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# Relative Deprivation and Malnutrition in Ecuador

**Ana Larrea**

**Xavier Ramos**

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Edifici B2
Campus de la UAB
08193 Bellaterra
(Cerdanyola del Vallès)
Barcelona · Spain
Tel. +34 93 581 16 80
Fax +34 93 581 22 92
d.econ.aplicada@uab.cat
www.uab.cat/departament/
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# Relative Deprivation and Malnutrition in Ecuador

Ana Larrea
Universitat Autònoma de Barcelona

Xavier Ramos
Universitat Autònoma de Barcelona, IZA & EQUALITAS

*Abstract*: We hypothesize that relative deprivation has a deleterious effect on children's malnutrition, one of the most prevalent health problems in the word, and that the main pathway of this relationship is the larger psychosocial stress of parents with higher relative deprivation. We model parental mental health as a function of own consumption and others' consumption levels by means of Fehr and Schmidt's (1999) utility function and assume a positive association between stress and malnutrition. Our findings for Ecuador suggest that relative deprivation leads to children's malnutrition. The effect is obtained after controlling for a rich set of individual and regional controls, which include, for the first time in a study of this sort, measures of parental height and weight. Heterogeneous effects indicate that breastfeeding can be very effective at compensating the deleterious effects of relative deprivation. After controlling for relative deprivation, inequality shows no effect on malnutrition.

Keywords: relative deprivation, malnutrition, Ecuador.

JEL Codes: I14, D3

# 1. Introduction

Chronic malnutrition affects 1 in 4 children in the world (De Onis, et al., 2012), and is the root cause of just under half (45%) of child (age<5 years) deaths (Horton & Lo, 2013). Malnutrition is also associated with deficits in cognition and school achievements and has long-term functional consequences (Granthan-MacGregor, et al., 2007; Grantham-McGregor, et al., 2000; Walker, et al., 2000; Walker, et al., 2007), therefore potentially playing a key role in the intergenerational transmission of poverty. It is an important public health problem in many Latin American countries, particularly among indigenous populations in countries with strong socioeconomic disparities such as Bolivia, Peru, Ecuador, Guatemala, and Honduras (Larrea & Freire, 2002; Farrow, et al., 2005).

There are two immediate causes of chronic malnutrition, firstly, insufficient access to nutrients and secondly, high disease exposure (Larrea & Freire, 2002). Biological mechanisms determine malnutrition at an individual level, however, the lifestyles and behaviours that lead to both a reduced nutritional intake and a high level of disease exposure may, in fact, be shaped and constrained by socioeconomic context and regional disparities at the aggregate level (Diez-Roux, 1998). In our case, the socioeconomic context may impact children's malnutrition via maternal stress. Wilkinson (2000a) forcefully argues that socially unequal societies that are characterized by "stressful strategies of dominance, conflict and submission" (p. 4) produce psychosocial and psychosomatic stress. This stress impairs parents' capacity to care and rare for their small children, which in turn has deleterious effects on infants' nutritional status, among other things. Hence, children of stressed mothers are more likely be malnourished.

Following Deaton (2003), we model mental health by means of Fehr and Schmidt's (1999) utility function, and thus assume that individual stress depends on the difference between own income and income of other individuals from a relevant community or reference group. This way of modelling child malnutrition produces two testable predictions, that we examine in our empirical work. First, Yitzhaki's (1979) measure of individual relative deprivation is a cause of individual mental health and therefore of children's malnutrition. Second, Yitzhaki's (1979) measure of aggregate relative deprivation is a cause of aggregate children's malnutrition.

In this study, we test the above two predictions using Ecuadorian data from the 2006 and 2014 LSMS. Our outcome variable is the z-score of height-for-age, which is zero among healthy children and is under -2 (i.e. two standard deviations below the mean) for children with chronic malnutrition (World Health Organization, 2013; World Health Organization, 1997). Since previous studies that examine the effect of contextual variables on health and wellbeing find that different types of geographic areas may have different effects, we measure relative deprivation over three geographic areas (the province, the county, and the parish --a small administration equivalent to a village or a neighbourhood). Our controls include a rich set of child, mother, household, and regional variables, which mitigate possible omitted variable issues that could bias our estimates of interest.

Our results show that relative deprivation has a significant deleterious effect on the z-score of height-for-age in Ecuador. This effect holds for the three geographic areas, but it is larger and more significant for larger (provinces and counties) than smaller (parishes) areas. As noticed above, the effect is obtained after controlling for a rich set of individual and regional controls, which include, for the first time in a study of this sort, measures of parental height and weight. In exploring heterogeneous effects, we find that breastfeeding can be very effective at compensating the deleterious effects of relative deprivation. Our results suggest that two additional months of breastfeeding can offset the harmful effects of one-standard-deviation increase in relative deprivation.

To the best of our knowledge, this is the first study exploring the impact of relative deprivation on children's malnutrition. We have some evidence that relative deprivation has a deleterious effect on numerous health outcomes, such as probability of death, self-reported health, self-reported limitations, own body mass index, probability of taking health risks, or mental health disorders (Eibner et al., 2004; Eibner and Evans, 2005; Adjaye-Gbewonyo and Kawachi, 2012). This evidence, however, applies mostly to the US.

Our work speaks to a large literature that studies the importance for individual health outcomes of living in socially unequal communities. As Wilkinson (1996) has persuasively explained, one major pathway of such effect is the stress produced by the (very) unequal, competitive, and hierarchical social contexts people live in. With very few exceptions,[1] this literature employs inequality measures to capture the effects of socially unequal contexts (Wilkinson and Pickett, 2006). In contrast to this common practice, we suggest in this paper that relative deprivation captures much better these contextual effects, especially if they are brought about by increased psychosocial stress. We empirically explore this idea by running a horse race regression that includes both variables (inequality and relative deprivation) and find that relative deprivation continues to be relevant and statistically significant while inequality is not.

The rest of the paper is organized as follows. We explain the theoretical framework and the ensuing empirical strategy in Section 2. We present and discuss our data in Section 3. We present our main results about the effect of relative deprivation on children's malnutrition both at individual and aggregate level in Section 4: In Section 5, we explore whether our results survive the inclusion of two important confounders that are only available in one of the two years of data, while Section 6 examines heterogeneous effects. In

[1] Blanco and Ramos (2010) argue in favour of using measures of polarisation and find supporting evidence in their application with data for Spain. Yao et al. (2019) also show data polarisation is a better predictor of BMI and blood pressure than inequality, using data from the China Health and Nutrition Survey (CHNS) from 1991 to 2011.

section 7, we test whether inequality or relative deprivation are better proxies for the social conditions we want to capture. Finally, Section 8 concludes.

## 2. Theoretical Framework and Empirical Strategy

When parents, and especially mothers, are not mentally well, their capacity to care and rare for their small children is impaired, and this has deleterious effects on infants' nutritional status, among other things. Stress and distress are important factors leading to mental health problems, such as depression or anxiety. Hence, children of stressed mothers are more likely be malnourished. In a recent longitudinal cohort study carried out in Brazil, for instance, Rondó et al (2013) followed a sample of women throughout pregnancy to 5–8 years postpartum, and their respective children, and found that BMI z-score for age of children was negatively correlated with maternal scores of stress.

Following Deaton (2003), we assume that individual stress depends on the difference between own income and income of other individuals from a relevant community or reference group. We shall explore three different communities: provinces, counties, and parishes. Having an income level lower than others' increases stress, while having an income level above others may reduce stress if the status associated to having more income than others has a soothing effect on stress, or may alternatively increase stress if one values equality. We thus adapt Fehr and Schmidt's (1999) utility function to model (mental) health as a function of own income and income relative to a reference group and assume that stress is equivalent to low levels of mental health. Mental health of individual $i$, $h_i(y)$, can be expressed as:

$$h_i(y) = y - \beta_1 \int_y^\infty (x - y) dF(x) + \beta_2 \int_0^y (y - x) dF(x) \quad (1)$$

where $y$ is own income, $x$ denotes the income of the other individuals in the reference group, and $F(x)$ is the cumulative distribution function of $x$. A positive $\beta_1$ captures the deleterious effect on mental health (i.e. higher levels of stress) of having a lower income level than others in the reference group, while $\beta_2$ captures the effect of having a higher income level than others in the reference group. Recall that $\beta_2$ may be positive, zero, or negative. Now, since the integral of ($y$-$x$) over the range of $x$ is $(y_i - \mu_R)$, where $\mu_R$ is mean income of the reference group, $h_i(y)$ can be expressed as a function of relative deprivation:

$$h_i(y) = y_i + \beta_2(y_i - \mu_R) - (\beta_1 - \beta_2)\mu_R D_i(y) \quad (2)$$

where $D_i(y)$ is Yitzhaki's (1979) measure of individual relative deprivation:

$$D_i(y) = \int_y^\infty [1 - F(x)] dx. \quad (3)$$

$D_i(y)$ measures the difference between individual's income and the average income in the individual's reference group for all incomes larger than that of the individual. Note then that individual relative deprivation of individuals that belong to the same reference group will differ if their incomes differ. In other words, the reference group has a different effect on individual's mental health depending on the relative standing of the individual in the group.

Studies for different countries show that Yitzhaki's individual deprivation index correlates negatively with adult self-reported health, mental health, and mental health services utilization while it correlates positively with the probability of death and the probability of taking health risks (Eibner et al., 2004; Eibner and Evans, 2005; Kondo et al., 2008). We want to go one step further and examine whether relative deprivation impacts infants' malnutrition via the effect that relative deprivation has on maternal mental health. To this end, we assume that malnutrition, as measured by infants' *z*-score of height-for-age, $z(y)$, is a monotonic function of mother's mental health, and use the following OLS regression:

$$z(y)_i = \alpha + y_i + \gamma_2(y_i - \mu_R) + \gamma_1 \mu_R D_i(y) + \delta_1 X_i + \delta_2 X_R + \varepsilon_i \quad (4)$$

where subscripts *i* and *R* stand for individual and region (i.e. province, county, or parish), respectively, the Greek letters are parameters to be estimated, $\mu_R$ is regional mean income, $X_i$ is a vector of control variables that refer to the child and the mother, $X_R$ is a vector of regional control variables, and $\varepsilon_i$ is a standard i.i.d. error term. By comparing equations (1) and (2) it is clear that $\gamma_2 = \beta_2$ and $\gamma_1 = (\beta_1 - \beta_2)$.

Aggregating individual mental health equation (2) for all individuals within a region we obtain a relationship between mental health and relative deprivation at the aggregated level of regions. Integrating (2) over *y*, we obtain:

$$h_R(y) = \int_y^\infty h_i(y)F(y) = \mu_R - (\beta_1 - \beta_2)D_R(y) \quad (5)$$

where regional relative deprivation, $D_R$, is a function of regional inequality, measured by the Gini coefficient, $G_R$ (Yitzhaki, 1979; Hey and Lambert, 1980):

$$D_R(y) = \mu_R G_R \quad (6)$$

We assume that regional malnutrition is a monotonic function of regional mother's mental health, and test whether regional relative deprivation has a deleterious effect on regional infant malnutrition using the following OLS regression:

$$z(y)_R = \alpha + \theta_2 \mu_R + \theta_1 D_R(y) + \theta W_R + \omega_R, \quad (7)$$

where, once again, the Greek letters are parameters to be estimated, $W_R$ is a vector of regional controls, and $\omega_R$ is a is a standard i.i.d. error term. We expect $\gamma_1 < 0$ in equation (4) and $\theta_1 < 0$ in equation (7) to capture the negative effect of relative deprivation on malnutrition both at individual and aggregated (regional) levels.

# 3. Data

Our data come from the Living Standards Measurement Surveys (LSMS) of two years: 2006 and 2014. The 2006 LSMS has national coverage of 55,666 observations over 16,414 households. The 2014 LSMS has national coverage of 109,694 observations over 28,970 households. Ecuador is divided into 25 provinces, 224 counties and 1024 parishes; the 2006 LSMS covers 22 provinces, 186 counties and 443 parishes while the 2014 LSMS covers 24 provinces, 213 counties, and 697 parishes. The questionnaire goes over various topics such as living conditions, education, health care, employment, consumption, income, and economic activities such as entrepreneurship and agriculture. This survey also includes anthropometric measures for 6,003 children under five in 2006 and 11,473 children under 5 in 2014, that will allow us to estimate the z-score of height-for-age as measure of malnutrition.

## Dependent variable: Chronic child malnutrition

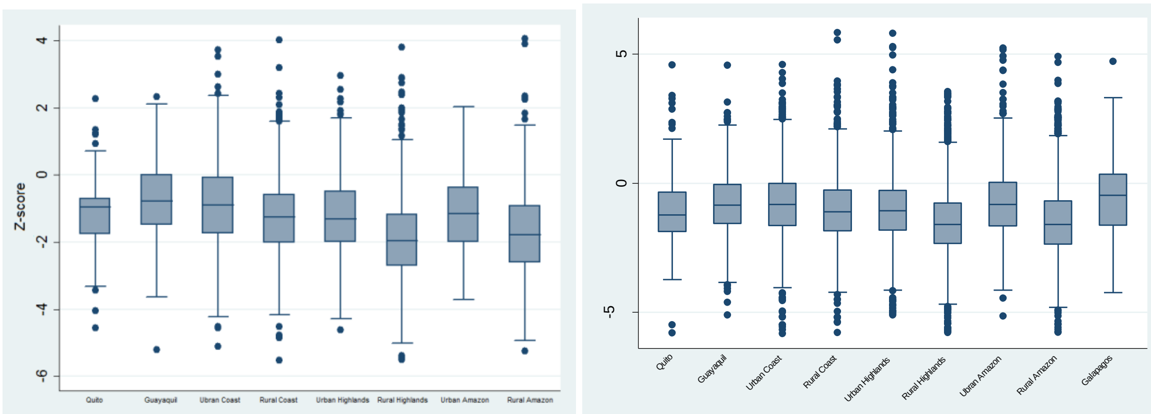
We estimate the z-score of height-for-age using the methodology developed and distributed freely by the World Health Organization (2013). The normalized z-score establishes the growth standard of children by defining a normal growth curve (World Health Organization, 2013; World Health Organization, 1997).

$$z\text{-}score = {(g_i - g_{median})}/{\sigma^g}$$

where $g_i$ is the height of child $i$, $g_{median}$ is the median height from the reference population of the same age and gender and $\sigma^g$ is the standard deviation of $g$ for the same reference population. We use anthropometric data available in the LSMS (2006 and 2014) to calculate the normalized z-score for each child below the age of five. The z-score ranges from $-\infty$ to $\infty$ as it is measured in standard deviations from the mean, which is zero. If a child's z-score is under -2, i.e. under two standard deviations below the median, the child is chronically malnourished or stunted (World Health Organization, 1997). Figures 1 and 2 show the average z-score in every sub-region and its distribution. The national average z-score was lower in 2006 (-1.22) (Figure 2.A) than in 2014 (-1.14) (Figure 2.B). However, the distribution is similar in that it is skewed to the left. The boxplot in Figure 1 shows little change across regions between 2006 and 2014. The rural highlands and rural amazon have the lowest averages in both years.

**Figure 1. Box plot z-score of height for age over sub-regions**

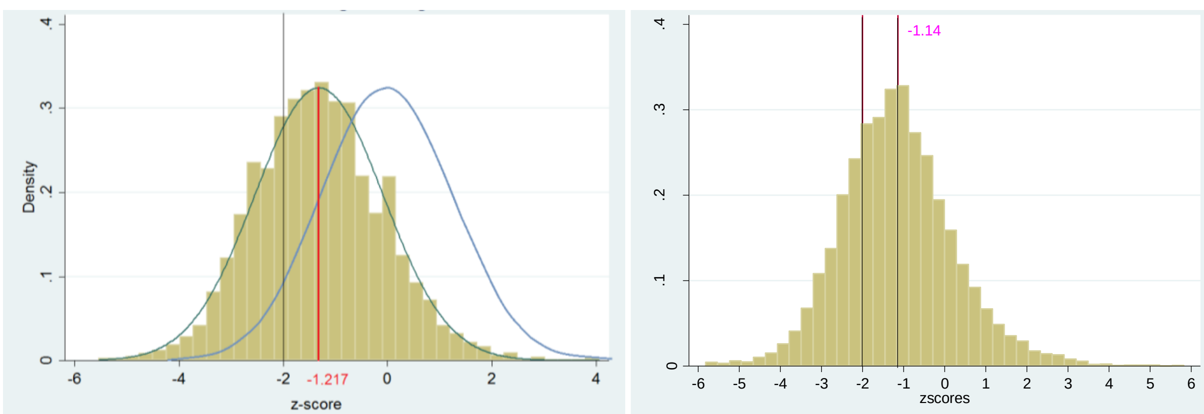
**A. LSMS 2006** **B. LSMS 2014**




Source: Authors' computation using 2006 and 2014 LSMS

**Figure 2. Distribution of z-score of height for age**

**A. LSMS 2006** **B. LSMS 2014**




Source: Authors' computation using 2006 and 2014 LSMS

## *Main independent variables*

Our main variable of interest is relative deprivation: individual relative deprivation in the individual analysis and regional relative deprivation in the aggregate analysis. As it is common when studying poor countries, we compute relative deprivation in consumption and not income, as the former is more reliable than the latter.

