

# Rural-urban differences in children's dietary diversity in Ethiopia

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*A Poisson decomposition analysis*

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*May 2016*

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## ABSTRACT

An emerging body of literature shows how low diversity in diets is associated with increased risk of chronic undernutrition and micro-nutrient deficiencies in young children. The latest available Demographic and Health Survey data for Ethiopia reveals unusually large differences in children's dietary diversity between rural and urban areas. Applying recently developed non-linear decomposition methods, this large rural-urban gap in dietary diversity can almost entirely be explained by differences in household wealth, parental education, and access to health services between rural and urban areas.

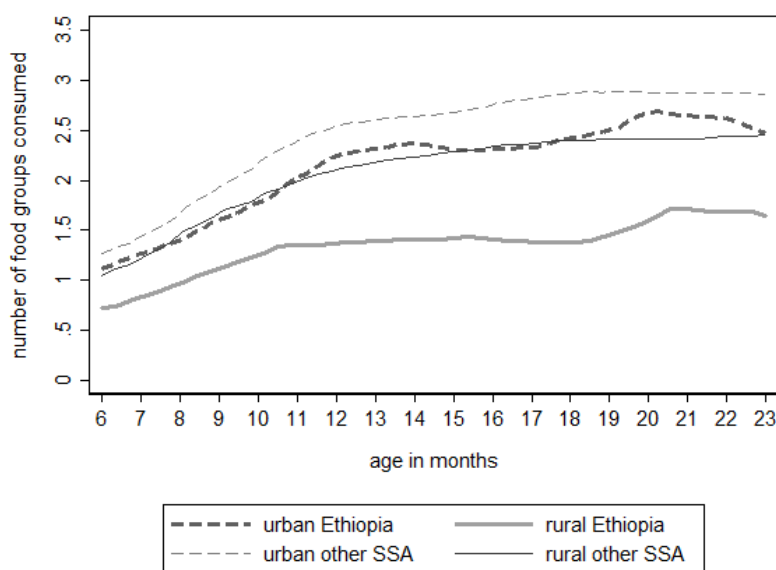
Keywords: child dietary diversity, complementary feeding, count data, decomposition analysis

JEL codes: Q18, C35

## I. INTRODUCTION

An emerging body of literature shows how low diversity in diets is associated with increased risk of chronic undernutrition and micro-nutrient deficiencies in young children (Arimond and Ruel 2004; Kennedy et al. 2007; Moursi et al. 2008). A comparison of children's diets between Ethiopia and the rest of sub-Saharan Africa reveals two striking features (Figure 1.1). First, Ethiopian children consume a diet that is one of the most undiversified on the continent. Second, there exists an extraordinary large rural-urban gap in children's dietary diversity.

**Figure 1.1: Children's dietary diversity by age in sub-Saharan Africa**



Note: Local polynomial regression.

Source: Own calculation from DHS data for 20 sub-Saharan African (SSA) countries.

Recent research suggests that low child dietary diversity in Ethiopia is due to a combination of poor access to nutritious foods and limited knowledge about appropriate feeding practices (Hirvonen and Hoddinott 2014; Stifel and Minten 2015; Hirvonen et al. 2016). This research paper examines the second striking feature observed in Figure 1.1: the large rural-urban gap in children's dietary diversity. Using the latest available Demographic and Health Survey (DHS) data for Ethiopia and applying recently developed non-linear decomposition techniques (Yun 2004; Bauer and Sinning 2008; Park and Lohr 2010), this gap is shown to be almost entirely due to differences in wealth and parental education levels, as well as unequal access to health services (antenatal care).

