Journal of Economics and Administrative Sciences
2024; 30(144), pp. 485-500

P-ISSN 2518-5764
E-ISSN 2227-703X

Journal of Economics and Administrative Sciences (JEAS)

Available online at http://jeasiq.uobaghdad.edu.iq
DOI: https://doi.org/10.33095/n4w7ca27

Robustness & Measurement of Multidimensional Poverty Index In Iraq

Mustafa Ahmed Hasan*
Department of Statistics
College of Administration & Economics;
University of Baghdad; Iraq.
E-mail: mostafa.ahmedl2101m@coadec.uobaghdad.edu.iq
ORCID: https://orcid.org/0009-0005-7970-2105
***Corresponding author**

Eman Muhammad al-Mashhadani
Department of Statistics
College of Administration & Economics;
University of Baghdad; Iraq.
E-mail: dreman@coadec.uobaghdad.edu.iq

Received:14/5/2024 Accepted: 3/7/2024 Published Online First: 1 /12/ 2024

Abstract:
Purpose: This paper aims to measure poverty in Iraq and its sub-indicators using a multidimensional methodology. It also examines the robustness and sensitivity of the estimated indicators and models the determinants of poverty through a binary logistic regression approach.
Theoretical framework: Poverty is commonly measured through two primary methodologies. The first is a one-dimensional approach, which defines poverty as insufficient income to meet a specific set of needs required for a decent standard of living. The second is a multidimensional approach, which aligns with Amartya Sen's capabilities framework. Sen conceptualizes poverty as "the deprivation of basic capabilities rather than merely as lowness of incomes, which is the standard criterion of poverty identification" (Sen, 1999, p. 87). Income, while significant, represents just one dimension of capabilities and cannot substitute for other crucial aspects that contribute to poverty, such as deficiencies in health, education, and employment.
Design/methodology/approach: Previous studies on modeling poverty determinants in Iraq have predominantly employed a one-dimensional approach focused on income poverty. While valuable, this approach provides an incomplete understanding of poverty's multifaceted nature. This study proposes an indicator to measure poverty in Iraq using a multidimensional methodology. The analysis incorporates three dimensions of the global Multidimensional Poverty Index (education, health, and standard of living) and adapts the measurement indicators to reflect Iraq's specific context. Data from the sixth edition of the Multiple Indicator Cluster Survey (MICS-6) conducted in 2018 was utilized, employing the Alkire-Foster method to compute multidimensional poverty indicators.

Findings: The estimates revealed that 27% of Iraq's population experienced multidimensional poverty, with a multidimensional poverty gap of 11.7% and an intensity of poverty at 43.5%. The binary logistic regression results indicated that higher educational attainment of the household head and an improved wealth index significantly reduce the likelihood of multidimensional poverty. Additionally, households in rural areas were found to be more vulnerable to multidimensional poverty than those in urban areas.

Research, Practical & Social implications: This study seeks to enhance researchers' focus on poverty by exploring its diverse and multifaceted dimensions within the Iraqi context. By incorporating relevant and updated variables, it aims to enrich the discourse on poverty measurement and analysis.

Originality/value: The proposed indicator serves as a valuable analytical tool for identifying the most vulnerable individuals and highlighting the specific dimensions in which they face deprivation. This enables policymakers and stakeholders to allocate resources effectively and design targeted interventions to alleviate poverty.
Keywords: Aliker and Foster methodology, Dominance Analysis, Multidimensional poverty, Poverty measurement, Robustness,
JEL Classification: C1, D63, I3, I32,O1.
Note: The views and results of this paper cannot be considered official statements.
Acknowledgements:
We thank very much the assistance provided by staff from the Statistics Authority, especially Dr. Fadel. N. khayzirn, for his help in calculating the results, and for providing useful comments.

Introduction:

The methods used to measure poverty significantly influence how we understand and analyze this phenomenon, identify its causes and triggers, and develop policies to combat it effectively. Poverty indicators are typically assessed through two primary methodologies.

The first is a one-dimensional methodology (monetary poverty), which defines poverty as "the inability to attain a minimal standard of living" (World Bank, 1990, p. 26). This approach assumes that "money is a universal convertible asset that can be translated into satisfying all other needs" (Scott, 2002, p. 488). In this framework, individuals are classified as poor based on a fixed threshold, the "poverty line," which represents the minimum income required to meet a specific set of basic needs. Iraq's national poverty line was initially calculated using data from the Iraq Household Socio-Economic Survey (IHSES-2007) (Committee, 2011).

The second methodology views poverty as a multidimensional phenomenon, encompassing economic, social, political, and other diverse dimensions. This perspective has been highlighted in key global frameworks, including the 1997 Human Development Report, the Millennium Declaration and Development Goals (2000), and the Sustainable Development Goals (SDGs) 2015, with Goal 1 explicitly titled “End poverty in all its forms” (UN, 2015, p. 14). Various methods, such as the Unmet Basic Needs (UBN) approach, have been employed to measure multidimensional poverty. For example, the UBN method was applied to the 2004 Living Conditions Survey to create a map of deprivation and living standards in Iraq (CSO & UNDP, 2011). Similarly, efforts were made to estimate Iraq's Multidimensional Poverty Index (MPI) for 2013, using data from the Iraqi Knowledge Network Survey (IKN-2011) (Nawar, 2014).

Despite these efforts, poverty remains a pressing issue in Iraq. According to estimates by the Ministry of Planning (2022), approximately 25% of Iraqis live below the poverty line (Al-Mashreq, 2023). This persistent high poverty rate suggests that existing measurement methodologies and studies have not adequately captured the complexity and reality of poverty in the country.

This paper aims to address this gap by proposing a multidimensional poverty index focused on three core dimensions of development: education, health, and standard of living. The proposed index will be evaluated for reliability, sensitivity, and robustness to account for potential fluctuations by adjusting key parameters.

To better understand poverty in Iraq, the study will examine its characteristics and causes using generalized linear models to analyze the determinants of household poverty.

The structure of the paper is as follows:

- Section II provides a review of relevant literature on multidimensional poverty.
- Section III outlines the proposed index, detailing its dimensions and indicators, along witha theoretical explanation of the measurement and analysis methodology.
- Section IV presents the key findings of the study.
- Section V concludes with a discussion of the main findings and offers recommendations based on the results.