We compute individual relative deprivation as in equation (3), and aggregate or regional relative deprivation as the product of mean consumption and the Gini coefficient of the region –see equation (6). As household surveys that include measures of income and consumption are rarely representative at the local level, they are of insufficient size to yield statistically reliable estimates of inequality. Similarly, census data in Ecuador, which is generally of sufficient size to allow for reliability at small geographic scales, do not have information on income or consumption. The combination of census and survey data allows for reliable estimations of the Gini coefficient in subpopulations one hundredth the size of the subpopulations in the survey data and yet obtain very similar prediction errors (Elbers, et al., 2003). Hence, we estimate the Gini coefficient at the parish, county, and provincial level using the Small Area Estimates (SAE) method put forth by Elbers, et al. (2003). We outline Elbers et al. (2003) SAE method in Appendix A1.

The SAE estimation of the Gini coefficients on the 2006-2010 data was taken from data published by the government of Ecuador and measured by the Universidad Andina Simon Bolivar (Secretaria Nacional de Planificacion y Desarrollo, 2013), with the contribution of one of the authors of this paper. The estimation on 2014-2010 data was done by us replicating the method used in 2006.

In the individual level analysis, two other variables are key, namely own consumption and consumption relative to others, besides individual relative deprivation --see equation (2). In the aggregate analysis, mean income of the region is also important. We estimate own consumption and relative consumption from the 2006 and 2014 LSMS. In the computation of relative consumption, mean income refers to the relevant geographical area o region. For instance, we use the provincial mean income when the analysis is at the province level.

The controls we use include the variables the previous literature on the social determinants of malnutrition has shown influential (Adair and David, 1997; Larrea, et al., 2001; Marins and Almeida, 2002; Aerts, et al., 2004; El Taguri, et al., 2009; Willey, et al., 2009). These variables can be grouped into 3 categories: the characteristics of the child, the characteristics of the household, and the characteristics of the region. The latter are defined at various levels of aggregation depending on the nature of the information that is available.

In the first category, various individual level characteristics which may affect the z-score of the child are controlled for: a dummy variable indicating if the child was born with low birthweight (LBW),[2] the gender and age of the child (in months), a dummy indicating whether the child receives nutritional supplements, a dummy indicating whether the child has diarrhoea, a dummy indicating easy access to public day care, the

[2] LBW is typically defined as children weighing less than 2500g. In some cases, the mothers did not provide the exact weight of the child at birth; however, the survey does ask whenever the mother was told by her doctor or practitioner that the child was "underweight".

number of months of breastfeeding, and the proportion of required vaccines by age.[3] Ethnicity is an important confounder in Ecuador, as it is related to health conditions, in general, and to malnutrition in particular (Larrea and Kawachi, 2005), and also to relative deprivation. We thus include three ethnic categories in our regressions that identify mestizos,[4] indigenous,[5] and afro-Ecuadorian. Below, in Section 5, we report estimates when relevant anthropometric characteristics of the parents are also included in the regressions. We do not use them in our baseline estimates because they are only available for 2014.

The set of characteristics of the household includes variables which may affect the child during the pregnancy or after birth and comprise per capita household consumption, a dummy indicating whether the household received cash transfers, the number of children under the age of twelve living in the household, an index of housing conditions obtained using principal components analysis (see Appendix 4 for detailed results),[6] and the years of work experience of the head of the household.

Finally, the set of contextual variables include the mean size and rent of agricultural land in the parish, a dummy variable indicating whether the region is rural, and the natural log of provincial GDP.[7] Below, in Section 5, we report estimates that also control for the access to proper nourishment and food security, which are important contextual factors to avoiding malnutrition. We do not use them in our baseline estimates because they are only available for 2006. Finally, we also include fixed effects for very large regions (highlands, coast, amazon, Galapagos). These very large regions are very different in important aspects for us, such as their economic activity, their infrastructures, or the social services they have, such as hospitals. This is especially so for the amazon region as it is considerably different historically and economically to the rest of the country. The amazon region is the home of various relatively isolated first nations or indigenous groups such as the Waorani (Finer, et al., 2009), and it is also where extensive oil extraction activities and important environmental impacts of these activities take place (Finer, et al., 2009). The amazon fixed effect, then, captures the particular lifestyles of these groups along with the impact that oil extraction activities may have on human health which is, otherwise, difficult to control for.

Descriptive statistics for all the variables used in the empirical analysis are shown in Table A6.1.

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[3] Required vaccines are BCG for tuberculosis, Pentavalent which is DTP for diphtheria, tetanus, and pertussis, Hb for hepatitis B and HIB for type b Hemophilus influenzae, poliomyelitis, and finally, measles.

[4] Defined as a mix between Caucasian and Indigenous.

[5] Indigenous people are usually fluent in one of various indigenous languages as well as Spanish, whereas it is rare for non-indigenous peoples to be fluent in such languages. Therefore, it may be suggested that the fluency in these indigenous languages be used as a proxy for ethnicity. We define an individual as indigenous if she or he either states it directly, or if she or he states that the spoken language in the household is an indigenous one. We proceed this way not to underestimate the indigenous population.

[6] This methodology allows us to avoid using housing variables which may be highly correlated in our regression model in order to circumvent high levels of multicollinearity (see Appendix 4 for detailed results).

[7] In order to capture the effect of aggregate production as this may increase the access to specific health and welfare services.

# 4. Main Findings

In this section, we report our baseline results about the effect of relative deprivation on child malnutrition. Following the theoretical framework of Section 2, we first report results at individual level and then report our findings when we aggregate individual data into regions. Recall that we consider three definitions of region: province, county, and parish.

## *Effect of Individual Relative Deprivation on Child Malnutrition*

Tables 1a to 1c show OLS estimates of our parameters of interest from equation (3). We report four specifications with different controls to examine the stability of our estimates of interest to the inclusion of individual and regional controls. Model (4) includes no controls, model (3) includes individual (children and household) controls; model (2) adds regional controls to the previous specification, while our preferred specification, model (1), adds regional fixed effects to the previous specification. Our definition of region is the province in Table 1a, the county in Table 1b, and the parish in Table 1c. We report full estimates of our preferred specification in Appendix Table A6.2.

The estimates of Tables 1a and 1b show that individual relative deprivation has a deleterious effect on child malnutrition when deprivation is estimated relative to the other individuals in the same province (Table 1a) or in the same county (Table 1b). The estimated effect is larger and negative with no controls and continues to be negative but is smaller when we include child, household, and regional controls, and region fixed effects. Consistent with our theoretical framework, we contend that this effect goes through maternal mental health. The economic effect of individual relative deprivation is significant. Taking the estimate from our preferred specification shown in column (1), an increase in one standard deviation in individual relative deprivation reduces the average z-score of height-for-age by 7.3 per cent when the region is the province.[8] The size of this effect is only slightly smaller than the effect of receiving nutritional supplements and similar to the effect of 10 additional months of breastfeeding.

When we consider the county as the relevant region to measure deprivation, the deleterious effect of individual relative deprivation is practically the same as the effect we obtain when we work with provinces. However, the effect is much smaller and statistically insignificant when relative deprivation is computed

[8] We isolate the effect of a one-standard-deviation increase in relative deprivation ($\sigma_{D_i(y)}$) on the z-score of height-for-age ($z(y)_i$) by multiplying the standard deviation by the relevant parameter estimate ($\hat{\gamma}_1$) and multiplying this simple effect by the mean regional average consumption ($\overline{\mu_R}$). We are then evaluating the effect at the mean of average regional consumption. That is, we compute: $\Delta z(y)_i = \hat{\gamma}_1 \overline{\mu_R} \sigma_{D_i(y)} / \bar{z}(y)_i$

within parishes. Therefore, only when relative deprivation is computed within large regions, it seems to be a relevant negative determinant of children malnutrition. Finding that the effect of others differs depending on who these others are is a common result in the health and happiness literature (Ifcher et al, 2018; Ifcher et al. 2019).

Own consumption is statistically significant when regions are defined at county or parish level. Its impact on malnutrition is sizeable: Once again, using the estimate from our preferred specification shown in column (1) of Table 1b, an increase in one standard deviation in own consumption increases the average z-score of height-for-age by 24.3 per cent when the region is the county. The size of this effect is similar to the effect of the indigenous dummy, which indicates the difference on average in z-score of height-for-age between indigenous and mestizo children.

Relative consumption shows a negative impact on the z-score of height-for-age, but it is only statistically significant when we use counties (Table 1b). This implies that, conditional on own consumption, the larger mean consumption in the county the lower malnutrition. Previous studies suggest that positive impacts of mean income of the reference group on health and subjective wellbeing may be due to better public good provision in richer areas (Miller & Paxson, 2006, Deaton and Stone, 2013; Brodeur and Fleche, 2015; Ifcher et al., 2018). If this is the pathway between regional mean income and children malnutrition,[9] our estimates suggest that public good provision is relevant at county level, but not so at province or parish levels. Public goods at province level may not have any effect on malnutrition because they are far from where many reside while parishes may be too small an administrative unit and many parishes do not have relevant public health care services.

Table 1a. Estimates of individual malnutrition. Province is the region.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\mu_R$*Deprivation (x1000) | -0.0381*** | -0.0399*** | -0.0520*** | -0.0937*** |
| | (0.0081) | (0.0081) | (0.0120) | (0.0194) |
| Consumption per capita | 0.0025 | 0.0007 | 0.0045* | 0.0106** |
| | (0.0026) | (0.0009) | (0.0024) | (0.0039) |
| Relative Consumption | -0.0036 | 0.0004 | -0.0037 | -0.0098** |
| | (0.0025) | (0.0010) | (0.0024) | (0.0040) |
| Indiv. & HH Controls | X | X | X | |
| Region Controls | X | X | | |
| Province Fixed effects | X | | | |
| N | 15823 | 15823 | 15823 | 15823 |
| $R^2$ | 0.219 | 0.212 | 0.188 | 0.067 |

[9] We do not have information on public good provision at the three administrative levels we study (province, county, parish) to test this channel by including controls on public goods such as schools, or education expenditure, primary care centers and hospitals, or health expenditure, police, and security, in the regressions (Brodeur and Fleche, 2015).

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the individual, and the reference group is the province. The dependent variable is the z-score of height-for-age of the child. Individual and household controls include dummy for low birth weight (<2500 gr.), dummy for gender of child, square in age of the child in moths, ethnicity of the child, proportion of required vaccines by age, dummy indicating whether the child receives nutritional supplements, dummy indicating whether the child has diarrhoea, dummy indicating easy access to public day care, months breastfeeding, age mother, dummy whether household receives transfers, number of children below 12 in the household, work experience of head of household. Region controls include mean size and mean rent per ha. of agricultural land, dummy whether region is rural, log PIB of province, dummies for large regions (highlands, coast, amazon, Galapagos). A year dummy is also included. See the Data section above for a detailed explanation of variables. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table 1b. Estimates of individual malnutrition. County is the region.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\mu_R$*Deprivation (x1000) | -0.0334$^{***}$ | -0.0280$^{***}$ | -0.0390$^{***}$ | -0.0701$^{***}$ |
| | (0.0063) | (0.0060) | (0.0091) | (0.0001) |
| Consumption per capita | 0.0034$^{***}$ | 0.0037$^{***}$ | 0.0044$^{***}$ | 0.0099$^{***}$ |
| | (0.0013) | (0.0009) | (0.0016) | (0.0023) |
| Relative Consumption | -0.0023$^{*}$ | -0.0025$^{***}$ | -0.0036$^{**}$ | -0.0091$^{***}$ |
| | (0.0013) | (0.0010) | (0.0016) | (0.0023) |
| Indiv. & HH Controls | X | X | X | |
| Region Controls | X | X | | |
| County Fixed effects | X | | | |
| N | 15787 | 15787 | 15787 | 15787 |
| $R^2$ | 0.241 | 0.211 | 0.186 | 0.064 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the individual, and the reference group is the province. The dependent variable is the z-score of height-for-age of the child. Individual and household controls include dummy for low birth weight (<2500 gr.), dummy for gender of child, square in age of the child in moths, ethnicity of the child, proportion of required vaccines by age, dummy indicating whether the child receives nutritional supplements, dummy indicating whether the child has diarrhoea, dummy indicating easy access to public day care, months breastfeeding, age mother, dummy whether household receives transfers, number of children below 12 in the household, work experience of head of household. Region controls include mean size and mean rent per ha. of agricultural land, dummy whether region is rural, log PIB of province, dummies for large regions (highlands, coast, amazon, Galapagos). A year dummy is also included. See the Data section above for a detailed explanation of variables. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

Table 1c. Estimates of individual malnutrition. Parish is the region.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| $\mu_R$*Deprivation (x1000) | -0.0107 | -0.0110$^{**}$ | -0.0129$^{*}$ | -0.0235 |
| | (0.0071) | (0.0056) | (0.0072) | (0.0131) |
| Consumption per capita | 0.0027$^{***}$ | 0.0029$^{***}$ | 0.0027$^{***}$ | 0.0064$^{***}$ |
| | (0.0009) | (0.0006) | (0.0010) | (0.0017) |
| Relative Consumption | -0.0012 | -0.0014 | -0.0014 | -0.0047$^{**}$ |
| | (0.0009) | (0.0009) | (0.0011) | (0.0019) |
| Indiv. & HH Controls | X | X | X | |
| Region Controls | X | X | | |
| Parish Fixed effects | X | | | |

| | | | | |
|---|---|---|---|---|
| N | 15762 | 15762 | 15762 | 15762 |
| $R^2$ | 0.265 | 0.211 | 0.184 | 0.057 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the individual, and the reference group is the province. The dependent variable is the z-score of height-for-age of the child. Individual and household controls include dummy for low birth weight (<2500 gr.), dummy for gender of child, square in age of the child in moths, ethnicity of the child, proportion of required vaccines by age, dummy indicating whether the child receives nutritional supplements, dummy indicating whether the child has diarrhoea, dummy indicating easy access to public day care, months breastfeeding, age mother, dummy whether household receives transfers, number of children below 12 in the household, work experience of head of household. Region controls include mean size and mean rent per ha. of agricultural land, dummy whether region is rural, log PIB of province, dummies for large regions (highlands, coast, amazon, Galapagos). A year dummy is also included. See the Data section above for a detailed explanation of variables. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

## *Effect of Regional Relative Deprivation on Child Malnutrition*

In Section 2 we show that when we aggregate the individual functions (2) for all individuals within one region, we obtain a negative relationship between regional malnutrition and regional relative deprivation – see equation (5). In this section we report the estimates from regression (7), which is the empirical specification of (5). Tables 2a to 2c show the two parameters of interest for provinces, counties, and parishes, respectively.

We report three specifications with different controls to examine the stability of our estimates of interest to the inclusion of regional controls. Model (1) includes no controls, model (2) includes the same controls as the individual level specifications reported in Tables 1a to 1c, and model (3) adds regional fixed effects to the previous model. The last specification is very demanding on our data, and it is our preferred specification. Our definition of region is the province, in Table 2a, the county, in Table 2b, and the parish, in Table 2c. We report full estimates of our preferred specification in Appendix Table A6.3.

Consistent with the estimates we obtain in the individual level analysis, point estimates suggest that regional relative deprivation has a deleterious effect on regional child malnutrition irrespective of how regions are defined. Point estimates are imprecisely estimated for counties and parishes –see Tables 2b and 2c. Precision improves for provinces, where the point estimate is statistically significant. The economic effect of individual relative deprivation is sizeable. Taking the parameter estimate from our preferred specification shown in column (3), an increase in one standard deviation in regional relative deprivation reduces the average regional z-score of height-for-age by 28.9 per cent. The size of this effect is similar to the impact of reducing average provincial consumption by half a standard deviation.

Table 2a. Estimates of regional malnutrition. Province is the region.

| | (1) | (2) | (3) |
|---|---|---|---|
| Province Deprivation | -0.0137 | -0.0167 | -0.0258* |
| | (0.0125) | (0.0131) | (0.0040) |
| Province Average Consumption | 0.0078* | 0.0075* | 0.0175** |
| | (0.0040) | (0.0042) | (0.0014) |
| Controls | | X | X |
| Province Fixed effects | | | X |
| N | 47 | 45 | 45 |
| $R^2$ | 0.217 | 0.751 | 0.463 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the region, and the reference group is the province. The dependent variable is the z-score of height-for-age of the child. Controls as in Table 1. A year dummy is also included. See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2b. Estimates of regional malnutrition. County is the region.

| | (1) | (2) | (3) |
|---|---|---|---|
| County Deprivation | -0.0227*** | -0.0071 | -0.0033 |
| | (0.0060) | (0.0060) | (0.0100) |
| County Average Consumption | 0.0120*** | 0.0034 | 0.0035 |
| | (0.0021) | (0.0022) | (0.0039) |
| Controls | | X | X |
| County Fixed effects | | | X |
| N | 393 | 387 | 387 |
| $R^2$ | 0.172 | 0.413 | 0.331 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the region, and the reference group is the county. The dependent variable is the z-score of height-for-age of the child. Controls as in Table 1. A year dummy is also included. See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 2c. Estimates of regional malnutrition. Parish is the region.

| | (1) | (2) | (3) |
|---|---|---|---|
| Parish Deprivation (x1000) | -0.0077* | -0.0008 | -0.0080 |
| | (0.0046) | (0.0046) | (0.0091) |
| Parish Average Consumption | 0.0071*** | 0.0012 | 0.0039 |
| | (0.0016) | (0.0016) | (0.0031) |
| Controls | | X | X |
| Parish Fixed effects | | | X |
| N | 1085 | 1070 | 1070 |
| $R^2$ | 0.107 | 0.291 | 0.210 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the region, and the reference group is the parish. The dependent variable is the z-score of height-for-age of the child. Controls as in Table 1. A year dummy is also included. See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## 5. Exploring confounders

There are two variables that may be related to deprivation and children's malnutrition and that we have not been able to control for, as they are only available in one of the two cross-sections that we have employed to run the analysis so far. In this section we show that the estimated effect of relative deprivation on children's malnutrition survives the inclusion of these two variables, which are access to proper nourishment and food security and height of parents.

