 0.100*** | 0.046*** | 0.144*** |
| Number of children | −0.075*** | −0.035*** | −0.103*** | −0.001 | −0.116*** |
| Years of schooling | 0.113*** | 0.065*** | 0.136*** | 0.029** | 0.129*** |
| Age | 0.028** | 0.008 | 0.045*** | −0.008 | 0.079*** |
| Worked during first year of child's life = 1 | −0.021* | −0.025** | −0.009 | −0.024* | −0.003 |
| Average hours worked per month | 0.046*** | 0.042*** | 0.039*** | 0.032*** | 0.016 |
| Nino | | | | | |
| Lives with both parents | 0.027** | 0.032*** | 0.026** | 0.003 | 0.062*** |
| Low birthweight = 1 | −0.052*** | −0.042*** | −0.046*** | −0.032*** | −0.030** |
| Months breastfed | 0.012 | 0.019* | 0.015 | −0.010 | −0.010 |
| Poor nutrition = 1 | −0.013 | −0.010 | 0.000 | −0.032*** | −0.000 |
| Male child = 1 | −0.142*** | −0.175*** | −0.122*** | −0.045*** | −0.031** |
| Attends preschool = 1 | 0.076*** | 0.084*** | 0.080*** | 0.006 | 0.020 |
| Age | 0.093*** | 0.117 | 0.097*** | −0.091*** | 0.081*** |
| APGAR score | 0.134* | 0.076 | 0.150* | 0.080 | 0.012 |
| Other | | | | | |
| Urban = 1 | 0.042*** | 0.022** | 0.037*** | 0.046** | 0.048*** |
| Indigenous descent = 1 | −0.046*** | −0.009 | −0.056*** | −0.031*** | −0.040*** |
| Per capita family income | 0.015* | 0.010 | 0.017* | 0.002 | 0.028*** |
| Observations | 8.342 | 8.342 | 8.342 | 8.342 | 6.397 |
| *R*-squared | 0.143 | 0.110 | 0.157 | 0.033 | 0.164 |

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

**Table 2**
Linear regression model by income quintile.

| Variables | OLS–TEPSI score | | | | | OLS–TVIP score | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 | Quintile 1 | Quintile 2 | Quintile 3 | Quintile 4 | Quintile 5 |
| Mother | | | | | | | | | | |
| Poor nutrition during pregnancy = 1 | 0.004 | −0.035 | −0.005 | −0.044 | −0.058* | 0.025 | −0.054* | 0.006 | −0.017 | −0.072* |
| No pharmaceuticals during pregnancy = 1 | −0.019 | 0.055** | 0.019 | 0.016 | 0.049* | 0.021 | 0.010 | 0.010 | −0.041 | 0.034 |
| Preterm birth = 1 | 0.020 | −0.039 | −0.010 | −0.046 | −0.062* | 0.047 | −0.027 | −0.036 | −0.035 | −0.084*** |
| WAIS digit span subtest | 0.078*** | 0.089*** | 0.095*** | 0.090*** | 0.133*** | 0.128*** | 0.120*** | 0.105*** | 0.117*** | 0.176*** |
| WAIS vocabulary subtest | 0.129*** | 0.110*** | 0.053* | 0.085*** | 0.048 | 0.192*** | 0.147*** | 0.123*** | 0.133*** | 0.069 |
| Number of children | −0.158*** | −0.041 | −0.077** | −0.018 | −0.046 | −0.139*** | −0.100*** | −0.074** | −0.045 | −0.064 |
| Years of schooling | 0.049 | 0.146*** | 0.082*** | 0.027 | 0.139*** | 0.071** | 0.143*** | 0.081*** | 0.102*** | 0.120*** |
| Age | 0.094*** | 0.009 | 0.024 | −0.027 | 0.001 | 0.112*** | 0.079** | 0.057 | 0.011 | 0.090* |
| Worked during first year of child's life = 1 | −0.061** | 0.002 | 0.026 | −0.035 | 0.020 | −0.021 | −0.007 | 0.053 | −0.019 | 0.000 |
| Average hours worked per month | 0.033 | 0.045 | 0.044 | 0.064* | 0.022 | 0.005 | 0.032 | 0.039 | −0.018 | −0.007 |
| Child | | | | | | | | | | |
| Lives with both parents | 0.013 | 0.022 | −0.004 | 0.049 | 0.018 | 0.045 | 0.059* | 0.043 | 0.033 | 0.055 |
| Low birthweight = 1 | −0.078*** | −0.053* | −0.077** | −0.028 | −0.003 | −0.075*** | −0.039 | −0.051 | −0.001 | −0.032 |
| Months breastfed | 0.050* | 0.028 | 0.012 | −0.004 | −0.004 | 0.012 | 0.035 | 0.000 | −0.032 | −0.059* |
| Poor nutrition = 1 | −0.026 | 0.023 | −0.025 | −0.027 | 0.012 | 0.020 | 0.033 | −0.017 | 0.028 | 0.003 |
| Male child = 1 | −0.172*** | −0.119*** | −0.122*** | −0.115*** | −0.163*** | 0.004 | 0.003 | −0.049 | −0.038 | −0.114*** |
| Attends preschool = 1 | 0.127*** | 0.026 | 0.070** | 0.064** | 0.088*** | 0.028 | 0.027 | 0.008 | 0.001 | 0.040 |
| Age | 0.018 | 0.078** | 0.126*** | 0.127*** | 0.147*** | −0.063** | 0.042 | 0.057* | 0.103*** | 0.201*** |
| APGAR score | 0.118 | 0.335 | 0.179 | 0.347 | 0.002 | −0.253 | −0.219 | 0.139 | −0.092 | −0.026 |
| Other | | | | | | | | | | |
| Urban = 1 | 0.041 | 0.039 | 0.064** | 0.041 | 0.008 | 0.061** | −0.003 | 0.067** | 0.017 | 0.027 |
| Indigenous descent = 1 | −0.073*** | −0.019 | −0.074** | −0.064** | −0.018 | −0.073** | −0.006 | −0.043 | −0.046 | −0.034 |
| Observations | 1317 | 1327 | 1335 | 1261 | 1164 | 995 | 1017 | 1014 | 981 | 888 |
| *R*-Squared | 0.140 | 0.121 | 0.108 | 0.088 | 0.158 | 0.145 | 0.119 | 0.089 | 0.088 | 0.196 |

