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Abstract

This paper calculates estimates of inequality of opportunity among Egyptian children over time between the years 2000 and 2008 using Egypt Demographic and Health Surveys. The Human Opportunity Index (HOI) is calculated across four categories of access to services, including health utilization, nutrition, basic infrastructure services and school enrollment. Over these years, Egypt implemented several policies in the health and education sectors that improved the access of children to services through the nation-wide Family Health Model (FHM), as well as through a social marketing campaign to promote iodized salt. This paper finds improvements in the Human Opportunity Index linked to such policies, with HOI increasing from 38.8 to 67.7 for the probability of blood sample being taken from mother during pregnancy, and from 37.6 to 63.4 for births taking place in public or private health facilities. Increases in overall coverage of health services were responsible for improvements in the HOI. However, in terms of malnutrition, indicators have deteriorated during this time period, with HOI for not being stunted decreasing from 78.2 to 74. The decomposition of the HOI finds that the probability of malnutrition among Egyptian children is not closely linked to family circumstances, contrary to what one might expect, calling for more supply-side (and less targeted) efforts to reduce malnutrition for all Egyptian children.

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1 Introduction

Literature on the inequality of opportunity emphasizes the differences in outcomes that arise from differences in the initial circumstances into which individuals are born. Differences in adult outcome variables, such as educational attainment and income, are attributed in part to individual efforts and choices, but may also depend on initial endowments or circumstances.

One way to decompose *inequality into inequality as result of circumstances* and *inequality as a result of efforts* is to look at inequality in outcomes across initial circumstance groups. These circumstances (such as parental background, place of birth, number of siblings and wealth of household) are morally irrelevant to individual outcomes and should not matter in a context of equal opportunities. In other words, *on average* outcome indicators *in between* circumstance groups should be approximately equal in value, and all variation in outcomes should come from inequality within circumstance group, i.e., determined by individual effort within the group ((Bourguignon et al., 2007)).

For very young children (ages 0-4), it is not appropriate to speak about inequality in "efforts" since children are too young to exert relevant effort to influence their outcomes. Hence, all differences across early childhood outcome indicators can be attributed to inequality of opportunity. The early childhood years are important for the development of the linked domains of sensory-motor, cognitive-language and socio-emotional skills. Studies show that early biological and psychosocial risks affect individual development through changes in brain structure and function and lead to behavioral changes that have an impact on the individual and society for life ((Walker et al., 2007)). Circumstances such as poverty to the extent that they increase a child's exposure to certain biological and psychosocial risk factors may have long-lasting effects on individual lives. Poverty is transmitted across generations when the links between initial birth circumstances, childhood risks and subsequent outcomes remain in place and are perpetuated by repeated development failures.

This paper measures inequality of opportunities among children in Egypt on selected health utilization, nutrition, housing and educational enrollment indicators using the Human Opportunity Index (HOI). The HOI is a composite indicator that measures both coverage of a basic service and the distribution of access to the service (equality of opportunities), giving an indi-

cation to whether distribution of coverage is related to the circumstances into which children are born (Barros et al., 2009) (Molinas et al., 2010). As such, an increase in the coverage of a basic service improves the HOI, and if coverage of a service expands more for the disadvantaged group, then the index will improve even further, since the improvement in coverage also leads to a reduction in inequality of opportunity in accessing the service (Barros et al., 2009).

Numerous studies have been undertaken to examine the prevalence and impacts of inequality of opportunity on early childhood development. In a study investigating the correlation between socioeconomic status and malnutrition among children under the age of 5 in South Africa Zere and McIntyre (2003) analyzed household income and expenditure surveys compared with illness concentration indices and found that stunting and wasting were most highly concentrated in the poorest regions of the country. While the study found wasting and stunting to be significantly pro-rich (meaning that the poor suffered from the phenomenon the most), it also highlighted additional indicative circumstances, with inequality the highest along racial lines: among the white population, no significant inequities were observed, while colored children from metropolitan areas displayed the highest levels of stunting. In a similar study undertaken in Brazil, Monteiro et al. (2009) evaluated the prevalence of child malnutrition in correlation with income and basic services redistribution policies in the country (Monteiro et al., 2009). The study found that over the 33 years examined, the gap between children from poor and rich households in terms of stunting had narrowed significantly, in correlation with shrinking disparities in income distribution across the country and a rise in purchasing power and access to basic services and healthcare among the poor. Burgard (2002) also measures inequality of opportunities with a special focus on racial inequalities in child stunting in both Brazil and South Africa, employing generalized estimating equations. The paper finds that racial differences and household socio-economic status are strongly correlated in child stunting.

Singh (2011) uses an inequality of opportunity index and the HOI to measure inequalities in malnutrition and immunization for children in India, and finds significant regional disparities. In another study, Pathak and Singh (2011) use bivariate analysis, poor-rich ratios and concentration indices to evaluate the trends for malnutrition. Mohanty and Pathak (2009) use a similar methodological approach to measure the inequalities in access to maternal care services and child immunization. These studies also find disparities in outcomes to the disadvantage of

the poor.

Egypt is the focus of a number of such studies, including some cross-country evaluations. A recent study by Assaad et al. (2012) examines the patterns of inequality of opportunity in child health outcomes in a number of Arab countries and Turkey using demographic health survey data. The outcome variables used in the paper are standardized height and weight of children as indicators for stunting or wasting. Assaad et al. (2012) find that for Egypt, total inequality is rising over time. Inequality arising from regional differences is the most prevalent circumstance affecting height and weight of children, followed by demographics and parents' education.

Effect of inequality of opportunities on education enrollment has also received considerable attention in literature on early childhood development. In a number of cross-country analyses that include Egypt, Filmer and Pritchett (1999), Filmer (2005), Smits (2007), and Huisman and Smits (2009), socioeconomic status is found to be an important variable indicative of school. Filmer (2005) also noted that the prevalence of gender gaps in terms of school enrollment varies by regions across the world. Al-Qudsi (2003) also finds household wealth to be an important factor for determining school enrollment.Zhao and Glewwe (2010) in China and Tansel (2002) in Turkey reach similar results about the importance of household wealth/income and parents' education status in determining a child's enrollment in school. Inequality of opportunities in education in Egypt was analyzed by Salehi-Isfahani et al. (2012) alongside several other Middle East and North Africa (MENA) countries using the Trends in Mathematics and Science Study (TIMSS) data. The paper finds that inequality of test results in MENA countries can be largely explained by inequality of opportunities. In Egypt, more than one-third of inequality in of test scores is found to be attributable to inequality in opportunity.

In contributing to the sizable body of literature evaluating inequality of opportunities in early childhood development, this paper focuses specifically on two DHS data sets gathered in 2000 and 2008 to measure the extent and any changes of early childhood inequality in Egypt in between 2000 and 2008. Section 2 of this paper continues with a description of the data and methodological approach used to run the tests in our approach to this study. Next, in Section 3, the paper lays out the main results of the study by providing a description of the data gathered from the two DHS surveys, outcomes of the indicators used in the measurement and their influence on HOI in both years. Section 4 provides a conclusion summarizing these

results and policy recommendations for the application of these findings.