## 2. DATA

The analysis is based on the nationally representative 2010/11 Demographic Health Survey (DHS) data for Ethiopia. The 2010/11 survey instrument contained a standard module to collect information about children's diets. Specifically, the questionnaire included a series of Yes/No questions about children's food consumption in the previous day. Following WHO

(2008) guidelines for assessing the feeding practices of children between 6 and 23 months of age, the responses were grouped into the following seven food group categories: grains, roots and tubers (e.g. barley, *enset*, maize, teff, and wheat); legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, poultry and fish products); eggs; Vitamin A rich fruits and vegetables; and other fruits and vegetables. Totalling the number of food groups consumed by a child yields a dietary diversity score ranging in value from zero to seven. This simple indicator is considered in the literature as a good proxy of the quality of children's diets (Ruel 2003; Steyn et al. 2006; Kennedy et al. 2007; Moursi et al. 2008).

The DHS surveys routinely collect information on household characteristics, including education levels, assets and access to health services. This information is used to construct the covariates used in the decomposition analysis. After data cleaning, the final sample used in this analysis includes 2,898 children (2,383 rural and 515 urban) aged 6 to 23 months. Table 2.1 provides the summary statistics for all variables used in this study.<sup>1</sup>

**Table 2.1: Summary statistics**

	rural	urban	difference
Dietary diversity score	1.491 (1.043)	1.847 (1.371)	-0.36***
Child's age (months)	13.90 (5.175)	13.67 (5.134)	0.23
Female child (0/1)	0.495 (0.500)	0.505 (0.500)	-0.01
Maternal education (years)	0.863 (1.739)	2.519 (2.693)	-1.66***
Paternal education (years)	1.753 (2.398)	3.400 (2.412)	-1.65***
Mother's age (years)	28.24 (6.539)	28.06 (5.969)	0.18
Four or more antenatal visits (0/1)	0.125 (0.331)	0.487 (0.500)	-0.36***
DHS asset index	-53,900 (30,346)	87,757 (86672)	-141,657***
Owns cows, bulls, goats or sheep (0/1)	0.881 (0.324)	0.292 (0.455)	0.59***
Owns chickens (0/1)	0.617 (0.486)	0.202 (0.402)	0.42***
observations	2,383	515	

Note: (0/1) indicates a binary (dummy) variable.

Statistical significance based on a two-tailed t-test and denoted at \*\*\* p<0.01, \*\* p<0.05, \* p<0.1.

### 3. ECONOMETRIC APPROACH

Following Blinder (1973) and Oaxaca (1973), the difference in the mean dietary diversity ( $\bar{D}$ ) between rural (subscript  $r$ ) and urban (subscript  $u$ ) areas is formally expressed as:

$$\bar{D}_r - \bar{D}_u = [f(\bar{X}_r \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_r)] + [f(\bar{X}_u \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_u)], \quad (1)$$

where  $\bar{X}$  refers to a vector of covariates at mean values and  $\hat{\beta}$  to estimated coefficients. The first part of the right-hand side of the equation  $[f(\bar{X}_r \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_r)]$  captures the 'explained' component, which is due to differences in child or household characteristics between rural and urban areas (in coefficients estimated for the rural sample). The second part is the 'unexplained' component  $[f(\bar{X}_u \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_u)]$ , which is due to differences in the estimated coefficients.

The functional form ( $f$ ) depends on the underlying data generating process (linear or non-linear). Our dependent variable of interest – the number of food groups consumed by the child (dietary diversity score) – takes only non-negative integer values. This warrants a count-data modelling approach (Winkelmann 2008). Fortunately, the Poisson distribution fits the unconditional distribution extremely well (Figure 3.1). Of note is that over-dispersion in the form of excess zeroes, does not seem to be a concern for the analysis. The Poisson model can be used to estimate the  $\hat{\beta}$  coefficients in equation (1).