Literature review and Hypothesis Development:

Costa (2003) conducted a comparative analysis of one-dimensional (material) poverty methodologies, which rely on income or consumer expenditure as their primary indicators, and multidimensional poverty methodologies, which incorporate a range of social, demographic, economic, and cultural factors. Using rank correlation analysis, specifically Spearman's and Kendall's rank correlation coefficients, Costa concluded that the multidimensional poverty methodology provides a more accurate representation of deprivation than the one-dimensional approach.

Alkire and Foster (2008) introduced a groundbreaking methodology for measuring multidimensional poverty, which leverages the concepts of intersection and union to classify poverty and define who is considered poor. This methodology identifies the poor by applying specific cut-offs for each dimension and then determining aggregate cut-offs across selected dimensions. Using this approach, they developed indicators such as the poverty rate, poverty gap, and the Multidimensional Poverty Measure (Alkire & Foster, 2011).

In 2010, Alkire and Santos, with the support of UNDP and the Oxford Poverty and Human Development Initiative (OPHI), developed the Multidimensional Poverty Index (MPI). The MPI measures non-monetary aspects of poverty using ten indicators grouped into three dimensions: health, education, and living standards, which are weighted equally. These dimensions align with those of the Human Development Index (HDI), providing a comprehensive tool for assessing poverty in developing countries (Alkire & Santos, 2010).

Calvo and Fernandez (2012) highlighted potential sources of error in poverty measurement. For one-dimensional poverty measures, such errors often stem from sampling issues, leading to biases that affect analysis and policy formulation. In the case of multidimensional poverty indices, errors may arise from bias in selecting cut-off points, specifically the dual cut-off strategy, which determines the threshold separating poor and non-poor individuals (Calvo & Fernandez, 2012).

Khaizaran (2015), in his thesis *"Inequality and Fuzzy Measures for Multidimensional Poverty Index in Iraq"*, explored various fuzzy methods for estimating multidimensional poverty indices. These methods include the Totally Fuzzy Method, Totally Fuzzy and Relative Method, Integrated Fuzzy and Relative Method, and the Fuzzy Membership Ranking Model. His work provides valuable insights into the use of fuzzy logic for addressing ambiguities and improving the accuracy of multidimensional poverty measurement.

Research Methodology:

Indicator structure and measurement method:

This paper introduces a proposed indicator for measuring poverty in Iraq within a multidimensional framework. The indicator encompasses three dimensions—health, education, and living standards—represented by 14 specific indicators. These indicators were selected based on available data and insights from experts at the Statistics Authority, drawing on global

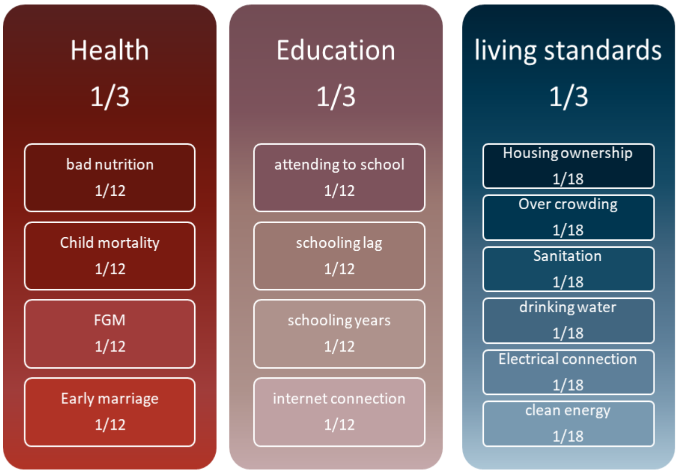
P-ISSN 2518-5764
E-ISSN 2227-703X

and Arab indices for multidimensional poverty measurement. Four indicators are allocated to each of the health and education dimensions, while the living standards dimension comprises six indicators.

The selection process was guided by the Global Multidimensional Poverty Index (MPI)**,** the Human Development Index (HDI)**,** and Iraq's National Development Plan 2018–2022**.**

Poverty indicators are calculated using the Alkire and Foster methodology, which involves two steps. The first step identifies "who is poor" (P_k) by assessing the extent of their deprivations. The second step, "aggregation," generates a set of poverty measures (M_α) based on the traditional poverty measures proposed by Foster, Greer, and Thorbecke (1984)**.** These measures are designed to target the most deprived groups effectively (Ortiz, Daniels, & Engilbertsdóttir, 2012, p. 18).

The analysis is based on data from the sixth round of the Multiple Indicator Cluster Survey (MICS-6) conducted in 2018 (UNICEF, KRSO, & Ministry of Health, 2018). The methodology requires that all indicators used to construct the Multidimensional Poverty Index (MPI) are sourced from the same dataset to ensure consistency (Alkire & Santos, 2014).



The deprivation score for each individual is calculated as the weighted average of their deprivations. Equal weights are assigned to the three dimensions, with each dimension contributing one-third (1/3) to the overall index. Indicators within each dimension are also equally weighted, with weights summing to one (1). Thus, each indicator in the health and education dimensions is assigned a weight of 1/12, while each indicator in the living standards dimension is assigned a weight of 1/18.

The proposed Multidimensional Poverty Index for Iraq (MPI-IQ) applies a double-cutoff approach to define poverty in a multidimensional context. The first threshold, the deprivation threshold **(**Z_j**)**, identifies individuals as deprived if their achievements fall below this threshold for a given indicator. The second threshold, the poverty cutoff **(**K**)**, determines whether an individual is multidimensionally poor based on their overall deprivation score (C_i), calculated as the sum of weighted deprivations. An individual is classified as poor if their deprivation score is greater than or equal to K.

The selection of the poverty cutoff value does not follow a specific algorithm and is typically based on standard, empirical, or statistical considerations, or expert judgment. For this study, the cutoff threshold was set at K=0.34, reflecting input from experts at the Authority of Statistics and Geographic Information Systems**.**

The Multidimensional Poverty Index (MPI) is calculated using one of the measures developed by the Alkire and Foster methodology, the headcount ratio **(**M_0**)**, which combines two key indicators:

1. The multidimensional poverty headcount ratio **(**H**)**, representing the proportion of the population identified as multidimensionally poor.

2. The intensity of poverty **(**A**)**, which measures the average proportion of weighted indicators in which poor individuals are deprived.

Together, these components provide a comprehensive measure of multidimensional poverty in Iraq, facilitating targeted interventions to reduce poverty and address its root causes.