2 Data and Methodology

2.1 Data

This paper derives its main data from the Egypt Demographic Health Survey (DHS) conducted in 2000 and 2008 to measure health utilization, nutrition, access to basic services and educational enrollment. The samples in the DHS are nationally representative and include interviews with 15,573 ever-married women in the 15-49 age group in DHS 2000 and 16,527 ever-married women in DHS 2008. Our calculations are made based on key circumstance and outcome variables derived for the children in the early age group (ages 0-4) living in these households, considering access of these children to healthcare, nutrition and basic services. Analysis on educational enrollment is also carried out for later age groups based on observations gleaned from the DHS samples on the women to which these children were born. These four categories are broken down into 18 separate indicator variables, which are then measured for levels of inequality. Additionally, we have constructed three composite indicators for healthcare utilization, nutrition, and housing and access to basic services to measure exposure to multiple risk factors.

The Egypt Household Income, Expenditures and Consumption Survey (HIECS) for 2000 and 2008 are concurrently used to impute the per adult equivalent consumption expenditures at the household. The imputed consumption expenditure is used as a circumstance variable along with those obtainable from the DHS data [1].

This study defines seven initial circumstances in determining a child's opportunity access pool and the outcome variables of these in order to measure for HOI levels. Grouping based on circumstance variables allows us to categorize children in terms of least and most advantaged

[1] Egypt's HIECS measures household expenditures in detail and allows for consumption based poverty estimation. The Demographic and Health Surveys on the other hand, which are the main datasets used in this analysis focusing on children's early health and education outcomes, do not have any detailed welfare measures of income or consumption. In the absence of consumption data, we impute per adult equivalent consumption aggregates into the DHS data by using assets and household head characteristics that are available in both datasets. We run the imputation for 2000 and 2008 separately. The dependent variable in the HIECS we run in the consumption imputation is a log of per adult equivalent consumption. The independent variables are household demographics and household head characteristics (such as educational attainment, gender and age of household head), regional variables, household assets and characteristics (ownership of assets, access to basic services). The number of variables that are jointly found in DHS and HIECS in 2000 are more limited than in 2008 hence the specification is not exactly the same across the two years. (For instance in 2000, the DHS does not have some of the asset variables that are available in 2008 data).

in the country. The seven circumstance variables used in this study are:

1. Region: Urban Governorates, Lower Egypt Urban, Lower Egypt Rural, Upper Egypt Urban, Upper Egypt Rural, Frontier Governorates (6 categories)
2. Mother's Education: No formal education, primary/preparatory, secondary, higher education (4 categories)
3. Father's Education: No formal education, primary/preparatory, secondary, higher education(4 categories)
4. Number of Children at home: 1-2 children, 3-4 children, 5 or more children (3 categories)
5. Household wealth (asset) quintiles: 5 quintiles (5 categories)
6. Gender of child
7. Imputed household consumption using HIECS surveys (continuous variable)

2.2 Methodology

Human Opportunities Index

Empirically, the HOI of a given basic service or opportunity is the coverage rate ($\bar{p}$), adjusted for difference in access to basic services. The level of opportunity measured by this index can be interpreted as the number of existing opportunities in a given society that have been allocated based on an equal opportunity principle:

$$\text{HOI} = \bar{p}(1 - \text{D}) \tag{1}$$

where D is a dissimilarity index, which is widely used in the sociology literature for dichotomous outcomes. D measures the dissimilarity or inequality of opportunity in access rates to a given basic service for groups defined by circumstances, compared with the average access rate to the same service for the population as a whole Barros et al. (2009). D can be interpreted as the share of the total number of opportunities that needs to be reallocated among circumstance groups to ensure equal access. (1-D) is equal to 1 if access to opportunity is independent of the circumstances, in which case HOI is equal to the average coverage rate ($\bar{p}$).

With mutually exclusive circumstance groups, one can compute D as follows:

$$\text{D} = \frac{1}{2\text{p}} \sum_{\text{k}=1}^{\text{m}} \text{a}_\text{k} \, |\text{barp} - \text{p}_\text{k}| \tag{2}$$

where k denotes a circumstance group (group of children with a specific set of circumstances); p_k is the specific coverage rate of group k ; a_k is the share of group k in total population of children; and m is the number of groups defined by circumstances. D is equal to zero when $\bar{p}$=p_k for all k circumstance groups, in which case HOI is equal to the coverage rate $\bar{p}$. It can also be shown that D is equal to the *share* of total opportunities that are "misallocated" in favor of (against) circumstance groups that have coverage rates higher (lower) than $\bar{p}$.

The first component of HOI, $\bar{p}$, the coverage of basic services, can be calculated using the DHS data. Intuitively, the HOI takes access to a basic opportunity, the coverage rate, and discounts it if those opportunities are allocated inequitably. Two factors drive the index: for a given level of D, an increase in the prevalence of opportunities (that is, a higher) increases the index, while an improvement in the way existing opportunities are allocated (a reduction in D) will also improve the index. The index is also pareto-consistent in the sense that it will improve if the overall average access to a given opportunity increases, no matter how access is distributed, because at least someone is better off and no one is worse off. If the equal opportunity principle is consistently applied, an exact correspondence between population and opportunity distribution would be observed.

Note that access probability gaps are at the heart of the dissimilarity index (D). D is a weighted average of the absolute differences of group specific access rates, pi (the average probability in the subgroup i that a child will have access to a certain basic service, such as primary education), from the overall access rate, (the average probability in the entire population) Barros et al. (2009) and Azevedo et al. (2010). D gives much greater weight to those opportunities allocated to a disadvantaged group of the population than to those allocated to an advantaged group, and is therefore a distribution-sensitive measure. D ranges from 0 to 1 (0 to 100 in percentage terms), and in a situation of perfect equality of opportunity, D will be 0. In other words, D depends on the circumstances and will be zero if no circumstances are considered. Therefore, the maximum value HOI can take is the average coverage rate by a particular basic service, given by $\bar{p}$. It also implies that an HOI of 100 is possible only when access is universal ($\bar{p}$ is 100 and D is 0).

Scale and Distribution Decomposition

In estimating the HOI level for each outcome variable in this study in 2000 and 2008, it is possible to decompose the changes in the index by scale and distribution effects and to understand the sources of the estimated change over time Barros et al. (2009). One property of the HOI is that changes are additively decomposable. Any improvement in the index can be attributed either to an increase in the coverage rate (scale effect) or a reduction in the index of inequality of opportunity, D (distributional effect). The changes in HOI between 2000 and 2008 can be decomposed into scale and equalization effects for each of the outcome variable as:

Change in HOI:

$$HOI^{final} - HOI^{initial} = \Delta\bar{p} + \Delta D \tag{3}$$

Scale effect:

$$\Delta\bar{p} = \bar{p}^{final}(1 - D^{initial}) - \bar{p}^{initial}(1 - D^{initial}) \tag{4}$$

Distribution effect:

$$\Delta D = \bar{p}^{final}(1 - D^{final}) - \bar{p}^{final}(1 - D^{initial}) \tag{5}$$

Shapley Decomposition

To measure the contributions of different circumstance variables in inequality of opportunity, we employ the decomposition procedure proposed by Shorrocks (2012), which is based on the concept of Shapley value in cooperative games. The procedure allows us to measure how much individual circumstances (such as gender, location, parental characteristics) contribute to inequality in access to basic services. Shapley decomposition consists of computing the marginal effect on the inequality index, in this case HOI, of adding or removing each contributing factor in a given sequence of elimination (Betti, 2008), (Shorrocks, 2012). The decomposition involves calculating the marginal impact of each of the circumstances as they are eliminated in succession, and then averaging these marginal effects over all the possible elimination sequences. The contribution of all circumstances yields an exact, additive decomposition between group inequalities (in this case the dissimilarity index). The resulting formula is formally identical to the Shapley value in a cooperative game. To illustrate the procedure, we apply it to the anthropometric measures for children's height and weight-for-age and estimate the relative contributions of each circumstances to the observed variance in anthropometric indicators.

