

**MEASURING THE ATTRIBUTES OF POVERTY AND ITS  
“RESIDUAL PERSISTENCE” IN ERITREA**

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# MEASURING THE ATTRIBUTES OF POVERTY AND ITS “RESIDUAL PERSISTENCE” IN ERITREA: AN INNOVATIVE APPROACH

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## Summary

This paper attempts to identify the determinants of urban poverty in Eritrea using an estimation technique (the DOGEV model) that also allows for the inclusion of a measure of “residual persistence” in poverty levels in cross-sectional estimation. The results confirm that, indeed, 17 to 22 percent of poverty in Eritrea is attributable to “residual persistence” – the tendency for individuals to remain poor despite profiles that suggest they should fare better. This result suggests that attempts to reduce the extent of intergenerational life-course transmission of poverty need to go beyond the more obvious interventions such as access to education. The results also suggest that education faces serious incentive problems because median levels of education had limited statistical impact on poverty while the number employed per household (including children) did.

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**Key Words:** Poverty, Determinants, Urban, Eritrea, Africa, DOGEV.

**JEL Classification:** C3, I32, O15, O18.

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## INTRODUCTION

Eritrea, one of the fifty least developed countries, was ranked 157<sup>th</sup> (out of 177 countries) by the 2006 Human Development Report, in terms of both its (\$PPP) per capita income and human development indices (UNDP, 2006). Though this is an improvement on its rankings from the previous year, the implied levels of consumption and human development suggest that poverty is a pressing and immediate challenge and will continue to be so for some time. In this context, an appreciation of the extent and characteristics of poverty is an invaluable tool in the development and implementation of effective poverty reduction strategies. Yet, perhaps partly because modern Eritrea is a young nation, the nature and extent of poverty in that country has yet to receive significant attention in the economic research literature.<sup>1</sup> There has been no fully-fledged poverty study in Eritrea to date and, most previous work on that subject, have been based on the

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<sup>1</sup> Eritrea fought a 30-year war of liberation with Ethiopia. Hostilities ended in 1991 and the country became independent in 1993.

Rapid Appraisal Survey conducted in 1993/94 (World Bank, 1996).<sup>2</sup> However, because that survey came immediately after the war of independence (from Ethiopia), the results from these studies can only be considered preliminary. From that study, it was estimated that about 50 percent of households in Eritrea were poor - they did not have sufficient income or endowments to consume the minimum requirements for subsistence (2000 calories a day of food, basic housing, and minimal clothing). In that particular year, because of drought, 70-80 percent of the households received food aid. The World Bank (1996) estimated that, without that aid, 69 percent of the population would have been unable to consume the minimum basket of food and other essential commodities.

This study contributes both to the broader literature on poverty, and to a more specific understanding of poverty in Eritrea, by employing a newly-developed statistical technique that allows for the estimation of, not only the measurable determinants of poverty, but also the degree of inertia in such poverty (beyond that which can be attributed to measured household and individual characteristics). In essence, we employ an econometric technique (The DOGEV model) that allows us to condition on the fact that poverty (particularly extreme poverty) may have a significant self-perpetuating tendency even in the face of changing individual and social characteristics.<sup>3</sup> This approach thus offers results that are richer than those provided by the standard Probit analysis. More importantly, in the developed country environment where micro time series and inter-generational data are rarely available, this approach allows us to assess the degree to which poverty may be resistant to interventions directed at the more typically observed attributes, such as education, ethnicity and gender (because it is perpetuated by other, less easily measured, attributes likely related to family histories and life experiences) through the most widely available source of micro data – household expenditure surveys.

The approach to measuring poverty in this investigation follows the methodology employed by the World Bank's Quick Appraisal Group, (World Bank, 1996). That approach defined the poverty line as “the minimum cash and non cash expenditure needed to be made by a person or

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<sup>2</sup> Arneberg and Pedersen (2001) do examine some characteristics of poverty based on the results of the 1996/97 survey, but theirs is a much broader study of which the examination of urban poverty is only a small part.

<sup>3</sup> This self-perpetuating tendency or “inertia” is presumed to be associated with unmeasured inter-generational and life course transmission factors that tend to reproduce or sustain poverty, even when the more easily observed individual and environmental attributes normally associated with poverty are no longer present.

household in order to be able to consume a minimum number of calories (food) plus a small number of essential non-food items such as housing and clothing” (World Bank, 1996, p.5).<sup>4</sup> Using this definition, the World Bank estimated poverty lines at both regional and national levels. Each regional poverty line reflected regional prices on basic items as well as small adjustments to the (minimum) consumption basket to reflect availability and regional consumption preferences. In this study, we make use of these regional poverty lines.<sup>5</sup>

Beyond this, we differentiate between ‘moderate’ and ‘extreme’ levels of poverty (based on distance from the poverty line). In relating these poverty (or welfare) categories to particular household and regional characteristics, we try to account for “residual persistence” in poverty levels across individuals. The empirical literature on poverty in both developed and developing countries clearly indicates that poverty has a tendency to reproduce itself across generations and over individuals’ lifetimes (intergenerational and life course transmission respectively) for a significant proportion of the population classified as poor (Corcoran, 1995; Andersen, 2002; Binder and Woodruff, 2002). This is part of the phenomenon often referred to, in the dynamic context, as the “vicious circle of poverty” or the “poverty trap.” However, even in cross-sectional studies, measures of poverty can be conditioned on many of the factors known to be associated with inter-temporal poverty transmission (such as education, gender, ethnic minority status, etc.). But less measurable factors, such as poor childhood health and limited family and social connections, are also responsible for the transmission of poverty. Poor childhood health, for example, can lead to poor adult health and skill development, and thus to low earnings potential (even after accounting for the effects that are transmitted through low education attainment) while limited family and social connections (low social capital) constrain opportunities and

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<sup>4</sup> Poverty is typically measured with reference to a particular tool of measurement (such as income or physical stature) or a particular approach to the phenomenon of poverty (such as subjective versus objective, absolute versus relative approaches or the more broad capabilities approach). However, these measures have been found to be significantly positively correlated (Kanbur and Squire, 2001; Razafindrakoto and Roubaud, 2003). Though Razafindrakoto and Roubaud (2003) found this correlation much less robust across than within types of measures, they did find that monetary measures of poverty were the ones most correlated with all other measures of poverty. This is very reassuring, since the approach used here employs a largely (though not completely) monetary measure of poverty.