The Multidimensional Poverty Index (MPI) is calculated using the following formula:

$M_0 = (MPI - IQ) = H \times A,$ (1)

Where:

- $\mathbf{M_0}$: The adjusted headcount ratio, representing the MPI.
- **H**: The incidence of multidimensional poverty, which reflects the proportion of the population experiencing multidimensional poverty relative to the total population. It is computed using the formula:

$H = q/n$ (2)

- Here, q denotes the number of individuals classified as multidimensionally poor, and n is the total population.
- **A**: The intensity of multidimensional poverty, calculated as:

$A = \sum_{i=1}^{q} C_i \,/\mathrm{q}$ (3)

In this equation, C_i represents the deprivation score for individual i.

The deprivation score Ci is determined as:

$C_i = \sum_{j=1}^{d} W_j I_j^i,$ (4)

Where:

- W_j: The weight assigned to the jjj-th indicator.
- I_j^i: A binary variable indicating the state of deprivation for individual iii in indicator jjj. It takes the value 000 if the individual is not deprived in that indicator and 111 if they are deprived.
- d: The total number of indicators.

One of the key features of the Alkire-Foster (AF) methodology is its Subgroup Decomposition (Alkire and Santos, 2013), which enables the analysis of overall poverty by dividing it into specific subgroups (e.g., by region, environment, gender, etc.). The contribution of a subgroup α to total poverty is given by:

$D_\alpha = \frac{v_\alpha M_{0\alpha}}{M_0} \times 100,$ (5)

Where:

- D_α: The contribution of subgroup α to total poverty.
- v_α: The population share of subgroup α, calculated as n_α/n.

Another notable feature of the AF methodology is Dimensional Breakdown, which facilitates the disaggregation of the total poverty index into its individual indicators. This allows for the measurement of each indicator's contribution to overall poverty. The contribution of indicator α at a specific poverty cutoff k is expressed as:

$\varphi_\alpha(k) = w_j \frac{h_j(k)}{M_0} \times 100,$ (6)

Where:

- $\varphi_\alpha(k)$: The contribution of indicator α to total poverty at a specific cutoff k.
- $h_j(k)$: The sum of censored deprivations within indicator j.

Robustness:

When measuring poverty, two primary challenges must be addressed:

1. **Identification**: Determining who is considered poor. This involves selecting appropriate indicators and establishing their respective deprivation thresholds.
2. **Aggregation**: Constructing a statistical index of poverty based on available data about the poor. These challenges must account for two essential axioms that are fundamental to poverty indices: monotonicity and transfer (Sen, *Poverty: An Ordinal Approach to Measurement*, 1976).

The Alkire-Foster (AF) methodology satisfies both axioms and offers additional advantageous properties, such as the use of ordered data, a focus on poverty, dimensional breakdown, and subgroup decompositions. Due to these strengths, this analysis does not focus on evaluating the robustness of the aggregation method.

Focusing on the identification challenge, the AF methodology classifies individuals as multidimensionally poor if their deprivation score is greater than or equal to the poverty cutoff (k), which is set in this study at 34%. Similar to the unidimensional concept of a "poverty line," the poverty cutoff defines who is poor within a multidimensional framework. However, unlike the poverty line, there is no universal algorithm for determining the cutoff value.

Its selection depends on the number of indicators in each dimension, the country's priorities, and its policies for addressing poverty. Consequently, the cutoff value varies across indices and countries.

Changes to the poverty cutoff can significantly affect several factors, including the identification of the poor, the contribution of dimensions and indicators to overall poverty, and the ranking of regions or population groups. Rankings are considered robust if they remain consistent despite changes in parameters. Therefore, assessing the robustness and sensitivity of the poverty cutoff is crucial (Yalonetzky, 2011).

To evaluate the reliability and stability of the Multidimensional Poverty Index for Iraq (MPI-IQ) under alternative cutoff thresholds (k), we conduct a series of robustness tests.

Dominance Analysis:

The adjusted headcount ratio satisfies key properties, such as monotonicity and transfer. As a result, small changes in the poverty cutoff value should not significantly alter poverty measurements or the ranking of entities. Stochastic dominance analysis is used to test this property.

Stochastic **dominance** is an effective method for comparing two random variables with an equal number of possible outcomes. Let X and Y be two random variables associated with the same outcome (x_i) and having n possible outcomes. If an outcome is not expected, its probability is set to zero. Stochastic dominance can then be expressed as:

$$P_r(X \leq x_i) \leq P_r(Y \leq x_i) \qquad i = 1,2,3,\ldots,(n-1)$$

Alternatively, this can be represented in terms of the cumulative distribution functions of X and Y:

$F_X(x) \leq F_Y(x) \quad for\ all\ (x)$

If the cumulative distribution function $F_X(x)$ of X is less than or equal to $F_Y(x)$, this is referred to as first-order stochastic dominance (FSD) (Anderson, 1954, p. 155). Stochastic dominance has been applied in the unidimensional approach to poverty measurement (Davidson & Duclos, 1998) and in multidimensional methodologies. Alkire and Foster (2011) employed FSD to identify robust pairwise comparisons when varying the poverty threshold.

Here, we apply FSD to evaluate the robustness and sensitivity of pairwise comparisons under changes to the poverty cutoff (k). An individual is considered poor if their deprivation score is greater than or equal to k. Conversely, in the context of achievement, an individual is poor if their achievement is below the poverty threshold. Extending the cumulative distribution function to its complement (CCDF) is required. The CCDF for a variable Y is expressed as: $\bar{F}_Y = 1 - F_y$

This means that $\bar{F}_Y(b)$ represents the proportion of the population with values greater than or equal to b.

The first-order stochastic dominance condition can be defined using CCDFs as:

x FSD y if $\bar{F}x\,(b) \geq \bar{F}y\,(b)$ for all (b).
And $\bar{F}x\,(b) > \bar{F}y\,(b)$ for some (b).

P-ISSN 2518-5764
E-ISSN 2227-703X

Rank Robustness Analysis:

Meeting the dominance condition for all poverty cutoffs can be a stringent requirement, especially when comparing a large number of entities or accounting for varying poverty cutoff levels. To address this challenge, alternative methods, such as calculating rank correlation coefficients, are often employed to assess the robustness of rankings. Among the most widely used rank correlation coefficients are Spearman's rank correlation coefficient (**R^{ρ}**) **and** Kendall's rank correlation coefficient (**R^{τ}**).