**Table 3**
Linear regression model by age.

| Variables | OLS–TEPSI score | | | OLS–TVIP score | | |
|---|---|---|---|---|---|---|
| | 2 years | 3 years | 4 years | 30 months to 3 years | 3 years | 4 years |
| Mother | | | | | | |
| Poor nutrition during pregnancy = 1 | −0.030* | 0.002 | −0.021 | −0.049** | −0.015 | −0.049* |
| No pharmaceuticals during pregnancy = 1 | 0.026 | −0.006 | 0.064** | 0.041* | 0.015 | −0.007 |
| Preterm birth = 1 | −0.037** | −0.020 | −0.017 | −0.025 | −0.016 | −0.036 |
| WAIS digit span subtest | 0.112*** | 0.074*** | 0.102*** | 0.126*** | 0.117*** | 0.132*** |
| WAIS Vocabulary subtest | 0.046** | 0.145*** | 0.130*** | 0.067** | 0.166*** | 0.165*** |
| Number of children | −0.062*** | −0.058*** | −0.163*** | −0.142*** | −0.103*** | −0.118*** |
| Years of schooling | 0.111*** | 0.130*** | 0.058* | 0.124*** | 0.138*** | 0.116*** |
| Age | 0.027 | 0.020 | 0.057* | 0.062** | 0.072*** | 0.108*** |
| Worked during first year of child's life = 1 | −0.022 | −0.007 | −0.042 | −0.017 | 0.018 | −0.025 |
| Average hours worked per month | 0.056*** | 0.046*** | 0.037 | 0.032 | 0.003 | 0.028 |
| Child | | | | | | |
| Lives with both parents | 0.028 | 0.026 | 0.007 | 0.080*** | 0.049*** | 0.077*** |
| Low birthweight = 1 | −0.038** | −0.068*** | −0.031 | −0.035 | −0.038** | −0.003 |
| Months breastfed | −0.003 | 0.019 | 0.028 | −0.044* | −0.003 | 0.010 |
| Poor nutrition = 1 | 0.002 | −0.013 | −0.050* | −0.051** | 0.025 | −0.022 |
| Male child = 1 | −0.126*** | −0.155*** | −0.156*** | −0.017 | −0.031* | −0.044 |
| Attends preschool = 1 | 0.017 | 0.125*** | 0.079*** | −0.018 | 0.028 | 0.046 |
| APGAR score | 0.241* | 0.095 | 0.043 | 0.150 | 0.075 | −0.251 |
| Other | | | | | | |
| Urban = 1 | 0.045*** | 0.029* | 0.053* | 0.038* | 0.045*** | 0.063** |
| Indigenous descent = 1 | −0.014 | −0.069*** | −0.054* | −0.007 | −0.049*** | −0.042 |
| Per capita family income | 0.013 | 0.014 | 0.020*** | 0.022 | 0.051*** | 0.018* |
| Observations | 3616 | 3481 | 1245 | 1788 | 3376 | 1233 |
| *R*-squared | 0.096 | 0.171 | 0.168 | 0.128 | 0.169 | 0.207 |

signficant for motor skills). Furthermore, children born underweight[16] scored 0.052 and 0.030 points lower on the TEPSI and TVIP, respectively. Children with poor nutritional status at the time of the interview also had lower test scores, but this difference is not significant. Lastly, although the literature shows that children who were breastfed for longer display a higher level of psychomotor development,[17] in the model estimated, the breastfeeding duration is not significant.

Table 1 shows the effect of mother's cognitive ability, measured by years of schooling and WAIS results, on child's psychomotor development. Controlling for factors related to the child and family background, it can be observed that, on average, one additional point on the WAIS Test increases TEPSI and TVIP scores by 0.10 and 0.13 points, respectively. Mothers with a higher intellectual coefficient have a positive influence on their child's psychomotor development through biological and psychological factors that lead to greater stimulation for the child. The evidence indicates that one additional year of schooling for the mother raises the child's performance on the TEPSI and TVIP by 0.112 (0.065 and 0.029 for coordination and motor skills) and 0.129 points, respectively, which translates into a higher level of psychomotor development. The mother's cognitive ability and education is highly significant and holds up throughout the analysis. It even holds within income quintiles (see Table 2) and it is independent of the test used as the dependent variable.

The family environment is usually the main source of stimulation and encouragement for a child's psychomotor development. The use of didactic material and games that encourage creativity and ingenuity allow the child to develop different cognitive and non-cognitive abilities. There is evidence that a higher number of children in the home have a negative influence on the psychosocial development of the children surveyed. One additional child reduces the child's performance on the TEPSI and TVIP by 0.075 and 0.12 points, respectively. Additionally, children who live with both parents scored 0.027 and 0.062 points higher on the TEPSI (motor skill not significant) and TVIP, respectively, than those who lived only with their mothers.

Another characteristic worth analyzing is the mother's relationship to the labor market. The evidence indicates that children whose mothers work during the first year of life score lower on the TEPSI. However, the parameters are significant only at 10%.[18]

The preschool establishment plays a key role that often complements or substitutes for stimulation in the home, above all for the more vulnerable. It offers care and stimulates children's motor and intellectual development. In the linear regression model, children attending day care or junior kindergarten achieved 0.076 points more on the TEPSI compared to children who did not attend any educational establishment. These impacts, however, were not significant for motor skills or for the TVIP.

Lastly, there is evidence that children living in urban areas perform better on the test, while children of indigenous descent generally perform poorly. This may be related to less access to resources. In terms of gender, girls perform better than boys in both the TEPSI and the TVIP.

[16] Weighing less than 2.5 kg.

[17] Although the difference is only significant at 24 months (Rogan and Gladen, 1993).

[18] In general, the labor market outcomes (time and income) does not necesarelly provides a clear picture on child development. There are important variation in the significance of the parameters and some results vary according to the test. Theoretically, both time availability and family income are important inputs in child development. However, there are at leat two potential effects that might be moving in opposity directions. On the one hand, by participating in labor market parents may reduce the time dedicated to stimulate children. On the other hand, this labor activities brings additonal resources to the family. A higher level of income, meanwhile, will allow the child access to more stimuli that can substitute for the mother's absence. In addition, there are 23% of missing information in family income. In the estimation we use a dummy variable in order to control for the missing information. Although, the analysis of the missing data shows a random pattern in the underreporting of family income we should interpret labor matket variables carefully.

Several of the factors analyzed previously are related to the level of stimulation that children receive during early childhood. Thus, some evidence suggests that children who live with both parents, or those who attend preschool display a higher level of biopsychosocial development. Table 2 analyzes the impact of each of the factors according to family socioeconomic level.[19] When breaking the analysis down by income quintile, health variables tend to become insignificant. The opposite situation occurs with variables related to the mother's cognitive ability. The impact of cognitive ability, measured through the WAIS digital span subtest, is positive and significant across all quintiles. Nevertheless, this effect is slightly but still significantly higher among lower income quintiles.

This preliminary evidence has been found that children who live with siblings and those of indigenous descent perform worse on the psychomotor test; this impact is intensified for families in the lower income quintiles. In addition, preschool education's positive impact (and highly significant) on the TEPSI is greater among children in the lower and higher income brackets. This is to be expected, since more vulnerable families have fewer resources to foster and encourage child development while higher income families have access to a higher quality of preschool education.

Lastly, by observing the effect of child's age on the score obtained on the TEPSI and TVIP, the study found that in the linear regression model the impact is positive and significant (Tables 1 and 1A). It must be noted however that psychosocial development during the first few years of life does not occur in a linear fashion as not all children move from one stage of development to another at the same age. Table 3 present the results by age group. The effect of the mother's cognitive ability on the child's psychomotor development is positive and significant across all age groups. In addition, siblings seem to compete for resources within the family reducing child development.

On the other hand, being male and attending preschool are significant to explain TEPSI. It is interesting to note that attending preschool shows a positive effect only for children older than 3 years old (not for motor skills). This variable is not significant for the TVIP.

In summary, there is evidence that health, cognitive ability, and demographic variables are important factors associated with-children's biopsychosocial development. Measures of cognitive ability have the greatest impact. They are also significant in the different specific models. Additionally, demographic variables and those related to the family environment have a greater impact than health ones.

### 4.1. Sensitivity analysis

A sensitivity analysis was carried out in order to identify the magnitude and direction of the effects found when potentially endogenous variables are not included. For example, mothers who work are more likely to send their children to preschool, and children attending daycare or junior kindergarten are more likely to have working mothers.

The analysis was carried out by estimating various models[20] interchanging the following variables: the mother's current employment status, whether the child attends preschool, and whether he or she lives with both parents. In general, the results found only slight changes and no change in the significance of the variables.

Considering the TEPSI score as a dependent variable, when the child's preschool attendance and the mother's current average hours of work are not included, the role of the mother's schooling increases in significance, along with the number of children in the home, and the child's age. In turn, if the child's attendance at preschool is not considered, the impact of the mother's current average monthly hours of work increases.

Lastly, the analysis examined how the results varied when measures of the mother's cognitive ability were not included. In this case, the variation in the coefficients is greater. When a mother has one additional year of schooling, the TEPSI score increases from 0.112 to 0.187 points and the TVIP from 0.129 to 0.235 points. Meanwhile, the impact of other variables – if the child lives with both parents, the area of residence, whether or not the child is of indigenous descent, and per capita household income – on the child's development increases.