<sup>5</sup> See World Bank (1996) for the details of calculations. In addition, the International poverty line of one USD per day was employed, but they give almost the same classification, which does not significantly change the multivariate analysis. In the later section of the paper, we present the sensitivity of our model to the employment of one dollar per day as opposed to the regional poverty lines.

upward occupational mobility.<sup>6</sup> In the literature on poverty, measurements of the magnitude of these effects have been constrained by the need for data that span generations and/or stages of life (or for which reasonable proxies have are available). Such data are not often available in developed countries and rarely so in developing countries. The contention here is that, even in a cross-sectional estimate of the determinants of poverty, the effects of these unmeasured (inter-generational and life course) transmission factors will show up as a persistence attribute which can be measured. That attribute is demonstrated in much the same way (in a statistical sense) that brand loyalty, with respect to consumer products, results in a persistence in measured preference beyond what can be explained by measurable determinants.

## THEORETICAL BACKGROUND

### *The Basic Equation*

In line with the approach taken by Glewwe (1991), we consider household expenditure to be the outcome of constrained utility maximization. The (regionally-specific) expenditure outcome ( $C^{Rh}$ ) reflects a utility level ( $U$ ), regionally specific prices ( $p_1^R, \dots, p_n^R$ ) and a set of household-specific characteristics ( $b_1^h, \dots, b_m^h$ ). We define the expenditure function  $C(\cdot)$  such that it is a product of a general per capita expenditure function  $f(\cdot)$  and a set of multiplicative factors  $m(\cdot)$  that define individual household characteristics.

$$\begin{aligned} C^{Rh} &= C(U; p_1^R, \dots, p_n^R; b_1^h, \dots, b_m^h) \\ &= m(b_1^h, \dots, b_m^h; p_1^R, \dots, p_n^R) f(U; p_1^R, \dots, p_n^R) \end{aligned} \quad (1)$$

Dividing both sides of the equation by  $m(\cdot)$  yields, on the left hand side, a (regional) money metric measure of utility, because it is monotonic with respect to utility for any given set of prices within each region (Glewwe, 1991).<sup>7</sup>:

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<sup>6</sup> There is a substantial literature on intergenerational and life course transmission of poverty in developed country and a smaller literature on the same in developing countries. More particularly, Schultz and Tansel (1997), Case *et al* (2002) and Case *et al* (2003)) provide empirical evidence of the substantive relationship between adult health and earnings and between childhood health and adult health and Berhman and Wolfe (1984), Lam and Schoeni (1993), Baker (2001) and Di Pietro and Urwin (2003) do the same with respect to the effects of family connections and other social networks (or lack thereof) on occupational access, choice and advancement.

<sup>7</sup> For formal treatment, the interested reader is referred to Mas-Colell, Andreu *et. al* (1995)

$$\frac{C^{Rh}}{m(b_1^h, \dots, b_m^h; p_1^R, \dots, p_n^R)} = f(U; p_1^R, \dots, p_n^R) \quad (2)$$

We define discrete welfare categories by making the (testable) assumption that households within the same welfare bracket share similar attributes with respect to a wide range of factors and characteristics but are identifiably different across welfare brackets.<sup>8</sup> Moreover, households of the same welfare bracket demonstrate identical attributes across regions – allowing us to ignore regional identifiers once household welfare categories are identified (given that the regional poverty lines, used to determine the welfare brackets, take account of differences in prices and consumption preferences across regions).<sup>9</sup> We can thus derive an estimable but discrete welfare function of the form:

$$\frac{C_k^h}{m(b_1^h, \dots, b_m^h)} = F(X, \beta_k) + \varepsilon \quad k = 1 \dots K \quad (3)$$

Where  $\varepsilon$  is the usual random error term,  $\beta_k$  is a vector of parameters specific to welfare category  $k$  (across all regions), and  $X$  represents a range of explanatory variables that include household characteristics, community characteristics, human capital, and other relevant variables such as the regional employment level. In this study,  $m(\cdot)$  is interpreted (narrowly) as the age composition of households and can thus be approximated by the scaling parameter for deriving adult equivalent expenditure.<sup>10</sup>

### ***An Estimable Discrete Choice Model of Poverty***

The basic economic model above allows us to analyze poverty within the framework of a discrete choice model – an approach used in many poverty studies (see Niimi *et al* (2004); Glewwe *et al* (2001); Watson (2000)). However, Ravallion (1996) correctly questions the use of discrete choice models (over more conventional regression approaches) in constructing poverty profiles, except in the case where different levels of poverty are associated with different

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<sup>8</sup> This, of course, begs some quite obvious questions: how does one define these income brackets and is the variation across income groups sufficient to justify abandoning the assumption of continuity? However, if it is the broad levels of deprivation (i.e. poverty or lack thereof), rather than simply the absolute level of expenditure that matters, then that condition is much more likely to be captured by discrete groupings.

<sup>9</sup> However, the Regional identifier is critical up to this point because the cut-off expenditure levels for welfare categories are regionally specific because of price and product variations (factors that are reflected in the regionally-specific poverty lines).

<sup>10</sup> In particular, equivalency scales derived from the Engel's method as in Anderson and Arneberg (1999).

response levels - but this is, in fact, the assumption here. Beyond this basic framework, however, the model is designed to capture varying levels of persistence in the poverty stratum beyond what can be explained by observable factors.

A useful starting point for motivating that discrete choice model, and one that is common in the literature (see Fry and Harris, 2005), is a random utility maximization (RUM) model of the form:

$$\begin{aligned} u_{ij}^* &= V_{ij} + \varepsilon_{ij} \text{ with} \\ V_{ij} &= x'_{ij}\beta_j \end{aligned} \tag{4}$$

where  $u_{ij}^*$  is an indirect utility function made up of a deterministic component  $V_{ij}$ , and a random component  $\varepsilon_{ij}$ . The deterministic component can be expressed as a (linear in the parameters) function of an observed set of  $j$  characteristics for each individual  $i(x_{ij})$  with unknown weights ( $\beta_j$ ). Utility is unobserved, but can be proxied by the expenditure function as given by Equation (2). We construct the welfare categories, which are assumed to represent the true underlying poverty levels, using the adjusted expenditure function per capita as follows:

$$W_i = Y_i^R / Z^R$$

- Where :
- $Y_i^R$  = per capita (adult equivalent) expenditure based on uniform prices within regions (but allowing price variation across regions)
  - $Z_R$  = regional poverty line (interpreted in regional prices and consumption preferences)
  - $W_i$  = the welfare ratio.