The Spearman correlation coefficient (R^{ρ}) is calculated using the squared difference between the rankings of entities in the primary and alternative distributions. Its formula is:

$$R^{\rho} = 1 - \left(\frac{1}{m(m^2-1)} \times 6\sum_{\ell=1}^{m}(r_\ell - r'_\ell)^2\right) \qquad (7)$$

Here, m represents the number of components being compared, r_ℓ is the rank in the primary distribution, and r_ℓ is the rank in the alternative distribution. The coefficient ranges between -1 and +1, indicating the strength and direction of the relationship. According to Alkire and Foster (2007), correlation values are interpreted as follows:

- 0.000.000.00–0.190.190.19: Very weak
- 0.200.200.20–0.390.390.39: Weak
- 0.400.400.40–0.590.590.59: Moderate
- 0.600.600.60–0.790.790.79: Strong
- 0.800.800.80–1.001.001.00: Very strong

Positive values indicate a direct relationship, while negative values denote an inverse relationship.

The Kendall correlation coefficient **(**R^{τ}**)** is based on the difference between concordant and discordant pairs. A pair is concordant if the order of two entities remains consistent across both distributions, indicating a robust comparison. Conversely, a discordant pair occurs when the order changes, reflecting a non-robust comparison. The formula is:

$$R^{\tau} = \frac{\#\,Concordant\ Pairs - \#\,Discordant\ Pairs}{m(m-1)/2} \cdots \qquad (8)$$

While Kendall's R^{τ} typically produces slightly lower values than Spearman's R^{ρ}, it handles tied ranks more effectively and is preferred in such cases (Bryman & Cramer, 2004).

Standard economic analysis:

To analyze the determinants of multidimensional poverty at the household level, a binary logistic regression model is employed. This model classifies households into two groups poor and non-poor based on the household's deprivation score (c_i) relative to the poverty cutoff threshold (K):

$$Y_i = f(x) = \begin{cases} 1 & if\ C_i \geq K \\ 0 & Other\ wise \end{cases} \qquad (9)$$

The model is expressed as:

$$Y^*_i = \acute{\beta}_j x_{ij} + \varepsilon_i \qquad (-\infty < Y^* < \infty) \qquad (10)$$

Where:

- Y^*_i: The natural logarithm of the odds ratio,

$$Y^*_i = ln\frac{\pi}{1-\pi} = \acute{\beta}_j x_{ij} + \varepsilon_i \qquad (11)$$

This formula represents the likelihood of a household being poor.

- π_i : Probability of the household being poor.
- $1-\pi_i$: Probability of the household not being poor.
- β_j : Parameters estimated using the Iterative Weighted Least Squares (IWLS) method.
- x_{ij}: Vector of explanatory variables representing the characteristics of the i-th household.
- ε_i : Logistically distributed error term.

Results:

Paragraph 1:

The report begins by presenting the key findings of Iraq's Multidimensional Poverty Index (MPI-IQ), focusing on the overall statistics of the adjusted headcount ratio and its partial indices: incidence (H) and intensity (A) among those experiencing multidimensional poverty. The analysis also includes a breakdown of results by governorates, urban versus rural areas, and selected demographic characteristics of household heads. Additionally, the contribution of individual indicators to the overall poverty index is examined.

Paragraph 2:

The robustness test results are discussed, providing an assessment of the reliability and stability of the MPI-IQ outcomes when alternative poverty cutoff thresholds are applied.

Paragraph 3:

The report concludes with the findings from the logistic regression analysis, which identifies and evaluates the determinants of poverty. This analysis offers insights into the factors influencing multidimensional poverty in Iraq.

Mpi-Iq Findings:

The analysis reveals that over a quarter of Iraq's population experiences multidimensional poverty, with an incidence rate of 27%. This rate, adjusted by the average intensity of poverty (43.5%), results in a multidimensional poverty index (MPI) of 11.7%. While the overall MPI value may appear relatively modest, it highlights a significant concern: nearly half of the individuals classified as poor face severe and profound poverty challenges.

Table 1: Multidimensional Poverty Index of Iraq (MPI-IQ) and Partial Indices – by IRAQ

Indicators	Value	St. error	Confidence interval [95%]	
Incidence Rate (H)	0.270	0.444	0.253	0.287
Intensity of Poverty (A)	0.435	0.000	0.431	0.440
adjusted headcount ratio (MPI-IQ)	0.117	0.1967	0.110	0.125

As observed in the data presented in Table 1, the multidimensional poverty index (MPI) is a composite measure derived from both the incidence of poverty and its intensity, making it sensitive to changes in either of these components.

Classifying poverty data by environment—urban versus rural—provides valuable insights, as it highlights the structural disparities in poverty levels between these settings. This classification enhances the utility of the MPI as a critical tool for monitoring poverty trends and informing policies designed to reduce or eliminate poverty effectively.

Table 2: Multidimensional Poverty Index of Iraq (MPI-IQ) and its partial indices - by environment

Area	**Population Share**	**MPI-IQ**	**H**	**A**
Urban	69.3%	0.093	21.7 %	**43.0%**
Rural	30.7%	0.172	38.9 %	**44.2%**
Total	100.0%	0.117	27.0%	**43.5%**

The data in Table 2 highlight significant disparities in multidimensional poverty and its partial indicators across urban and rural areas in Iraq. Urban areas comprise approximately 69% of the population, while rural areas account for about 31%. However, the incidence of poverty (H) and the overall multidimensional poverty index (MPI-IQ) in rural areas are nearly double those in urban areas. Despite this, the intensity of poverty (A) is nearly identical in both environments, suggesting that the depth of deprivation among the poor is similar across urban and rural settings.

P-ISSN 2518-5764
E-ISSN 2227-703X

The results also reveal notable regional disparities, with higher poverty rates observed in the governorates of Missan, Nineveh, and Babylon. In contrast, the lowest poverty rates were recorded in Kirkuk, Dohuk, and Baghdad, respectively.