### *Access to proper nourishment and food security*

As outlined in the Introduction, insufficient access to nutrients, like vitamins, minerals, proteins, carbohydrates, lipids, and some other essential substances that the body needs to function, is an immediate cause of (chronic) malnutrition. In turn, such deficient intake of nutrients results from high prevalence of poor diets, which in poor countries are often based on cheap carbohydrates.[10] Insufficient nutrient intake is usually associated with poverty, and indeed, our estimates systematically show a negative relationship between own consumption and malnutrition (see Tables 1a to 1c or Tables 2a to 2c above).

Beyond own diet, access to proper nourishment and food security are important contextual factors to avoiding malnutrition. Living in communities that lack places that sell healthy and affordable food, where consumption habits cannot include healthy and balanced diets, and where food conditions are unstable reduces the likelihood of proper nourishment and increases the likelihood of malnutrition (Christian et al., 2020). Poor access to proper nourishment and food security is also related with deprivation. We thus examine whether including information on access to poor nourishment affects the estimated relationship between relative deprivation and malnutrition that we have obtained in our baseline analysis.

To this end, we use a food consumption index which identifies the average carbohydrates, fat, and protein consumed in each parish (Programa Alimentate Ecuador, Ministerio de Inclusión Económica y Social, Ecuador, 2009). The index gives high scores to parishes with high carbohydrate consumption, indicating a severe protein deficiency and a lack of micronutrient intake from fruits (see Appendix 5 for details) (Larrea & Kawachi, 2005), and captures the social and institutional barriers present in the access to proper

[10] Essentially a potato-based diet.

nourishment and food security. It is worth noting that we have not included the food consumption index in our baseline analysis because we can only compute it for 2006.

Since the food consumption index only has variability across parishes and not across households and the sample is now smaller, we do not include regional controls or region fixed effects in the regressions. Table 3 shows estimates of our variables of interest with and without the food consumption index. The negative and statistically significant point estimates of the food consumption index in all models suggests a robust negative relationship between poor access to proper nourishment and food security and the z-score of height-for-age, which does not depend on how regions are defined. The second point worth noting from Table 3 is that the inclusion of the food consumption index does not eliminate the effect of relative deprivation; the latter remains constant for provinces and parishes, as point estimates between the models with and without the food consumption index are not statistically significantly different, and it is reduced a bit for counties, remaining sizeable and significant.

Table 3. Estimates of individual malnutrition, controlling for access to proper nourishment, 2006

| | Province | | County | | Parish | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mu_R$*Deprivation (x1000) | -0.0623** | -0.0782*** | -0.0594*** | -0.0738*** | -0.0437*** | -0.0452*** |
| | (0.0291) | (0.0301) | (0.0020) | (0.0019) | (0.0106) | (0.0133) |
| Consumption per capita | 0.0078** | 0.0067 | 0.0053** | 0.0044** | 0.0038** | 0.0022 |
| | (0.0031) | (0.0041) | (0.0022) | (0.0025) | (0.0018) | (0.0018) |
| Relative Consumption | -0.0061** | -0.0055 | -0.0037 | -0.0032 | -0.0019 | -0.0006 |
| | (0.0034) | (0.0044) | (0.0024) | (0.0027) | (0.0019) | (0.0020) |
| Food Consumption Index | -0.1434 | | -0.1363 | | -0.1363 | |
| | (0.0163) | | (0.0133) | | (0.0163) | |
| Indiv. & Household Controls | X | X | X | X | X | X |
| N | 5175 | 5175 | 5175 | 5175 | 5175 | 5175 |
| $R^2$ | 0.236 | 0.212 | 0.237 | 0.216 | 0.239 | 0.218 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the individual, and the reference group is the province in columns (1) and (2), the county, in columns (3) and (4), and the parish, in columns (5) and (6). The dependent variable is the z-score of height-for-age of the child. Individual and household controls include the same variables as Table 1. We also control for whether the region is rural. See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## *Is deprivation simply capturing the effect of parental height and weight?*

Malnutrition has an intergenerational component, which is a combination of nature and nurture. On the one hand, the genetics of parents determine offspring's height (Duggal and Petri, 2018) and, on the other, the socio-economic circumstances (mostly) of the mother while young, during pregnancy, and when her child is young also condition the height of her child. Because of poverty persistence, a poor child is likely to become a poor youth, and later, a poor pregnant woman facing bad nutritional conditions. Conditions at birth are an important determinant of birthweight, which in turn determines height and weight during the early childhood years that we study in this paper, and later in life. Because of this, our regressions control for low birthweight.

Besides the direct effect of parental height and weight on children's height, parental anthropometric measures also have an indirect effect on children's height through their influence on relative deprivation, as height and weight are associated with economic status (Steckel, 1995; Case and Paxton, 2008). Thus, parental height may be a confounder in our regressions. In other words, the relationship we obtain between relative deprivation and malnutrition may be capturing the more fundamental relationship between parents' and offspring' height. To check whether this is the case, we include the height and the weight of both the mother and the father in the regression models. Before doing that, however, we check whether parental height and weight have a direct influence on relative deprivation in our data. Table 4 shows that parental height and paternal weight have a negative relationship with individual relative deprivation, regardless of whether the latter is measured within provinces, counties, or parishes. The point estimate of maternal weight is positive and small, but not precisely estimated.

Table 4. Effect of parental height and weight on relative deprivation, 2014.

| | Province<br>(1) | County<br>(2) | Parish<br>(3) |
|---|---|---|---|
| Maternal height | -0.8188*** | -0.8512*** | -0.9581*** |
| | (0.1356) | (0.1498) | (0.1581) |
| Maternal weight | 0.0480 | 0.0648* | 0.0844* |
| | (0.0350) | (0.0370) | (0.0459) |
| Paternal height | -0.5141*** | -0.5533*** | -0.5823*** |
| | (0.0978) | (0.0887) | (0.0828) |
| Paternal weight | -0.3153*** | -0.2953*** | -0.2748*** |
| | (0.0315) | (0.0381) | (0.0468) |
| N | 7685 | 7659 | 7637 |
| $R^2$ | 0.240 | 0.358 | 0.418 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The region is the province, in column (1), the county, in column (2), and the parish, in column (3). The dependent variable is individual relative deprivation. The set of controls includes only region fixed effects. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Once corroborated that height and weight have a negative relationship with relative deprivation, we examine whether parental heigh and weight reduce the effect that relative deprivation has on child malnutrition. Table 5 presents estimates of our preferred specification with and without the four variables of parental anthropometric measures for the three types of regions and shows that, as expected, parental height and weight reduce the effect that relative deprivation has on child malnutrition.

Since we only observe parental height and weight for 2014, the even-numbered columns in Table 5 show estimates of our baseline model that do not control for the anthropometric parental measures. Estimates reported in even-numbered columns corroborate the findings we obtain when we use the two years of data we have (2006 and 2014), namely, relative deprivation has a negative and significant effect when regions are provinces or counties but shows no significant effect when they are parishes. By comparing the estimates in the first two columns, we see that the reduction in the effect of relative deprivation on the z-score of height-for-age that results from the inclusion of parental anthropometric measures in our regressions, when regions are provinces, is sizeable. The effect of a one-standard-deviation increase in relative deprivation on the z-score drops by 46% when parental height and weight are taken into account; the effect goes from 6.1% to 3.6%. Likewise, the effect of relative deprivation drops by 48% when regions are counties –as shown by columns (3) and (4). The effect of relative deprivation is not precisely estimated at parish level. This notwithstanding, ff we take the point estimates at face value, controlling for parental heigh and weight reduces the effect of relative deprivation on the z-score by 59%.

Table 5. Estimates of individual malnutrition, controlling for parental height and weight, 2014.

| | Province | | County | | Parish | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| $\mu_R$*Deprivation (x1000) | -0.0269*** | -0.0498*** | -0.0196** | -0.0376*** | -0.0036 | -0.0088 |
| | (0.0083) | (0.0102) | (0.0081) | (0.0086) | (0.0046) | (0.0069) |
| Parental height and weight | X | | X | | X | |
| Indiv. & Household Controls | X | X | X | X | X | X |
| Region Controls | X | X | X | X | X | X |
| County Fixed effects | X | X | X | X | X | X |
| N | 7685 | 7685 | 7659 | 7659 | 7637 | 7637 |
| $R^2$ | 0.284 | 0.202 | 0.305 | 0.227 | 0.334 | 0.261 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The unit of analysis is the individual, and the reference group is the province in columns (1) and (2), the county, in columns (3) and (4), and the parish, in columns (5) and (6). The dependent variable is the z-score of height-for-age of the child. Individual and household controls include dummy for low birth weight (<2500 gr.), dummy for gender of child, square in age of the child in moths, ethnicity of the child, proportion of required vaccines by age, dummy indicating whether the child receives nutritional supplements, dummy indicating whether the child has diarrhoea, dummy indicating easy access to public day care, months breastfeeding, age mother, dummy whether household receives transfers, number of children below 12 in the household, work experience of head of household. Region controls include mean size and mean rent per ha. of agricultural land, dummy whether region is rural, log PIB of province, dummies for large regions (highlands, coast, amazon, Galapagos). See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## 6. Heterogeneous Effects

To gain an insight about possible pathways that can inform public health policy, in this section we explore heterogeneous effects. Many of our individual controls are good candidates to produce heterogenous effects. Low birthweight, for instance, makes the child more vulnerable to unfavourable circumstances (Negrato and Gomes, 2013), and thus may exacerbate the negative impact of deprivation, so its deleterious effect on malnutrition is worse for children born with low weight. Likewise, if parents are biased towards boys and share time and material resources in an uneven way across genders (Barcellos et al., 2014), the detrimental impact of relative deprivation may be larger for girls. Since (infectious) disease and nutrition are two very important determinant of malnutrition, being protected by vaccines and receiving nutritional supplements may partly compensate the harmful effect of deprivation on malnutrition. Finally, breastfeeding reduces malnutrition and infectious diseases, especially during the first 6 months of life. Breast milk is believed to benefit children because it contains the ideal mix of nutrients for infants, factors which promote development of the infant's gut and immune system and which prevent pathogen invasion, and because exclusive breast-feeding prevents intake of pathogens in food or water (Filteau, 2000). Thus, if insufficient intake of nutrients and higher disease likelihood are pathways through which relative deprivation leads to malnutrition, breastfeeding may counteract the deleterious effect of relative deprivation.

We examine whether any of the above variables originates heterogeneous effects and find that only breastfeeding duration mediates the deleterious effect of relative deprivation on malnutrition. This mediating effect holds for the three types of regions.[11] To study heterogeneous effects, we interact the relevant variable, i,e. months breastfeeding, with the three variables that derive from equation (2). Table 6 shows level and interaction effects of the relevant variables, when relative deprivation is measured within provinces, counties, and parishes. The positive interaction effect indicates that additional months of breastfeeding compensates the deleterious effect of relative deprivation. The compensation capacity of breastfeeding is remarkable. A one-standard-deviation increase in relative deprivation reduces the average z-score by 11 per cent for children who were no breast-fed at all, when deprivation is measured within provinces. Now, each month of breastfeeding nearly compensates the effect of half-a-standard-deviation increase in deprivation on the z-score of height-for-age. That is, two months of breastfeeding entirely compensate the harmful effect of a one-standard-deviation increase in relative deprivation. These figures

[11] When regions are defined at parish level, the deleterious effect of relative deprivation is lower for girls and for children who have a larger proportion of vaccines per age. Since we do not observe these two effects for provinces and counties, we do not discuss them in the main text. Further details are available from the authors.

are very similar when deprivation is measured within counties, but much smaller when the region is defined at parish level.

Table 6. Heterogeneous effects of breastfeeding duration

| | Province (1) | County (2) | Parish (3) |
|---|---|---|---|
| (A) $\mu_R$*Deprivation (x1000) | -0.0516*** | -0.0503*** | -0.0277** |
| | (0.0097) | (0.0089) | (0.0109) |
| (B) Months breastfeeding | -0.0198 | -0.0165 | -0.0048 |
| | (0.0199) | (0.0143) | (0.0103) |
| Interaction (AxB) | 0.0045** | 0.0054*** | 0.0046** |
| | (0.0018) | (0.0016) | (0.0021) |
| Indiv. & Household Controls | X | X | X |
| Region Controls | X | X | X |
| County Fixed effects | X | X | X |
| N | 15823 | 15787 | 15762 |
| $R^2$ | 0.220 | 0.243 | 0.267 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The dependent variable is individual relative deprivation. Individual and household controls, and regional controls include the same variables as Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

## 7. The competing effect of inequality

We defend in this paper that individual relative deprivation captures the psychological and psychosomatic stress that may result from socially unfair societies characterised by strict social hierarchies that generate a strong perception of place and station. The previous sections suggest that our modelling of individual stress as a function of the accumulated consumption gaps between an individual and the rest of individuals in the relevant community is a promising route, which has been hardly explored so far. Unlike this, following the pioneering work by Wilkinson (1996), the large bulk of the literature[12] favours the use of a measure of inequality, typically de Gini coefficient, to proxy the psychological and psychosomatic stress that is associated to living in unfair communities.

To check which one of these two competing empirical strategies provides a better framework to model the detrimental effects of unfair societies on children's malnutrition, we run a horse race and add the Gini coefficient to our baseline specifications. Table 7 shows that it is relative deprivation and not inequality

[12] See Lynch et al. (2004) for a review of nearly 100 studies.

that correlates with the z-score of height-for-age. The Gini coefficient is not statistically significant, irrespective of how we define region to measure inequality and deprivation.

Table 7. The competing effect of inequality

| | Province<br>(1) | County<br>(2) | Parish<br>(3) |
|---|---|---|---|
| $\mu_R$*Deprivation (x1000) | -0.0379*** | -0.0333*** | -0.0107 |
| | (0.0082) | (0.0063) | (0.0070) |
| Consumption per capita | 0.0023 | 0.0034*** | 0.028*** |
| | (0.0025) | (0.0013) | (0.0009) |
| Relative Consumption | -0.0034 | -0.0024** | -0.0012 |
| | (0.0024) | (0.0012) | (0.0010) |
| Gini coefficient | -0.1501 | -0.0879 | -0.3543 |
| | (0.6233) | (0.5256) | (0.06982) |
| Indiv. & Household Controls | X | X | X |
| Region Controls | X | X | X |
| County Fixed effects | X | X | X |
| N | 15823 | 15787 | 15762 |
| $R^2$ | 0.219 | 0.241 | 0.265 |

Notes: The Table shows coefficient estimates above and standard errors in parentheses below. Standard errors are clustered at region level. The dependent variable is individual relative deprivation. Individual and household controls, and regional controls include the same variables as Table 1. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

This result comes to no surprise. As Deaton (2003) indicates “relative deprivation is a term frequently used by Wilkinson in his discussions of social stress” (p. 127). Moreover, Yitzhaki’s (1979) measure of individual relative deprivation is able to accommodate the different effect that the social context may have on each individual. In contrast, inequality measures are invariant within the relevant reference group and thus do not accommodate differentiated individual impacts of social conditions.

# 8. Conclusions

Child malnutrition is one of the main public health problems, especially in poor countries, which severely conditions children's life, when young and when adult, and perpetuates the vulnerable part of society to stay at the bottom of the distribution. Beyond the immediate causes of malnutrition, namely, insufficient access to nutrients and high disease exposure, we contend that the social context individuals face also affect child malnutrition. We hypothesise that relative deprivation increases psychosocial stress of parents and this, in turn, reduces the z-score of height-for-age of their offspring. Following Deaton (2003), we assume that individual stress depends on own income and others' income according to Fehr and Schmidt's (1999) function. We further assume child malnutrition to be positively related to parental stress. This theoretical framework produces two predictions that can be tested empirically. First, child malnutrition increases as individual relative deprivation increases, ceteris paribus. Second, when we aggregate the individual functions within relevant social groups, we obtain that aggregated child malnutrition is higher where aggregated relative deprivation is larger.