The implied heterogeneity in the expenditure-welfare relationships across regions, suggested by Equation (2), is nullified by the use of regional poverty lines. Since regional poverty lines are based on a (nationally) uniform approximation of welfare in terms of basic needs, but translated into income equivalents using regional price indices and consumption preferences, the use of regional poverty lines to determine welfare categories cancels out the regionally-specific effects,

leaving a welfare ratio that is a consistent reflection of real consumption outcomes across regions, as suggested by Equation (3).<sup>11</sup>

Using the welfare ratio, we develop three poverty categories (PC's), numbered in reverse order (in terms of the absolute value of the welfare ratio), such that for each individual ( $i$ ) the mapping from welfare level to welfare category is:

$$PC_i \begin{cases} = 2 & \text{if } W_i < 0.75 \Rightarrow \text{extreme poor} \\ = 1 & \text{if } 0.75 < W_i \leq 1.25 \Rightarrow \text{moderate poor} \\ = 0 & \text{if } W_i > 1.25 \Rightarrow \text{non-poor} \end{cases} \quad \dots \forall i$$

According to the underlying economic model, the individual “chooses” that welfare category  $j = 1, \dots, J$  which maximises her utility. Under the assumption that the  $\varepsilon_{ij}$  independently follow a Type 1 Extreme Value Distribution, a multinomial logit (MNL) model results (Maddala, 1983). In the modelling of such poverty levels, it is usual in the literature to employ either an MNL model or to take the ordering in the observed outcomes into account via use of ordered probit/logit models (see Niimi *et al* (2004); Glewwe *et al* (2001); Watson (2000)). The latter could be preferred because they utilize the inherent ordering of outcomes but, compared to the former, they are inflexible in that there is only one latent variable and hence only one parameter vector. Moreover, they are inconsistent with the notions of RUM.

Small (1987), introduced the Ordered Generalised Extreme Value (OGEV) model that, essentially, builds on MNL probabilities but includes an additional single parameter  $\rho$  (in the simplest case), which captures correlation between observed discrete outcomes and thus allows for ordering (akin to a moving average process).<sup>12</sup> Use of the OGEV type specification is further justified here by the fact that the poverty ordering is derived from an underlying continuous welfare variable. The fact that we employ a poverty line to create a jump, or discontinuity, in the

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<sup>11</sup> Regional poverty lines, in defining basic needs, adjusts for differentials in consumption baskets (deriving from availability and consumption patterns), as well as prices across regions (World Bank, 1996).

<sup>12</sup> No explicit closed form expression exists for the actual correlations(s) but they are inversely related to the parameter  $\rho$ , such that, a test of the null hypothesis  $\rho = 1$  is a test of no ordering. A failure to reject implies that there is no correlation between adjacent outcomes. Thus, ordering is not justified and the multinomial logit model (MNL) is preferred over the OGEV model.

poverty status of households, will lead to correlations between neighbouring poverty outcomes - exactly that which will be captured by the parameter  $\rho$ .

However, as stated above, even after one has conditioned on individuals' attributes (such as education levels and such like), some individuals may still be (exogenously) caught, to a certain extent, in particular levels of poverty. In the strictly theoretical interpretation of the RUM, there will be a certain amount of "free-choice" for the individual as to which welfare category she is observed to be in (driven by  $V_{ij}$  in Equation (4) above, rather than the error term). The inclusion of  $\theta_j$  parameters into the MNL framework, along the lines of the DOGIT model of Gaudry and Dagenais (1979), can account for this "choice". The result is a DOGEV model.

Essentially, what the DOGEV model does is to combine the flexibility of the MNL model, with the ordering of the OGEV model and the inclusion of the captivity parameters of the DOGIT model (Fry and Harris's, 2005). The standard probability for the DOGEV is given by:

$$P_{ij}^{DOGEV} = \frac{\theta_j}{1 + \sum_{k=1}^M \theta_k} + \frac{1}{1 + \sum_{k=1}^M \theta_k} \times P_{ij}^{OGEV} \quad (5)$$

with the standard OGEV probabilities being given by

$$P_{ij}^{OGEV} = \frac{\exp(\rho^{-1}V_{ij})}{\sum_{r=1}^{J+1} (\exp(\rho^{-1}V_{ir-1}) + \exp(\rho^{-1}V_{ir}))^\rho + (\exp(\rho^{-1}V_{ij}) + \exp(\rho^{-1}V_{ij+1}))^{\rho-1}} \times [(\exp(\rho^{-1}V_{ij-1}) + \exp(\rho^{-1}V_{ij}))^{\rho-1}] \quad (6)$$

where we have the nested models: OGEV -  $\theta_1 = \dots = \theta_M = 0$ ,  $0 < \rho \leq 1$ ; Dogit -  $\rho = 1$  and at least one  $\theta_j > 0$ ,  $j = 1, \dots, J$ ; and MNL -  $\theta_1 = \dots = \theta_M = 0$ ,  $\rho = 1$ .

The first term of Equation (5) represents the amount of the total poverty of category  $j$  that is attributable to exogenous captivity. In other words, the significance (or not) of  $\theta_2$ , for example, indicates whether a substantial number of individuals appears to "choose" extreme poverty,

despite characteristics that would suggest other outcomes. As noted earlier, the poverty literature does indicate that poverty status persists for some individuals even after several of the measured attributes typically identified with that status are no longer present. This parameter captures at least part of that “residual persistence” which can also be considered a manifestation of the existence of poverty traps.<sup>13</sup> The magnitude of these effects can be determined by evaluation of the relevant first term of Equation (5).