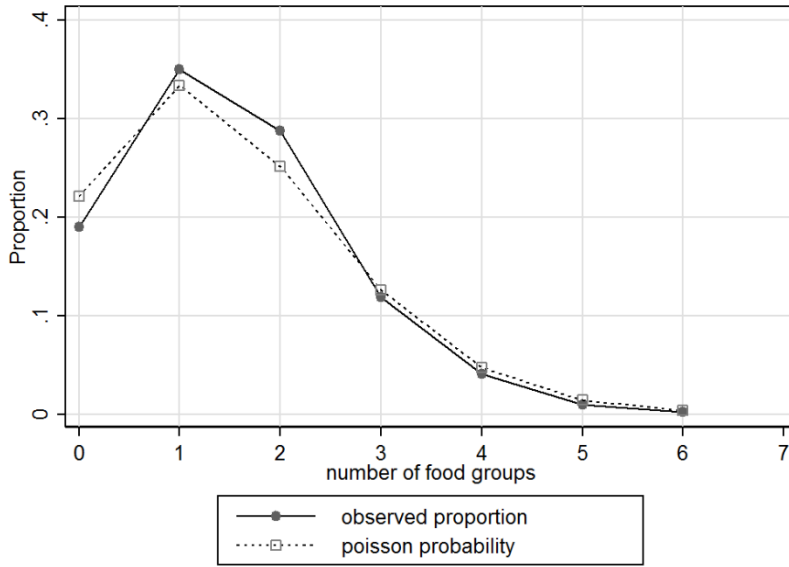
<sup>1</sup> The choice of the covariates is motivated by Headey (2014) who offers a careful analysis of the long-run trends in child nutrition in Ethiopia.

Specifically, a maximum likelihood method is used to estimate the following Poisson model separately for the rural and urban samples, for child  $i$  residing in household  $h$ :

$$\bar{D}_{ih} = \exp(c'_{ih}\gamma + x'_h\delta + \varepsilon_{ih}), \quad (2)$$

where  $c'_{ih}$  is a vector of child level characteristics (sex and age in months) and  $x'_h$  is a vector of household level characteristics that includes maternal and paternal education in years, a wealth index, mother's age, and livestock ownership.

**Figure 3.1: Fitting a Poisson distribution on dietary diversity scores**



Source: Own calculation from 2010/11 Demographic Health Survey for Ethiopia

The contribution of each variable in Equation (1) to the overall difference in dietary diversity between rural and urban areas is also examined. In the case of a non-linear decomposition, the results of such detailed decomposition are sensitive to the order in which the variables enter the decomposition equation. The solution proposed by Yun (2004) is to apply weights that are proportional to the overall contribution of the characteristics or coefficient portion to the difference. The equation for the detailed decomposition for  $K$  explanatory variables can now be expressed as:

$$\bar{D}_r - \bar{D}_u = \sum_{i=1}^K w_{\Delta X}^i [f(\bar{X}_r \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_r)] + \sum_{i=1}^K w_{\Delta \beta}^i [f(\bar{X}_u \hat{\beta}_r) - f(\bar{X}_u \hat{\beta}_u)] \quad (3)$$

where

$$w_{\Delta X}^i = \frac{(x_r^i - x_u^i)\beta_r^i}{(x_r - x_u)\beta_r} \quad \text{and} \quad w_{\Delta \beta}^i = \frac{x_u^i(\beta_r^i - \beta_u^i)}{x_u(\beta_r - \beta_u)} \quad (4)$$

The sum of each weight category ( $w_{\Delta X}^i$  and  $w_{\Delta \beta}^i$ ) equals to one. The decomposition was implemented using Stata 14.1 statistical software using the user-written *mvdcmp* command (Powers, Yoshioka, and Yun 2011).

## 4. RESULTS

Table 4.1 provides the results of the Poisson decomposition exercise. First, we see that differences in observed characteristics (or endowments) explain about 72 percent of the difference in children's dietary diversity between rural and urban areas. A detailed decomposition reveals that the rural-urban gap is mostly explained by wealth differences. Moreover, differences in parental (mostly maternal) education and access to antenatal care also have strong influences on this divide. Interestingly, the larger likelihood of owning livestock in the rural areas observed in Table 2.1 is found to narrow the difference in dietary diversity between the two groups. This is possibly due to the increased consumption of animal source foods in livestock owning households (Hoddinott, Headey, and Dereje 2015).