We test these two predictions for the first time and find empirical support for the two predictions using data for Ecuador, 2006 and 2014. The negative relationship between child malnutrition and relative deprivation obtains after controlling for a rich set of child, parents, household, and regional variables, which include, for the first time, parental height and weight measures. This effect is also quite robust to using different geographic areas (provinces, counties, and parishes) to compute relative deprivation, but it is larger and more significant for larger (provinces and counties) than smaller (parishes) areas. We find that breastfeeding can be very effective at compensating the deleterious effects of relative deprivation. Our results suggest that two additional months of breastfeeding can offset the harmful effects of one-standard-deviation increase in relative deprivation.

We also show that relative deprivation captures much better than inequality the social conditions and structure that, possibly through stress, have a deleterious impact on child malnutrition.

Our study provides novel evidence on the impact of relative deprivation on child malnutrition for a poor country. It would be interesting to check if these findings apply to other countries, especially richer ones with better institutions and social safety nets. Also, future studies with better data should also explore the mechanisms that make relative deprivation impact child malnutrition, especially stress.

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# Appendix 1 Small area estimates methodology (Elbers et al., 2003)

In this Appendix we outline the Small Area Estimates (SAE) method put forth by Elbers et al. (2003) that we employ to estimate the Gini coefficient at the parish, county, and provincial level and provide details about the 2006 and 2014 Gini estimates.

Let W be an indicator of welfare (e.g. the Gini coefficient) based on the distribution of household-level consumption, $y_h$. Using the sample from the LSMS[13] the joint distribution of $y_h$ and its covariates $x_h$ can be estimated. The fitted model parameters can be then used to generate the distribution of $y_h$ for any subpopulation of the census[14] if the set of explanatory variables are restricted to those which can also be found in the census. Once a simulation of household consumption $y_h$ is made, the conditional distribution of W (the Gini coefficient), its point estimate and its prediction error can be estimated (Elbers, et al., 2003).

Consider equation (A1), a linear approximation of the conditional distribution of $y_{ch}$, where $c$ is a sample cluster, $h$ is household, and the vector of disturbances is $u \backsim \mathcal{F}(0, \Sigma)$. Equation (A2) allows for a within-cluster-correlation in disturbances. η and ε are independent of each other and uncorrelated with $x_h$.

$$\ln y_{ch} = E\left[\ln y_{ch} | x_{ch}^T\right] + u_{ch} = x_{ch}^T \beta + u_{ch} \quad \text{(A1)}$$

$$u_{ch} = \eta_c + \varepsilon_{ch} \quad \text{(A2)}$$

We obtain estimates of β in equation (A1) using OLS and then predict the residuals of the regression, $\hat{u}_{ch}$. With consistent estimates of β, the residuals $e_{ch}$ can be used to estimate the variance of $\varepsilon_{ch}$.

$$\hat{u}_{ch} = \hat{u}_{c.} + (\hat{u}_{ch} - \hat{u}_{c.}) = \hat{\eta}_c + e_{ch} \quad \text{(A3)}$$

Subsequently, this estimated distribution in equation (A1) is used to generate the expected value of W in a subpopulation of the census which is denoted v for village. Thus, it is written: $W(m_v, X_v, \beta, u_v)$ where $m_v$ is the $M_v$-vector of household sizes in village v, $X_v$ is the matrix of observable characteristics, and $u_v$ is the vector of disturbances which is unknown and therefore estimated as explained above. The expected value of W is then $\mu_v = E[W | m_v, X_v, \zeta_v]$ where ζ is the vector of model parameters which includes the disturbances. In constructing an estimator of $\mu_v$, $\zeta_v$ is replaced with $\hat{\zeta}_v$. This gives us $\hat{\mu}_v = E\left[W | m_v, X_v, \hat{\zeta}_v\right]$ which is often analytically intractable, so simulation is used to obtain the estimator $\tilde{\mu}_v$.

The difference between $\tilde{\mu}_v$ and the actual level of W has three components and can be written as follows

[13] In our case of 2006 and 2014, in the case of Elbers et al. (2003) of 1998.
[14] In our case of 2010, in the case of Elbers et al. (2003) of 2001.

$$W - \tilde{\mu} = (W - \mu) + (\mu - \hat{\mu}) + (\hat{\mu} - \tilde{\mu}) \tag{A4}$$

The idiosyncratic error – $(\mathrm{W} - \mu)$: the difference between the actual value and the expected value of W arises from the unobserved component of consumption and increases as the size of the target population shrinks which limits the degree of desegregation possible.

The model error – $(\mu - \hat{\mu})$: given $\hat{\zeta}_v$ are consistent estimators of $\zeta_v$, $\hat{\mu}$ is a consistent estimator of $\mu$ and $\sqrt{s}(\mu - \hat{\mu}) \overset{d}{\rightarrow} \mathcal{N}(0, \Sigma_M)$ as $s \longrightarrow \infty$. However, given that this component of the prediction error is determined in (2), it does not change systematically with changes in the size of the target population.

The computation error – $(\hat{\mu} - \tilde{\mu})$: when simulation is used as a method of computation, this error has an asymptotic distribution $\sqrt{R}(\hat{\mu} - \tilde{\mu}) \overset{d}{\rightarrow} \mathcal{N}(0, \Sigma_c)$ as $R \longrightarrow \infty$, where R is the number of independent random draws used for the simulation and therefore this error can be as small as the computational resources allow.

Tarozzi & Deaton (2009) argue that, in order to match survey and census data in the way which is proposed by Elbers et al. (2003), a degree of spatial homogeneity is required for which the method has no basis. They propose that estimates based on those assumptions may underestimate the variance of the error in predicting $W$ (estimated at the local level) and therefore overstate the coverage of confidence intervals. In response, Elbers, et al. (2008) compare their small area estimate welfare results in Minas Gerais, Brazil, a notably heterogeneous area, with the true welfare values and find that the methodology yields welfare estimations which are close to these true values and had confidence interval estimations which were appropriate. This demonstrates that if the methodology is applied with careful control over the conditional distribution of income, the estimations can be reliable.

In the 2006-2010 simulation, Ecuador is divided into eight sub-regions --see Table A1.1. Firstly, three general geographic regions: coast, highlands and Amazon basin which are further divided into rural and urban areas excluding the two largest cities (Quito and Guayaquil), which are considered their own sub-regions. A separate consumption model for each one of these eight sub-regions was built. Therefore, a household in the rural area of a given province will have a predicted consumption resulting from the model fitted using only observations in the rural part of that province. Likewise, a household in an urban area of the same province will have a predicted consumption resulting from the model fitted using only observations from the urban part of that province. Given there can be both rural and urban areas within the same province, county, or parish, separating them increases the level of homogeneity within each sub-region and within each *small area estimate* model (see Appendix 2 for details on consumption models per sub-region). Once each observation (household) has a predicted consumption on the census, it is possible to estimate Gini coefficients over every province, county, and parish.

For the 2014-2010 simulation we divide the country into these eight sub-regions and then further divide the data into groups of provinces within either urban or rural, coast, highlands, and amazon regions which are similar to each other. We define similar as those groups where the model yields the smallest errors (through iteration) between true (2014 LSMS) and predicted values (2014-2010 SAE). We estimate 16 different consumption models for 16 different sub-sub-regions.

Table A1.1 presents the 2006-2010 simulation and compares them to the Gini coefficients estimated directly from the LSMS (2006) over the sub-regions, while Table A1.2 presents the 2014-2010 simulations and compares them to the Gini coefficients from LSMS (2014) over the provinces. In both cases the SAE estimations consistently underestimate the Gini coefficients as measured by the LSMS's. This may be due to the fact that the SAE simulation models tend to underestimate the household consumption of high-income households as the variables used in the equation estimations are generally measuring lack of resources –see Appendix 2.

Notwithstanding, the results have a certain geographic consistency. In the case of the 2006 LSMS, Quito and Guayaquil have the highest levels of inequality followed by the rural amazon and rural highlands both in the simulated and non-simulated estimations. Table A1.2 presents the Gini coefficients in ascending order to show how, in general, the highest simulated values coincide with the highest true values.

The most important limitation of the way this method is applied is that, in both cases, the 2010 census is used. Basically, a consumption model on 2006 household behaviour is built and simulated onto the 2010 census. Similarly, a consumption model on 2014 household behaviour is built and simulated onto the same 2010 census. This might be methodologically interesting as --given there is no difference in the census population-- the only difference in the Gini coefficient results would be the product of the change in household behaviours between 2006 and 2014. However, this is paradoxical because, in order to use the 2006 estimated parameters (correlation coefficients) to simulate consumption using the population characteristics of 2010, it must be assumed there is very little change in behaviours between 2006 and 2010. This same assumption must be made when the 2014 parameters are used to simulate consumption on the 2010 census. However, this cannot be true as the resulting Gini coefficients are fundamentally different. Obviously, it is very improbable to have a LSMS and a census on the same year, and in the case of Ecuador there is a census only once every 10 years. Therefore, we have chosen to use the 2010 census for both cases.

**Table A1.1 Comparison of estimations of the Gini coefficient from the LSMS (2006) and using SAE (2006-2010)**

| | Regional Gini | |
|---|---|---|
| Region | LSMS (2006) | SAE (2006-2010) |
| Quito | 0.463 | 0.403 |
| Guayaquil | 0.416 | 0.386 |
| Urban Coast | 0.409 | 0.358 |
| Rural Coast | 0.357 | 0.281 |
| Urban Highlands | 0.411 | 0.346 |
| Rural Highlands | 0.454 | 0.387 |
| Urban Amazon | 0.416 | 0.355 |
| Rural Amazon | 0.47 | 0.454 |
| National Total | 0.466 | 0.419 |

Source: Small Area Estimates using Living Standards Measurement Survey, Ecuador 2006 and Ecuadorian Census of 2010. Instituto Nacional de Encuestas y Censos, Ecuador. Data procesing: Unidad de Infromación Socio Ambiental, Universidad Andina Simón Bolívar.

**Table A1.2 Comparison of estimations of the Gini coefficient from the LSMS (2014) and using SAE (2014-2010)**

| | Gini province | |
|---|---|---|
| Province ID | LSMS (2014) | SAE (2014-2010) |
| 20 | 0.319 | 0.308 |
| 7 | 0.357 | 0.291 |
| 12 | 0.363 | 0.28 |
| 9 | 0.365 | 0.36 |
| 3 | 0.368 | 0.327 |
| 8 | 0.376 | 0.376 |
| 23 | 0.376 | 0.303 |
| 13 | 0.377 | 0.301 |
| 2 | 0.379 | 0.365 |
| 21 | 0.382 | 0.385 |
| 24 | 0.382 | 0.305 |
| 4 | 0.384 | 0.339 |
| 5 | 0.385 | 0.344 |
| 11 | 0.399 | 0.363 |
| 1 | 0.401 | 0.388 |
| 19 | 0.402 | 0.362 |
| 18 | 0.404 | 0.355 |
| 6 | 0.411 | 0.404 |
| 17 | 0.429 | 0.418 |
| 10 | 0.43 | 0.363 |
| 14 | 0.446 | 0.397 |
| 22 | 0.446 | 0.425 |
| 16 | 0.473 | 0.368 |
| 15 | 0.495 | 0.381 |

Source: Authors’ computation of Small Area Estimates using Living Standards Measurement Survey, Ecuador 2014 and Ecuadorian Census of 2010.

