

MEASURING THE ATTRIBUTES OF POVERTY AND ITS PERSISTENCE: A CASE STUDY OF ERITREA

BY EYOB FISSUH* AND JOHN SERIEUX

Department of Economics, University of Manitoba, Canada

AND

MARK N. HARRIS

Department of Econometrics and Business Statistics, Monash University, Australia

This paper tries to identify the correlates of poverty in urban Eritrea using an estimation technique (the DOGEV model) that also allows for the inclusion of a measure of “persistence” in poverty levels from cross-sectional estimation. The results suggest that 17 percent of the probability of being moderately poor and 22 percent of the probability of being extremely poor in Eritrea was attributable to this “persistence”—a predisposition toward poverty likely due to latent attributes related to past experience of poverty itself. The results also suggest that, in the post-war economy of the mid-1990s, those with vocational training fared best among all education groups. Being a war veteran also had a strong negative association with the poverty—reflecting successful attempts to support that group. The receipt of remittances also reduced the likelihood of poverty; though receipts from outside Eritrea had a much stronger effect than receipts from within Eritrea.

1. INTRODUCTION

Eritrea, one of the 50 least developed countries, was ranked 165th (out of 179 countries) by the United Nations, in terms its human development index (UNDP, 2008). This least developed status and low level of human development indicate 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, 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.¹ There has been no fully-fledged poverty study in Eritrea to date, and most of the previous work on that subject has been based on the Rapid Appraisal Survey conducted in 1993/94 (World Bank, 1996).² However, because that survey came immediately after the war of indepen-

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*Correspondence to: Eyob Fissuh, Department of Economics, 501 Fletcher Argue Building, University of Manitoba, Winnipeg, MB R3T 5V5, Canada (fissuh@gmail.com).

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

²Arneberg 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.

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dence (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.

A subsequent, and more extensive, survey of (the income and expenditure of) urban households was carried out in 1996/97. By that time, the major effect of the drought had been overcome, and though effects of the war were still present, the immediate post-war consolidation phase was complete. The results of this survey can, therefore, be considered more indicative of the broad living condition of urban households in Eritrea, as expressed in expenditure levels and choices.

This study presents estimates of the determinants of poverty in Eritrea based on the results of the 1996/97 urban household income and expenditure survey. It 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 facilitates not only estimation of the determinants of poverty but also an estimate of the presence and strength of any persistence element in that poverty. In essence, we employ an econometric technique (the DOGEV model) that allows us to model the fact that not only do certain measured household, community and geographic attributes directly influence the condition of poverty, but additionally, this condition (of poverty) is likely a presumptive one for a significant proportion of those in that welfare category due to the effect of unmeasured (and sometimes unmeasurable) attributes related to the past and present condition of poverty itself. This approach thus offers results that are richer than those provided by more standard analyses. More importantly, in the developing country environment, where micro time series and inter-generational data are rarely available, this approach allows us to offer an assessment of the likely importance of the persistence factor in explaining overall poverty levels even when only cross-section data is available.

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 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).³ Using

³Poverty 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 measures, 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.

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.⁴ Beyond this, we differentiate between “moderate” and “extreme” levels of poverty based on distance from the poverty line (though we include a dichotomous analysis of poor versus non-poor for comparison). We try to relate these poverty (or welfare) categories to particular household and regional characteristics, in terms of both their direct impact and their influence on the “persistence” in poverty levels across households.

2. ACCOUNTING FOR “PERSISTENCE”

The empirical literature on poverty in both developed and developing countries clearly indicates that, for a significant proportion of the population classified as poor, the condition of poverty has a tendency to reproduce itself across generations and over individuals’ lifetimes (intergenerational and life course transmission respectively) or to be associated with contemporaneous elements that perpetuate the condition (Corcoran, 1995; Verner and Alda, 2004; Case *et al.*, 2005). This is part of the phenomenon often referred to, in the dynamic context, as the “poverty trap” or “poverty cycle.”

The variables that are known to be involved in the transmission of poverty across lifetimes and across generations include (but are not limited to): poor childhood health and nutrition, low parental levels of education, and low level of social capital. Poor childhood health and nutrition are likely to result in both poor adult health and low skill development in the growing years. Both of these factors compromise earning capacity in later life (Case *et al.*, 2005; de Walque, 2005). Low parental levels of education affect the decisions made with respect to children’s education, career choices, and other factors related to future adult earning capacity (Heckman and Hotz, 1986). Low levels of social capital limit an individual’s ability to assess and access opportunities and to choose certain careers (and sometimes even employment) because of limited access to the requisite network of social institutions that offer information, support, and protection, or even means of avoiding more immediate obstacles like high neighborhood crime (Baker, 2001; Verner and Alda, 2004).