Following Barros et al. (2009), inequality of opportunity is measured by the dissimilarity

index (D) as defined in Equation 2. The value of D is dependent on the set of circumstances considered. Moreover, they have the important property that adding more circumstances always increases the value of D. For example, if we have two sets of circumstances, C1 and C2, and set C1 and C2 do not overlap, then HOI(C1,C2) $\leq$ HOI(C1). Similarly, D(C1,C2) $\geq$ D(C1). The impact of adding a circumstance A is given by:

$$D_{C1} = \sum_{S \subseteq N \setminus \{C1\}} \frac{|s|!\,(n-|s|-1)!}{n!} \left[D\left(S \cup \{C1\}\right) - D(S)\right] \tag{6}$$

Where N is the set of all circumstances, which includes $n$circumstances in total; S is a subset of N (containing s circumstances) that does not contain the particular circumstance C1. $D(S)$ is the dissimilarity index estimated with the set of circumstances S. $D\left(S \cup \{C1\}\right)$ is the dissimilarity index calculated with set of circumstances S and the circumstance C1. We can define the contribution of circumstance C to the dissimilarity index as:

$$\theta_{C1} = \frac{D_{C1}}{D(N)}, where \sum_{i \in N} \theta_i = 1 \tag{7}$$

In other words, the sum of the contributions of all circumstances to the dissimilarity index adds up to 100 percent – a critical property satisfied by the Shapley decomposition.

To measure the contribution of each circumstance to inequality of access to an opportunity, we apply the above procedure on the dissimilarity index (i.e., Equation 2). We apply it for all seven circumstances and most of the outcomes of interest. Consider any opportunity (e.g., whether a blood sample is taken from a mother during pregnancy), defined as a discrete (0-1) variable, with "1" denoting "yes" and "0" denoting "no". Our objective is to obtain the conditional probabilities of access to this opportunity for each child based on his/her circumstances. In order to do so, a logistic model, linear in the parameters β, where the event I corresponds to "whether a blood sample taken from the mother during pregnancy" and C is the set of circumstances. The following logistic regression is fitted using DHS data:

$$\ln\left(\frac{P\left\{I=1|C=(c_1,\ldots\ldots,c_n)\right\}}{1-P\left\{I=1|C=(c_1,\ldots\ldots,c_n)\right\}}\right) = \sum_{\mathrm{k}=1}^{\mathrm{n}} \mathrm{c_k}\beta_{\mathrm{k}} \tag{8}$$

The decomposition method outlined earlier allows us to estimate the contribution of each covariate to the estimated D-index. The contribution of covariate k to the D-index for a particular opportunity can be estimated as in Equation 6 and Equation 7, with $\hat{D}$ substituted for D. The contribution of each circumstance to $\hat{D}$ should add up to 100 percent.

3 Main Results

We measure improvements or falls in HOI in Egypt in the time period surveyed based on four main indicator categories to which we apply the data from the 2000 and 2008 DHS samples. These categories are: (i) healthcare utilization before, during and after pregnancy and a child's access to healthcare services in the early years; (ii) nutrition and micronutrient intake; (iii) access to basic services and housing; and (iv) education enrollment and attainment.

3.1 Health Utilization Indicators

We consider the use of health care services during pregnancy (antenatal care), during birth and in the early postnatal period after the birth. These health utilization variables are analyzed for children in the 0-4 age group. We also consider whether the child has received a complete set of immunizations between the ages of 12-23 months. For antenatal care, we consider whether a blood sample was taken from the mother during pregnancy. This indicator is important in that such a sample helps to detect nutritional deficiencies of the infant before birth.

The coverage (prevalence) of antenatal care as measured by the blood sample indicator has increased in Egypt from 46.8% of pregnancies in 2000 to 70.6% of pregnancies in 2008. In the same time period, the dissimilarity index, which measures inequality of opportunities related to the specific outcome variable, has gone down from 17.2 to 4.1. As a result, the HOI has increased significantly for antenatal care: from 38.8 to 67.7 (see Table **??** and Figures 1 and 2). Utilization of health services during birth has similarly increased in this time period, with increases in coverage and reductions in the dissimilarity index. The HOI associated with births assisted by trained staff has increased from 50.0 to 71.5 between 2000 and 2008, and the HOI for birth taking place at a public or private health facility has increased from 37.6 to 63.4.

Figures 1 and 2 provide an analysis of the coverage and dissimilarity index across all selected indicators in the analysis for 2000 and 2008. Each of the variables has a combination of coverage and dissimilarity index that produces a certain level of HOI in the calculations. The figures provide thresholds for HOI at 20%, 40%, 60% and 80%, and it becomes possible to compare variables according to their coverage and dissimilarity components separately, while comparing with specific levels of the HOI. As we move to the right side of each graph, the coverage on a certain indicator increases, and as we move up, inequality of opportunities is reduced. At the top right hand corner of the HOI graph we have a situation with perfect coverage (100%) and equal distribution of opportunities (where the dissimilarity index = 0). It is possible to observe between Figure 1 (2000) and Figure 2 (2008) how the health utilization variables move toward better coverage and reduced inequality in access.

For immunizations, the coverage is already high in 2000 and it remains that way in 2008. The post-natal check up variable for the probability of the infant being evaluated by a doctor within two months of birth remains at lower levels of coverage, with only 29.6% of children in the 0-4 year age group having had a post-natal check up. This variable still falls below the 40% threshold for HOI in 2008, while the other utilization variables are all above the 60% threshold.

We also construct a composite health utilization variable for the child having adequate access to healthcare during birth in the postnatal period. The variable is constructed as a dummy variable taking the value 1 for children whose births were attended by skilled health staff (a midwife, doctor or nurse), were born in a public or private health facility and who had a postnatal check up within two months of birth. Since this variable requires all of these conditions to be met, it takes a lower value in terms of coverage. As of 2000, only about 14.8% of children in the 0-4 year old age group had benefited from all of these services, and in 2008 the coverage of these services increased to 23.5%. The HOI on the composite health utilization indicator has increased in this time period from 10.8 to 19.9.

The region circumstance group, that is, the location where a child is born, measures as a strong indicator in signaling differences in the HOI that relates to health utilization indicators. On this variable we find that in 2008, rural regions, particularly Upper Egypt Rural and Frontier Governorates, lag behind other regions in HOI measurement. However, over time there has been significant catch-up: rural regions and Frontier Governorates have improved on the HOI measure

more rapidly than urban regions between 2000 and 2008. In the Lower Egypt Rural areas, the HOI measure increased by 29.9%, while in Lower Egypt Urban areas the change in HOI was 10.1%, and in the Urban Governorates the change in HOI on this indicator was 11.1%.