## 5. Conclusions

Early childhood is a crucial stage in the biopsychosocial development of an individual. In the first few years of life, psychomotor growth is influenced by the stimuli and incentives offered by the family and social environment. Public policies that focus on interventions at this stage of life have a greater impact and are efficient in encouraging children's psychosocial development, which is a key factor in their later academic and occupational development. Evidence has been found that health, cognitive, and demographic variables influence children's psychomotor development with significant heterogeneity. Among these, the mother's cognitive ability and educational level are notable, as are the child's attendance at preschool (mainly for TEPSI), low weight at birth, her area of residence, belonging to low income families and indigenous status, as well as the total number of children in the home.

Health variables are examined for both mother and child. On the one hand, the results show that the poor nutrition of a mother during pregnancy has a negative correlation with a child's performance on the TEPSI. However, this parameter is not significant when controlling for demographic characteristics. Additionally, children of mothers who did not take pharmaceuticals during the nine months of pregnancy scored higher compared to those whose mothers did take such substances. When the TVIP is used as a measure, poor maternal nutrition reduces the score obtained, while the ingestion of pharmaceuticals has a positive but not significant impact. Interestingly, none of the other health and nutrition variables seem to hold up as having a significant effect on cognitive development. That runs against the idea that often prevails in the health community (and elsewhere) that public policy should emphasize health and nutrition programs first (because they are the root cause) and only bring in programs that pay explicit attention to psycho-social development later on.[21]

On the other hand, one potential channel of intervention is that of prenatal care. Poor nutrition during this period has a negative effect on later development, as is found in tests measuring psychomotor development. Low Birth Weight is significant at ages 2 and 3 for the TEPSI and at age 3 for the TVIP. In the analysis by quintiles, this variable is significant for the lower 3 quintiles on the TEPSI but only for the lowest quintile for the TVIP. In a sense this strengthens the conclusion about the importance of attention to prenatal care for lower income families. According to Currie and Hyson (1999), children who are born with low birthweight yield lower test results compared to those who weigh more than 2.5 kg at birth.[22] Public policies that focus on encouraging and raising the

[19] The quintile of family income was calculated using 76% of the sample given that 23% of the obervations were missing in this variable. See footnote 19.

[20] See Annex 3.

[21] Given that Chile is middle income country with a long tradition in public health intervention may explain less variation in health variables and consequently, less correlation with children development. In any case further research is needed to fully understand these effects.

[22] By using a panel of data, the authors found evidence that children with low birthweight scored lower on measures of health, education, and occupation.

quality of prenatal care (targeting poor families) would ultimately produce a positive long-term effect on children's observed results.

A second channel of intervention would be the mother's role as the child's main caregiver. Evidence was found that children whose mothers scored highest on the WAIS, performed better on both the TEPSI and TVIP. Furthermore, in regard to the mother's education, it was found that for each additional year of schooling the mother had, her child's score on the psychomotor development test increased. The conclusion that mother's cognitive ability and education is highly significant holds up throughout the analysis. It even holds within income quintiles, and it is independent of the test used as the dependent variable.

This is in line with the findings of Carneiro et al., 2007, which provide evidence that children of more highly educated mothers obtain higher scores in mathematics and reading at 7 and 8 years-of-age. In effect, it is to be expected that children of more highly educated mothers would reach a higher level of development that would, in turn, have a positive influence on their long-term achievements and generate positive externalities in upcoming generations. For this reason, public policies focalized on fostering education among the population and on keeping adolescent mothers in school, would not only have the direct effect of increasing individual productivity, but would also produce an intergenerational effect.

A third channel of intervention would focus specifically on children under the age of 5. This paper provides some limited evidence on the role of preschool education on children's psychomotor development. According to the data, children who attend preschool perform better on the TEPSI, especially children from lower income households. Altough more evidence is needed, these preliminary results suggest public policies focused on increasing access to and the quality of such education would help to bridge the exogenous gap in children's development caused by negative variables. In Chile, according to information from the latest *Encuesta de Caracterización Socioeconómica* (Socioeconomic Characteristic Survey, CASEN 2011), in 1990 only 15.9% of the population went to preschool, but rose to 43.5% in 2011. It is hoped that such a policy, with a suitable focus on quality and proper implementation, would have a positive impact on children's development by helping to close the gap observed among children from different income quintiles.

The immediate family is responsible for providing children with their first stimuli. Games, didactic material, and the building of affective bonds and trust are used to foster the child's optimum growth and the development of different abilities. In this regard, children from more vulnerable families are born with a clear disadvantage. Evidence reported in the literature on unequal opportunity shows these type of preexisting circumstances influence the results observed. Ferreira and Gignoux (2011), using scores from the PISA 2006 for 15 year-old, found evidence that unequal opportunity accounts for at least 24% to 33% of the difference in the educational achievements of young Chileans. This evidence, meanwhile, does not show any opportunity inequality when the measure of interest is birthweight and size. While measuring the percentage of unequal opportunity on the unequal scores obtained in the TEPSI, there is evidence that opportunity inequality accounts for close to 15% of the difference (Contreras et al., 2012).[23]

Children from homes falling into the first income quintile grow up in a cultural and social environment characterized by poverty, and the level of stimulation provided by their parents is limited by a lack of resources. On average, compared to those in the upper quintile, families falling into the lower quintile have more children, are more likely to be of indigenous descent, and are less likely to send their children to preschool. This contributes to the gap that are born in households of different socioeconomic level, and the effects of this are intensified for those in the first income quintile. Living with other siblings and/or being of indigenous descent have a negative impact on children, especially for those in the lowest income quintile.

The difference in the results and therefore the gap that exists in the performance of children at different socioeconomic levels, combined with the lack of public intervention and the absence of compensation mechanisms, means that inequality persists over generations. Public policies play an important role, not only because they provide required resources, but also because they can break this cycle by compensating for economic inequalities.

The weaker performance of indigenous children on psychomotor development tests is supported by international evidence, which identifies that individuals belonging to certain ethnic or racial groups often achieve poorer results. Winkler and Cueto (2004) examines several studies from five Latin American countries that provide evidence of the effect that ethnic origin, race, and gender have on children's observed results. In general, evidence is found for lower educational outcomes, lower salary earned, and worse living conditions. The analysis shows that there is a difference caused by pre existing conditions even in the first few years. While it is impossible to focus a public policy directly on closing this type of gap, this reasearch shows why it is desirable to create compensation mechanisms that lead to more equitable living conditions and opportunities. Providing children with a childhood in which they can develop to their fullest potential both socially and intellectually brings benefits not only for their later academic and occupational performance, it also provides more opportunities for future generations, generates greater social mobility and helps to break the cycle of poverty.

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## Annex 1

Descriptive analysis
See Tables 4–8.

[23] Contreras et al. (2012) "Inequality of Opportunities at Early Age. Evidence from Chile", 2012. Mimeo. Universidad de Chile.