# Appendix 2. Consumption prediction models using Small Area Estimates

### Table A2.1 Consumption prediction model for Small Area Estimates 2006-2010

| Dependent Variable: LNCONPCM Weighted by: FEXP | Quito | Guayaquil | Urban Coast | Rural Coast | Urban Highlands | Rural Highlands | Urban Amazon | Rural Amazon |
|---|---|---|---|---|---|---|---|---|
| _intercept_ | 3.9244*** | 4.69609*** | 4.95897*** | 4.24822*** | 4.66441*** | 3.81323*** | 4.21719*** | 5.12909*** |
| | (0.54644) | (0.32232) | (0.17108) | (0.16086) | (0.23849) | (0.17533) | (0.33065) | (0.2845) |
| Access to higher education | 0.90309*** | | | | | | | |
| | (0.09756) | | | | | | | |
| Average proportion of household with cement walls in statistical area | | | | -0.14443*** | | 0.13408*** | | |
| | | | | (0.04016) | | (0.03017) | | |
| Average proportion of houses with connection to public water disposal service | | | | | -0.16132** | -0.12525** | | |
| | | | | | (0.05754) | (0.03788) | | |
| Average proportion of housing with exclusive toilets in statistical area | -0.11827 | | -0.11533 | | 0.22179** | | | |
| | (0.14344) | | (0.06497) | | (0.07307) | | | |
| Average proportion of houses with garbage truck service in statistical area | 1.231* | | -0.12598* | | | | | |
| | (0.5303) | | (0.05113) | | | | | |
| Average proportion of houses with publicly provided drinking water in statistical area | | | 0.05851 | | | | -0.32875** | |
| | | | (0.03787) | | | | (0.11025) | |
| Average proportion of persons per room in statistical area | | -0.20641 | -0.05895** | | | -0.06983*** | 0.04303 | -0.20006*** |
| | | (0.15818) | (0.02121) | | | (0.01585) | (0.02425) | (0.02644) |
| Average years of schooling in parish | | 0.04799** | | | | | | |
| | | (0.0176) | | | | | | |
| Dummy amplified nuclear family | | | | | -0.08971** | 0.05536* | | |
| | | | | | (0.02868) | (0.02572) | | |
| Dummy Cuenca | | | | | 0.16585*** | | | |
| | | | | | (0.02294) | | | |
| Dummy bamboo flooring or similar | | -0.21931** | -0.07458 | -0.09438** | | -0.06947** | | |
| | | (0.07354) | (0.0439) | (0.03403) | | (0.02424) | | |
| Dummy for cement or brick flooring | | -0.1966*** | | | | -0.08137*** | | |
| | | (0.04597) | | | | (0.02228) | | |
| Dummy for walls made of bamboo wood or similar | | -0.17853** | -0.06676* | | | | | |
| | | (0.0547) | (0.0309) | | | | | |
| Dummy head of household affiliated to social security | | 0.08396** | 0.0631** | 0.11415** | | 0.1265*** | | |
| | | (0.03172) | (0.0237) | (0.03546) | | (0.03291) | | |
| Dummy head of household construction worker | | -0.0573 | 0.32542*** | -0.12684* | 0.08557*** | 0.12598*** | 0.20716*** | |
| | | (0.04312) | (0.06257) | (0.04962) | (0.02146) | (0.02989) | (0.05118) | |
| Dummy head of household directive position | 0.17944* | 0.31372*** | | 0.27233* | | | 0.31744** | |
| | (0.07427) | (0.067) | | (0.12508) | | | (0.10396) | |
| Dummy head of household employer | 0.09348 | 0.15455*** | 0.23413*** | 0.19037*** | 0.22634*** | 0.16207*** | 0.21176** | |
| | (0.05634) | (0.04382) | (0.02869) | (0.02919) | (0.03255) | (0.03692) | (0.06899) | |
| Dummy head of household ethnic | 0.07023 | 0.07685 | | | | | | -0.14128** |
| | (0.05121) | (0.04629) | | | | | | (0.04509) |
| Dummy head of household female | -0.08383* | | | | -0.09081** | 0.04279 | | |
| | (0.03465) | | | | (0.02807) | (0.02744) | | |
| Dummy head of household in hotel industry | | | | | 0.12719* | 0.12641 | | |
| | | | | | (0.04931) | (0.07932) | | |
| Dummy head of household in manufacturing | | | 0.05821 | | | | | |
| | | | (0.03067) | | | | | |
| Dummy head of household in retail sale | | | 0.10744*** | 0.04692 | 0.0947** | | -0.0909 | -0.39423*** |
| | | | (0.02441) | (0.03929) | (0.02895) | | (0.06048) | (0.10429) |
| Dummy head of household inactive | | | 0.09164* | | 0.04816 | | 0.4985*** | |
| | | | (0.04158) | | (0.03294) | | (0.1199) | |
| Dummy head of household marital status divorced/separated | | | -0.05765* | 0.00655 | | | | |
| | | | (0.02748) | (0.03115) | | | | |
| Dummy head of household marital status single | | | -0.13252*** | -0.06892 | | -0.11749*** | | |
| | | | (0.03986) | (0.04049) | | (0.03471) | | |
| Dummy head of household non-qualified agricultural worker | | | 0.0731* | | | | | -0.23459*** |
| | | | (0.0363) | | | | | (0.053) |
| Dummy head of household non-qualified worker | | | -0.04806* | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | (0.02252) | | | | | |
| Dummy head of household other service position | -0.15888 | 0.12451* | | | | -0.11051 | | |
| | (0.08409) | (0.05073) | | | | (0.06869) | | |
| Dummy head of household over 65 years of age | | | | -0.15334** | -0.07733* | -0.158*** | | |
| | | | | (0.04989) | (0.03123) | (0.02902) | | |
| Dummy head of household public sector | | 0.38836 | 0.15076*** | | | 0.2044 | -0.36949* | 0.23886** |
| | | (0.22173) | (0.03427) | | | (0.11238) | (0.16818) | (0.0731) |
| Dummy head of household salary worker | -0.08119* | -0.0754* | | | -0.08235** | -0.08073** | | -0.14238** |
| | (0.0359) | (0.03323) | | | (0.02572) | (0.0247) | | (0.05453) |
| Dummy head of household speaks native language | | | | | | -0.03236 | | -0.10053* |
| | | | | | | (0.0292) | | (0.04922) |
| Dummy head of household speaks native language and Spanish | | | | | | | 0.0881 | |
| | | | | | | | (0.0559) | |
| Dummy head of household transportation | | 0.09764* | 0.11166** | | 0.15424*** | 0.12366** | 0.17751* | |
| | | (0.04331) | (0.03431) | | (0.03626) | (0.04404) | | |
| Dummy head of household wholesale worker | | 0.10023* | 0.09169* | 0.24802*** | 0.12789*** | 0.19403*** | | |
| | | (0.04689) | (0.0401) | (0.07271) | (0.03801) | (0.05837) | | |
| Dummy head of household widow/widower | | -0.05469 | | -0.01949 | | | | |
| | | (0.05432) | | (0.03492) | | | | |
| Dummy head of household works in modern sector | | | | 0.05895** | | 0.09492*** | 0.12742* | |
| | | | | (0.02019) | | (0.01993) | (0.05373) | |
| Dummy household garbage is burnt or buried | | | | 0.06808*** | | | 0.13293 | 0.11474* |
| | | | | (0.01873) | | | (0.08065) | (0.04524) |
| Dummy household garbage is thrown in empty lot | | | | | | | 0.29669* | |
| | | | | | | | (0.11947) | |
| Dummy household that share or do not have toilet | | | | 0.04359 | | | | |
| | | | | (0.02267) | | | | |
| Dummy household water connection outside the building and the property | -0.27689* | | | -0.01256 | | -0.17965*** | -0.38079** | |
| | (0.12968) | | | (0.01809) | | (0.04664) | (0.14088) | |
| Dummy household with adobe walls | | | | -0.15419* | | | | |
| | | | | (0.06985) | | | | |
| Dummy household water connection outside the building but inside the property | | | | | -0.07658* | -0.0674* | 0.1763** | |
| | | | | | (0.03296) | (0.02751) | (0.06746) | |
| Dummy household with asbestos roof or similar | -0.09016* | | | 0.02289 | 0.00517 | 0.05291** | | |
| | (0.03702) | | | (0.03795) | (0.02097) | (0.02006) | | |
| Dummy household with electric stove | 0.47731** | | | | | 0.97216* | | |
| | (0.15683) | | | | | (0.42308) | | |
| Dummy household with palm/straw roof or similar | | | | -0.08914* | | -0.04628 | | |
| | | | | (0.03572) | | (0.08125) | | |
| Dummy household with room for rent | | | | | 0.0358 | | | |
| | | | | | (0.03725) | | | |
| Dummy household with wood walls | | | | | -0.05554 | | | |
| | | | | | (0.09368) | | | |
| Dummy household wood/coal stove | | | | -0.10355*** | -0.23951** | -0.17803*** | -0.61124** | -0.28142*** |
| | | | | (0.02589) | (0.08161) | (0.02292) | (0.19751) | (0.05506) |
| Dummy housing with no electricity | | -0.67314 | 0.0689 | | -0.38417* | -0.10891** | | |
| | | (0.38913) | (0.0757) | | (0.17524) | (0.03945) | | |
| Dummy housing with no telephone | -0.22134*** | -0.13318*** | -0.23438*** | -0.26983*** | -0.19948*** | -0.17905*** | -0.19044*** | -0.28064*** |
| | (0.03785) | (0.02912) | (0.02075) | (0.04135) | (0.02135) | (0.02539) | (0.04837) | (0.08092) |
| Dummy housing provided in exchange for services | | | -0.07415** | -0.07281** | -0.09788*** | -0.04755* | | -0.12341* |
| | | | (0.02395) | (0.02215) | (0.02516) | (0.02301) | | (0.05236) |
| Dummy housing with exclusive room for cooking | | 0.18247** | | 0.1422* | | 0.36858** | | 0.40627*** |
| | | (0.06259) | | (0.05986) | | (0.11203) | | (0.12162) |
| Dummy housing with latrine | -0.95173*** | -0.18963* | | | | -0.04757 | | |
| | (0.27272) | (0.08365) | | | | (0.02945) | | |
| Dummy housing with no shower | -0.20037*** | -0.10793** | -0.14549*** | | -0.01579 | -0.11995*** | -0.13628* | |
| | (0.04564) | (0.03456) | (0.02258) | | (0.03132) | (0.02232) | (0.05606) | |
| Dummy housing with other stove | -0.14827 | | | | | | | |
| | (0.17555) | | | | | | | |
| Dummy housing with toilet and septic tank | | 0.04789 | 0.03785 | 0.12972*** | | 0.0763*** | | |
| | | (0.0315) | (0.02089) | (0.02104) | | (0.02111) | | |
| Dummy incomplete nuclear family | | | 0.04721 | | -0.01417 | 0.09195** | 0.08409 | |
| | | | (0.02525) | | (0.02866) | (0.02787) | (0.05071) | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Dummy indigenous head of household | 0.08425 | | | | | | | |
| | (0.09848) | | | | | | | |
| Dummy metal zinc roof | | -0.07327* | | | 0.0561 | | 0.0607 | |
| | | (0.0302) | | | (0.03515) | | (0.04587) | |
| Dummy tile flooring or similar | | | | | 0.08308*** | | | |
| | | | | | (0.02116) | | | |
| Dummy precarious housing | | 0.41124** | | | | -0.12429 | | |
| | | (0.15054) | | | | (0.07863) | | |
| Dummy rented housing | -0.12113*** | -0.08006** | -0.07646** | | | -0.08938* | -0.12164* | |
| | (0.03102) | (0.0302) | (0.02409) | | | (0.04269) | (0.04872) | |
| Dummy semi-precarious housing | | 0.13243** | 0.08558* | 0.04575 | | -0.12763*** | | |
| | | (0.04624) | (0.0334) | (0.03728) | | (0.03208) | | |
| Dummy tile flooring or similar | | 0.05854 | 0.19685*** | 0.23252*** | | 0.11607* | 0.14214** | |
| | | (0.05148) | (0.02308) | (0.04915) | | (0.04679) | (0.05326) | |
| Elementary school attendance net rate | | | | | | | 0.23752 | -0.54376** |
| | | | | | | | (0.16138) | (0.18509) |
| Head of household education * dummy head of household formal sector | 0.0108** | | | | 0.01024*** | | | |
| | (0.00329) | | | | (0.00183) | | | |
| Head of household education * dummy head of household public sector | | 0.00409 | 0.00498* | | | -0.02533* | | |
| | | (0.00289) | (0.00227) | | | (0.01004) | | |
| Head of household education * dummy head of household house worker | | -0.02849** | | | | | | -0.07134* |
| | | (0.00974) | | | | | | (0.03342) |
| Head of household education * dummy head of household public sector | | -0.02311 | | | | | 0.01864 | |
| | | (0.0149) | | | | | (0.01284) | |
| Head of household education * head of household experience | 0.00017 | 0.00078*** | 0.00027** | 0.00065*** | 0.00046*** | | | |
| | (0.00024) | (0.00022) | (0.0001) | (0.00012) | (0.000074955) | | | |
| Head of household experience | 0.00323 | | -0.00072 | 0.01974* | | 0.0009 | | |
| | (0.00436) | | (0.00214) | (0.00993) | | (0.00104) | | |
| Head of household experience2 | 0 | -0.00036* | | -0.00093* | | | | |
| | (0) | (0.00014) | | (0.00036) | | | | |
| Head of household experience3 | | 0* | 0 | 0.000011198** | | | | |
| | | (0) | | (0) | | | | |
| Head of household schooling | 0.01307 | -0.03468* | | | 0.03081*** | 0.00616 | | 0.02007*** |
| | (0.01875) | (0.01688) | | | (0.00305) | (0.00684) | | (0.00584) |
| Head of household schooling2 | 0.00066 | 0.0012 | 0.00081*** | 0.0004 | | 0.00168*** | 0.00078* | |
| | (0.00068) | (0.00064) | (0.0002) | (0.00027) | | (0.00043) | (0.00033) | |
| High school attendance net rate in parish | 0.15497* | -0.05731 | 0.05553 | 0.09346** | | -0.07176* | | |
| | (0.06223) | (0.0506) | (0.04261) | (0.03176) | | (0.03481) | | |
| Household water obtained from stream or similar | | | -0.13784*** | | | 0.09818** | 0.17614 | |
| | | | (0.03786) | | | (0.03553) | (0.10576) | |
| Household water obtained well | | | -0.13309*** | 0.03924* | | 0.18506** | | |
| | | | (0.03445) | (0.01996) | | (0.064) | | |
| Household with room for family business | | | 0.03804 | | | | | 0.2489*** |
| | | | (0.03129) | | | | | (0.07349) |
| Household with toilet without septic tank, just dung up well | | | -0.02735 | | -0.1627* | | | 0.09123 |
| | | | | | (0.07835) | | | (0.05648) |
| Ln(Income per-capita) | 0.04942*** | 0.17483*** | | 0.14104*** | | 0.14508*** | 0.11786*** | 0.17597*** |
| | (0.01444) | (0.02635) | | (0.01217) | | (0.01589) | (0.0289) | (0.03269) |
| Percentages of houses in parish with parquet floors or similar | | -0.39243 | | 0.08402 | -0.26581 | | | |
| | | (0.24413) | | (0.07599) | (0.20628) | | | |
| Rate of literacy in statistical area | | | 0.37477* | | 0.40517 | 0.21459** | | |
| | | | (0.14607) | | (0.2192) | (0.07405) | | |
| Rooms per person | 0.22059*** | 0.25524*** | 0.21138*** | 0.16251*** | 0.21087*** | 0.18977*** | 0.14312** | 0.09979** |
| | (0.02652) | (0.03094) | (0.01879) | (0.01775) | (0.01513) | (0.01748) | (0.04331) | (0.03445) |
| Square root of number of basic needs met | -0.08573*** | -0.06066 | -0.05829** | -0.13819*** | -0.11805*** | -0.08635** | -0.21112*** | -0.1249*** |
| | (0.02511) | (0.03152) | (0.01799) | (0.0273) | (0.02079) | (0.02689) | (0.04291) | (0.03662) |
| Square root of number of hours of work of head of household | | -0.02393** | 0.02043*** | | -0.00328 | | 0.03463** | 0.02253 |
| | | (0.00832) | (0.0048) | | (0.00457) | | (0.013) | (0.01175) |
| Square root of number of people in household | -0.38042*** | -0.28734*** | -0.33855*** | -0.33752*** | -0.2499*** | -0.30488*** | -0.34108*** | -0.43351*** |
| | (0.05296) | (0.04401) | (0.03044) | (0.03138) | (0.03465) | (0.03308) | (0.0697) | (0.05541) |
| Square root of number of people under 12 in household | -0.08027** | -0.03039 | -0.11979*** | -0.11686*** | -0.1102*** | -0.04395* | -0.14246** | -0.10295* |
| | (0.03088) | (0.02715) | (0.01808) | (0.02152) | (0.01927) | (0.02126) | (0.04559) | (0.04293) |
| University attendance net rate in parish | -0.05373 | 0.20962** | -0.0629 | | 0.18251*** | 0.17734** | 0.47892** | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | (0.07623) | (0.06353) | (0.03785) | | (0.03706) | (0.05998) | (0.18259) | |
| Water provision by water truck | | 0.17168*** | | | | 0.20028*** | | |
| | | (0.04711) | | | | (0.05823) | | |
| R2 | 0.77657 | 0.75135 | 0.69353 | 0.62719 | 0.69593 | 0.63059 | 0.8007 | 0.80229 |
| N | 878 | 1010 | 2566 | 2154 | 2314 | 3008 | 388 | 592 |

Source: Authors' computation using 2006 LSMS.