Table 3 : Multidimensional Poverty Index of Iraq (MPI-IQ) and its partial indices - by Governorate

Governorate	**Population Share**	**MPI-IQ**	**H**	**A**
Anbar	0.058	0.1356	0.313	**0.436**
Babil	0.052	0.1438	0.329	**0.441**
Baghdad	0.109	0.0959	0.222	**0.433**
Basrah	0.058	0.1116	0.251	**0.448**
Diala	0.053	0.1098	0.263	**0.421**
Duhok	0.050	0.0787	0.187	**0.425**
Erbil	0.036	0.1184	0.283	**0.422**
Karbala	0.051	0.1399	0.312	**0.452**
Kirkuk	0.044	0.0708	0.162	**0.440**
Missan	0.058	0.1833	0.410	**0.450**
Muthana	0.062	0.1394	0.319	**0.439**
Nineveh	0.055	0.1490	0.34	**0.441**
Najaf	0.054	0.1255	0.269	**0.471**
Qadisiya	0.058	0.1048	0.242	**0.435**
Salahaddin	0.054	0.0998	0.237	**0.424**
Sulaymaniyah	0.036	0.1025	0.242	**0.429**
Thiqar	0.059	0.1013	0.231	**0.442**
Wasit	0.053	0.1464	0.328	**0.450**
Iraq	1.000	0.1174	0.270	**0.435**

The analysis of household demographic characteristics reveals a clear relationship between household size and multidimensional poverty. The multidimensional poverty index (MPI) is significantly lower for small households consisting of one to three individuals, at 2.6%. However, the MPI increases steadily with household size, reaching 18.8% for households with 10 or more members.

Educational attainment of the household head also plays a pivotal role in reducing poverty. Households led by individuals without any formal education exhibit an MPI of 18.1%, compared to 3.5% for those headed by individuals with at least a secondary education certificate. Additionally, male-headed households show a slightly higher MPI of 11.9% compared to 9.5% for female-headed households.

When examining deprivation across the three dimensions, education emerges as the most severely impacted, with a deprivation rate of 50.9%. This is particularly pronounced in indicators such as low internet use (21.7%) and academic delay (17.4%). The dimension of living standards follows, with notable deprivation in areas such as overcrowded housing and limited access to clean energy sources.

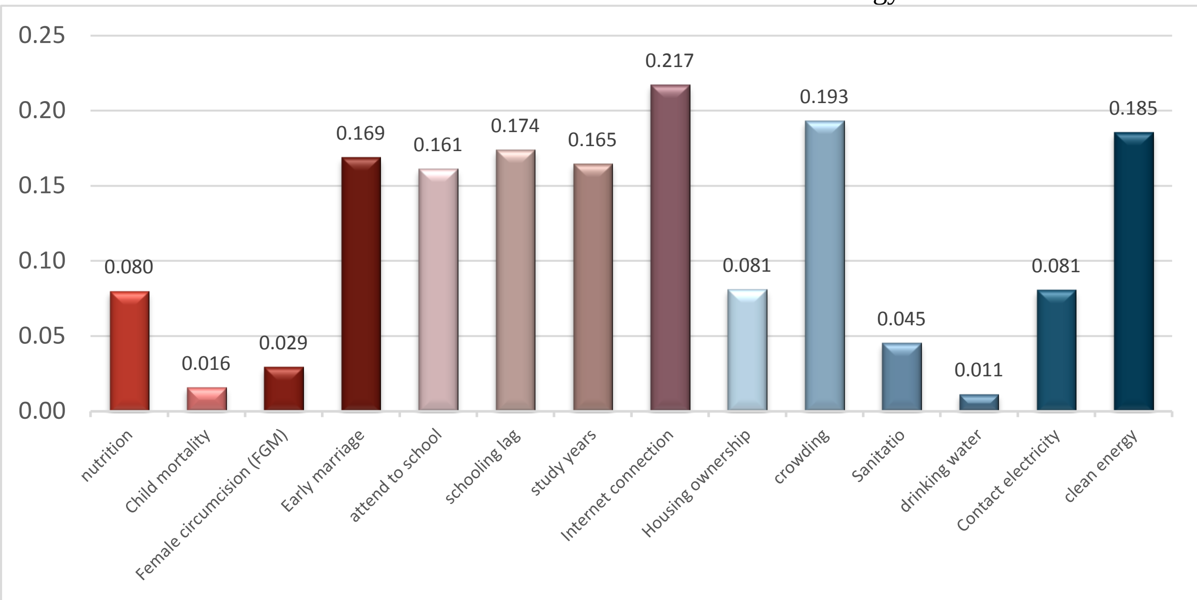


Figure 1: Multidimensional Poverty Index of Iraq (MPI-IQ) - by Indicators

The censored headcount ratio (H) reflects the extent of deprivation that individuals experience, but it does not provide insight into the relative importance of each indicator. For instance, if two indicators have the same censored headcount ratio, their contributions to the total index may differ, as the contribution depends not only on the proportion of the poor population but also on the weight assigned to each indicator. Therefore, a complementary analysis to the censored headcount ratio is needed to assess the relative contribution of each indicator to the overall measure of multidimensional poverty.

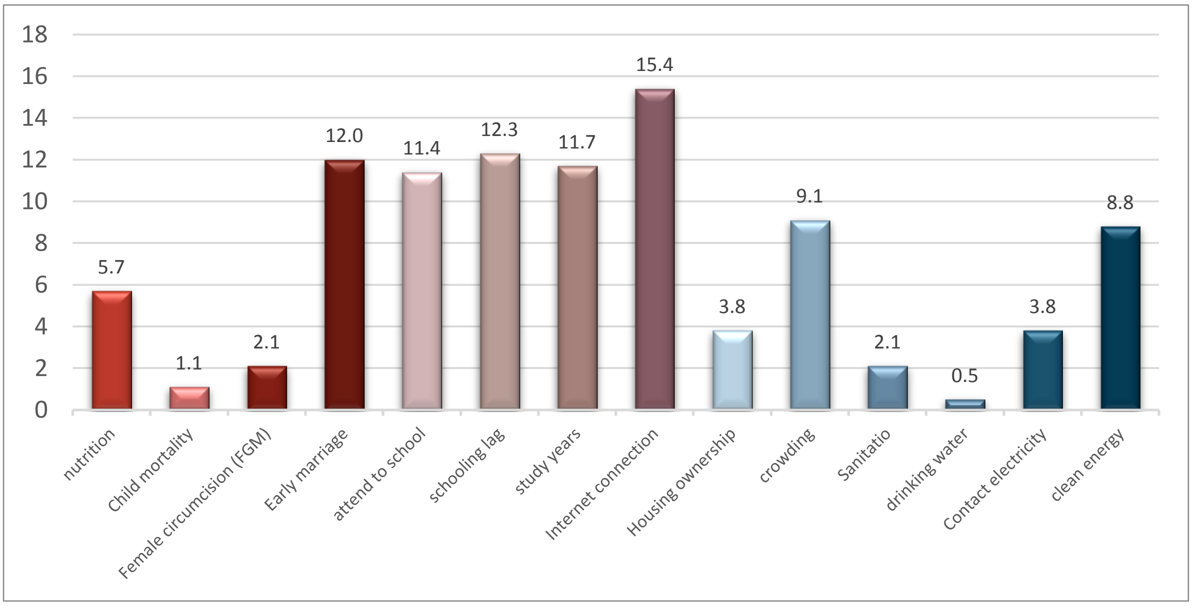


Figure 2: The contribution of each indicator in forming the multidimensional poverty index