## **DATA**

The data comes from the Eritrean Household Income and Expenditure Survey (EHIES), an urban survey conducted in the 12 large towns of Eritrea in 1996/97 (which is still the latest household expenditure survey carried out in Eritrea to date). The survey was conducted from July 1996 to September 1997 in four stages in an attempt to capture seasonal variations in economic activity and consumption. It was designed to enable separate reporting from five main geographical reporting regions, corresponding to the three large towns (Asmara, Keren, Mendefera), the Highlands (Dekemhare, Adikeyih, Ghindae), the Western Lowlands (Barentu, Akurdar, Tesseney) and the port cities of Assab and Massawa. The National Statistics Office selected a sample size of 5,061 households. Of that total, 4,644 households were included in the final dataset. The non-response rate was very low. However, the data did not include some important variables needed for the analysis. The data set also had many missing observations and some outliers - problems that are omnipresent in surveys carried out in developing countries (Deaton, 1997). As a result, the data had to be “cleaned,” resulting in a usable data set of 3,712 households. The absence of any operational sampling framework in the country necessitated complete mapping and listing of all households in all towns except in one town, Keren. The sampling method employed was a one-stage stratified sampling in all towns. Simple random sampling was used to choose households from the selected clusters (World Bank, 1996). This survey still remains the latest household expenditure survey for Eritrea.

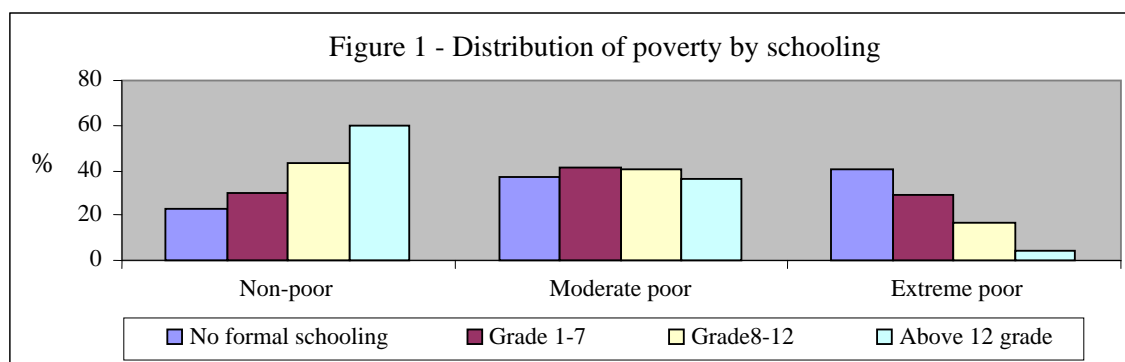
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<sup>13</sup> Though the concept of a “poverty trap” is a dynamic one, the argument here is that these effects are manifested by the inability of some individuals to respond (except, perhaps, with extended lags) to identifiable changes in their environment and/or personal and household characteristics. That attribute can be observable, to some degree, in cross-sectional data in the form of an inexplicable “preference” for poverty or what we call “residual persistence.”

## A PRELIMINARY PROFILE OF POVERTY

The composition of the data set, with respect to the poverty categories constructed earlier, is presented in Table A1 of the Appendix. It shows that the majority of the sample population, 68.5%, live in poverty, with 30 percent in extreme poverty and 39 percent in moderate poverty. Even though, strictly speaking, this is not a poverty index, it suggests a lower level of poverty than was indicated by the results of the Rapid Appraisal Survey of 93/94. The World Bank's head count index, derived from that survey data, indicated a poverty level of 69 percent (World Bank, 1996) which is almost identical to our estimate, but we are using a broader definition of poverty (below 1.25% of the poverty line). This may be, in a large part, due to the drought situation as well as the residual effects of the war in that earlier period. Use of international poverty lines also produced similar proportions to those derived using our definition of poverty. Using (PPP) \$1 a day and \$2 a day to delineate the welfare categories (below \$1 as extreme poor and above \$2 as non-poor) resulted in 31, 35 and 34 percent for extreme poor, moderate poor and non-poor categories.<sup>14</sup>

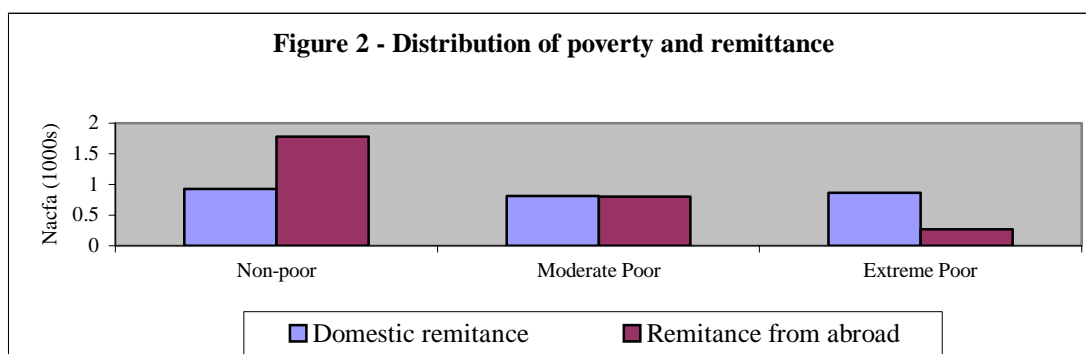
Figure 1, below, summarizes the distribution of poverty across different levels of educational attainment of household heads. The results show a strong negative association between extreme poverty and educational attainment, a strong positive association between the non-poor status and education attainment but no clear pattern for the moderate poor.