The scale effect (increase in the coverage of services) dominates the increase in the HOI measure for all health utilization indicators, though redistribution has also played into the change in HOI. Figure 4 Panel A shows the decomposition of the changes in HOI into the scale and distribution effects for health utilization variables. According to this analysis, the HOI for health utilization indicators have increased (except for immunizations, which has stayed relatively stable), and scale effects have been the major source of improvements in HOI. For instance, the HOI for the indicator on births taking place at a health facility has increased from 37.6% to 63.4% in this time period. Of this increase in the HOI, 18% can be attributed to the scale effect (services becoming more widely available and being utilized by all households) and 7.8% is due to the distribution effect (services becoming more available equally across opportunity groups).

The Shapley decomposition for health utilization indicators reveals that wealth status as proxied by asset quintiles still plays a major role in determining access and utilization of healthcare during the pregnancy and postnatal periods. About one-third of the differences across circumstances in terms of whether birth was assisted by skilled staff and whether it took place in a health facility is explained by asset quintiles in 2008 (see Table **??**). The parental educational attainment variables, particularly mother's education, play an important role in the utilization of health services during pregnancy and birth (one-fifth of the variation in the D-index is attributable to mother's educational attainment). The regional variables are the most important determinants of access to public health services as measured by the variation in whether a child (ages 12-23 months) has a complete set of immunizations.

3.2 Malnutrition and Micronutrient Intake

Malnutrition indicators such as stunting, wasting and underweight prevalence have deteriorated in Egypt during the time period analyzed. The HOI calculations using these malnutrition indicators also suggest that there has been deterioration in the HOI that considers "not being malnourished" as measured by these indicators as the outcome variable. The HOI for *not* being

stunted has decreased from 78.2% to 74%. Stunting (defined as being two standard deviations below the median reference child in the height-for-age measure) is the most prevalent form of malnutrition in Egypt. Wasting and underweight prevalence have also increased in this time period, reducing the HOI measure on these indicators as well, from 97.3 to 92.9 and from 95.1 to 91.7, respectively.

Malnutrition is a problem for Egyptian children regardless of background and circumstances. The dissimilarity index is very low for these indicators measuring only around 1.49% for stunting in 2008. This is also visible in the analysis in Figures 1 and 2, where nutrition indicators are among those with highest "equality of opportunity" (high on the y axis), in that the circumstances that children are born into *do not matter as much* in determining their probability of being malnourished. Similarly, as across different circumstance groups, the HOI for nutrition indicators such as "not being stunted" do not vary widely across regions; the HOI for not being stunted ranges between 63.5% in Lower Egypt Urban and 79.3% in Upper Egypt Urban as of 2008 (see Table **??** and Figure 3 for details).

Another way of analyzing this is to decompose the percentage of the variance in anthropometric measures explained by circumstances following the methodology outlined by Ferreira and Gignoux (2008). Here we also observe that circumstances only explain a very small percentage in the variance of anthropometric measures for children in Egypt: only 1.6% of the variance in height-for-age z-scores and 2.6% of the variance in weight-for-age z-scores for children in the 0-4 age group are explained by circumstances into which a child is born. This calculation is carried out using a parametric simulation model that decomposes the level of variance of z-scores by holding circumstances constant and predicting the variance of z-scores when each circumstance is fixed in turn[2]. As such, the problem with malnutrition appears to be a problem for the overall population of children and should likely be tackled through general supply-side reforms and policies that tackle food availability rather than *targeted* policies.

The scale and distribution decomposition of changes in HOI in nutrition indicators reveals

[2]This parametric decomposition allows us to look at the total share of the variance due to circumstance, into the components due to each element of the vector of circumstances. .()..(Ferreira and Gignoux 2008). These partial shares of inequality of opportunity associated with each individual element of C of the vector of circumstances, are computed using the regression coefficients where we use as the dependent variable z-scores (transposed such that they all take positive values) for height for age, weight for age and weight for height for children in the age group 0-4, and as the independent variables 6 circumstance variables (as listed on Page 1) that take on categorical values.

that most of the change (deterioration) in nutrition among children is due to the scale factor rather than the distribution factor in recent years, meaning that children across Egypt from different circumstance groups have been impacted by increased malnutrition prevalence.

The Shapley decomposition for malnutrition indicators shows that gender is the most important determinant for Egyptian children in terms of not being stunted: gender explains 58.5% of the variation in the dissimilarity index for stunting (see Table **??**), and it explains a quarter of the variation in underweight prevalence. Asset index or consumption does not factor into the probability of a child being stunted, although these welfare indicators seem to hold more weight for wasting and underweight prevalence, explaining about one-third of variation in wasting prevalence.

In terms of micronutrient intake, we consider two outcome variables for early opportunities of children: (i) adequate salt iodization in the household and (ii) whether the mother of the child took iron tablets during pregnancy. Both these factors influence subsequent brain and physical development of children and are therefore considered important opportunity variables that impact on later development and outcomes. In the time period analyzed, Egypt has massively scaled up the iodization of salt available at the household level, which has significantly enhanced the HOI measure on this indicator. Whereas in 2000 HOI for a child living in a household with adequately iodized salt was 19.6%, this level increased to 71.9% by 2008. The shift is clearly observed in comparing Figures 1 and 2. The increase in the HOI is mainly due to the scale effect (40.3 percentage points), with more households overall having access to adequately iodized salt, and the redistribution effect has had some influence as well (11.9 percentage points) with the inequality in the distribution of this variable being reduced. The HOI on whether the mother has received iron tablets during pregnancy also increased from, 18.8% to 37.3%, in this time period.

Once again the increase in the HOI is mostly due to the scale factor. The dissimilarity circumstances are computed using the regression coefficients where we use as the dependent variable z-scores (transposed such that they all take positive values) for height for age, weight-for-age and weight-for-height for children in the 0-4 age group, and 6 circumstance variables that take on categorical values as the independent variables. The index on these micronutrient intake variables is higher than malnutrition variables analyzed earlier, suggesting that circumstances

of children still play an important role in determining micronutrient intake, at least as measured by these two specific outcome variables. Household asset index explains the largest portion of the variation in access to micronutrient intake as of 2008 (explaining 45.2% of the variation in whether the child lives in a household with adequately iodized salt and one-third of the variation in whether the mother received iron tablets during pregnancy). Mother's educational attainment is also a big factor in determining micronutrient intake during pregnancy, explaining close to one-fifth of the variation on the iron intake indicator (see Table **??**).

3.3 Housing and Access to Basic Services

In terms of housing and access to basic services for young children, we consider four variables: (i) access to an improved water source at the household level; (ii) whether the household has electricity; (iii) whether the household has a non-shared toilet; and (iv) whether the child has an identity card, in other words whether the child is a registered citizen, which would impact on his or her access to all public services throughout life. In Egypt, the HOI for these variables is quite high, with extensive coverage levels and a low dissimilarity index. In the time period analyzed, there have been improvements in the coverage of some of these services (such as improved drinking water at the household level), which have positively impacted on HOI measures. As of 2008, these four indicators have HOI levels all above 90% (see Figures 1 and 2).