Robustness Analysis:

Verifying the robustness of the multidimensional poverty index (MPI) is a crucial aspect of its development. Since the MPI adheres to the fundamental poverty axioms of monotonicity and transformation (Alkire & Foster, 2007), any minor changes to the poverty threshold (K) should not significantly alter the ranking of the entities under study. In the robustness test, we will examine the stability of rankings across Iraq's governorates and assess the sensitivity of the estimates when different thresholds for the poverty cutoff (K) are applied, ranging from 10% to 100%.

Through dominance analysis, Figures (4) and (5) illustrate the changes in the poverty incidence rate and the MPI when adjusting the poverty cutoff (K). These percentages decrease for all governorates as the cutoff value (K) increases and become equal when the cutoff reaches approximately 70% or more. Figure (3) clearly shows the presence of stochastic dominance for Missan Governorate from 10% to 50%, as its poverty rates exceed those of other governorates. However, these rates align with certain governorates as the cutoff value increases, demonstrating the stability of poverty levels despite variations in the cutoff. Additionally, there is a high percentage of stable pairwise comparisons, with 108 out of 153 comparisons (over 70%) being robust across the 18 governorates.

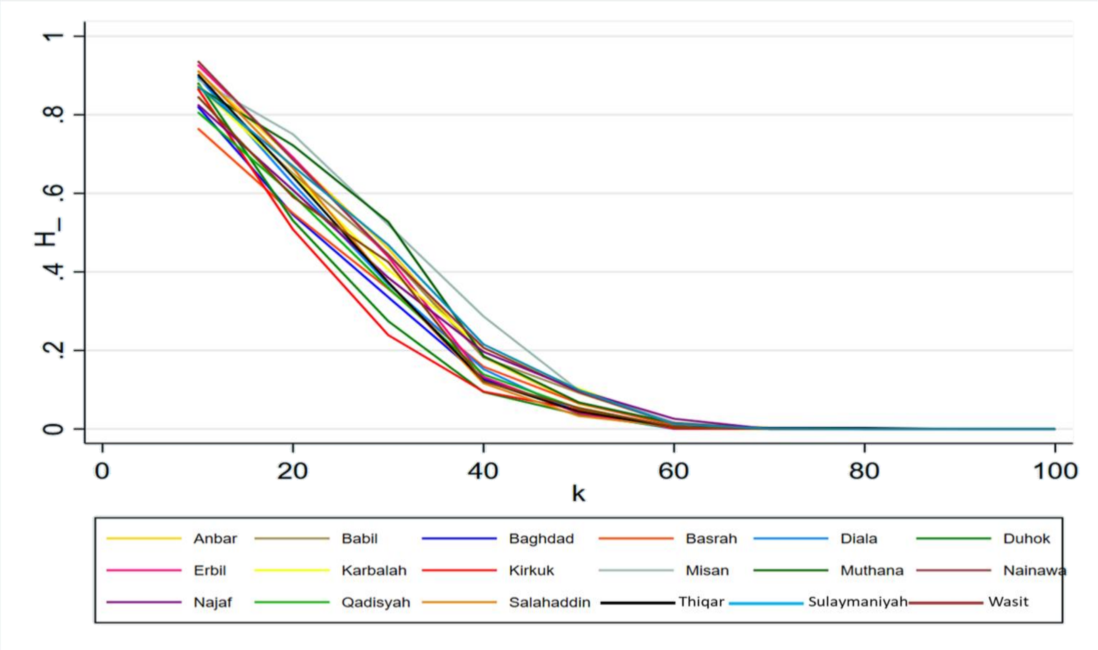


Figure 3: Stochastic dominance of (H) with a cutoff (k=10%-100%) – by Governorates

P-ISSN 2518-5764
E-ISSN 2227-703X

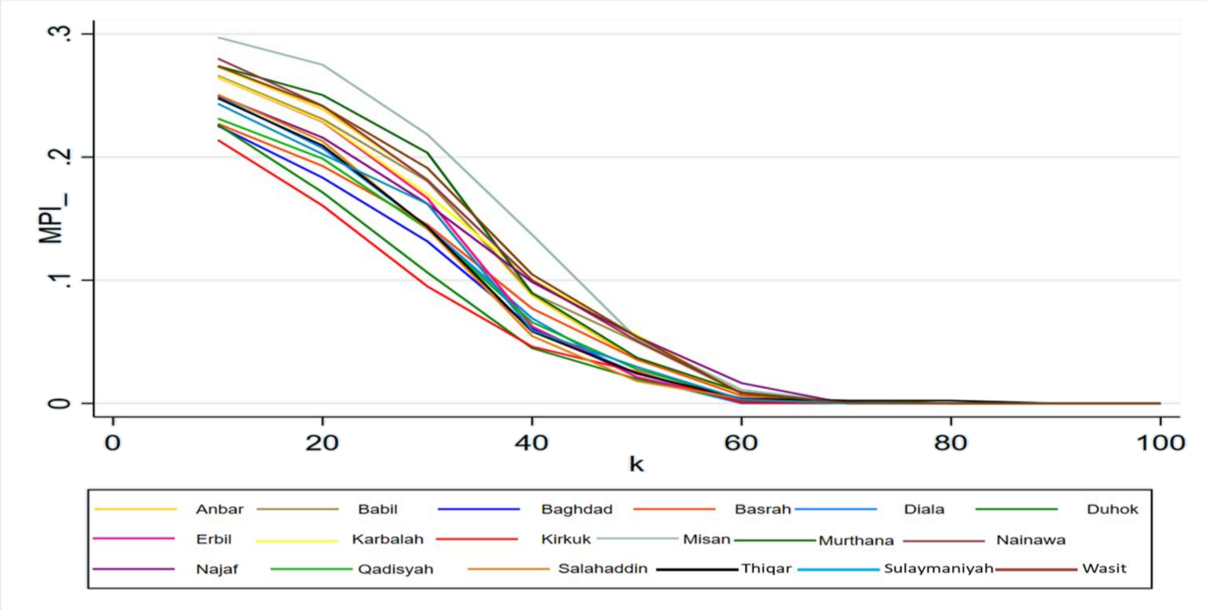


Figure 4: Stochastic dominance of (MPI-IQ) with a cutoff (k=10%-100%) – by Governorates