**Table 4**
Descriptive analysis of the sample of children 2–4 years of age who took the TEPSI test, and the sample of children 30 months to 4 years of age who took the TVIP test.

| Variables | TEPSI | | TVIP | |
|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. |
| TEPSI standardized score | 54.21 | 12.32 | 105.84 | 15.14 |
| TEPSI = 1 normal; TVIP = 1 high or superior score | 88.26% | 32.19% | 50.39% | 50.00% |
| Mother | | | | |
| Poor nutrition during pregnancy = 1 | 49.12% | 50.00% | 49.21% | 50.00% |
| No pharmaceuticals during pregnancy = 1 | 80.51% | 39.62% | 80.49% | 39.63% |
| Preterm birth = 1 | 7.34% | 26.07% | 7.07% | 25.64% |
| WAIS digit span subtest | 6.93 | 2.95 | 6.96 | 2.94 |
| WAIS vocabulary subtest | 8.30 | 3.74 | 8.40 | 3.72 |
| Number of children | 1.99 | 1.00 | 1.99 | 1.00 |
| Years of schooling | 11.62 | 3.12 | 11.66 | 3.13 |
| Age | 30.22 | 7.08 | 30.49 | 7.10 |
| Worked during first year of child's life = 1 | 30.54% | 46.06% | 31.16% | 46.32% |
| Average hours worked per month | 70.10 | 84.29 | 73.54 | 85.09 |
| Child | | | | |
| Lives with both parents | 69.89% | 45.88% | 69.96% | 45.85% |
| Low birthweight = 1 | 7.90% | 26.97% | 7.52% | 26.38% |
| Months breastfed | 13.27 | 10.35 | 1341.25% | 1067.29% |
| Poor nutrition = 1 | 20.99% | 40.72% | 20.93% | 40.69% |
| Male child = 1 | 50.21% | 50.00% | 49.42% | 50.00% |
| Attends preschool = 1 | 57.48% | 49.44% | 64.59% | 47.83% |
| Age | 2.72 | 0.71 | 2.91 | 0.68 |
| APGAR score[a] | 9.24 | 0.77 | 9.24 | 0.76 |
| Other | | | | |
| Urban = 1 | 90.47% | 29.37% | 90.57% | 29.23% |
| Indigenous descent = 1 | 8.04% | 27.20% | 7.67% | 26.61% |
| Per capita family income[b] (Chilean Pesos, in thousands) | 122.73 | 296.29 | 125.03 | 319.24 |
| Observations | 8342 | | 6397 | |

*Source*: Prepared by the authors.
[a] APGAR Test: a clinical neonatal exam applied to study the vitality of the newborn child. In the TEPSI general model there are 4796 subjects with APGAR scores, while there are 3650 in the TVIP model.
[b] The TEPSI model has 6404 data that include per capita household income, while the TVIP model contains 4915 observations.

**Table 5**
Descriptive analysis of children who took the TEPSI test, by age.

| Variables | 2 years | | 3 years | | 4 years | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| TEPSI standardized score | 53.30 | 11.95 | 53.45 | 12.16 | 58.90 | 12.75 |
| TEPSI = 1 normal | 89.04% | 31.24% | 86.32% | 34.37% | 91.36% | 28.10% |
| Mother | | | | | | |
| Poor nutrition during pregnancy =1 | 48.33% | 49.98% | 50.16% | 50.01% | 48.53% | 50.00% |
| No pharmaceuticals during pregnancy = 1 | 80.19% | 39.87% | 80.48% | 39.64% | 81.52% | 38.83% |
| Preterm birth = 1 | 7.94% | 27.04% | 6.94% | 25.41% | 6.70% | 25.01% |
| WAIS digit span subtest | 6.97 | 2.95 | 6.87 | 2.89 | 6.97 | 3.09 |
| WAIS vocabulary subtest | 8.23 | 3.78 | 8.29 | 3.71 | 8.49 | 3.73 |
| Number of children | 1.95 | 1.00 | 2.00 | 1.01 | 2.09 | 0.99 |
| Years of schooling | 11.69 | 3.11 | 11.54 | 3.09 | 11.66 | 3.25 |
| Age | 29.35 | 6.91 | 30.61 | 7.16 | 31.64 | 7.04 |
| Worked during first year of child's life = 1 | 30.66% | 46.11% | 30.27% | 45.95% | 30.93% | 46.24% |
| Average hours worked per month | 64.33 | 82.54 | 72.91 | 84.61 | 78.90 | 87.20 |
| Child | | | | | | |
| Lives with both parents | 70.42% | 45.65% | 68.93% | 46.28% | 71.02% | 45.39% |
| Low birthweight = 1 | 8.36% | 27.68% | 8.01% | 27.14% | 6.29% | 24.28% |
| Months breastfed | 12.77 | 9.38 | 13.55 | 10.98 | 13.96 | 11.14 |
| Poor nutrition = 1 | 19.37% | 39.53% | 21.90% | 41.36% | 23.10% | 42.16% |
| Male child = 1 | 50.30% | 50.01% | 50.36% | 50.01% | 49.50% | 50.02% |
| Attends preschool = 1 | 39.67% | 48.93% | 64.28% | 47.92% | 89.75% | 30.35% |
| APGAR score[a] | 9.26 | 0.72 | 9.21 | 0.85 | 9.25 | 0.71 |
| Other | | | | | | |
| Urban = 1 | 90.99% | 28.63% | 90.19% | 29.75% | 89.73% | 30.37% |
| Indigenous descent = 1 | 8.00% | 27.13% | 8.45% | 27.82% | 7.06% | 25.62% |
| Per capital family income[b] (Chilean Pesos, in thousands) | 126.48 | 275.77 | 116.96 | 238.20 | 128.12 | 457.15 |
| Observations | 3616 | | 3481 | | 1245 | |

*Source*: Prepared by the authors.
[a] APGAR Test: a clinical neonatal exam applied to study the vitality of the newborn child. In the TEPSI age-based model there are 2146 observations of the APGAR test for children 2 years of age, 1951 for 3-year-old children and 699 for 4-year old children.
[b] In the TEPSI age-based model, there are 2616 data for household per capita income for children 2 years of age, 2685 observations for 3-year-old children, and 946 data for the subsample of 4-year-old children.

**Table 6**
Descriptive analysis of children who took the TVIP test, by age.

| Variable | 30 months to 3 years | | 3 years | | 4 years | |
|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| TVIP standardized score | 104.27 | 11.56 | 105.83 | 16.00 | 108.10 | 16.89 |
| TVIP = 1 high or superior score | 42.78% | 49.49% | 50.23% | 50.00% | 61.81% | 48.61% |
| Mother | | | | | | |
| Poor nutrition during pregnancy = 1 | 47.80% | 49.97% | 50.16% | 50.01% | 48.68% | 50.00% |
| No pharmaceuticals during pregnancy = 1 | 80.22% | 39.85% | 80.27% | 39.80% | 81.49% | 38.86% |
| Preterm birth = 1 | 7.83% | 26.87% | 6.81% | 25.19% | 6.70% | 25.01% |
| WAIS digit span subtest | 7.07 | 2.92 | 6.88 | 2.89 | 6.98 | 3.09 |
| WAIS vocabulary subtest | 8.44 | 3.77 | 8.35 | 3.69 | 8.50 | 3.72 |
| Number of children | 1.93 | 0.99 | 1.99 | 1.00 | 2.09 | 0.99 |
| Years of schooling | 11.79 | 3.15 | 11.59 | 3.07 | 11.67 | 3.25 |
| Age | 29.55 | 6.95 | 30.57 | 7.14 | 31.63 | 7.03 |
| Worked during first year of child's life = 1 | 32.66% | 46.91% | 30.46% | 46.03% | 30.90% | 46.23% |
| Average hours worked per month | 69.94 | 84.26 | 73.41 | 84.63 | 79.07 | 87.27 |
| Child | | | | | | |
| Lives with both parents | 70.82% | 45.47% | 69.07% | 46.23% | 71.15% | 45.33% |
| Low birthweight = 1 | 7.67% | 26.63% | 7.90% | 26.98% | 6.28% | 24.28% |
| Months breastfed | 12.84 | 9.80 | 13.48 | 10.93 | 14.04 | 11.14 |
| Poor nutrition = 1 | 18.06% | 38.48% | 21.73% | 41.25% | 22.92% | 42.05% |
| Male child = 1 | 48.83% | 50.00% | 49.81% | 50.01% | 49.25% | 50.01% |
| Attends preschool = 1 | 47.06% | 49.93% | 64.60% | 47.83% | 89.80% | 30.27% |
| APGAR score[a] | 9.28 | 0.62 | 9.21 | 0.84 | 9.26 | 0.71 |
| Other | | | | | | |
| Urban = 1 | 91.26% | 28.25% | 90.49% | 29.34% | 89.79% | 30.29% |
| Indigenous descent = 1 | 7.06% | 25.62% | 8.22% | 27.47% | 7.05% | 25.61% |
| Per capital family income[b] (Chilean Pesos, in thousands) | 137.67 | 340.43 | 117.09 | 234.52 | 128.55 | 459.09 |
| Observations | 1788 | | 3376 | | 1233 | |