However, some differences remain across regions in terms of measures in access to infrastructure. In considering a child's probability of having access to an improved water source at the household, we find that in the Frontier Governorates the HOI is 74.9% in 2008, much lower in comparison to Urban Governorates that have an HOI on this indicator at 99.6%. The increases in HOI across regions indicate once again that there has been a significant reduction in differences across regions between 2000 and 2008. In 2000, the percentage of children with access to an improved water source was only 70.4% in the Frontier Governorates, with a high dissimilarity index (at 22.8%), hence constituting a low HOI for this measure at around 54.3%. As of 2008, the coverage of this indicator has increased in the Frontier Governorates to 81.2%, and the dissimilarity index has been reduced, bringing the HOI to 74.9% on this indicator. In the same time period, the urban areas already had high coverage and HOI levels on this indicator (above 97%), and they maintained these high coverage and HOI levels (See Figure 3).

We also analyze the HOI for a composite measure of access to services, defined as the child being formally registered (having an identity card), and living in a household with improved water source, electricity and a non-shared toilet. On this composite indicator, we find that the HOI increases from 73.8% to 86.0%. There are variations across regions for this composite measure, with Upper Egypt Rural and Frontier Governorates taking on much lower levels of HOI for this composite score at 75.1% and 65.9%, respectively, as of 2008.

The Shapley decomposition indicates that regional variables still explain the largest variation in access to improved water at home and a child's official registration status. In fact, regional variables explain more than half of the variation in access to improved drinking water at home, and about one-third of the variation in whether the child is registered (see Table **??**). For access to a non-shared toilet and electricity in the home, the asset index of the household is the main indicator explaining variation in outcomes.

3.4 Educational Enrollment Indicators

In determining HOI levels for educational enrollment among Egyptian children, we consider four variables that help us measure access to opportunities in this realm. They are: (i) the probability of enrollment for age group 6-14 (primary and preparatory levels); (ii) probability of enrollment for children in age group 15-17 (secondary school level); (iii) probability of completing 6th grade on time; and (iv) the probability of completing 9th grade on time (preparatory).

The HOI for enrollment for age group 6-14 is 85.4% in 2000 and increases to 92.2% in 2008. For the older age group of 15-17 year olds, the probability of enrollment also increases in this time period, with HOI growing from 60.7% to 65.9 %. At the secondary school level (ages 15-17), coverage of children is lower and the dissimilarity index is higher than at the basic education level (which is compulsory schooling in Egypt) (see Table **??** and Figures 1 and 2). The HOI measurement on the probability of being enrolled at both levels of schooling varies significantly by region in 2000. Upper Egypt Rural has the lowest HOI for this indicator, at 75.7% and 48.1%, respectively, for these age groups, while Lower Egypt Rural has the highest HOI, with 91.5% and 75%, respectively, for these age groups.

We see that the disparities in HOI across regions are reduced in the time period analyzed in terms of educational enrollment. At the secondary school level (ages 15-17) the difference in

HOI between Upper Egypt Rural and Lower Egypt Urban is reduced from 26.9% to 19.3%. We also consider the variables on on-time completion of 6th and 9th grades for children as outcome variables in the education sector. Again, on both of these indicators of access to education, we find improvements on the HOI measurement over time. The changes in HOI in the education sector are mostly a result of the expansion of coverage of children overall (the scale effect) rather than the distribution effect. Figure 4 Panel D shows the decomposition of changes in HOI for educational enrollment variables where we can observe that the expansion in coverage across all children dominates the changes (improvements) in the HOI measure.

Parental education variables are consistently the most important factors explaining variation in enrollment rates in Egypt at the basic and secondary education levels. Educational attainment of the mother and father combined explains more than half of the variation in the probability of a child's enrollment in the age groups 6-15 and 15-17. Similarly, these variables explain more than half of the variation in the probability of completing 6th grade and 9th grades on time. Following parental education variables, the asset index and consumption level of the household together explain about one-fourth of the variation in educational enrollment. Regional variables, on the other hand, explain less than 10% of the variation in enrollment rates in Egypt.

4 Conclusion

The study shows that significant progress has been attained in Egypt with regards to the availability of and access to basic services for children and mothers, in some cases with a pro-poor overall effect. In particular, improvements can be observed in connection with healthcare utilization before and during pregnancy, and in children's immunization. As a result, there has been decline in measures of inequality of opportunity in access to these basic services over the last decade, mostly through increased coverage rather than through redistribution effects. However, there are some areas of persistent and emerging concerns where further efforts are required to ensure full and more equitable access that is crucial for a child's development and his or her chances to attain full potential later in life. These include postnatal care utilization, adequate nutrition and schooling. The findings confirm that wide differences in school enrollment persist,

notably at the higher levels, and mostly based on the family's socioeconomic background. Additionally, large regional disparities in access to household-level basic infrastructure and healthcare utilization continue to exist, with Upper Egypt and the Frontier Governorates lagging behind other regions.

Children's nutrition in Egypt emerges as a key area where there remains large room for improvement. It is noteworthy that the levels of malnutrition and stunting have worsened over time and reached high levels for all children in Egypt, regardless of background. Inequality of opportunity concerning these outcomes barely exists, with gender appearing to be the main source of disparities. Nutritional deficiencies combine with other risk factors, such as lack of cognitive stimulation, for a large share of the least advantaged children, rendering this group particularly vulnerable.

The report's findings point to family background, especially the level of parents' education and wealth, and geographic factors as key factors determining child development outcomes. Targeted interventions aimed at enhancing access for these groups could thus offer significant potential to enhance overall and relative postnatal care utilization and access to education. In the case of nutrition, on the other hand,supply-side non-targeted approaches would be more appropriate, since circumstances play a small role in determining malnutrition in Egypt and the problem is pervasive across circumstance groups.