**Table 4.1: Decomposition of the rural-urban gap in children's dietary diversity**

	Estimate	Standard error	Percent
Explained: due to differences in characteristics	-0.390***	0.149	71.8
Unexplained: due to differences in coefficients	-0.153	0.164	28.2
Raw difference	-0.543***	0.066	100.0
<b>Due to differences in characteristics:</b>			
Age in months	0.004***	0.000	-0.7
Female child	0.000	0.002	0.1
Maternal education (years)	-0.128***	0.030	23.5
Paternal education (years)	-0.058***	0.020	10.7
Mother's age	0.001	0.002	-0.1
Four or more antenatal visits	-0.124***	0.037	22.8
DHS asset index	-0.282*	0.147	52.0
Owns cows, bulls, goats or sheep	0.099*	0.053	-18.2
Owns chicken	0.099***	0.025	-18.3
<b>Due to differences in coefficients:</b>			
Age in months	-0.413	0.252	76.2
Female child	-0.024	0.078	4.4
Maternal education (years)	0.103	0.081	-18.9
Paternal education (years)	0.182	0.106	-33.5
Mother's age	0.335	0.370	-61.7
Four or more antenatal visits	-0.007	0.100	1.2
DHS asset index	0.005	0.136	-0.9
Owns cows, bulls, goats or sheep	-0.026	0.052	4.9
Owns chicken	0.048	0.032	-8.8

Note: A detailed non-linear (Poisson) decomposition. The 'Percent' column gives the contribution of each variable to the overall difference in children's dietary diversity between rural and urban areas. This is computed by dividing the estimate by the overall difference (0.543).

Statistical significance denoted at \*\*\* p<0.01, \*\* p<0.05, \* p<0.1. Sample: 2,898 children who are 6-23 months of age.

## 5. CONCLUDING REMARKS

The non-linear decomposition exercise reveals that the rural-urban gap in children's dietary diversity is mostly due to differences in household wealth and parental education, as well as unequal access to health care. Therefore, on the policy front, Ethiopia should continue its efforts to expand access in rural areas to education and health care services, e.g., nutrition counselling. Carefully designed livestock interventions may also generate significant positive outcomes in diets, as rural livestock ownership is found to narrow the rural-urban gap in children's dietary diversity. Finally, even though dietary diversity in the urban areas is higher than in the rural areas, the average child in both these areas is far from meeting the minimum dietary diversity (four or more food groups per day) for infant and young children as specified by the World Health Organization (WHO 2008).

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## Acknowledgment

Funding for this work was received through the Feed-the-Future initiative funded by the United States Agency for International Development (USAID). I thank the Demographic and Health Surveys (DHS) Program for making the data available.

## About ESSP

The Ethiopia Strategy Support Program is an initiative to strengthen evidence-based policymaking in Ethiopia in the areas of rural and agricultural development. Facilitated by the International Food Policy Research Institute (IFPRI), ESSP works closely with the government of Ethiopia, the Ethiopian Development Research Institute (EDRI), and other development partners to provide information relevant for the design and implementation of Ethiopia's agricultural and rural development strategies. For more information, see <http://www.ifpri.org/book-757/ourwork/program/ethiopia-strategy-support-program>; <http://essp.ifpri.info/>; or <http://www.edri-eth.org/>.

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The Ethiopia Strategy Support Program (ESSP) is financially supported by the United States Agency for International Development (USAID) and the Department for International Development (DFID) of the government of the United Kingdom and is undertaken as part of the CGIAR Research Program on Policies, Institutions, and Markets (PIM) led by the International Food Policy Research Institute (IFPRI). This publication has been prepared as an output of ESSP and has not been independently peer reviewed. Any opinions expressed here belong to the author(s) and do not necessarily reflect those of IFPRI, the Ethiopian Development Research Institute, USAID, DFID, PIM, or CGIAR.

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