*Source*: Prepared by the authors.
[a] APGAR Test: a clinical neonatal exam applied to study the vitality of the newborn child. In the TVIP age-based model there are 1058 observations of the APGAR test for children 2 years of age, 1899 for 3-year-old children and 693 for 4-year-old children.
[b] In the TEPSI age-based model, there are 1370 data for household per capita income for children 30–35 months of age, 2608 observations for 3-year-old children, and 937 data for the subsample of 4-year-old children.

**Table 7**
Descriptive analysis of children who took the TEPSI by income quintile.

| Variables | Q1 | | Q2 | | Q3 | | Q4 | | Q5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| TEPSI standardized score | 50.82 | 12.38 | 52.68 | 12.19 | 53.85 | 12.28 | 55.32 | 11.64 | 57.67 | 11.86 |
| TEPSI = 1 normal | 82.83% | 37.72% | 86.79% | 33.87% | 87.68% | 32.88% | 90.81% | 28.89% | 93.27% | 25.07% |
| Mother | | | | | | | | | | |
| Poor nutrition during pregnancy = 1 | 52.43% | 49.96% | 53.74% | 49.88% | 51.79% | 49.99% | 49.62% | 50.02% | 43.74% | 49.63% |
| No pharmaceuticals during pregnancy = 1 | 81.37% | 38.95% | 82.07% | 38.37% | 80.70% | 39.48% | 81.65% | 38.73% | 79.45% | 40.43% |
| Preterm birth = 1 | 8.32% | 27.63% | 6.29% | 24.28% | 7.30% | 26.03% | 6.64% | 24.92% | 7.45% | 26.27% |
| WAIS digit span subtest | 5.99 | 2.87 | 6.39 | 2.84 | 6.60 | 2.84 | 7.02 | 2.69 | 8.15 | 2.89 |
| WAIS vocabulary subtest | 6.81 | 3.65 | 7.35 | 3.46 | 7.84 | 3.38 | 8.52 | 3.33 | 10.26 | 3.65 |
| Number of children | 2.44 | 1.17 | 2.10 | 0.96 | 1.92 | 0.92 | 1.76 | 0.82 | 1.75 | 0.86 |
| Years of schooling | 9.72 | 2.87 | 10.38 | 2.63 | 11.17 | 2.59 | 12.13 | 2.34 | 14.11 | 2.79 |
| Age | 30.44 | 7.42 | 29.56 | 7.14 | 29.66 | 7.28 | 29.43 | 6.71 | 31.69 | 6.50 |
| Worked during first year of child's life = 1 | 19.35% | 39.52% | 21.31% | 40.97% | 25.13% | 43.39% | 34.40% | 47.52% | 50.33% | 50.02% |
| Average hours worked per month | 43.99 | 72.98 | 51.89 | 79.07 | 64.89 | 83.87 | 87.68 | 87.14 | 106.33 | 83.26 |
| Child | | | | | | | | | | |
| Lives with both parents | 60.88% | 48.82% | 69.30% | 46.14% | 68.36% | 46.53% | 68.64% | 46.41% | 80.34% | 39.76% |
| Low birthweight = 1 | 9.07% | 28.73% | 6.97% | 25.47% | 8.08% | 27.26% | 7.46% | 26.28% | 6.81% | 25.20% |
| Months breastfed | 15.26 | 10.99 | 15.04 | 11.26 | 13.67 | 10.36 | 13.39 | 10.24 | 10.33 | 8.73 |
| Poor nutrition = 1 | 23.97% | 42.71% | 23.12% | 42.17% | 22.01% | 41.45% | 22.48% | 41.76% | 14.70% | 35.43% |
| Male child = 1 | 49.88% | 50.02% | 50.86% | 50.01% | 50.58% | 50.02% | 50.58% | 50.02% | 50.51% | 50.02% |
| Attends preschool = 1 | 53.67% | 49.88% | 53.74% | 49.88% | 55.15% | 49.75% | 60.23% | 48.96% | 61.79% | 48.61% |
| Age | 2.74 | 0.71 | 2.72 | 0.72 | 2.71 | 0.70 | 2.72 | 0.70 | 2.70 | 0.71 |
| APGAR score[a] | 9.16 | 0.85 | 9.20 | 0.64 | 9.20 | 0.85 | 9.23 | 0.63 | 9.30 | 0.83 |
| Other | | | | | | | | | | |
| Urban = 1 | 81.30% | 39.01% | 87.68% | 32.88% | 91.34% | 28.14% | 92.71% | 26.01% | 97.63% | 15.22% |
| Indigenous descent = 1 | 11.68% | 32.13% | 10.40% | 30.54% | 9.16% | 28.86% | 7.63% | 26.57% | 5.00% | 21.80% |
| Per capita family income (Chilean Pesos, in thousands) | 27.07 | 8.33 | 46.80 | 4.82 | 66.91 | 7.20 | 101.85 | 13.98 | 371.35 | 598.35 |
| Observations | 1317 | | 1327 | | 1335 | | 1261 | | 1164 | |

*Source*: Prepared by the authors.
[a] APGAR Test: a clinical neonatal exam applied to study the vitality of the newborn child. In the TEPSI income-based model there are 738 observations of the APGAR test for children in the first quintile, 755 observations for children in the second quintile, 754 for those in the third quintile, 732 for those in the fourth quintile, and 695 data for children in the fifth.