In the empirical literature, three types of approach have typically been used to establish the existence of poverty trap mechanisms at the individual and family levels.⁵ The most widely used approach, particularly in developed countries, involves the use of longitudinal data that follow individuals across different periods of their life, or families over different generations and therefore provide direct ways of linking generational or life-course attributes (Charles and Hurst,

⁴See World Bank (1996) for the details of calculations. In addition, the international poverty line of US\$1 per day was employed, but they give almost the same classification, which does not significantly change the multivariate analysis. In a later section of the paper, we present the sensitivity of our model to the employment of \$1 per day as opposed to the regional poverty lines.

⁵There is an overlapping (more macro-focused) literature that explores the possibility of poverty traps at the national or community level, rather than the individual or family level (see, for example, Bowles *et al.*, 2006).

2003; Case *et al.*, 2005). An alternative approach is to use survey or census data that include information about the parents of the main survey subjects (DiPietro and Urwin, 2003; de Walque, 2005). A third approach is to supplement quantitative survey or census data with qualitative survey data that allow for additional levels of discrimination beyond what is supported by direct survey or census data. This is a particularly useful approach when trying to identify the effect of more contemporaneous poverty trap mechanisms such as limited social capital and neighborhood effects (Baker, 2001).

Longitudinal datasets are extremely rare in developing countries; putting this approach out of reach in most developing country investigations. Surveys that include parental data, though more immediately obtainable, are also not very commonly performed in developing countries. Supplementing survey data is more easily executed, but it has narrow applicability. The most widely available data on individuals and households in developing countries is household income and expenditure surveys; but these are cross-sectional datasets that, at face value, can tell us little about the factors typically presumed to be associated with poverty traps (inter-generational and life course experiences and social capital endowments).

The estimation approach followed here, using data from an income and expenditure survey, tries to separately identify and estimate that part of the poverty condition that is due to a persistence element in poverty and is additional to measured household, community, or geographical characteristics in explaining poverty. To a certain extent this measure tries to pick up the effect of latent variables that create a “predisposition” to poverty that is not directly related to measured characteristics—indicators that poverty trap mechanisms are likely at work. It is anticipated that this greater richness in the model will, if its validity is supported, provide results that are, potentially, more useful to policy makers and researchers interested in a deeper understanding of the nature of poverty in Eritrea; and beyond that, will offer a technique that adds value to future assessments of poverty based on cross-sectional data.

3. THEORETICAL BACKGROUND

In line with the approach taken by Glewwe (1991), we consider household expenditure to be the outcome of constrained utility maximization. We can thus specify an expenditure or welfare function that approximates (or is at least monotonically related to) unobserved utility. With the addition of a persistence parameter to the typical derived welfare function, we obtain an estimable but discrete welfare function of the form:

$$(1) \quad \frac{C_j^h}{m(b_1^h, \dots, b_m^h)} = F(X, \beta_j) + \theta_j + \varepsilon \quad j = 1 \dots J$$

where C_j^h is the expenditure level for households in welfare category j , ε is the usual random error term, β_j is a vector of parameters specific to welfare category j (across all regions), and X represents a range of explanatory variables that include household, community, and geographic attributes. The term θ_j represents the persistence

element in the welfare category (j) that reflects attributes not directly related to the explanatory variables. In this study, $m(\cdot)$ is interpreted (narrowly) as the age composition of households which is approximated by the scaling parameter for deriving adult equivalent expenditure—making the dependent variable the average adult-equivalent level of consumption for each household in the welfare category.⁶

The welfare categories can be interpreted as (three) poverty categories (PC) 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:

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

The welfare ratio is defined as follows:

$$(3) \quad W_i = Y_i^R / Z^R$$

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).

According to the underlying economic model, the individual “selects” that welfare category $j = 1, \dots, J$ which maximizes her utility (given her attributes). Under the assumption that the ε_{ij} independently follow a Type 1 extreme value distribution, a multinomial logit (MNL) model results (Maddala, 1983). In the modeling of such poverty levels, it is usual in the literature either to employ a MNL model or to take the ordering in the observed outcomes into account via the use of ordered probit/logit models (see Watson, 2000; Glewwe *et al.*, 2001; Niimi *et al.*, 2004). 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 the random utility maximization (RUM) model which is, typically, the interpretative framework for discrete choice models.