The Kendall correlation coefficient reveals that approximately 78% of the pairwise comparisons between governorates are concordant when the poverty cutoff is set at 0.30, compared to the chosen cutoff of 0.34. Meanwhile, the Spearman correlation coefficient indicates that around 91% of the comparisons are significant. This suggests that the selected indicators for building the index at the poverty cutoff of 0.34 are able to explain 91% of the multidimensional poverty situation, even in the event of emergencies that may cause an increase in the country's poverty levels. Similarly, when the poverty cutoff is adjusted to 0.40 instead of 0.34, the Kendall correlation coefficient shows that approximately 80% of pairwise comparisons are concordant, while the Spearman correlation coefficient indicates that around 94% of the pairwise comparisons remain stable.

Table 2: Kendall-Tau and Sperman correlation coefficients for poverty segments - Iraq

Poverty cutoffs (K)	Kendall-tau correlation coefficient	Spearman correlation coefficient
MPI_34_30	0.7778	0.9092
MPI_34_40	0.8039	0.9422
MPI_30_40	0.6601	0.8246

Analysis of the determinants of poverty:

To identify the key underlying determinants of household poverty in Iraq, the study used the multidimensional poverty index at the disadvantage rate (k = 0.34) as the dependent variable. Five explanatory variables, which are not included in the structure of the proposed multidimensional poverty index, were considered. Below, we summarize the most significant results from the logarithmic model:

P-ISSN 2518-5764
E-ISSN 2227-703X

Table 3: Results of the econometric ologit model

MPI (K=34)	Coefficients (β_j)	Odds ratio	Robust std. err.	z	P>z	[95% conf. interval]	
Environment							
Rural	0.102	1.116	0.019	6.310	0.000	1.079	1.155
Governorate							
Nineveh	0.327	1.434	0.072	7.180	0.000	1.300	1.582
Sulaymaniyah	0.915	2.910	0.165	18.860	0.000	2.604	3.252
Kirkuk	-0.343	0.819	0.048	-3.410	0.001	0.731	0.919
Erbil	0.911	2.780	0.155	18.360	0.000	2.493	3.101
Diala	-0.824	0.458	0.024	-14.860	0.000	0.413	0.507
Anbar	-0.612	0.572	0.029	-10.960	0.000	0.517	0.632
Baghdad	-0.487	0.682	0.032	-8.270	0.000	0.623	0.747
Babil	-0.672	0.550	0.028	-11.590	0.000	0.497	0.608
Karbala	-0.691	0.546	0.029	-11.460	0.000	0.493	0.606
Wasit	-0.659	0.577	0.030	-10.670	0.000	0.521	0.638
Salahaddin	-0.709	0.517	0.028	-12.300	0.000	0.465	0.574
Najaf	-1.404	0.270	0.014	-24.500	0.000	0.243	0.300
Qadisiya	-1.320	0.284	0.015	-24.420	0.000	0.256	0.314
Muthana	-0.990	0.414	0.021	-17.610	0.000	0.375	0.456
Thiqar	-1.535	0.224	0.012	-28.660	0.000	0.202	0.248
Missan	-0.971	0.403	0.021	-17.850	0.000	0.365	0.445
Basrah	-1.522	0.234	0.012	-27.800	0.000	0.211	0.259
Wealth index							
Poor	-1.136	0.329	0.007	-54.650	0.000	0.316	0.342
Middle	-1.747	0.179	0.004	-73.850	0.000	0.171	0.187
Rich	-2.552	0.081	0.002	-86.550	0.000	0.076	0.085
Richest	-3.339	0.036	0.001	-86.000	0.000	0.033	0.039
Educational level of the head of the household							
HH level	-0.394	0.667	0.005	-53.830	0.000	0.657	0.677
Household Size							
No. Of Household	0.174	2.284	0.021	89.230	0.000	2.243	2.326
Cons	0.158	0.417	0.022	-16.570	0.000	0.376	0.462

Note: The constant term estimates the baseline odds. Parameters with a negative sign indicate a decrease in the odds, while parameters with a positive sign indicate an increase in the odds. This is calculated as (odds ratio - 1) × 100.

The odds ratio shows that as the educational level of the head of the household improves, the probability of the household falling into multidimensional poverty decreases. For each stage increase in the head of the household’s education level, the likelihood of falling into poverty decreases by approximately 33%. Similarly, the wealth index demonstrates that the probability of falling into poverty decreases as the household moves toward the wealthiest quintile.

Conversely, households in rural areas are about 12% more likely to experience multidimensional poverty than those in urban areas. Additionally, the probability of a household being multidimensionally poor increases with the number of household members.

At the governorate level in Iraq, the results show a decrease in the probability of multidimensional poverty for most governorates, except for Nineveh, Sulaymaniyah, and Erbil.

The odds ratio indicates a higher probability of households falling into multidimensional poverty in these regions, with the probabilities being 43%, 1.9%, and 1.78%, respectively.

Discussion of Results:

The results of the study indicate that poverty rates, in the multidimensional context, vary across governorates and tend to increase as one moves south, which aligns with findings from previous monetary poverty measures. Poverty rates in rural areas are higher than in urban areas; however, due to the larger urban population, the total number of poor people in urban areas surpasses that in rural regions.

Regarding the relative contribution of the dimensions of poverty, the results show that the education dimension is the largest contributor among all other dimensions.

The multidimensional poverty index proposed in this study proves to be a stable and robust indicator for assessing future fluctuations through changes in the poverty cutoff (K). The results demonstrate that the proposed index can explain more than 90% of the multidimensional poverty situation, even in the face of emergency events.

The estimated indicators, whether within the index (multidimensional poverty and its sub-indices) or the regression coefficients for the selected indicators, are reliable, with very small standard errors, and all fall within the upper and lower confidence limits.

The results also show that the Pseudo R^2 value is 0.2413, indicating that the proposed model is both good and applicable.