**Table 8**
Descriptive analysis of children who took the TVIP test, by income quintile.

| Variable | Q1 | | Q2 | | Q3 | | Q4 | | Q5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. | Mean | Std. Dev. |
| TVIP standardized score | 100.63 | 14.00 | 102.89 | 14.06 | 103.96 | 14.43 | 107.78 | 14.85 | 111.76 | 15.34 |
| TVIP = 1 high or superior score | 34.98% | 47.71% | 43.74% | 49.49% | 44.25% | 49.69% | 56.26% | 49.63% | 67.18% | 46.98% |
| Mother | | | | | | | | | | |
| Poor nutrition during pregnancy = 1 | 52.21% | 49.98% | 55.05% | 49.77% | 50.92% | 50.02% | 50.72% | 50.02% | 43.84% | 49.65% |
| No pharmaceuticals during pregnancy = 1 | 80.33% | 39.77% | 81.92% | 38.50% | 80.51% | 39.63% | 82.05% | 38.40% | 79.77% | 40.20% |
| Preterm birth = 1 | 8.11% | 27.31% | 6.04% | 23.83% | 7.31% | 26.04% | 6.36% | 24.42% | 7.28% | 25.99% |
| WAIS digit span subtest | 6.03 | 2.87 | 6.44 | 2.80 | 6.70 | 2.85 | 7.07 | 2.63 | 8.13 | 2.90 |
| WAIS vocabulary subtest | 6.95 | 3.58 | 7.50 | 3.42 | 7.98 | 3.29 | 8.57 | 3.32 | 10.39 | 3.65 |
| Number of children | 2.45 | 1.17 | 2.10 | 0.95 | 1.91 | 0.91 | 1.75 | 0.83 | 1.78 | 0.86 |
| Years of schooling | 9.77 | 2.91 | 10.43 | 2.62 | 11.17 | 2.58 | 12.21 | 2.30 | 14.13 | 2.80 |
| Age | 30.61 | 7.39 | 29.73 | 7.11 | 30.09 | 7.37 | 29.66 | 6.61 | 32.04 | 6.61 |
| Worked during first year of child's life = 1 | 19.78% | 39.85% | 21.67% | 41.22% | 24.79% | 43.20% | 34.49% | 47.56% | 52.60% | 49.96% |
| Average hours worked per month | 45.37 | 73.80 | 55.08 | 80.25 | 69.33 | 85.51 | 92.03 | 87.27 | 109.23 | 82.30 |
| Child | | | | | | | | | | |
| Lives with both parents | 61.80% | 48.61% | 68.72% | 46.39% | 68.22% | 46.59% | 69.70% | 45.98% | 79.79% | 40.18% |
| Low birthweight = 1 | 8.52% | 27.93% | 6.67% | 24.97% | 8.12% | 27.33% | 6.98% | 25.49% | 5.85% | 23.48% |
| Months breastfed | 15.51 | 11.46 | 15.38 | 11.62 | 13.68 | 10.58 | 13.57 | 10.56 | 10.40 | 8.94 |
| Poor nutrition = 1 | 22.67% | 41.89% | 23.59% | 42.48% | 21.88% | 41.36% | 22.53% | 41.80% | 14.70% | 35.43% |
| Male child = 1 | 49.91% | 50.02% | 49.25% | 50.02% | 48.65% | 50.01% | 49.51% | 50.02% | 51.03% | 50.02% |
| Attends preschool = 1 | 61.49% | 48.69% | 60.06% | 49.00% | 62.90% | 48.33% | 67.11% | 47.00% | 68.60% | 46.44% |
| Age | 2.93 | 0.68 | 2.92 | 0.69 | 2.90 | 0.67 | 2.93 | 0.67 | 2.88 | 0.69 |
| APGAR score[a] | 9.19 | 0.78 | 9.20 | 0.57 | 9.21 | 0.82 | 9.23 | 0.72 | 9.29 | 0.88 |
| Other | | | | | | | | | | |
| Urban = 1 | 82.01% | 38.43% | 88.32% | 32.13% | 90.97% | 28.67% | 92.96% | 25.60% | 97.59% | 15.36% |
| Indigenous descent = 1 | 10.31% | 30.42% | 9.56% | 29.42% | 9.02% | 28.66% | 7.94% | 27.05% | 4.92% | 21.63% |
| Per capital family income (Chilean Pesos, in thousands) | 27.43 | 8.17 | 46.98 | 4.86 | 66.86 | 7.07 | 103.59 | 15.12 | 392.67 | 664.06 |
| Observations | 1014 | | 1022 | | 1006 | | 1032 | | 841 | |

*Source*: Prepared by the authors.
[a] APGAR Test: a clinical neonatal exam applied to study the vitality of the newborn child. In the TVIP income-based model there are 563 data for the APGAR test for children in quintile 1, 571 observations for children in quintile 2, 565 for those in quintile 3, 586 for those in quintile 4, and 503 data for children in quintile 5.

## Annex 2

See Charts 1–3.

**Chart 1**
Categories of the TEPSI scores.

| Category | Scoring range |
|---|---|
| Delayed | 19–29 |
| At risk | 30–49 |
| Normal | 50–80 |

*Source*: Haeussler and Marchant (2007).

**Chart 2**
Categories of TVIP scores.

| Category | Scoring range |
|---|---|
| Extremely low | 55–70 |
| Moderately low | 71–85 |
| Low | 86–95 |
| Average | 96–103 |
| High | 104–115 |
| Moderately high | 116–130 |
| Extremely high | 131–145 |

*Source*: Dunn et al. (1986).

**Chart 3**
Categories of WAIS scores.

| Ability | Standard score |
|---|---|
| Strongly diminished | 0–1–2 and 3 |
| Moderately diminished | 4 and 5 |
| Slightly diminished | 6 and 7 |
| Normal or adequate | 8–9–10 and 11 |
| Good | 12 and 13 |
| Very good | 14 and 15 |
| Excellent | 16–17–18 and 19 |

*Source*: Apfelbeck and Hermosilla (2000).

## Annex 3

Sensitivity analysis
See Tables 9 and 10.

**Table 9**
Sensitivity analysis for the TEPSI model.

| Variables | Base model | TEPSI model – sensitivity analysis | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mother | | | | | | | | | | | | |
| Poor nutrition during pregnancy = 1 | −0.017 | −0.019* | −0.017 | −0.016 | −0.014 | −0.016 | −0.015 | −0.013 | −0.013 | −0.013 | −0.016 | −0.015 |
| No pharmaceuticals during pregnancy = 1 | 0.022** | 0.022** | 0.022** | 0.022** | 0.023** | 0.023** | 0.023** | 0.022** | 0.023** | 0.023** | 0.022** | 0.023** |
| Preterm birth = 1 | −0.025** | −0.023* | −0.026** | −0.025** | −0.026** | −0.025** | −0.026** | −0.026** | −0.026** | −0.026** | −0.026** | −0.026** |
| WAIS digit span subtest | 0.091*** | | 0.091*** | 0.092*** | 0.092*** | 0.091*** | 0.091*** | 0.093*** | 0.092*** | 0.092*** | 0.091*** | 0.092*** |
| WAIS vocabulary subtest | 0.100*** | | 0.102*** | 0.101*** | 0.100*** | 0.100*** | 0.101*** | 0.101*** | 0.101*** | 0.103*** | 0.103*** | 0.103*** |
| Number of children | −0.075*** | −0.068*** | −0.080*** | −0.072*** | −0.075*** | −0.074*** | −0.071*** | −0.072*** | −0.072*** | −0.077*** | −0.077*** | −0.080*** |
| Years of schooling | 0.112*** | 0.187*** | 0.114*** | 0.112*** | 0.116*** | 0.110*** | 0.110*** | 0.117*** | 0.115*** | 0.119*** | 0.115*** | 0.120*** |
| Age | 0.028** | 0.029** | 0.032** | 0.034*** | 0.023* | 0.028** | 0.034*** | 0.028** | 0.028** | 0.031** | 0.037*** | 0.027** |
| Worked during first year of child's life = 1 | −0.021* | −0.014 | −0.003 | −0.022* | −0.019 | −0.021* | −0.022* | −0.020 | −0.020* | 0.003 | −0.004 | 0.005 |
| Average hours worked per month today | 0.047*** | 0.049*** | | 0.044*** | 0.057*** | 0.046*** | 0.043*** | 0.055*** | 0.054*** | | | |
| Child | | | | | | | | | | | | |
| Lives with both parents | 0.027** | 0.033*** | 0.023** | | 0.024** | 0.028** | | | | | | 0.019* |
| Low birthweight = 1 | −0.052*** | −0.056*** | −0.050*** | −0.052*** | −0.051*** | −0.053*** | −0.054*** | −0.051*** | −0.053*** | −0.053*** | −0.051*** | −0.050*** |
| Months breastfed | 0.011 | 0.007 | 0.010 | 0.012 | 0.009 | | | 0.009 | | | 0.011 | 0.007 |
| Poor nutrition = 1 | −0.013 | −0.015 | −0.013 | −0.014 | −0.014 | −0.013 | −0.014 | −0.014 | −0.014 | −0.014 | −0.013 | −0.013 |
| Male child = 1 | −0.142*** | −0.143*** | −0.142*** | −0.142*** | −0.141*** | −0.143*** | −0.143*** | −0.141*** | −0.142*** | −0.142*** | −0.142*** | −0.141*** |
| Attends preschool = 1 | 0.076*** | 0.078*** | 0.082*** | 0.075*** | | 0.076*** | 0.074*** | | | | 0.080*** | |
| Age | 0.093*** | 0.094*** | 0.095*** | 0.092*** | 0.120*** | 0.093*** | 0.093*** | 0.119*** | 0.119*** | 0.124*** | 0.094*** | 0.124*** |
| APGAR score | 0.134* | 0.149* | 0.133* | 0.138* | 0.140* | 0.129* | 0.133* | 0.143* | 0.138* | 0.135* | 0.137* | 0.140* |
| Other | | | | | | | | | | | | |
| Urban = 1 | 0.042*** | 0.051*** | 0.042*** | 0.040*** | 0.050*** | 0.041*** | 0.039*** | 0.048*** | 0.048*** | 0.049*** | 0.041*** | 0.051*** |
| Indigenous descent = 1 | −0.045*** | −0.055*** | −0.045*** | −0.045*** | −0.047*** | −0.045*** | −0.045*** | −0.046*** | −0.046*** | −0.046*** | −0.045*** | −0.047*** |
| Per capita family income | 0.015* | 0.022*** | 0.016** | 0.016** | 0.014* | 0.015* | 0.016** | 0.016* | 0.016** | 0.017** | 0.017** | 0.015* |
| Observations | 8342 | 8345 | 8395 | 8342 | 8344 | 8373 | 8373 | 8344 | 8375 | 8429 | 8395 | 8397 |
| *R*-squared | 0.143 | 0.123 | 0.141 | 0.142 | 0.138 | 0.142 | 0.142 | 0.137 | 0.137 | 0.135 | 0.141 | 0.135 |