**Source:** Authors calculation from EHIES 1996/97

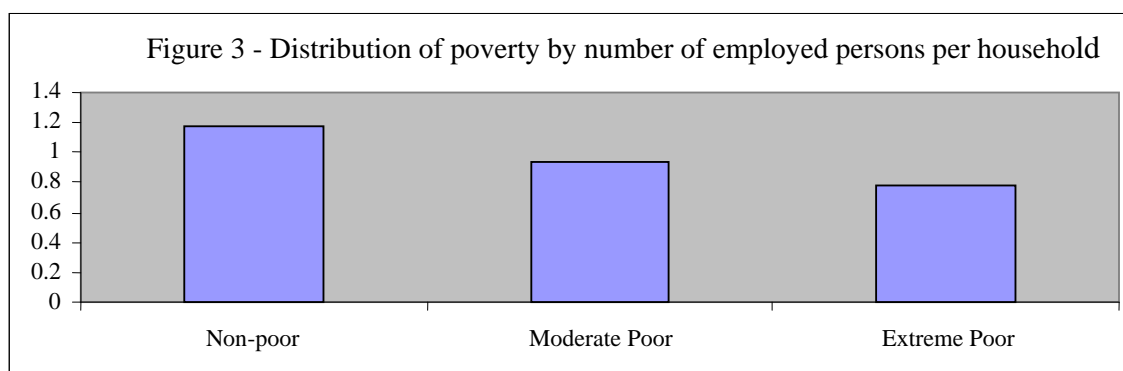
<sup>14</sup> Those with income of less the (PPP) \$1 a day are considered extreme poor, those with income between \$1 and \$2 a day are counted as the moderate poor and those with higher than \$2 a day are considered non-poor.

*A priori*, one would expect remittances (transfers payments from relatives within Eritrea or abroad) to be negatively related to poverty in Eritrea, as suggested by Arneberg and Pederson (2001). This presumption is confirmed by the data. However, the source of remittances appears to make a difference. Remittance from abroad (mainly from relatives in North America, the Middle East and Europe) is larger in both relative and absolute amounts for the non-poor (compared to the poor) while local-sourced remittance dominates the smaller average amount of remittance received by the extreme poor.<sup>15</sup>



**Source:** Authors calculation from EHIES 1996/97.

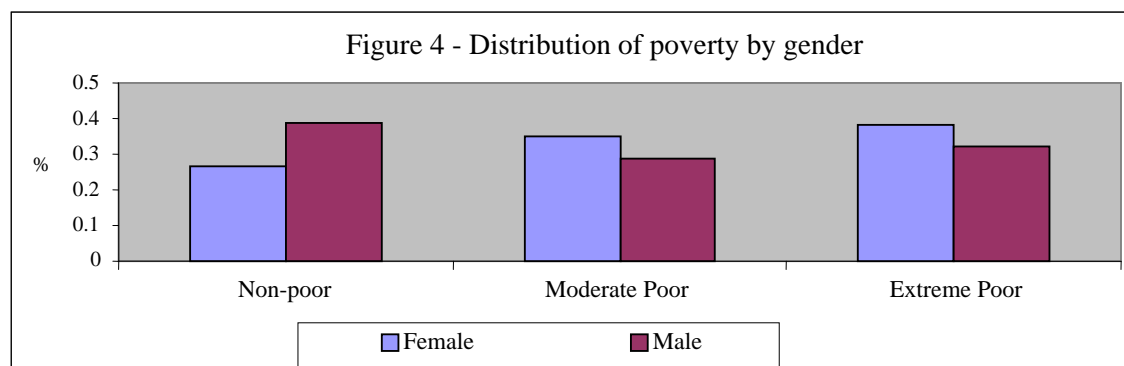
The number of employed persons per household is often to be a good gauge of poverty. Figure 3 confirms that expectation. On average, the non-poor have a higher number of people employed per household than the moderate poor who, in turn, have more people employed, on average, than the extreme poor.



**Source:** Authors calculation from EHIES 1996/97.

<sup>15</sup> Even though there are no reliable data so far, more than one fourth of Eritrean nationals are presumed to be living in the Diaspora. Remittance from Eritreans in diaspora to their families was more than 70% of the GDP in 2003 (World Bank, 2003).

Figure 4 depicts percentage distribution of poverty by the gender of the household head. It indicates that a higher percentage of female-headed households live in poverty than male-headed households. This is in line with a consistent finding in the poverty literature – the overrepresentation of female-headed households in poverty.<sup>16</sup>



**Source:** Authors calculation from EHIES 1996/97

In summary, the above preliminary analysis confirms our presumption that, to a considerable degree, the likelihood of being poor can be, at least partially, explained by measurable, human capital, economic and geographic attributes.<sup>17</sup> However, it is left to be seen, through more precise analysis, how much of poverty can be explained by these factors, the relative importance of the various factors and, no less importantly, how much of the deterministic component of poverty remains outside the scope of these attributes (i.e. how important is the residual persistence measure).

## THE DETERMINANTS OF POVERTY – DOGEV MODEL RESULTS

This section presents the results from the estimation of DOGEV model. The dependent variables were the welfare categories, and the explanatory variables were a set of variables typically assumed to be correlates of poverty. The DOGEV specification was found to be statistically preferable to all of its nested sub-models (because there is evidence of ordering/correlation in the

<sup>16</sup> See, for example, the World Development Report 2000/2001.

<sup>17</sup> It should be noted that these “characteristics” do not imply direct causal linkages. They are “correlates” of poverty. That correlation may be due to a causal link in either direction or, more likely, it may be due to the fact that these characteristics are related to the factors that cause poverty.

observed poverty outcomes and significant extents of captivity to various poverty categories). Those attributes will be discussed shortly.

A comparison of estimated probabilities with sample proportions is one way of evaluating the fit of such discrete choice models. Another is the so-called hit/miss table, which compares predicted outcomes (based on the maximum probability rule), with actual outcomes. The results of such an exercise are presented in Table A2 of the Appendix. For the three welfare categories (non-poor, moderate poor and extreme poor) the percentage of households correctly predicted from our preferred specification were 67, 54 and 70, respectively. In total, 65 percent of observations are correctly predicted.

Since our interest is in the attributes of poverty, the captivity parameter for the non-poor category was constrained to be zero after it proved to be insignificant in the initial estimation of the unrestricted model (more on this later). As is the case in most discrete choice models, the coefficients of the DOGEV model determine, but do not represent, actual probabilities. Thus, Table 1 reports the marginal effects (for several correlates of poverty) when the captivity parameter for the non-poor category is constrained to be zero (the restricted model).