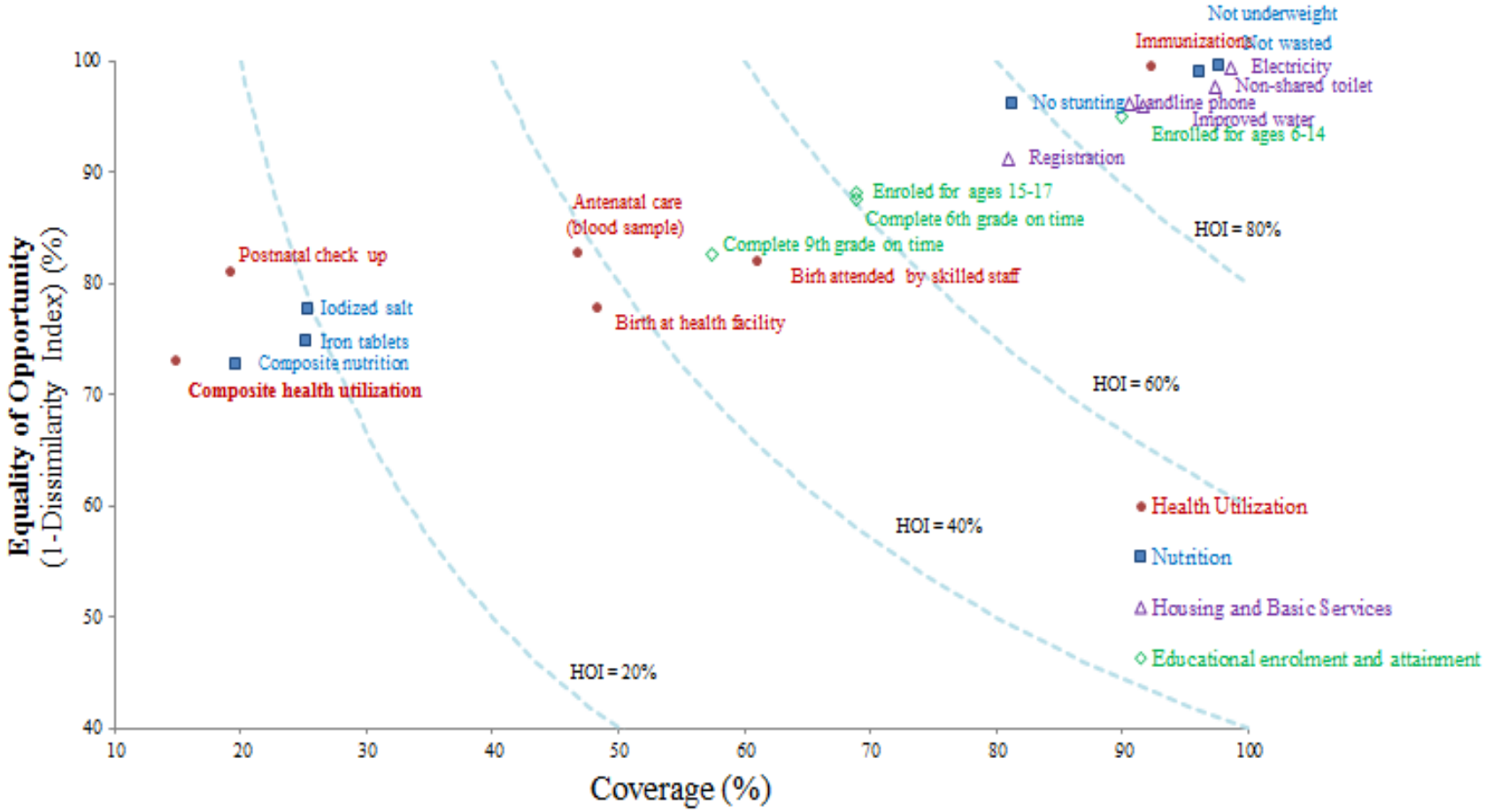
Table 1: Summary Table: Human Opportunity Index on Selected Indicators for Egypt (2000, 2008)

		2000				2008			
		C = Coverage	D= Dissimilarity Index	(1-D)= 1 - Dissimilarity Index	Human Opportunity Index (HOI) = C * (1-D)	C = Coverage	D= Dissimilarity Index	(1-D)= 1 - Dissimilarity Index	Human Opportunity Index (HOI) = C * (1-D)
Health Utilization	During pregnancy, blood sample was taken from mother	46.8	17.2	82.8	38.8	70.6	4.1	95.9	67.7
	Birth assisted by trained health staff (doctor/midwife/nurse)	61.0	18.0	82.0	50.1	78.6	9.1	90.9	71.5
	Birth given at public or private health facility	48.3	22.2	77.8	37.6	71.5	11.3	88.7	63.4
	Baby postnatal check within 2 months of birth	19.1	18.9	81.1	15.5	29.6	7.6	92.4	27.3
	Child received all immunization (ages in months 12-24)	92.3	0.5	99.5	91.9	91.6	1.4	98.6	90.3
	Composite variable for having adequate access to health services (birth by skilled staff, in health facility, with postnatal checkup)	14.8	27.0	73.0	10.8	23.5	15.4	84.6	19.9
Nutrition	Not stunted	81.1	3.6	96.4	78.2	75.1	1.5	98.5	74.0
	No wasting	97.5	0.2	99.8	97.3	93.4	0.6	99.4	92.9
	Not underweight	95.9	0.8	99.2	95.1	92.4	0.7	99.3	91.7
	Child lives in hh with adequately iodized salt (>.15 ppm iodine)	25.2	22.1	77.9	19.6	77.0	6.6	93.4	71.9
	The mother received iron tablets during pregnancy	25.1	25.1	74.9	18.8	41.5	10.0	90.0	37.3
	Composite variable for having adequate nutrition (not stunted, not underweight & lives in hh with adequate salt iodization)	19.4	27.1	72.9	14.2	49.3	6.5	93.5	46.1
Housing and access to basic s	HH has access to improved drinking water (hv201 variable is used)	91.5	4.0	96.0	87.9	97.5	1.0	99.0	96.5
	HH has non-shared toilet	90.4	3.6	96.4	87.1	93.7	3.0	97.0	90.9
	HH has electricity	97.3	2.2	97.9	95.2	97.6	1.1	98.9	96.5
	Child is reported to have an identity card	98.5	0.4	99.6	98.1	98.6	0.3	99.7	98.3
	Composite variable for having access to basic infrastructure (registered child in hh with improved water source, electricity and non-shared toilet)	80.8	8.6	91.4	73.8	89.9	4.4	95.7	86.0
Education enrolment and att	Enrollment rate for ages 6-14 (inclusive)	89.9	4.9	95.1	85.4	94.5	2.4	97.6	92.2
	Enrollment rate for ages 15-17 (inclusive)	68.8	11.7	88.3	60.7	73.5	10.4	89.7	65.9
	Probability of completing sixth grade ontime (among children ages <=13)	68.7	12.2	87.8	60.3	84.1	6.3	93.7	78.8
	Probability of completing 9th grade (preparatory) ontime (among children ages <=16)	57.3	17.3	82.7	47.4	62.8	15.6	84.4	53.0

Table 2: Shapley Decomposition of the Dissimilarity Index by Circumstance Groups (2000 and 2008)