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

**Table 10**
Sensitivity analysis for the TVIP model.

| Variables | Base model | Sensitivity analysis – TVIP model | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Mother | | | | | | | | | | | | |
| Poor nutrition during pregnancy = 1 | −0.031** | −0.035*** | −0.032** | −0.029** | −0.031** | −0.031** | −0.028** | −0.028** | −0.028** | −0.029** | −0.030** | −0.032** |
| No pharmaceuticals during pregnancy = 1 | 0.016 | 0.015 | 0.017 | 0.015 | 0.016 | 0.015 | 0.014 | 0.015 | 0.014 | 0.015 | 0.015 | 0.017 |
| Preterm birth = 1 | −0.024* | −0.021 | −0.022* | −0.025* | −0.024* | −0.022* | −0.023* | −0.025* | −0.023* | −0.021 | −0.023* | −0.022* |
| WAIS digit span subtest | 0.120*** | | 0.120*** | 0.121*** | 0.120*** | 0.119*** | 0.120*** | 0.121*** | 0.120*** | 0.120*** | 0.121*** | 0.120*** |
| WAIS vocabulary subtest | 0.144*** | | 0.148*** | 0.145*** | 0.144*** | 0.145*** | 0.147*** | 0.145*** | 0.147*** | 0.151*** | 0.149*** | 0.148*** |
| Number of children | −0.116*** | −0.106*** | −0.118*** | −0.108*** | −0.116*** | −0.115*** | −0.108*** | −0.108*** | −0.108*** | −0.110*** | −0.110*** | −0.118*** |
| Years of schooling | 0.129*** | 0.235*** | 0.127*** | 0.130*** | 0.130*** | 0.130*** | 0.132*** | 0.132*** | 0.133*** | 0.131*** | 0.128*** | 0.129*** |
| Age | 0.079*** | 0.082*** | 0.080*** | 0.092*** | 0.078*** | 0.077*** | 0.091*** | 0.091*** | 0.090*** | 0.091*** | 0.093*** | 0.079*** |
| Worked during first year of child's life = 1 | −0.003 | 0.006 | 0.003 | −0.005 | −0.002 | −0.002 | −0.005 | −0.005 | −0.004 | 0.001 | −0.002 | 0.005 |
| Average hours worked per month today | 0.016 | 0.020 | | 0.010 | 0.019 | 0.016 | 0.010 | 0.013 | 0.013 | | | |
| Child | | | | | | | | | | | | |
| Lives with both parents | 0.062*** | 0.068*** | 0.061*** | | 0.061*** | 0.063*** | | | | | | 0.059*** |
| Low birthweight = 1 | −0.030** | −0.037*** | −0.029** | −0.031** | −0.030** | −0.031** | −0.032** | −0.031** | −0.032** | −0.032** | −0.030** | −0.029** |
| Months breastfed | −0.010 | −0.020 | −0.010 | −0.010 | −0.011 | | | −0.010 | | | −0.009 | −0.011 |
| Poor nutrition = 1 | −0.000 | −0.002 | −0.001 | −0.001 | −0.000 | 0.000 | −0.001 | −0.001 | −0.001 | −0.001 | −0.002 | −0.000 |
| Male child = 1 | −0.031** | −0.031** | −0.031** | −0.032** | −0.031** | −0.032** | −0.032*** | −0.032** | −0.032** | −0.032** | −0.032** | −0.031** |
| Attends preschool = 1 | 0.020 | 0.020 | 0.021 | 0.018 | | 0.019 | 0.017 | | | | 0.019 | |
| Age | 0.081*** | 0.082*** | 0.082*** | 0.080*** | 0.087*** | 0.081*** | 0.080*** | 0.085*** | 0.085*** | 0.087*** | 0.081*** | 0.088*** |
| APGAR Score | 0.012 | 0.021 | 0.010 | 0.016 | 0.016 | 0.018 | 0.022 | 0.020 | 0.026 | 0.022 | 0.015 | 0.014 |

**Table 10** (*Continued*)

| Variables | Base model | Sensitivity analysis – TVIP model | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Other | | | | | | | | | | | | |
| Urban = 1 | 0.048*** | 0.058*** | 0.049*** | 0.044*** | 0.051*** | 0.048*** | 0.044*** | 0.047*** | 0.046*** | 0.047*** | 0.045*** | 0.052*** |
| Indigenous descent = 1 | −0.040*** | −0.052*** | −0.040*** | −0.040*** | −0.041*** | −0.041*** | −0.041*** | −0.041*** | −0.041*** | −0.041*** | −0.041*** | −0.041*** |
| Per capita family income | 0.028*** | 0.038*** | 0.029*** | 0.032*** | 0.028*** | 0.029*** | 0.032*** | 0.032*** | 0.032*** | 0.033*** | 0.032*** | 0.029*** |
| Observations | 6397 | 6400 | 6437 | 6397 | 6398 | 6420 | 6420 | 6398 | 6421 | 6462 | 6437 | 6438 |
| *R*-squared | 0.164 | 0.126 | 0.164 | 0.160 | 0.163 | 0.164 | 0.160 | 0.160 | 0.160 | 0.160 | 0.160 | 0.163 |

* $p < 0.1$.
** $p < 0.05$.
*** $p < 0.01$.

## Annex 4

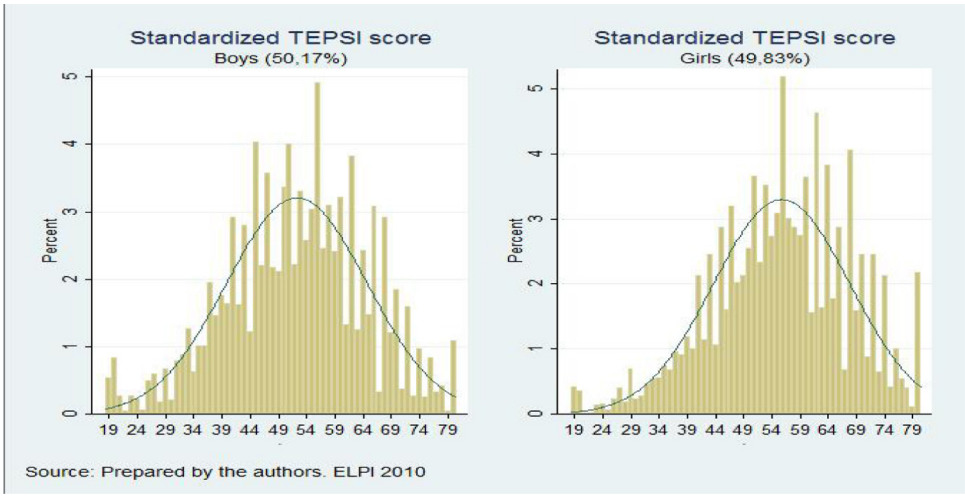


**Fig. 1.** Distribution of the psychomotor development test applied to children 2–4 years of age. Boys display an average distribution of 52.4 points and a standard deviation of 12.4. Girls have a distribution sloping to the right, with an average of 56.0 points and a standard deviation of 12.0 points.