An immediately obvious, and surprising, feature of the estimation results is the fact that the moderate poor category is only significantly associated (in a statistical sense) with two household characteristics – gender and remittance from relatives in the Diaspora. The implication is that most of the measured characteristics were not particularly good at distinguishing that group from the non-poor or extreme poor categories (though they did distinguish these other two categories from each other quite well). One likely cause was the fact that this category is large and brackets the median (and mean) consumption group for Eritrea. It thus includes many whose consumption levels were significantly above or below the median level – implying a diversity of profiles that were not always easily differentiable from the other two categories. This is confirmed by the relatively low predictability of that category suggested by the Hit-and-Miss table, as well as the lack of a clear preference among the moderate poor in Figures 1 and 2 above.

**Table 1: Marginal effects for DOGEV model: dependent variable is welfare category**

Variable	Non-poor		Moderate Poor		Extreme poor	
Constant	0.217	(0.139)	-0.078	(0.149)	-0.138***	(0.084)
Age of head of household	-0.088*	(0.047)	0.059	(0.051)	0.029	(0.029)
Age Square of household head	0.070	(0.044)	-0.061	(0.049)	-0.009	(0.028)
Male	0.073***	(0.033)	-0.047***	(0.017)	-0.027**	(0.012)
Single	0.094***	(0.034)	0.006	(0.035)	-0.101***	(0.025)
Married	0.041	(0.039)	-0.009	(0.039)	-0.032	(0.025)
Fighter	0.082***	(0.034)	0.006	(0.037)	-0.088***	(0.029)
Years of Schooling						
No schooling	-0.132**	(0.072)	0.021	(0.077)	0.111***	(0.055)
1-7 years	-0.062	(0.064)	0.031	(0.070)	0.031	(0.052)
8-12 years	0.067	(0.063)	0.019	(0.072)	-0.086	(0.058)
12 or more years	0.280***	(0.0900)	0.098	(0.106)	-0.378***	(0.102)
Household size	-0.035**	(0.009)	0.006	(0.009)	0.029***	(0.005)
Ethnic majority (Tigrigna)	0.006	(0.052)	-0.007	(0.027)	0.001	(0.017)
Number of employed per household	0.157***	(0.042)	-0.010	(0.040)	-0.147***	(0.023)
Remittance from relatives in Eritrea	0.043***	(0.011)	-0.018	(0.013)	-0.061***	(0.011)
Remittance from relatives in Diaspora	0.058***	(0.013)	-0.033**	(0.014)	-0.091***	(0.014)
Home ownership	0.234***	(0.072)	-0.084	(0.073)	-0.150***	(0.025)
Regional unemployment rate	-0.019***	(0.006)	0.003	(0.006)	0.016***	(0.003)
Number of observations	3712		3712		3712	

**Source:** Authors calculation from EHIES 1996/97 values in parenthesis standard errors.

**Notes:** \* Significant at the 10% level; \*\* Significant at the 5 % level; \*\*\* Significant at the 1% level.

#The model was originally estimated with widowed female and divorced female interactive variables, but they were found to be insignificant.

In terms of the importance of particular characteristics, many of the results obtained for Eritrea were quite typical of findings in the literature on poverty in general, and African poverty in particular. These include: the age of household head (which was only very weakly significant); the gender of the household head (poverty is strongly female); household size (poorer households are generally larger); regional employment level (which implies less poverty); and home ownership (which is low among the poor). However, atypically, the only marital status found to be correlated with poverty (negatively in this case) was never having been married (single). No other marital status was found to be significantly related to poverty or non-poor status. Also atypically, ethnic status was not related to poverty. In the particular case of Eritrea,

this can be attributed to the fact that the minority ethnic groups tend to be concentrated in the better-off lowland towns, which likely compensates for any socio-political disadvantages. Beyond these attributes, however, certain characteristics have important implications for the post-war economic reconstruction of Eritrea and these will be discussed in greater detail.

### ***Liberation-war Veteran***

According to the estimation results, war veterans were less likely to be among the extreme poor and more likely to be non-poor (with coefficients of nearly equal, but opposite, dimensions). This may be explained by the different affirmative action programs and privileges available to ex-liberation fighters in securing employment and receiving a party membership premium on their salaries. Fissuh (2003) and Arneberg and Pederson (2001) report that there is a huge premium for party membership in the determination of earnings in Eritrea.

### ***Schooling***

Education, both as human capital and as a correlate of other attributes (such as material wealth, childhood health and cognitive ability, etc.) is expected to have a strong negative association with poverty.<sup>18</sup> However, the effect of years of schooling of the household head on per capita (adult equivalent) welfare does not appear to be uniform across the different welfare categories or across different education levels. The marginal effect for no schooling is positive and significant (at the one percent level) for the extreme poor category (Table 1), but negative and significant (at the five percent level) for the non-poor category. In effect, the lack of schooling of the household head increases the likelihood of being poor in general, with a strong bias towards extreme poverty. In and of itself, this is not a surprising result since a voluminous literature in both developed and developing countries documents the relationship between the lack of education and poverty.

The marginal effects for post-secondary education (12+ years) was negative and significant (at the one percent level) for the extreme-poor category, and similarly significant but positive for the non-poor category. Clearly, those with high levels of education were unlikely to be among the

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<sup>18</sup> Though childhood health and cognitive ability affect achievements in education, they also affect future adult welfare in different ways (such as increased probability of adult ill health and reduced skill development), and both of these are high correlates of childhood poverty. Thus, these effects also affect the persistence measure.

extreme poor and more likely to be non-poor (though they appear not to have been particularly unlikely to be moderately poor). Again, this negative association between high levels of education and poverty is in line with the general findings of the literature, but the failure of that group to avoid moderate poverty in significant numbers is surprising and, perhaps, speaks as much to the low level of welfare in the country in general.

The more surprising result was the indication that primary and secondary levels of education (1-7 and 8-12 years respectively) were not important in determining welfare categories. None of the marginal effects for these variables was significant for any welfare category in the regression results reported in Table 1. However, as Figure A1 (Appendix) suggests, education does in fact appear to increase the likelihood of being non-poor. Primary and secondary education, respectively, do appear to halve the probability of being extremely poor and double the probability of being non-poor. The limited significance level may be suggestive of the fact that moderate levels of education may not be very good predictors of welfare status because other unmeasured variables (social capital and health in particular) may be critical in determining the ability to translate education into increased income (and consumption). We anticipate that the persistence parameter will pick up some of this limited effect generated to the absence of co-requisites.