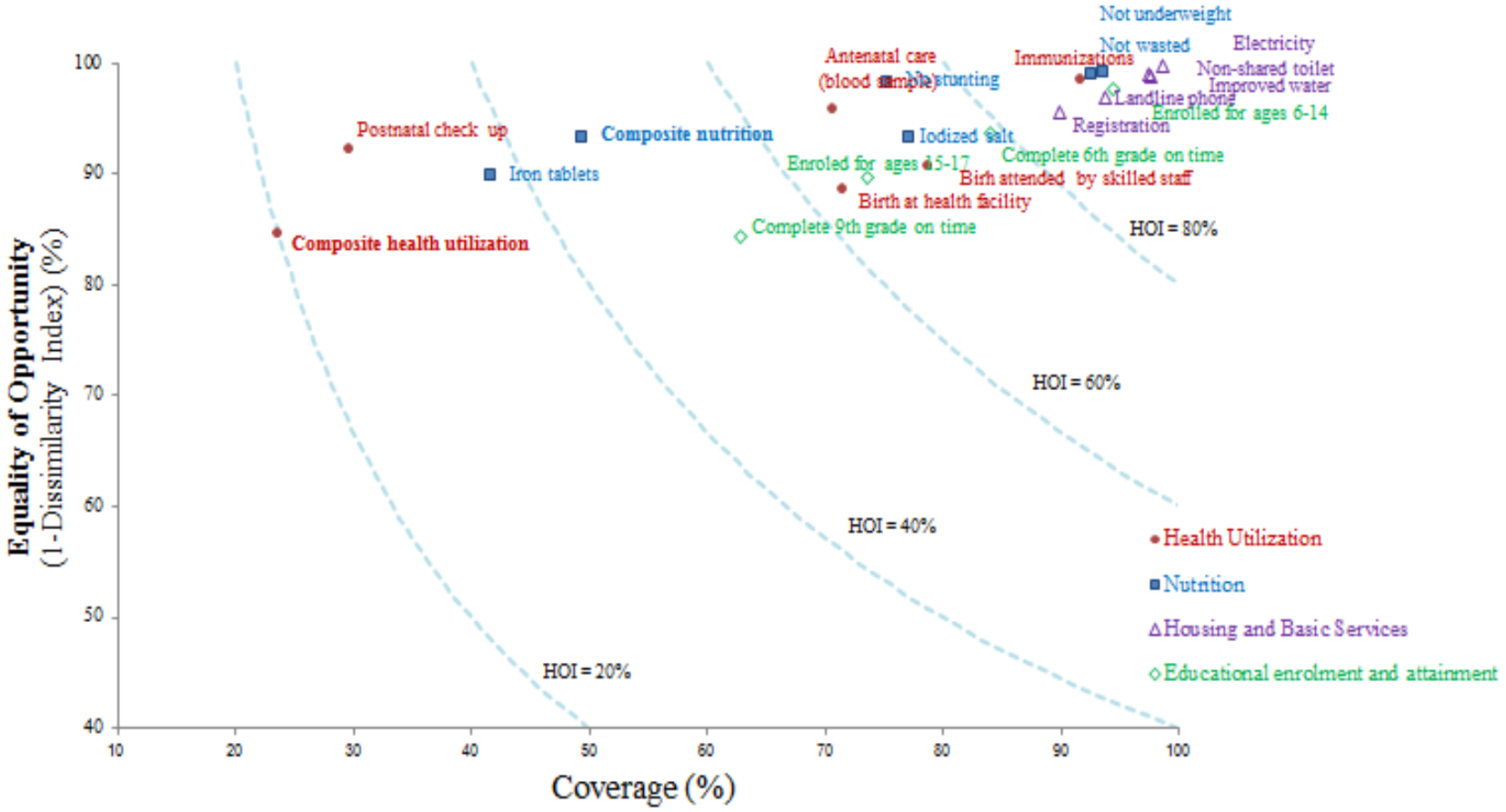
		Health Utilization					Nutrition					Housing and access to basic services				Education enrolment		
		During pregnancy, blood sample was taken from mother	Birth assisted by trained health staff (doctor/midwife/nurse)	Birth given at public or private health facility	Baby postnatal check within 2 months of birth	Child received all immunization (ages in months 1224)	Not stunted	Not wasted	Not underweight	Child lives in hh with adequately iodized salt (>.15 ppm iodine)	The mother received iron tablets during pregnancy	HH has access to improved drinking water	HH has nonshared toilet	HH has electricity	Child is reported to have an identity card	Enrollment rate for ages 614 (inclusive)	Enrollment rate for ages 1517 (inclusive)	Probability of completing sixth grade ontime (among children ages <=13)
2000	Region	12.9	15.9	19.3	5.7	9.0	38.6	7.1	35.1	7.7	7.4	10.2	13.5	12.3	11.3	6.6	6.8	6.7
	Mother's Educational Attainment	26.3	24.1	20.7	28.6	18.3	11.6	1.8	12.2	23.0	30.7	15.7	19.9	14.1	15.5	21.2	21.0	23.0
	Father's Educational Attainment	15.2	15.5	14.3	21.2	12.3	8.8	6.6	9.4	18.2	21.3	12.2	14.3	10.6	14.5	27.8	27.6	25.5
	Number of children at home	14.0	12.6	13.5	13.3	13.8	5.1	11.6	9.6	3.9	7.8	3.8	6.5	6.0	8.5	12.4	8.8	8.9
	Asset quintiles	27.9	30.1	29.7	27.6	20.0	22.5	14.2	23.9	38.8	29.0	55.0	34.4	50.4	36.8	23.6	26.6	28.2
	Consumption	2.7	1.8	2.3	2.6	21.4	3.3	0.5	3.9	8.1	2.7	2.5	11.0	6.3	8.5	2.7	4.7	7.1
	Gender of child	1.1	0.1	0.2	1.0	5.1	4.1	58.2	5.8	0.3	1.2	0.6	0.2	0.3	5.0	5.6	4.5	0.6
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
2008	Region	11.7	20.6	21.8	5.0	42.5	19.7	9.5	18.2	18.1	8.1	50.9	22.5	8.3	31.9	7.7	6.2	7.7
	Mother's Educational Attainment	21.1	21.4	20.2	23.8	5.3	1.6	5.9	21.1	16.5	18.8	11.3	14.7	15.0	18.7	24.2	31.2	28.8
	Father's Educational Attainment	11.9	11.9	10.0	19.4	6.7	9.9	1.0	8.6	11.2	18.2	3.4	9.1	8.6	13.8	27.0	25.3	25.5
	Number of children at home	30.7	9.9	10.8	10.9	5.8	7.8	14.3	5.5	4.7	15.5	1.2	1.7	8.1	1.6	10.0	5.4	7.6
	Asset quintiles	23.5	32.4	33.6	31.1	27.4	1.3	10.9	18.2	45.2	33.0	25.5	45.1	38.1	19.3	23.4	21.9	20.4
	Consumption	1.1	2.6	2.9	3.2	3.6	1.1	20.4	4.0	4.0	5.7	6.8	6.2	21.6	6.2	6.2	8.7	6.3
	Gender of child	0.0	1.3	0.8	6.7	8.8	58.5	38.0	24.3	0.1	0.6	0.9	0.8	0.3	8.5	1.5	1.3	3.7
		100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
	Differences																	
	Region	(1.2)	4.7	2.5	(0.7)	33.5	(18.9)	2.3	(16.9)	10.4	0.7	40.7	9.0	(4.0)	20.6	1.1	(0.6)	1.0
	Mother's Educational Attainment	(5.2)	(2.7)	(0.5)	(4.9)	(13.0)	(9.9)	4.2	8.9	(6.5)	(11.9)	(4.4)	(5.3)	0.9	3.3	3.0	10.2	5.7
	Father's Educational Attainment	(3.3)	(3.6)	(4.3)	(1.9)	(5.6)	1.1	(5.6)	(0.8)	(7.0)	(3.1)	(8.8)	(5.3)	(2.0)	(0.7)	(0.9)	(2.2)	0.1
	Number of children at home	16.7	(2.7)	(2.7)	(2.3)	(8.1)	2.8	2.7	(4.0)	0.8	7.7	(2.6)	(4.9)	2.1	(6.9)	(2.4)	(3.5)	(1.3)
	Asset quintiles	(4.5)	2.3	3.9	3.4	7.4	(21.2)	(3.3)	(5.7)	6.5	4.1	(29.5)	10.7	(12.3)	(17.5)	(0.1)	(4.7)	(7.8)
	Consumption	(1.6)	0.8	0.6	0.6	(17.8)	(8.2)	13.9	0.1	(4.1)	3.0	4.3	(4.8)	15.3	(2.3)	3.5	4.0	(0.8)
	Gender of child	(1.0)	1.2	0.6	5.7	3.7	54.4	(20.1)	18.4	(0.1)	(0.5)	0.3	0.5	(0.0)	3.5	(4.2)	(3.2)	3.1

Figure 1: Human Opportunity Index in Egypt for Various Indicators (2000)



Source: Author calculations using Egypt DHS 2000 .
HIECS 2000 data used for the imputation of consumption in DHS.