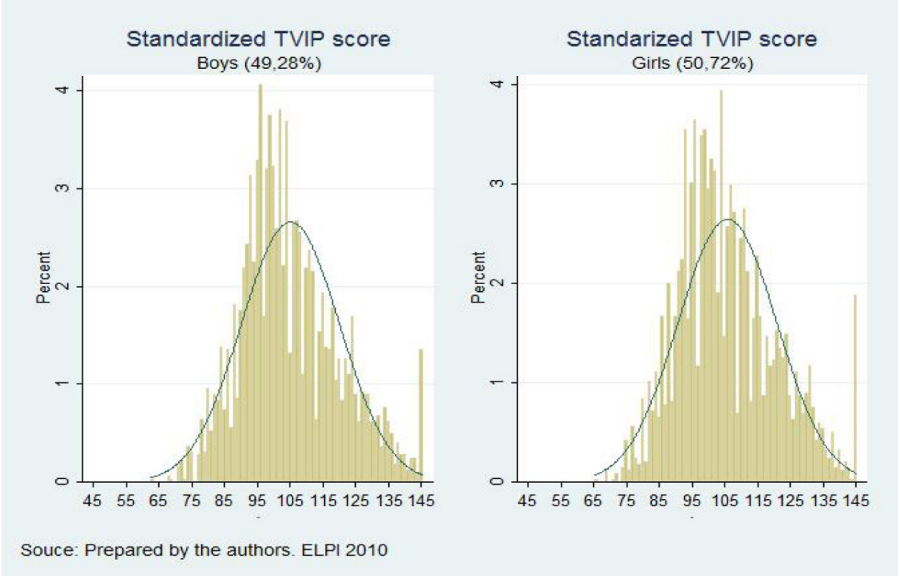


**Fig. 2.** When analyzing distribution ofthe scores obtained on the Peabody Picture Vocabulary Test by sex, it was observed that boys obtained an average score of 105.4 points with a standard deviation of 15.0 points, while girls obtained a slightly higher average score of 106.3 points with a standard deviation of 15.2 points.

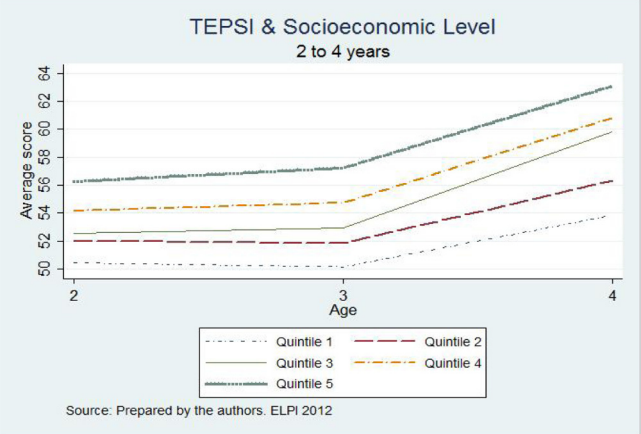


**Fig. 3.** Analysis of the TEPSI psychomotor test by socioeconomic level. A significant gap is observed among the average scores of children from different income quintiles.

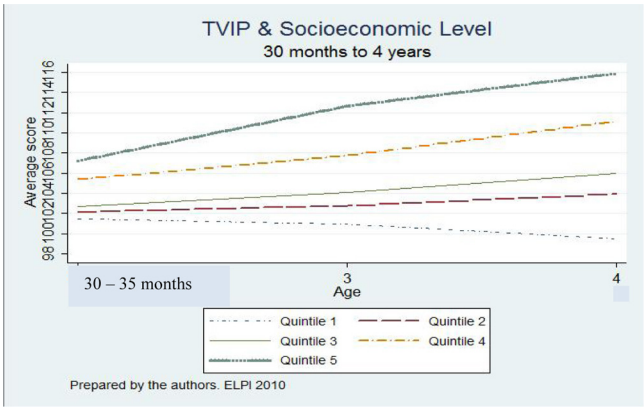


**Fig. 4.** Analyzing the TVIP scores, it can be observed that the scores of children in the lower quintiles vary only slightly by age, while those of children in the higher quintiles increase with age. A significant gap can also be observed among children from different socioeconomic levels.

## References


Apfelbeck, E.-M., Hermosilla, M., 2000. Manual de Administración y Tabulación del. Test de WAIS, Santiago.

Bradley, R., Corwyn, R., 2002. Socioeconomic status and child development. Annual Review of Psychology 53, 371–399.

Bradley, R., Whiteside, L., Caldwell, B., Casey, P., Kelleher, K., et al., 1993. Maternal IQ, the home environment, and child IQ in low birth weight, premature children. International Journal of Behavioral Development 16 (March (1)), 61–74.

Carneiro, P., Heckman, J.J., 2003. Human Capital Policy. In: James, J., Heckman, Alan, B., Krueger, Benjamin, M., Friedman, (Eds.), Inequality in America: What Role for Human Capital Policies? MIT Press, Cambridge, MA.

Carneiro, P., Meghir, C., Parey, M., 2007. Maternal education, home environments and the development of children and adolescents. Journal of the European Economic Association.

Contreras, D.E.P., Gonzalez, S., 2012. Inequality of Opportunities at Early Age. Evidence from Chile. Universidad de Chile, Mimeo.

Currie, J., Hyson, R., 1999. Is the impact of health shock cushioned by socioeconomic status? The case of low birthweight. American Economic Review 89 (2), 245–250.

Currie, J., Moretti, E., 2003. Mother's education and the intergenerational transmission of human capital: evidence from college openings. Quarterly Journal of Economics 118 (November (4)), 1495–1532, MIT Press.

Dunn, L.M., Padilla, E., Lugo, D., Dunn, L.M., 1986. Manual del examinador para el Test de Vocabulario en Imágenes Peabody. Pearson, Minneapolis.

Ferreira, F., Gignoux, J., 2011. The measurement of inequality of opportunity: Theory and an application to Latin America. Review of Income and Wealth 57 (4), 622–657.

Grantham-McGregor, S., Cheung, Y.B., Cueto, S., Glewwe, P., Richter, L., Strupp, B., The International Child Development Steering Group, 2007. Child development in developing countries. Developmental potential in the first 5 years for children in developing countries. Lancet 369, 60–70.

Haeussler, I., Marchant, T., 2007. Test de desarrollo psicomotor 2–5 años TEPSI. Ediciones Universidad Católica de Chile. Undécima Edición, Santiago.

Heckman, J.J., Masterov, D.V., 2007. The productivity argument for investing in young children. Review of Agricultural Economics 29 (3), 446–493.

Rogan, W., Gladen, B., 1993. Breast-feeding and cognitive development. Early Human Development 31, 181–193.

Winkler, D., Cueto, S., 2004. Etnicidad, Raza, Género y Educación en América Latina (1a Edición). PREAL, Washington D.C..