### ***Number of Employed Persons in the Household***

According to the results presented in Table 1, the number of employed persons in a household was, not surprisingly, negative and significantly related (at the one percent level) with extreme poverty, and positively associated with non-poor status. Figure A2 (Appendix) clearly indicates that the probability of being non-poor rose rapidly as the number of employed persons increased and continued to do so until five members of the household were employed. Thus, while households with more than three employed persons enjoyed a virtual certainty of escape from extreme poverty, it would take the employment of five persons before no further changes could be made (in a probabilistic sense) to at least the moderate poverty status by further employment.

From a policy perspective, this employment result contains both good news and bad news. The good news is that the generation of employment opportunities, in and of itself, could be nearly

sufficient to eliminate extreme poor (assuming no significant fall in real wages). However, that result also seems to suggest that child labor, by increasing the number of employed persons in the household, can substantially reduce poverty (particularly, extreme poverty). It illustrates the strong temptation poor families face to choose child labor over investment in education for children. The earlier finding that the returns to median levels of education do not have statistically strong relationships to welfare levels would appear to exacerbate this problem. Education policies in Eritrea may need to address that incentive problem if objectives such as universal primary education and increased secondary education are to become reality.

### ***Remittance from Relatives***

Remittances from relatives mean an increase in household income and thus a potential increase in real consumption. It is therefore not surprising that both related variables (remittance from relatives in Eritrea and remittance from relatives abroad) were strongly and negatively associated with extreme poverty, and strongly and positively associated with non-poor status. However, only remittance from relatives abroad had a significant negative association with moderate poverty as well. This difference probably reflects the fact that remittances from relatives abroad were likely to be larger, and thus more capable of reducing moderate poverty than the smaller contributions from relatives in Eritrea. (In effect, remittance from relatives in Eritrea was sometimes sufficient to push poor households up one welfare category, but not two, whereas remittance from relatives abroad was sometimes sufficient to bump the extreme poor up into the non-poor category).

### **INDICATIONS OF “RESIDUAL PERSISTENCE”**

It is our contention that, beyond the welfare status suggested by observed personal and household characteristics, individuals will tend to show an additional preference for poverty – a reflection of unobserved factors that perpetuate the condition. These effects will be captured, at least to some degree, by the captivity parameters. The DOGEV model is also based on the presumption that neighboring poverty categories are correlated, and that this will be picked-up by the  $\rho$  parameter. However, as noted above, the definition of “extreme poor” could be considered somewhat arbitrary. Therefore, in addition to our preferred measure of regional poverty lines, we also experimented with the international poverty lines (one and two

international dollars a day) in defining welfare categories.<sup>19</sup> We present the results of these captivity and correlation parameters, for both poverty line definitions, in Table 2.

Some small differences were found between the two approaches (to defining the boundaries of the welfare categories). As can be seen from Table 2, the correlation between poverty categories was lower when the dollar-per-day poverty lines were used to define the welfare boundaries (recalling that actual correlations, are *inversely* related to the parameter  $\rho$ ). As for the captivity elements, marginal differences were also found. Using the one and two-dollars-per-day poverty lines, the captivity element in the non-poor category was significant at only the ten percent level, whereas in the analysis using regional poverty lines it was insignificant. We thus also present results from constraining it *a priori* to zero. It is the results of this restricted specification which are used to estimate the marginal effects reported in Table 1.<sup>20</sup>

Focusing on the restricted version using regional poverty lines (or preferred specification because we take the regional poverty line approach to be more precise), the estimated value of  $\rho$  was significantly different from both 0 and 1 at 0.453 - corresponds approximately to an actual correlation of just over 0.35 (Small, 1987). This value indicates that there was significant ordering/correlation in the poverty outcomes, confirming one of our basic contentions. Indeed, such correlation was found for both restricted and unrestricted specifications and regardless of poverty lines was used. This supports at least one aspect of the DOGEV framework.

Turning to the main justification for the DOGEV approach – that there was captivity to the various poverty levels – Table 2 indicates that there was significant captivity to both the moderate poor and extreme poor categories (but, as noted earlier, only weak evidence of such captivity for the non-poor category). In effect, individuals “choose” poverty significantly more often than their personal, household and regional characteristics suggest they should. This is also true irrespective of poverty line used, and whether, or not,  $\theta_0$  has been restricted to zero.

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<sup>19</sup> In effect, extreme poverty was defined as a consumption level of less than one dollar a day and moderate poverty was defined as a consumption level of more than one dollar but less than two dollars a day.

<sup>20</sup> In any case, the results of the restricted and unrestricted specifications were not significantly different.

**Table 2: Captivity elements and robustness test**

Parameter	Using Regional Poverty Lines		Using Dollar-a-Day Poverty Lines	
	Unrestricted	Restricted	Unrestricted	Restricted
$\theta_0$	0.002 (0.024)	- -	0.015* (0.09)	- -
$\theta_1$	0.088*** (0.03)	0.086*** (0.047)	0.058*** (0.013)	0.085** (0.04)
$\theta_2$	0.037*** (0.005)	0.059*** (0.005)	0.08*** (0.005)	0.061*** (0.004)
$\rho$	0.527*** (0.214)	0.453*** (0.135)	0.653*** (0.077)	0.515*** (0.254)

**Source:** Authors calculation from Eritrea Household Income and Expenditure Survey (EHIES) 1996/97

**Notes:** \* significant at 10% level; \*\* significant at 5% level; \*\*\* significant at 1% level.

Values in parenthesis are standard errors

Using Equation (5) the amount of captive probability to moderate poor is 0.086, representing 17 percent of the total probability of this welfare category (evaluated at sample means). On the other hand, the captivity component of the extreme welfare category is 0.059, representing 22 percent of the total probability of this outcome. These are indeed remarkably large proportions of the total predicted probabilities for each category and justify the employment of the DOGEV model in estimating the determinants of poverty. It also suggests that a substantial proportion of those in poverty remain poor despite having profiles that suggest higher welfare categories – poverty lasts beyond obvious changes in measurable attributes. Further, the statistical insignificance (or weak significance) of the persistence attribute for the non-poor group confirms our presumption that this persistence applies to upward (welfare) mobility and not downward mobility.