## Table A2.2 Consumption prediction model for Small Area Estimates 2014-2010

| | RA | UA (1) | UA (2) | RC (3) | RC (4) | UC | G | Q | RH(5) | RH (6) | RH (7) | RH (8) | RH (9) | UH (10) | UH (11) | UH (12) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) | b(s.e.) |
| Intercept | 4.7 | 5.23 | 4.76 | 5.1 | 4.61 | 5.1938 | 6.77 | 6.29 | 5.05 | 4.16 | 4.93 | 5.2 | 8.19 | 5.52 | 5.25 | 5.06 |
| | (0.24) | (0.2) | (0.4) | (0.2) | (0.32) | (0.18) | (0.34) | (0.64) | (0.22) | (0.39) | (0.24) | (0.44) | (1.57) | (0.63) | (1.04) | (0.35) |
| Access to higher education | 0.42 | | | 0.44 | 1.25 | 0.2397 | 0.39 | 0.34 | | | | -0.65 | 0.3 | -1.18 | 0.68 | 0.32 |
| | (0.13) | | | (0.14) | (0.31) | (0.07) | (0.15) | (0.15) | | | | (0.23) | (0.17) | (0.41) | (0.15) | (0.09) |
| Number of rooms per person | 0.22 | 0.15 | 0.24 | 0.15 | | 0.1203 | 0.23 | 0.24 | 0.27 | 0.16 | 0.23 | 0.19 | 0.13 | 0.13 | 0.23 | 0.18 |
| | (0.03) | (0.04) | (0.04) | (0.02) | | (0.01) | (0.03) | (0.03) | (0.05) | (0.03) | (0.04) | (0.04) | (0.04) | (0.06) | (0.03) | (0.02) |
| D. drinking water from distribution truck | | 0.66 | -0.13 | | 0.22 | 0.0447 | | | | | | | | | | |
| | | (0.39) | (0.04) | | (0.07) | (0.02) | | | | | | | | | | |
| D. drinking water from well | 0.04 | 0.66 | | | | -0.0395 | | | | | -0.2 | -0.44 | | 0.32 | | |
| | (0.02) | (0.28) | | | | (0.02) | | | | | (0.13) | (0.28) | | (0.13) | | |
| D. drinking water from public works | | | 0.53 | | -0.51 | -0.1023 | | | | | | | | | | |
| | | | (0.27) | | (0.2) | (0.05) | | | | | | | | | | |
| D. driking water from public works connected outside building | | -0.1 | -0.13 | | -0.08 | -0.0713 | | | | | | -0.1 | -0.13 | | -0.06 | -0.06 |
| | | (0.04) | (0.04) | | (0.05) | (0.01) | | | | | | (0.03) | (0.03) | | (0.04) | (0.02) |
| D. driking water from river or thelike | | -0.19 | -0.1 | | | -0.1087 | -0.41 | | | | | -0.1 | -0.11 | | | |
| | | (0.09) | (0.07) | | | (0.03) | (0.13) | | | | | (0.05) | (0.06) | | | |
| D. nuclear family plus extended | 0.07 | | -0.07 | 0.04 | | 0.0258 | | | -0.09 | 0.08 | | 0.07 | | | | 0.03 |
| | (0.02) | | (0.04) | (0.02) | | (0.01) | | | (0.05) | (0.03) | | (0.03) | | | | (0.02) |
| D. renting loggings or anthicresis | | | | | | 0.2011 | | -0.06 | | | | | | | | |
| | | | | | | (0.2) | | (0.03) | | | | | | | | |
| D. renting loggings | | | | | | -0.2456 | | | | | | | | | | |
| | | | | | | (0.2) | | | | | | | | | | |
| D. dispose garbage in own land | -0.11 | -0.23 | | | | | | | -0.13 | -0.13 | | | | | | -0.12 |
| | (0.02) | (0.09) | | | | | | | (0.05) | (0.06) | | | | | | (0.06) |
| D. dispose garbage by burning | | | | 0.07 | 0.05 | | | | | | | | | | | |
| | | | | (0.02) | (0.04) | | | | | | | | | | | |
| D. homeowener | | 0.07 | | | | 0.0624 | 0.03 | 0.09 | | 0.03 | | | | | 0.16 | 0.11 |
| | | (0.03) | | | | (0.01) | (0.02) | (0.03) | | (0.02) | | | | | (0.02) | (0.01) |
| D. hut | | 0.79 | | 0.39 | | -0.2434 | | | | | | | | | | 0.81 |
| | | (0.28) | | (0.16) | | (0.16) | | | | | | | | | | (0.38) |
| D. electric stove | | | | -0.38 | | | 0.17 | 0.27 | | | | | | | | |
| | | | | (0.26) | | | (0.13) | (0.16) | | | | | | | | |
| D. wood stove | -0.11 | -0.22 | | -0.05 | -0.15 | -0.115 | | | | -0.13 | -0.12 | -0.09 | -0.13 | | | -0.2 |
| | (0.02) | (0.09) | | (0.03) | (0.06) | (0.06) | | | | (0.04) | (0.04) | (0.04) | (0.04) | | | (0.05) |
| D. house with exclusive kitchen area | 0.03 | | | 0.07 | 0.07 | 0.0519 | | 0.07 | | 0.03 | 0.05 | 0.07 | 0.05 | 0.13 | 0.06 | 0.05 |
| | (0.01) | | | (0.01) | (0.03) | (0.01) | | (0.03) | | (0.02) | (0.03) | (0.03) | (0.02) | (0.06) | (0.02) | (0.01) |
| D. Cuenca | | | | | | | | | | | | | | | 0.17 | |
| | | | | | | | | | | | | | | | (0.03) | |
| D. household with room for family business | 0.09 | | | | | | | | 0.22 | 0.09 | -0.08 | -0.05 | | | | |
| | (0.04) | | | | | | | | (0.1) | (0.04) | (0.03) | (0.03) | | | | |
| D. outhouse toilet | -0.06 | | | | | | | | | | | | | | | -0.17 |
| | (0.02) | | | | | | | | | | | | | | | (0.05) |
| D. toilet with septic tank | 0.04 | | 0.07 | | 0.06 | 0.0283 | | | | | | | | -0.11 | | 0.02 |
| | (0.02) | | (0.03) | | (0.03) | (0.01) | | | | | | | | (0.06) | | (0.03) |
| D. head speaks Spanish and native language | -0.18 | -0.11 | 0.19 | | -0.24 | | | | | -0.18 | | | -0.08 | | | |
| | (0.02) | (0.05) | (0.12) | | (0.11) | | | | | (0.05) | | | (0.04) | | | |
| D. head agricutural worker | | 0.11 | | | | | | | | -0.11 | 0.2 | | | | | |
| | | (0.09) | | | | | | | | (0.04) | (0.08) | | | | | |
| D. head wage employee | | -0.09 | | | -0.07 | | | | | | | | | | -0.06 | -0.15 |
| | | (0.03) | | | (0.03) | | | | | | | | | | (0.02) | (0.03) |
| D. head of hh employed in retail industry | | 0.1 | | | | | 0.05 | | | | | 0.08 | 0.17 | | | |
| | | (0.05) | | | | | (0.03) | | | | | (0.06) | (0.06) | | | |
| D. head of hh employed in wholesale industry | | | -0.2 | 0.2 | | 0.08 | 0.15 | | | | | 0.39 | 0.2 | | | |
| | | | (0.13) | (0.07) | | (0.03) | (0.06) | | | | | (0.16) | (0.13) | | | |
| D. head of hh works in construction industry | | | | | -0.13 | -0.0298 | | | 0.17 | -0.06 | | 0.09 | | | | -0.08 |
| | | | | | (0.09) | (0.02) | | | (0.07) | (0.03) | | (0.03) | | | | (0.03) |
| D. head of hh self-employed | 0.13 | | | | | 0.0484 | 0.1 | | 0.22 | 0.14 | 0.12 | -0.07 | | | | -0.05 |
| | (0.04) | | | | | (0.01) | (0.03) | | (0.09) | (0.03) | (0.04) | (0.04) | | | | (0.03) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D. head of hh employed in directing role | 0.17 | | 0.36 | 0.16 | | 0.2834 | 0.18 | | | 0.31 | | | 0.19 | | 0.17 | 0.15 |
| | (0.09) | | (0.16) | (0.09) | | (0.04) | (0.1) | | | (0.13) | | | (0.09) | | (0.07) | (0.05) |
| D. head employed in hotel-restaurant industry | | -0.08 | -0.13 | 0.07 | | | | | | -0.2 | | | | -0.39 | | |
| | | (0.06) | (0.06) | (0.05) | | | | | | (0.08) | | | | (0.14) | | |
| D. head access to social security | 0.22 | | 0.07 | 0.09 | | 0.1082 | 0.12 | 0.04 | 0.15 | 0.14 | 0.09 | | 0.04 | 0.1 | 0.06 | 0.09 |
| | (0.02) | | (0.03) | (0.02) | | (0.01) | (0.02) | (0.02) | (0.08) | (0.03) | (0.06) | | (0.03) | (0.07) | (0.02) | (0.02) |
| D. head of hh not in labour force | | 0.12 | 0.11 | | | 0.0596 | -0.1 | 0.13 | -0.14 | | | | | 0.15 | | 0.07 |
| | | (0.07) | (0.08) | | | (0.02) | (0.03) | (0.05) | (0.06) | | | | | (0.11) | | (0.04) |
| D. head in hh works in manufacturing industry | -0.1 | | -0.11 | | | -0.0415 | | | | -0.14 | | | | | -0.08 | -0.07 |
| | (0.05) | | (0.05) | | | (0.02) | | | | (0.04) | | | | | (0.03) | (0.02) |
| D. head of hh female | | | | -0.07 | -0.1 | -0.0392 | | | | | | | -0.12 | | -0.1 | -0.07 |
| | | | | (0.02) | (0.05) | (0.01) | | | | | | | (0.03) | | (0.03) | (0.02) |
| D. head of hh native American | -0.17 | | | | | | | -0.68 | | | | | -0.29 | | | 0.16 |
| | (0.14) | | | | | | | (0.4) | | | | | (0.17) | | | (0.1) |
| D. head of hh unskilled | | -0.08 | -0.1 | -0.06 | | -0.0606 | -0.05 | -0.06 | | | -0.1 | -0.14 | | | -0.03 | -0.05 |
| | | (0.04) | (0.04) | (0.02) | | (0.01) | (0.03) | (0.04) | | | (0.05) | (0.03) | | | (0.03) | (0.02) |
| D. head of hh in service industry | 0.14 | | | | | | -0.1 | | | -0.35 | | | | | | -0.12 |
| | (0.1) | | | | | | (0.06) | | | (0.14) | | | | | | (0.04) |
| D. head of hh in fishing industry | 0.18 | | | 0.19 | -0.12 | | 0.15 | | | | | | | | | |
| | (0.12) | | | (0.04) | (0.09) | | (0.08) | | | | | | | | | |
| D. head of hh business owner and chief | 0.45 | 0.18 | 0.28 | | 0.46 | 0.2755 | 0.3 | 0.31 | | 0.36 | | 0.22 | 0.28 | 0.53 | 0.31 | 0.22 |
| | (0.08) | (0.07) | (0.06) | | (0.11) | (0.02) | (0.06) | (0.05) | | (0.1) | | (0.08) | (0.07) | (0.16) | (0.05) | (0.04) |
| D. head of hh domestic worker | 0.13 | | | | | -0.0019 | -0.04 | 0.04 | -0.57 | | | | 0.26 | | | |
| | (0.1) | | | | | (0.04) | (0.09) | (0.03) | (0.27) | | | | (0.15) | | | |
| D. head in formal economic sector | 0.08 | | | | | | | | 0.19 | | | | | | 0.07 | 0.08 |
| | (0.03) | | | | | | | | (0.1) | | | | | | (0.03) | (0.02) |
| D. head of hh single | -0.14 | -0.13 | 0.18 | | -0.1 | -0.0872 | | | -0.1 | -0.1 | -0.23 | -0.1 | | | -0.08 | -0.09 |
| | (0.04) | (0.05) | (0.06) | | (0.07) | (0.02) | | | (0.07) | (0.04) | (0.07) | (0.05) | | | (0.04) | (0.03) |
| D. head of hh works in public sector | 0.18 | | | | | | | 0.08 | | 0.23 | | | 0.13 | | | |
| | (0.1) | | | | | | | (0.04) | | (0.14) | | | (0.06) | | | |
| D. head of hh separated/divorced | -0.08 | | 0.1 | | | -0.053 | -0.04 | -0.12 | 0.16 | -0.1 | -0.09 | | | | | |
| | (0.04) | | (0.05) | | | (0.02) | (0.03) | (0.05) | (0.09) | (0.04) | (0.07) | | | | | |
| D. head of hh in transportation industry | | | | | | | | | | -0.09 | -0.13 | | | | -0.13 | -0.07 |
| | | | | | | | | | | (0.07) | (0.07) | | | | (0.05) | (0.03) |
| D. head of hh widow(er) | -0.09 | | | | | -0.0586 | | | | -0.06 | | | 0.11 | | 0.07 | 0.07 |
| | (0.04) | | | | | (0.02) | | | | (0.04) | | | (0.05) | | (0.05) | (0.04) |
| D. head o hh over 65 years of age | -0.09 | | | | | | 0.18 | | | -0.08 | | 0.09 | -0.05 | | 0.11 | |
| | (0.05) | | | | | | (0.07) | | | (0.05) | | (0.07) | (0.05) | | (0.06) | |
| D. toilet is latrine | | | -0.29 | | | -0.051 | -0.13 | | | | | | | | | |
| | | | (0.17) | | | (0.03) | (0.07) | | | | | | | | | |
| D. house basic prefabricated structure | | | | | | | | -0.14 | | | -0.1 | | | | | |
| | | | | | | | | (0.08) | | | (0.05) | | | | | |
| D. house has no shower | -0.1 | -0.15 | | -0.1 | -0.19 | -0.0699 | | | -0.12 | -0.1 | -0.06 | | -0.07 | | -0.09 | -0.11 |
| | (0.02) | (0.05) | | (0.02) | (0.04) | (0.01) | | | (0.05) | (0.03) | (0.04) | | (0.03) | | (0.06) | (0.03) |
| D. house has no landline telephone | 0.11 | 0.2 | 0.26 | 0.1 | 0.07 | 0.194 | 0.14 | 0.14 | | 0.23 | | 0.13 | 0.13 | 0.12 | 0.17 | 0.16 |
| | (0.02) | (0.03) | (0.03) | (0.02) | (0.04) | (0.01) | (0.03) | (0.03) | | (0.02) | | (0.03) | (0.03) | (0.07) | (0.03) | (0.02) |
| D. house has no electricity connection | | | | -0.13 | | | | | -0.25 | | | -0.19 | -0.48 | -0.54 | -0.29 | |
| | | | | (0.05) | | | | | (0.12) | | | (0.12) | (0.19) | (0.18) | (0.17) | |
| D. nuclear family incomplete | 0.06 | -0.08 | | | 0.12 | 0.0546 | | | | | | | | -0.1 | | 0.04 |
| | (0.03) | (0.04) | | | (0.05) | (0.02) | | | | | | | | (0.07) | | (0.02) |
| D. house adobe walls | | | | -0.19 | | | | | | | | -0.07 | | | -0.11 | -0.05 |
| | | | | (0.05) | | | | | | | | (0.04) | | | (0.04) | (0.03) |
| D. house with precarious walls | 0.09 | -0.2 | | | | | | | | | | | | | 0.22 | |
| | (0.05) | (0.1) | | | | | | | | | | | | | (0.19) | |
| D. house ceramic, vinyl or tile flooring | -0.12 | | | 0.15 | 0.23 | -0.2177 | | -0.06 | | | 0.2 | | | | -0.05 | -0.02 |
| | (0.03) | | | (0.02) | (0.05) | (0.05) | | (0.03) | | | (0.1) | | | | (0.02) | (0.02) |
| D. househ with precarious floors | | | | -0.06 | -0.2 | -0.0437 | | | | | | -0.07 | -0.15 | | -0.14 | |
| | | | | (0.03) | (0.11) | (0.03) | | | | | | (0.04) | (0.04) | | (0.08) | |
| D. house with cement or brick flooring | | -0.17 | -0.11 | | | -0.3522 | -0.14 | -0.17 | | -0.08 | 0 | -0.2 | -0.14 | -0.14 | -0.25 | -0.16 |
| | | (0.03) | (0.03) | | | (0.05) | (0.02) | (0.04) | | (0.03) | (0.09) | (0.03) | (0.03) | (0.08) | (0.03) | (0.02) |
| D. house with shared bathroom | | -0.11 | | | | -0.0432 | | | -0.26 | | | | | | | -0.06 |
| | | (0.05) | | | | (0.02) | | | (0.16) | | | | | | | (0.03) |
| D. house with asbestos roof | 0.01 | | | | 0.2 | | | -0.07 | | | | | -0.03 | 0.11 | -0.08 | |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (0.05) | | | | (0.08) | | | (0.04) | | | | | (0.02) | (0.06) | (0.02) | |
| D. house with precarious roof | -0.14 | | | | -0.08 | | | | | | | -0.67 | | | | |
| | (0.05) | | | | (0.12) | | | | | | | (0.41) | | | | |
| D. house with zinc roof | -0.05 | -0.04 | -0.11 | -0.05 | 0.11 | -0.0972 | | -0.11 | | -0.08 | -0.08 | | | -0.27 | -0.09 | -0.06 |
| | (0.03) | (0.03) | (0.04) | (0.02) | (0.06) | (0.01) | | (0.04) | | (0.02) | (0.03) | | | (0.07) | (0.05) | (0.03) |
| D. house with wooden roof | | | | | | -0.057 | | | | | | | 0.54 | | -0.11 | |
| | | | | | | (0.05) | | | | | | | (0.27) | | (0.08) | |
| D. housing in exchange for service or other non conventional agreement | | | | | | | | | | | | | | | 0.22 | |
| | | | | | | | | | | | | | | | (0.15) | |
| Schooling of head * D. head of hh domestic worker | | | | | | | 0 | | | | | | | | | |
| | | | | | | | (0) | | | | | | | | | |
| Schooling of head * D. head of hh domestic worker_00 | | | | | | | | | | | | | | | | 0.1 |
| | | | | | | | | | | | | | | | | (0.07) |
| Schooling of head * D. head of hh domestic worker_02 | | | | 0.7 | | | | | | | | | | | | |
| | | | | (0.35) | | | | | | | | | | | | |
| Schooling of head * D. head of hh domestic worker_05 | | | | | | | | | | -0.62 | | | | | | |
| | | | | | | | | | | (0.29) | | | | | | |
| Schooling of head * D. head of hh domestic worker_08 | | | | | | | | | | | | | | | -0.41 | |
| | | | | | | | | | | | | | | | (0.26) | |
| Schooling of head * D. head of hh domestic worker_09 | | | | | | | | | | | -0.37 | | | | -0.49 | |
| | | | | | | | | | | | (0.36) | | | | (0.22) | |
| Schooling of head * D. head of hh domestic worker_12 | | | -0.55 | | | | | | | | | | | | | |
| | | | (0.38) | | | | | | | | | | | | | |
| Schooling of head*Work experience | 0 | | | 0 | 0 | 0.0001 | 0 | | | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | (0) | | | (0) | (0) | (0) | (0) | | | (0) | (0) | (0) | (0) | (0) | (0) | (0) |
| Schooling of head*D. formal sector | | 0 | 0 | | | 0.0074 | 0.01 | | | 0.01 | 0.01 | | | 0.01 | | |
| | | (0) | (0) | | | (0) | (0) | | | (0) | (0) | | | (0) | | |
| Schooling of head * D. head of hh in public sector | -0.01 | 0.01 | | | 0.02 | | | | | -0.02 | 0.01 | | | | | |
| | (0) | (0) | | | (0) | | | | | (0.01) | (0) | | | | | |
| Schooling of head of hh | -0.01 | | 0.01 | -0.04 | | | -0.04 | -0.03 | -0.03 | 0 | | -0.04 | -0.02 | 0.02 | | -0.03 |
| | (0.01) | | (0) | (0.01) | | | (0.01) | (0.01) | (0.02) | (0.02) | | (0.01) | (0.02) | (0) | | (0.01) |
| Schooling of head ^2 | 0 | 0 | -0.15 | 0 | | 0.0009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | | 0 | 0 |
| | (0) | (0) | (0.07) | (0) | | (0) | (0) | (0) | (0) | (0) | (0) | (0) | (0) | | (0) | (0) |
| Average schooling in census sector | | | | | 0 | 0.0213 | 0.03 | 0.07 | | | | 0.04 | | 0 | -0.05 | 0.01 |
| | | | | | (0.02) | (0) | (0.01) | (0.01) | | | | (0.02) | | (0.04) | (0.01) | (0.01) |
| Years of work experience of head of hh | 0 | 0.01 | | | -0.01 | 0.0109 | | | | 0 | | | 0 | | | |
| | (0) | (0) | | | (0) | (0) | | | | (0) | | | (0) | | | |
| Years of work experience of head of hh^2 | | 0 | | 0 | 0 | -0.0003 | | | | | | | | | | 0 |
| | | (0) | | (0) | (0) | (0) | | | | | | | | | | (0) |
| Years of work experience of head of hh^3 | | | | 0 | 0 | 0 | 0 | -0.19 | | 0 | 0 | 0 | | | 0 | 0 |
| | | | | (0) | (0) | (0) | (0) | (0.11) | | (0) | (0) | (0) | | | (0) | (0) |
| Proportion in census sector of houses with water connected to public works | | -0.13 | | | -0.48 | -0.1048 | | | | | 0.19 | 0.1 | -0.07 | 0.34 | 0.17 | 0.13 |
| | | (0.05) | | | (0.13) | (0.02) | | | | | (0.11) | (0.06) | (0.05) | (0.2) | (0.07) | (0.03) |
| Proportion in census sector of houses with water disposal connected to public works | | 0.18 | | | | -0.0295 | | | | -0.1 | | | -0.11 | | | -0.07 |
| | | (0.06) | | | | (0.02) | | | | (0.04) | | | (0.05) | | | (0.04) |
| Proportion in census sector of houses with garbage collection service | | -0.15 | 0.16 | | 0.3 | | | | 0.21 | 0.07 | | 0.21 | 0.11 | | 0.26 | |
| | | (0.11) | (0.07) | | (0.07) | | | | (0.09) | (0.04) | | (0.04) | (0.05) | | (0.08) | |
| Mean number of people per rooms in census sector | | 0.05 | -0.09 | 0.04 | -0.05 | -0.0289 | -0.1 | | | | | 0.07 | | -0.24 | | |
| | | (0.03) | (0.03) | (0.02) | (0.04) | (0.01) | (0.02) | | | | | (0.03) | | (0.06) | | |
| Proportion in census sector of houses with electricity | | | 0.66 | | | 0.3621 | | | | 0.4 | | -0.86 | | -0.74 | 1.53 | 0.46 |
| | | | (0.33) | | | (0.13) | | | | (0.3) | | (0.35) | | (0.4) | (0.54) | (0.32) |
| Proportion in census sector of houses with concrete, bloque, brick walls | | 0.2 | | -0.07 | 0.16 | -0.1268 | -0.09 | -0.24 | | 0.1 | | | | | | -0.16 |
| | | (0.1) | | (0.05) | (0.11) | (0.02) | (0.05) | (0.11) | | (0.05) | | | | | | (0.05) |
| Proportion in census sector of houses with wooden, tile, vilyn flooring | 0.05 | | | 0.1 | | | -0.22 | -0.28 | 0.17 | 0.1 | 0.04 | | | | -0.48 | |
| | (0.04) | | | (0.04) | | | (0.09) | (0.14) | (0.07) | (0.06) | (0.07) | | | | (0.1) | |
| Proportion in census sector of houses with exclusive bathroom | | | | -0.19 | | | | | | | | | -0.32 | | | |
| | | | | (0.06) | | | | | | | | | (0.11) | | | |
| Proportion of members of household in workforce | 0.27 | 0.3 | 0.23 | 0.1 | 0.34 | 0.226 | 0.12 | 0.16 | | 0.19 | | 0.19 | 0.23 | 0.42 | 0.12 | 0.1 |
| | (0.04) | (0.07) | (0.08) | (0.04) | (0.08) | (0.03) | (0.06) | (0.06) | | (0.06) | | (0.06) | (0.06) | (0.14) | (0.06) | (0.04) |
| Square-root of number of children<12 in hh | | | -0.05 | -0.13 | | -0.0114 | | | -0.09 | | -0.1 | | -0.01 | -0.14 | -0.04 | -0.06 |
| | | | (0.04) | (0.02) | | (0.01) | | | (0.04) | | (0.03) | | (0.03) | (0.06) | (0.02) | (0.02) |
| Square-root of number of people in hh | -0.54 | -0.62 | -0.43 | -0.42 | -0.55 | -0.5122 | -0.46 | -0.42 | -0.31 | -0.51 | -0.44 | -0.5 | -0.54 | -0.29 | -0.46 | -0.46 |
| | (0.02) | (0.04) | (0.05) | (0.03) | (0.05) | (0.02) | (0.03) | (0.04) | (0.06) | (0.03) | (0.05) | (0.04) | (0.04) | (0.09) | (0.04) | (0.03) |