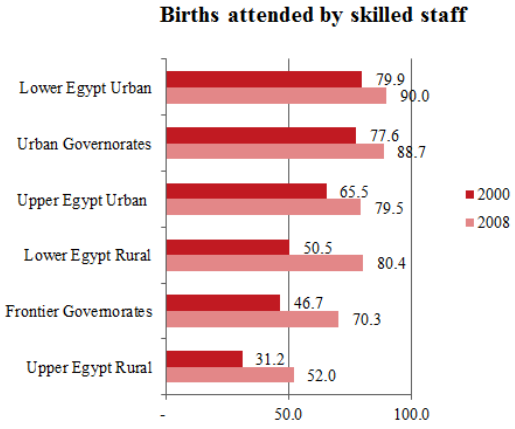
Figure 2: Human Opportunity Index in Egypt for Various Indicators (2008)



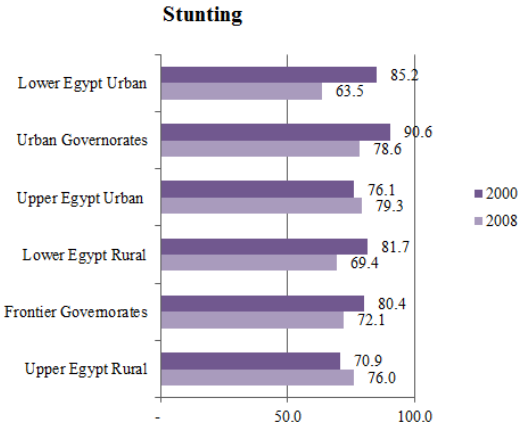
Source: Author calculations using Egypt DHS 2008.
HIECS 2008 data used for the imputation of consumption in DHS.

Figure 3: Changes in the Human Opportunity Index in Egypt by Region

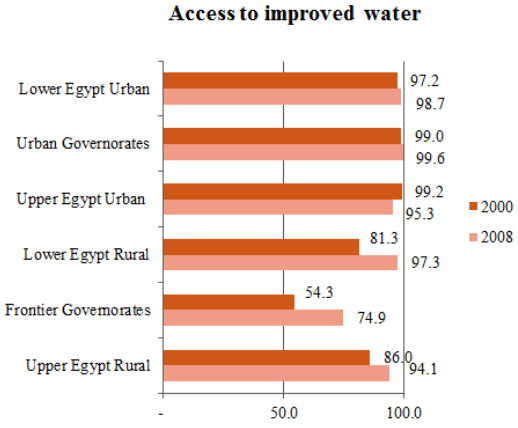
(a) Health Utilization



(b) Nutrition



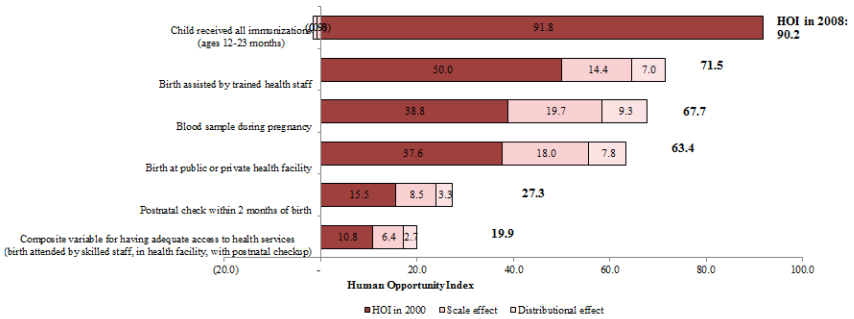
(c) Basic Services



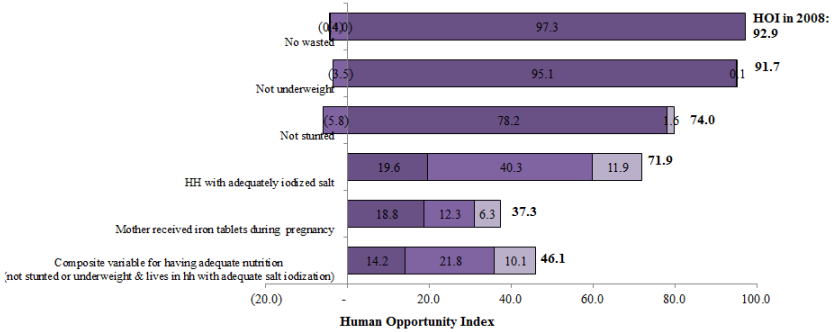
(d) Educational Enrollment

Figure 4: Decomposition of Changes in the Human Opportunity Index in Egypt by the Scale and Distribution Effect

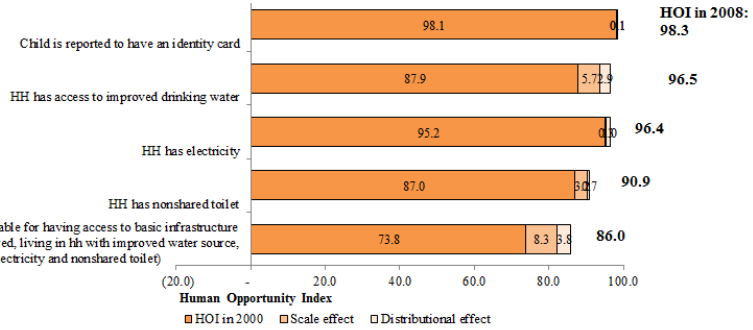
(a) Health Utilization



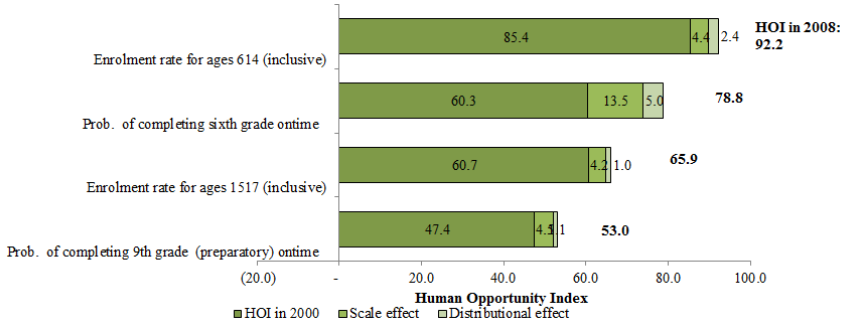
(b) Nutrition



(c) Basic Services



(d) Educational Enrollment



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