Through the logistic regression results, the Wald Chi-Square test yielded a value of 26,297.29 with a probability ($P \geq 0$), and the significance of all estimators was confirmed, which suggests that all selected variables are important and must be included in the model without exclusion.

Concluding:

In the monetary approach to studying poverty, income and consumption expenditures are typically used to assess household poverty. While these measures are important, they do not provide a comprehensive understanding of household poverty. Recently, there has been an increased focus on the multidimensional approach. In this context, 14 indicators, including those used in our index, were selected to offer a more accurate portrayal of household poverty in Iraq, which can aid in the design of effective poverty reduction strategies. Families were classified as either poor or non-poor based on the multidimensional poverty index, and generalized models were applied using a binary logistic model to identify the key determinants of poverty. It is hoped that researchers in the field of poverty will continue to explore the diverse and multifaceted dimensions of poverty and investigate new variables that may be equally impactful as income, reflecting their effects on the economic and social realities of households in Iraq in the future.

Authors' individual contribution: Conceptualization and design of the work — H.H.F.; Methodology — H.H.F.; Formal Analysis — H.H.F.; Investigation — H.H.F. and W.K.; Data Curation — H.H.F.; Writing —Original Draft — H.H.F.; Writing — Review & Editing — W.K., and H.H.F.; Visualization — H.H.F.; H.A.H. & G.A.K.A.; Supervision —W.K., and H.H.F.; Project Administration —H.H.F.

Declaration of conflicting interests: The Authors declare that there is no conflict of interest.

 P-ISSN 2518-5764
E-ISSN 2227-703X

Authors Declaration:

Conflicts of Interest: None

-We Hereby Confirm That All The Figures and Tables In The Manuscript Are Mine and Ours. Besides, The Figures and Images, which are Not Mine, Have Been Permitted Republication and Attached to The Manuscript.

- Ethical Clearance: The Research Was Approved by The Local Ethical Committee in The University.

References:

Alkire, S., Foster, J. E., Seth, S., Santos, M. E., Roche, J. M., & Ballon, P. (2015). *Multidimensional Poverty Measurement and Analysis: chapter 10* (Oxford ed.). New York: Oxford University Press.

Omar, N., & El Hage Sleiman., S. (2021). *Testing the Robustness of the Revised Multidimensional Poverty Index for Arab Countries* . Beirut: ESCWA, United Nations House.

Alkire, S., Foster, J., Ballon, P., Roche, J. M., Seth, S., & Santos, M. E. (2015). *Multidimensional Poverty Measurement and Analysis.* Newyork: Oxford University Press.

Alkire, S., & Santos, M. E. (2010). Acute Multidimensional Poverty: A New Index for Developing Countries. *SSRN, Working Paper No. 38*(Oxford Poverty & Human Development Initiative (OPHI)).

Alkire, S., & Santos, M. E. (2013). A Multidimensional Approach: Poverty Measurement & Beyond. *SpringerLink, 112*, 239–257.

Alkire, S., & Santos, M. E. (2014). Measuring Acute Poverty in the Developing World: Robustness and Scope of the Multidimensional Poverty Index. *World Development*, *59,* 251-274.

Alkire, S., & Foster , J. (2011). Understandings and misunderstandings of multidimensional poverty measurement. *The Journal of Economic Inequality, 9*(June 2011), 289–314.

Alkire, S., & Foster, J. (2007). Counting and multidimensional poverty measurement. University of Oxford: OPHI Working Paper 7.

Alkire, S., & Foster, J. (2011). Counting and multidimensional poverty measurement. *Journal of Public Economics, 95*(7-8), 476-487.

Ambaye, T. K., Tsehay, A. S., & Hailu, A. G. (2021). Application of Ordered Logit Model to Analyze Determinants of Rural Households Multidimensional Poverty in Western Ethiopia. *International Journal of Development and Economic Sustainability, 3*(9).

Anderson, E. J. (1954). *Business Risk Management: Models and Analysis* (2014 ed.). Chennai, India: John Wiley & Sons, Ltd.

Bryman, A., & Cramer, D. (2004). *Quantitative Data Analysis with SPSS 12 and 13: A guide for social scientists.* London: Routledge.

Calvo, C., & Fernandez, F. (2012, January). Measurement errors and multidimensional poverty. *Oxford Poverty & Human Development Initiative (OPHI).*

Committee, I. P. (2011). *Confronting Poverty in Iraq: Main Findings.* New york: World Bank Publications.

Costa, M. (2003). A comparison between unidimensional and multidimensional approaches to the measurement of poverty. *Luxembourg Institute of Socio-Economic Research (LISER), IRISS Working Papers; No. 2003-02*.

CSO, & UNDP. (2011). *Map of deprivation and living standards in Iraq 2011*. Baghdad: CSO.

Duclos, J.-Y., Sahn, D., & Younger, S. (2006). Robust Multidimensional Poverty Comparisons. *The Economic Journal*, *116*(514), 943–968.

Khaizaran, F. N. (2015). *Inequality and Fuzzy Measures for multidimensional poverty index in Iraq.* Cairo: PhD thesis, Cairo university.

P-ISSN 2518-5764
E-ISSN 2227-703X

Nawar, A.-H. (2014). *Multi-dimensional poverty index and tackling interlocking deprivations in the Arab States.* Brasilia: Working Paper, No. 125, International Policy Centre for Inclusive Growth (IPC-IG).

Ortiz, I., Daniels, L. M., & Engilbertsdóttir, S. (2012). *Child Poverty and Inequality: New Perspectives.* New York : United Nations Children's Fund (UNICEF), Division of Policy and Practice.

Sen, A. (1976). Poverty: An Ordinal Approach to Measurement. *Econometrica, 44*(The Econometric Society), 219-231.

Sen, A. (1999). *DEVELOPMENT AS FREEDOM* . New York : Alfred A. Knopf.

UN, U. (2015, September 18). *UN environment programme.* Retrieved from Transforming our world: the 2030 Agenda for Sustainable Development: https://wedocs.unep.org/20.500.11822/9814

UNICEF, I., KRSO, UNICEF, & Health, M. o. (2018). *2018 Multiple Indicator Cluster.* Baghdad: Central Organization for Statistics.

Yalonetzky, G. (2011, September). *Conditions for the Most Robust Poverty Comparisons Using the Alkire-Foster Family of Measures.* U.K: Oxford Poverty & Human Development Initiative (OPHI), Oxford University Research Archive (ORA).