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Square-root of number of laking basic needs in hh | -0.06 | 0.01 | -0.1 | -0.08 | | -0.0684 | -0.05 | -0.07 | -0.06 | -0.03 | -0.05 | 0.03 | -0.07 | -0.02 | | 0 |
| | (0.02) | (0.03) | (0.03) | (0.02) | | (0.01) | (0.02) | (0.03) | (0.05) | (0.02) | (0.04) | (0.01) | (0.03) | (0.05) | | (0.02) |
| Square-root of number of work hours of head of hh | 0.02 | 0.04 | 0.02 | 0.03 | 0.04 | 0.0231 | | | 0.02 | 0.01 | 0.01 | | 0.02 | 0.04 | 0.02 | 0.02 |
| | (0) | (0.01) | (0.01) | (0) | (0.01) | (0) | | | (0.01) | (0) | (0.01) | | (0.01) | (0.01) | (0.01) | (0) |
| Literacy rate in census sector | 0.28 | | | 0.56 | 0.28 | | -0.92 | -1.1 | | | 0.27 | 0.62 | | | | |
| | (0.17) | | | (0.15) | (0.26) | | (0.3) | (0.57) | | | (0.17) | (0.22) | | | | |
| Primary school attendance rate in census sector | 0.37 | | | | | 0.1631 | | 0.58 | | 0.39 | | | -2.41 | | -0.97 | |
| | (0.14) | | | | | (0.07) | | (0.29) | | (0.24) | | | (1.52) | | (0.85) | |
| Secondary school attendance rate in census sector | | | 0.23 | -0.2 | | | 0.15 | -0.21 | -0.1 | 0.1 | | | 0.1 | 0.33 | | |
| | | | (0.11) | (0.04) | | | (0.07) | (0.08) | (0.11) | (0.05) | | | (0.06) | (0.17) | | |
| Univserity attendance rate in census sector | | | 0.59 | 0.14 | | -0.0476 | -0.06 | 0.05 | -0.2 | 0.14 | | -0.14 | | | | |
| | | | (0.17) | (0.05) | | (0.03) | (0.05) | (0.04) | (0.15) | (0.09) | | (0.08) | | | | |
| N | 2482 | 825 | 663 | 2041 | 655 | 6196 | 1300 | 1032 | 357 | 1442 | 534 | 903 | 1135 | 248 | 1089 | 2775 |
| R2 | 0.6779 | 0.7548 | 0.7123 | 0.5838 | 0.7356 | 0.65 | 0.7035 | 0.6729 | 0.6058 | 0.5938 | 0.6302 | 0.6016 | 0.6359 | 0.7764 | 0.7159 | 0.7066 |

Source: Authors' computation using 2014 LSMS.

# Appendix 3 Point estimates and standard errors of Gini coefficients

**Table A3.1 2006 Point estimates and standard errors of Gini coefficients estimations for provinces**

| Region | Provincial code | Gini coefficient | Standard error | Population | Number of HH |
|---|---|---|---|---|---|
| Quito (county) | 1701 | 0.422 | 0.005 | 1933579 | 566115 |
| Guayaquil (county) | 901 | 0.401 | 0.007 | 1584401 | 589778 |
| Urban Coast (excluding Guayaquil) | 2 | 0.393 | 0.009 | 8766 | 3465 |
| Urban Coast (excluding Guayaquil) | 3 | 0.391 | 0.010 | 25560 | 8795 |
| Urban Coast (excluding Guayaquil) | 5 | 0.381 | 0.011 | 18015 | 6524 |
| Urban Coast (excluding Guayaquil) | 6 | 0.367 | 0.009 | 6220 | 2308 |
| Urban Coast (excluding Guayaquil) | 7 | 0.389 | 0.007 | 327899 | 119633 |
| Urban Coast (excluding Guayaquil) | 8 | 0.428 | 0.008 | 181985 | 69939 |
| Urban Coast (excluding Guayaquil) | 9 | 0.416 | 0.008 | 560022 | 214528 |
| Urban Coast (excluding Guayaquil) | 11 | 0.385 | 0.012 | 8329 | 3113 |
| Urban Coast (excluding Guayaquil) | 12 | 0.394 | 0.007 | 309347 | 114847 |
| Urban Coast (excluding Guayaquil) | 13 | 0.403 | 0.007 | 526870 | 193795 |
| Urban Coast (excluding Guayaquil) | 17 | 0.368 | 0.011 | 4552 | 1465 |
| Urban Coast (excluding Guayaquil) | 20 | 0.370 | 0.009 | 14601 | 5447 |
| Urban Coast (excluding Guayaquil) | 23 | 0.401 | 0.007 | 200708 | 69863 |
| Urban Coast (excluding Guayaquil) | 24 | 0.403 | 0.010 | 144331 | 49525 |
| Rural Coast | 2 | 0.353 | 0.009 | 31831 | 8387 |
| Rural Coast | 3 | 0.358 | 0.009 | 19543 | 4969 |
| Rural Coast | 4 | 0.370 | 0.015 | 6056 | 1351 |
| Rural Coast | 5 | 0.335 | 0.008 | 32110 | 8105 |
| Rural Coast | 6 | 0.339 | 0.017 | 4212 | 1118 |
| Rural Coast | 7 | 0.332 | 0.006 | 141682 | 39381 |
| Rural Coast | 8 | 0.342 | 0.006 | 240296 | 58969 |
| Rural Coast | 9 | 0.314 | 0.006 | 494855 | 136403 |
| Rural Coast | 10 | 0.345 | 0.012 | 8207 | 1928 |
| Rural Coast | 11 | 0.369 | 0.009 | 55279 | 14722 |
| Rural Coast | 12 | 0.313 | 0.005 | 318389 | 85089 |
| Rural Coast | 13 | 0.330 | 0.006 | 562389 | 144174 |
| Rural Coast | 17 | 0.344 | 0.007 | 47164 | 11460 |
| Rural Coast | 20 | 0.361 | 0.017 | 5720 | 1714 |
| Rural Coast | 23 | 0.337 | 0.007 | 85842 | 21646 |
| Rural Coast | 24 | 0.328 | 0.007 | 99719 | 24786 |
| Rural Coast | 90 | 0.319 | 0.006 | 31066 | 7834 |
| Urban Highlands (excluding Quito) | 1 | 0.371 | 0.004 | 273644 | 95965 |
| Urban Highlands (excluding Quito) | 2 | 0.375 | 0.005 | 21967 | 8391 |
| Urban Highlands (excluding Quito) | 3 | 0.370 | 0.004 | 38131 | 12784 |
| Urban Highlands (excluding Quito) | 4 | 0.362 | 0.004 | 58635 | 19304 |
| Urban Highlands (excluding Quito) | 5 | 0.366 | 0.004 | 74060 | 24665 |
| Urban Highlands (excluding Quito) | 6 | 0.361 | 0.004 | 116097 | 41975 |
| Urban Highlands (excluding Quito) | 10 | 0.380 | 0.004 | 187589 | 62345 |
| Urban Highlands (excluding Quito) | 11 | 0.377 | 0.004 | 157668 | 53480 |
| Urban Highlands (excluding Quito) | 17 | 0.381 | 0.004 | 133364 | 42489 |
| Urban Highlands (excluding Quito) | 18 | 0.356 | 0.003 | 163239 | 55994 |
| Rural Highlands | 1 | 0.400 | 0.007 | 306371 | 87950 |
| Rural Highlands | 2 | 0.444 | 0.010 | 96118 | 26867 |
| Rural Highlands | 3 | 0.401 | 0.007 | 100620 | 30827 |
| Rural Highlands | 4 | 0.386 | 0.009 | 76723 | 22245 |
| Rural Highlands | 5 | 0.426 | 0.009 | 235744 | 62505 |
| Rural Highlands | 6 | 0.421 | 0.008 | 256464 | 77644 |
| Rural Highlands | 10 | 0.420 | 0.008 | 136546 | 36813 |
| Rural Highlands | 11 | 0.403 | 0.009 | 141291 | 42390 |
| Rural Highlands | 17 | 0.435 | 0.008 | 358677 | 99396 |
| Rural Highlands | 18 | 0.385 | 0.006 | 278716 | 81438 |
| Rural Highlands | 23 | 0.382 | 0.009 | 8945 | 2514 |
| Urban Amazon | 14 | 0.397 | 0.009 | 26169 | 8657 |
| Urban Amazon | 15 | 0.397 | 0.007 | 22670 | 7428 |
| Urban Amazon | 16 | 0.391 | 0.008 | 30185 | 10249 |
| Urban Amazon | 19 | 0.378 | 0.007 | 16458 | 5275 |
| Urban Amazon | 21 | 0.379 | 0.007 | 49623 | 17991 |
| Urban Amazon | 22 | 0.394 | 0.009 | 38886 | 13992 |
| Rural Amazon | 14 | 0.560 | 0.010 | 81415 | 24128 |
| Rural Amazon | 15 | 0.524 | 0.010 | 59677 | 14910 |
| Rural Amazon | 16 | 0.540 | 0.010 | 33408 | 9212 |
| Rural Amazon | 19 | 0.491 | 0.012 | 53595 | 15710 |
| Rural Amazon | 21 | 0.485 | 0.013 | 83056 | 24791 |
| Rural Amazon | 22 | 0.511 | 0.012 | 64842 | 17385 |

Source: Authors’ computation using 2006 /LSMS

# Appendix 4. Housing conditions index

We use the first component as our housing conditions index. The index increases as the housing conditions improve.

**Table A4.1 Component Matrix Principal Components Analysis**

| | Component | |
|---|---|---|
| | 1 | 2 |
| Dummy houses with a sewage connection | .784 | -.228 |
| Dummy houses with public garbage collection services | .765 | -.081 |
| Dummy houses with exclusive washroom | .726 | -.211 |
| Dummy houses with electricity | .465 | .536 |
| Dummy houses with viable walls | .622 | .368 |
| Dummy houses with viable floors | .694 | .207 |
| Dummy houses with a water connection | .770 | -.097 |
| Dummy houses with viable roof | .232 | .605 |
| Dummy houses with phone connection | .657 | -.287 |
| Dummy houses with overcrowding | -.302 | .349 |

Source: Authors' computation using LSMS

**Table A4.2 Total Variance Explained**

| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 3.980 | 39.803 | 39.803 | 3.980 | 39.803 | 39.803 |
| 2 | 1.149 | 11.489 | 51.293 | 1.149 | 11.489 | 51.293 |
| 3 | .935 | 9.352 | 60.645 | | | |
| 4 | .875 | 8.748 | 69.393 | | | |
| 5 | .766 | 7.656 | 77.049 | | | |
| 6 | .673 | 6.726 | 83.775 | | | |
| 7 | .482 | 4.821 | 88.596 | | | |
| 8 | .448 | 4.484 | 93.080 | | | |
| 9 | .371 | 3.713 | 96.792 | | | |
| 10 | .321 | 3.208 | 100.000 | | | |

Source: Authors' computation using LSMS

**Table A4.3 Results of principal component analysis of housing conditions**

| Sub-region | Mean | N | Std. Deviation |
|---|---|---|---|
| Quito | 0.9154 | 496527 | .38313230 |
| Guayaquil | 0.4493 | 541943 | .70698084 |
| Sierra Urbana sin Quito | 0.7367 | 437262 | .56331707 |
| Sierra Rural | -0.4467 | 585807 | .81424722 |
| Costa Urbana sin Guayaquil | 0.2085 | 632177 | .75130373 |
| Costa Rural | -1.0964 | 434422 | .69612512 |
| Amazonia Urbana | 0.2571 | 44380 | .80840630 |
| Amazonia Rural | -1.0525 | 92347 | 1.05149895 |
| Total | 0.1005 | 3264866 | .96987113 |

Source: Authors' computation using LSMS

# Appendix 5. Food consumption index

Our food consumption index is based on the second factor component of this analysis. This factor assigns high values to households with high consumption of carbohydrates such as tubers.