## CONCLUSIONS

This study uses cross-sectional, micro level, data from the Eritrean Household Income and Expenditure Survey (EHIES) 1996/97 to identify the characteristics of poverty in Eritrea. The study aimed to demonstrate, among other things, that the effect of unmeasured attributes that perpetuate poverty across generations and lifespans (part of what is often termed the “poverty trap”) can be identified in cross-sectional analysis and its magnitude estimated (in terms of the

extent of its contribution to observed poverty). This was achieved through the use of the DOGEV estimation approach which allowed for the inclusion of a captivity parameter for each welfare category. That parameter, besides indicating the presence of an unexplained “preference” for poverty, also allowed us to measure the proportional contribution of that “preference” to the predicted level of poverty. In fact, this persistence attribute was found to explain 17.2% of moderate poverty and 21.9% of extreme poverty. The fact that these measures of “residual persistence” were significant only for the poverty categories (and largely indistinguishable from zero for the non-poor category) confirmed the presumption that these measures relate to resistance to upward mobility.

With respect to the measurable characteristics of poverty, female headship and large households were strongly associated with poverty. On the other hand, being an ex-fighter, never having been married, being part of a household with a high number of employed persons, or receiving remittance from relatives (at home or abroad) were all attributes that were positively associated with the non-poor status and negatively associated with extreme poverty. However, with respect to remittances, the source mattered. Remittance from relatives abroad was negatively (and strongly) associated with both moderate *and* extreme poverty, but remittance from relatives in Eritrea did not seem to have any particular relationship to moderate poverty (which is the Eritrean norm given that the median income is in that range).

The coefficient of post-secondary education was strongly and positively associated with being non-poor and negatively associated with extreme poverty. The opposite was true for the coefficient for no schooling. Surprisingly, however, the coefficients for primary and secondary education were not significant for any of the welfare categories (though the graphic analysis appeared to show some relationship based on the estimated marginal effects). Moreover, none of the education variables appeared to be particularly important in explaining moderate poverty. These results are consistent with the importance of co-requisites (such as health and social capital) in determining the ability of individuals to translate education (particularly moderate education) into higher income and consumption – factors captured, at least partially, in the captivity parameters. These results may also be related to the fact that, in the post-war period,

both employment and compensation decision in Eritrea were often based on factors other than education (such as war veteran status, ruling party membership, etc.). Combining these factors with the finding that the employment of each additional member of a household (up to five) significantly reduced the likelihood of poverty, makes it likely that Eritrean authorities faced a serious incentive problem in making universal primary (and increased secondary) education attractive. This, in turn, has serious implications in terms of the potential impact of education as a tool of poverty reduction. Given that we are a few years beyond the last survey, this provides a strong impetus for an update of the survey and a re-examination of the employment-education-poverty relationship, as well as a more thorough examination of Eritrea's progress in those areas.

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## APPENDIX

Table A1 - Distribution of poverty based on the welfare index

	Welfare Category			Total
	Non-poor	Moderate Poor	Extreme Poor	
Frequency	1,108	1,433	1,171	3,712
Percentage	29.85	38.60	31.55	100

**Source:** Authors' calculation from EHIES 1996/97.

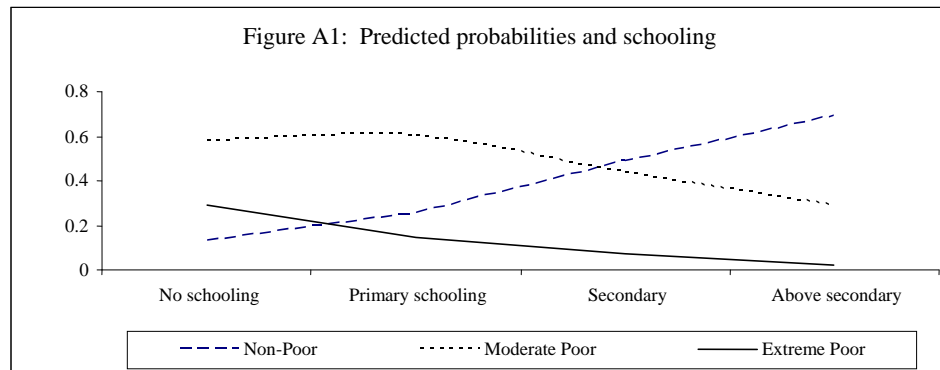
Table A2 - Hit and Miss table

ACTUAL	PREDICTED			
	Non-poor	Moderate Poor	Extreme Poor	Total
Non-poor	741	311	56	1108
Moderate Poor	297	778	358	1433
Extreme Poor	40	299	832	1171
Total	1078	1388	1246	3712

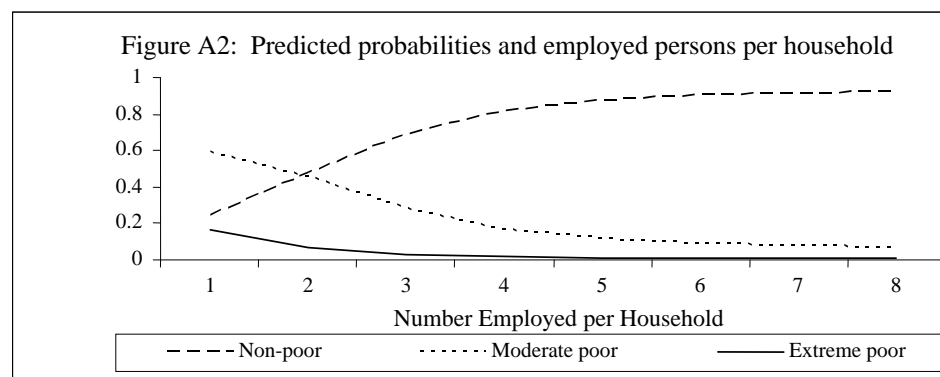
Sample proportions and predicted probabilities

	Captivity element	Predicted probabilities	sample proportions
Non-poor	-	0.23	0.30
Moderate Poor	0.086	0.50	0.39
Extreme Poor	0.059	0.27	0.32

**Source:** Authors calculation from Eritrea Household Income and Expenditure Survey (EHIES) 1996/97



Source: Authors calculation from DOGEV Model Results.



Source: Authors' calculation from DOGEV Model Results.