**Table A5.1 Component Matrix Principal Components Analysis**

| | Component | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Total calories consumed on average (parish) | .658 | -.256 | .252 | .363 | -.132 | .130 |
| Carbohydrates from cereal: gr per day consumed on average in every parish | .403 | -.350 | .463 | .422 | -.149 | .362 |
| Carbohydrates from fruit: gr per day consumed on average in every parish | .628 | .240 | -.225 | -.121 | -.619 | -.129 |
| Carbohydrates from milk and derivatives: gr or ml per day consumed on average in every parish | .665 | -.005 | -.465 | -.302 | .152 | .314 |
| Carbohydrates from legumes: gr per day consumed on average in every parish | .462 | .131 | .701 | -.502 | .056 | -.093 |
| Total carbohydrates: gr or ml per day consumed on average in every parish | .714 | -.071 | .412 | .342 | -.230 | .263 |
| Carbohydrates from tubers: gr per day consumed on average in every parish | .124 | .908 | .054 | .189 | .107 | .183 |
| Carbohydrates from vegetables: gr per day consumed on average in every parish | .766 | .025 | -.032 | .297 | .341 | -.369 |
| Fat from meats and derivatives: gr per day consumed on average in every parish | .779 | -.029 | -.143 | .005 | .061 | -.003 |
| Fat from fruit: gr per day consumed on average in every parish | .746 | .160 | -.314 | -.046 | -.420 | -.152 |
| Fat from milk and derivatives: gr per day consumed on average in every parish | .691 | -.109 | -.390 | -.406 | .207 | .333 |
| Fat from fats and oils: gr per day consumed on average in every parish | .268 | -.337 | .531 | .156 | -.029 | .101 |
| Fat from legumes: gr per day consumed on average in every parish | .431 | .225 | .702 | -.469 | .015 | -.117 |
| Fat from tubers: gr per day consumed on average in every parish | .061 | .937 | .042 | .223 | .112 | .188 |
| Fat from vegetables: gr per day consumed on average in every parish | .808 | .049 | -.117 | .247 | .312 | -.342 |
| Protein from meats and derivatives: gr per day consumed on average in every parish | .779 | .024 | -.163 | .030 | .092 | -.008 |
| Protein from fruit: gr per day consumed on average in every parish | .725 | .209 | -.282 | -.088 | -.551 | -.152 |
| Protein from milk and derivatives: gr or ml per day consumed on average in every parish | .686 | -.135 | -.366 | -.411 | .209 | .325 |
| Protein from legumes: gr per day consumed on average in every parish | .453 | .205 | .715 | -.459 | .065 | -.088 |
| Protein from fish and seafood: gr per day consumed on average in every parish | .385 | -.551 | -.002 | .100 | .147 | .060 |
| Total protein: gr per day consumed on average in every parish | .915 | -.112 | .101 | .183 | .015 | .135 |
| Protein from tubers: gr per day consumed on average in every parish | .042 | .928 | .037 | .226 | .110 | .184 |
| Protein from vegetables: gr per day consumed on average in every parish | .832 | .001 | -.091 | .215 | .293 | -.349 |

Source: Authors' computation using 2006 LSMS

**Table A5.2 Total Variance Explained**

| | Initial Eigenvalues | | | Extraction Sums of Squared Loadings | | |
|---|---|---|---|---|---|---|
| Component | Total | % of Variance | Cumulative % | Total | % of Variance | Cumulative % |
| 1 | 8.797 | 38.248 | 38.248 | 8.797 | 38.248 | 38.248 |
| 2 | 3.458 | 15.035 | 53.283 | 3.458 | 15.035 | 53.283 |
| 3 | 3.041 | 13.220 | 66.504 | 3.041 | 13.220 | 66.504 |
| 4 | 1.960 | 8.524 | 75.028 | 1.960 | 8.524 | 75.028 |
| 5 | 1.443 | 6.275 | 81.303 | 1.443 | 6.275 | 81.303 |
| 6 | 1.134 | 4.932 | 86.235 | 1.134 | 4.932 | 86.235 |

Source: Authors' computation using 2006 LSMS

**Table A5.3 Results of principal component analysis of food consumption**

| Sub-region | Mean | N | Std. Deviation |
|---|---|---|---|
| Quito | 0.5279 | 424982 | .0000000 |
| Guayaquil | -1.0238 | 541943 | .0000000 |
| Urban highlands | 0.4880 | 594103 | 1.0451720 |
| Rural highlands | 1.1804 | 489298 | 1.8296341 |
| Urban coast | -1.4320 | 759663 | .4421891 |
| Rural coast | -1.8843 | 306937 | .7794456 |
| Urban Amazon | -0.3765 | 56187 | .6162099 |
| Rural Amazon | -0.3728 | 67627 | .7688065 |
| Total National | -0.3627 | 3240740 | 1.4087608 |

Source: Authors' computation using 2006 LSMS

**Table A5.4 List of food items and their food groups**

| Food staple | Category | Food staple | Category | Food staple | Category |
|---|---|---|---|---|---|
| Rice | Cereals | Cheese | Milk and derivatives | Broccoli | Vegetables |
| Barley rice | Cereals | Yogurt | Milk and derivatives | White onion | Vegetables |
| Oatmeal | Cereals | Vegetable oil | Fats and oils | Red onion | Vegetables |
| Pasta | Cereals | Pig fat | Fats and oils | Corn in grain | Cereals |
| Cookies | Cereals | Vegetable butter | Fats and oils | Cabbage | Vegetables |
| Bean flower | Legumes | Margarine | Fats and oils | Cauliflower | Vegetables |
| Corn flower | Cereals | Butter | Fats and oils | Cilantro and parsley | Vegetables |
| Banana flower | Fruits | Avocado | Fats and oils | Red beans | Legumes |
| Wheat flower | Cereals | Banana | Fruits | Brown beans | Legumes |
| Machica | Cereals | Lemon | Fruits | Lettuce | Vegetables |
| Corn y morocho | Cereals | Apple | Fruits | Pickle | Vegetables |
| Mote | Cereals | Passion fruit | Fruits | Pepper | Vegetables |
| Bread | Cereals | Melon | Fruits | Radish | Vegetables |
| Quinua | Cereals | Blackberry | Fruits | Tomato | Vegetables |
| Lamb meat | Meats and derivatives | Orange | Fruits | Pepper | Vegetables |
| Pork | Meats and derivatives | Naranjilla | Fruits | Dry pea | Legumes |
| Beef | Meats and derivatives | Mandarin | Fruits | Corn on cob | Legumes |
| Cow entrails | Meats and derivatives | Papaya | Fruits | Dry red beans | Legumes |
| Chicken | Meats and derivatives | Pineapple | Fruits | Dry chickpea | Legumes |
| Chicken piece | Meats and derivatives | Sweet plantain | Fruits | Dry brown bean | Legumes |
| Chicken entrails | Meats and derivatives | Plantain | Fruits | Lentil | Legumes |
| Sausage | Meats and derivatives | Watermelon | Fruits | Cocoa | Sugars |
| Ham | Meats and derivatives | Tomate de árbol | Fruits | Chocolate | Fats and oils |
| Mortadela | Meats and derivatives | Grape | Fruits | Brown sugar | Sugars |
| Wiener | Meats and derivatives | Melloco/olluco | Tubers | Breakfast cereal | Cereals |
| Fresh fish | Fish and seafood | Potato | Tubers | Condiments | Miscellaneous |
| Tuna or sardines | Fish and seafood | Beet | Vegetables | Salt | Miscellaneous |
| Shrimp | Fish and seafood | Yucca | Tubers | Coffee | Miscellaneous |
| Clam | Fish and seafood | Carrot | Vegetables | Water | Miscellaneous |
| Chicken egg | Eggs and derivatives | Chard | Vegetables | Mineral water | Miscellaneous |
| Powder milk | Milk and derivatives | Garlic | Vegetables | Powder juice | Sugars |
| Liquid milk | Milk and derivatives | Fresh pea | Legumes | Juice from concentrate | Sugars |
| Formula (baby milk) | Milk and derivatives | Celery | Vegetables | Soft drinks | Sugars |

Source: Authors' computation using 2006 LSMS

# Appendix 6. Descriptive Statistics and Full Estimates of Main Regression Equations (3) and (7)

**Table A6.1 Descriptive statistics LSMS 2006 and 2014 (N=15,823)**

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| z-score | -1.21 | 1.33 | -5.82 | 5.83 |
| Relative Deprivation Province | 38.45 | 23.54 | 0 | 233.22 |
| Relative Deprivation County | 35.75 | 26.64 | 0 | 245.09 |
| Relative Deprivation Parish | 31.75 | 29.19 | 0 | 467.39 |
| Relative Consumption Province | .38 | 78.34 | -231.90 | 1010.90 |
| Relative Consumption County | .23 | 75.42 | -245.68 | 997.78 |
| Relative Consumption Parish | .09 | 70.67 | -488.58 | 921.30 |
| Consumption per capita | 98.69 | 86.65 | 2.12 | 1171.76 |
| Low birthweight | .10 | .30 | 0 | 1 |
| Girl | .49 | .50 | 0 | 1 |
| Age child (months) | 31.07 | 16.72 | 0 | 60 |
| Mestizos | .76 | .43 | 0 | 1 |
| Indigenous | .19 | .39 | 0 | 1 |
| Afro | .05 | .22 | 0 | 1 |
| Share of mandatory vaccines | .88 | .19 | 0 | 1.89 |
| Receives supplements | .40 | .49 | 0 | 1 |
| Has diarrhoea | .22 | .41 | 0 | 1 |
| Easy access to public day-care | .26 | .44 | 0 | 1 |
| Breastfeed (months) | 3.79 | 2.72 | 0 | 24 |
| Age mother | 22.95 | 13.05 | 0 | 64 |
| Household receives transfers | .38 | .49 | 0 | 1 |
| Number children in household below 12 years old | 2.55 | 1.41 | 1 | 12 |
| Job Experience household head | 23.71 | 14.00 | 0 | 90 |
| Mean size agricultural Land | 19.62 | 53.14 | .70 | 228.80 |
| Mean rent/ha. ag. Land | 161.40 | 120.30 | 6.10 | 497.60 |
| Rural | .52 | .50 | 0 | 1 |
| Ln PIBpc | 17.36 | 3.12 | 12.74 | 23.31 |
| Sierra | .39 | .49 | 0 | 1 |
| Costa | .31 | .46 | 0 | 1 |
| Amazon | .19 | .39 | 0 | 1 |
| Galapagos | .01 | .10 | 0 | 1 |
| Quito | .05 | .21 | 0 | 1 |
| Guayaquil | .06 | .24 | 0 | 1 |

Appendix Table A6.2. Full OLS estimates of equation (3) with baseline controls. The unit of analysis is the individual

| | Province | County | Parish |
|---|---|---|---|
| $\mu_R$*Deprivation (x1000) | -0.0381*** | -0.0334*** | -0.0107 |
| | (0.0081) | (0.0063) | (0.0071) |
| Consumption per capita | -0.0025 | 0.0034*** | 0.0027*** |
| | (0.0026) | (0.0013) | (0.0009) |
| Relative Consumption | 0.0036 | -0.0023* | -0.0012 |
| | (0.0025) | (0.0012) | (0.0010) |
| Low birthweight | -0.4071*** | -0.4028*** | -0.4032*** |
| | (0.0681) | (0.0547) | (0.0712) |
| Girl | 0.1583*** | 0.1561*** | 0.1563*** |
| | (0.0135) | (0.0204) | (0.0215) |
| Age child (months) | -0.0717*** | -0.0722*** | -0.0726*** |
| | (0.0037) | (0.0043) | (0.0050) |
| Age child squared | 0.0010*** | 0.0010*** | 0.0010*** |
| | (0.0001) | (0.0001) | (0.0001) |
| Indigenous | -0.2879*** | -0.2713*** | -0.2189*** |
| | (0.0329) | (0.0444) | (0.0527) |
| Afro | 0.1583** | 0.1476*** | 0.1138** |
| | (0.0679) | (0.0493) | (0.0487) |
| Share mandatory vaccines | 0.2422*** | 0.2840*** | 0.2931*** |
| | (0.0657) | (0.0816) | (0.0946) |
| Receives supplement | -0.1084*** | -0.1025*** | -0.1052*** |
| | (0.0220) | (0.0239) | (0.0246) |
| Has diarrhoea | -0.0972*** | -0.0943*** | -0.0984*** |
| | (0.0227) | (0.0238) | (0.0254) |
| Easy access to public day-care | -0.0318 | -0.0383 | -0.0318 |
| | (0.0206) | (0.0318) | (0.0315) |
| Breastfeed (months) | -0.0092 | -0.0098** | -0.0101** |
| | (0.0057) | (0.0041) | (0.0043) |
| Age mother | 0.0075** | 0.0085*** | 0.0091*** |
| | (0.0027) | (0.0020) | (0.0019) |
| Household receives transfers | -0.1341*** | -0.1181*** | -0.1230*** |
| | (0.0390) | (0.0356) | (0.0333) |
| 2 children below 12 in HH | -0.0887*** | -0.0845*** | -0.0918*** |
| | (0.0238) | (0.0256) | (0.0268) |
| 3 children below 12 in HH | -0.1579*** | -0.1501*** | -0.1640*** |
| | (0.0513) | (0.0430) | (0.0427) |
| 4 children below 12 in HH | -0.2833*** | -0.2783*** | -0.3046*** |
| | (0.0489) | (0.0439) | (0.0397) |
| 5 children below 12 in HH | -0.3565*** | -0.3596*** | -0.3708*** |
| | (0.0557) | (0.0646) | (0.0663) |

| | | | |
|---|---|---|---|
| 6 children below 12 in HH | -0.4570*** | -0.4320*** | -0.4648*** |
| | (0.0795) | (0.0809) | (0.0866) |
| 7 children below 12 in HH | -0.5909*** | -0.6171*** | -0.6580*** |
| | (0.1530) | (0.1199) | (0.1165) |
| 8 children below 12 in HH | -0.3338 | -0.2861 | -0.2469 |
| | (0.1959) | (0.2220) | (0.2483) |
| 9 children below 12 in HH | -0.0672 | -0.0779 | -0.1184 |
| | (0.2541) | (0.1796) | (0.1640) |
| 10 children below 12 in HH | -0.7362 | -0.6733 | -0.8260 |
| | (0.5367) | (0.4203) | (0.5428) |
| 12 children below 12 in HH | 0.4652*** | 0.4908*** | 0.7755*** |
| | (0.0487) | (0.0356) | (0.0533) |
| Job Experience household head | 0.0034** | 0.0035** | 0.0032** |
| | (0.0014) | (0.0016) | (0.0014) |
| Average size agricultural land | -0.2984* | -0.0467 | -0.0003 |
| | (0.1652) | (0.1289) | (0.0002) |
| Average rent per Ha agricultural land | -0.0005* | -0.0004** | -0.0005*** |
| | (0.0003) | (0.0002) | (0.0002) |
| Rural | -0.1075*** | -0.1088*** | -0.0831 |
| | (0.0346) | (0.0365) | (0.0561) |
| Ln PIBpc | 0.3576*** | 0.1585 | 0.1409 |
| | (0.1212) | (0.1363) | (0.1647) |
| Costa | 0.4267*** | 0.0224 | -0.0833 |
| | (0.1390) | (0.0918) | (0.1324) |
| Amazon | 3.6408* | 0.8737 | 0.4031*** |
| | (1.9729) | (1.5848) | (0.1212) |
| Galapagos | 16.7937** | 3.4313 | 0.9610* |
| | (7.6933) | (5.6387) | (0.5392) |
| Quito | -0.0201 | -0.0311 | -0.0220 |
| | (0.0182) | (0.0273) | (0.0972) |
| Guayaquil | 0.3949** | 0.4966*** | 0.7228*** |
| | (0.1408) | (0.0916) | (0.1403) |
| N | 15823 | 15787 | 15762 |
| $R^2$ | 0.2190 | 0.2409 | 0.2648 |

Notes: The Table shows coefficient estimates of column (1) in Tables 1a to 1c. Standard errors are clustered at region level and shown in parenthesis. The unit of analysis is the individual. The dependent variable is the z-score of height-for-age of the child. The first column also includes province dummies, the second column includes county dummies, while the third column includes parish dummies. See the Data section above for a detailed explanation of variables. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix Table A6.3. Full OLS estimates of equation (7) with baseline controls.
The unit of analysis is the region

| | Province | County | Parish |
|---|---|---|---|
| Average Consumption | 0.0175** | 0.0035 | 0.0039 |
| | (0.0014) | (0.0039) | (0.0031) |
| Relative deprivation | -0.0258* | -0.0033 | -0.0080 |
| | (0.0040) | (0.0100) | (0.0091) |
| Year | -4.5729* | 0.9790 | 1.5091 |
| | (0.3623) | (1.4383) | (1.4157) |
| Low birthweight | -0.7396 | 0.3435 | -0.0408 |
| | (0.2892) | (0.2623) | (0.1957) |
| Girl | -2.9520 | 0.0900 | 0.2837* |
| | (0.4944) | (0.1836) | (0.1484) |
| Receives supplement | 0.8178* | -0.2375 | -0.1259 |
| | (0.1190) | (0.2216) | (0.1412) |
| Has diarrhoea | 1.1579* | 0.2661 | -0.1042 |
| | (0.1520) | (0.2137) | (0.1657) |
| Easy access to public day-care | -1.2339 | 0.1572 | 0.1125 |
| | (0.2220) | (0.1850) | (0.1308) |
| Household receives transfers | 2.6004** | -0.1184 | -0.3924*** |
| | (0.1497) | (0.1593) | (0.1263) |
| Indigenous | 0.9345 | -0.3894 | -0.4454 |
| | (0.3054) | (0.3717) | (0.2930) |
| Afro | -0.5920 | -1.0994** | -1.0953*** |
| | (0.1372) | (0.4372) | (0.3142) |
| Age child (months) | -0.0302* | -0.0219*** | -0.0057 |
| | (0.0044) | (0.0067) | (0.0048) |
| Share mandatory vaccines | 0.1958 | 0.3609 | -0.1222 |
| | (0.4463) | (0.3894) | (0.3355) |
| Breastfeed (months) | 0.2459* | -0.0099 | 0.0255 |
| | (0.0196) | (0.0265) | (0.0211) |
| Age mother | -0.1794* | 0.0091 | 0.0034 |
| | (0.0195) | (0.0120) | (0.0091) |
| Number children below 12 in HH | 0.0289 | -0.1688*** | -0.1062** |
| | (0.0228) | (0.0618) | (0.0452) |
| Job Experience household head | -0.0097 | 0.0074 | -0.0036 |
| | (0.0041) | (0.0067) | (0.0044) |
| Rural | -3.3066** | 0.0847 | 0.0356 |
| | (0.1971) | (0.1626) | (0.1321) |
| Average rent per Ha agricultural land | 0.0003 | -0.0003 | -0.0004 |
| | (0.0001) | (0.0003) | (0.0004) |
| Ln PIBpc province | -0.0873 | 0.1246 | 0.2080 |
| | (0.0411) | (0.2481) | (0.2427) |

| | | | |
|---|---|---|---|
| N | 45 | 387 | 1070 |
| $R^2$ | 0.4629 | 0.3307 | 0.2103 |

Notes: The Table shows coefficient estimates of column (3) in Tables 2a to 2c. Standard errors are clustered at region level and shown in parenthesis. The unit of analysis is the region. The dependent variable is the average z-score of height-for-age of the child. See the Data section above for a detailed explanation of variables. $^{*}$ $p < 0.10$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.

GEAR

GRADUATE PROGRAM IN APPLIED ECONOMIC RESEARCH

UAB Universitat Autònoma de Barcelona