Small (1987), introduced the ordered generalized extreme value (OGEV) model that essentially builds on MNL probabilities but includes an additional single parameter ρ (in the simplest case), which captures correlation between observed discrete outcomes and thus allows for ordering (akin to a moving average process).⁷ Use of the OGEV type specification is further justified here by the fact that the poverty ordering derives from an underlying continuous welfare variable. The fact that we employ a poverty line (or distance from the poverty line) to create

⁶In particular, equivalency scales derived from Engel’s method as in Arneberg and Pedersen (2001).

⁷No explicit closed form expression exists for the actual correlations(s) but they are inversely related to the parameter ρ , 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 MNL is preferred over the OGEV model.

a jump, or discontinuity, in the poverty status of households will lead to correlations between neighboring poverty outcomes—exactly that which will be captured by the parameter ρ .

However, as stated above, even after one has conditioned on individuals' attributes (such as education levels), some individuals may still be (exogenously) caught, to a certain extent, in particular levels of poverty. In the strictly theoretical interpretation of the RUM, the welfare category itself has some influence on the individual's "selection" of the welfare category she is observed to be in. To account for this "gravity" effect, Gaudry and Dagenais (1979) developed a useful extension to the MNL model—the DOGIT model.

The DOGIT model was first introduced to "dodge" the well-known undesirable independence of irrelevant alternatives (IIA) property embodied in the MNL model. However, in so doing the DOGIT model alters the MNL probabilities to allow for a portion of the overall probabilities of being in each state (or outcome) to be determined by "free-choice" (akin to the usual MNL probabilities) *plus* that from being "captive," or drawn to, a particular outcome. Hence this model is often referred to as the "logit captivity" model (Swait and Ben-Akiva, 1985, 1987). This model has therefore found favor in areas such as marketing and transportation research where consumers might exhibit a degree of brand loyalty or be "captive" to particular modes of transport (see, for example, Gaudry, 1980; Bordley, 1990; Kannan and Yim, 2001).

Accordingly, such an approach is ideally suited to our research question since we wish to ascertain whether, and if so how much, individuals are captive to (or trapped in) poverty levels. Statistically, the DOGIT achieves this by inclusion of outcome specific parameters, θ_j (see below).

The key contribution of Fry and Harris (2005) was in recognizing the greater flexibility of the OGEV model (compared to ordered logits/probits) and thus combining this with the "captivity" aspects of the DOGIT model. The result is the DOGEV model. Essentially, the DOGEV model combines the flexibility of the MNL model, with the ordering of the OGEV model and the captivity of the DOGIT model (Fry and Harris, 2005). Using the simplest case of the OGEV model (the "standard" OGEV), the resulting DOGEV probabilities are given by:

$$(4) \quad P_{ij}^{DOGEV} = \frac{\theta_j}{1 + \sum_{k=1}^M \theta_k} + \frac{1}{1 + \sum_{k=1}^M \theta_k} \times P_{ij}^{OGEV}$$

with "standard" OGEV probabilities being given by:

$$(5) \quad P_{ij}^{OGEV} = \frac{\exp(\rho^{-1}V_{ij})}{\sum_{r=1}^{J+1} (\exp(\rho^{-1}V_{ir-1}) + \exp(\rho^{-1}V_{ir}))^\rho \times [(\exp(\rho^{-1}V_{ij-1}) + \exp(\rho^{-1}V_{ij}))^{\rho-1}] + (\exp(\rho^{-1}V_{ij}) + \exp(\rho^{-1}V_{ij+1}))^{\rho-1}}$$

This model nests the following sub-models that can be identified as follows:

$$\text{OGEV} \Rightarrow \theta_1 = \dots = \theta_M = 0, 0 < \rho \leq 1;$$

$$\text{DOGIT} \Rightarrow \rho = 1 \text{ and at least one } \theta_j > 0, j = 1, \dots, J;$$

$$\text{MNL} \Rightarrow \theta_1 = \dots = \theta_M = 0 \text{ and } \rho = 1.$$

The first term of equation (4) represents the amount of the total poverty of category j that is attributable to transmission effects. In other words, the significance (or not) of θ_2 , for example, indicates whether a substantial number of individuals appear to be trapped in extreme poverty, despite characteristics that suggest other potential 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 part of that “persistence” which can also be considered a manifestation of the existence of a poverty cycle (or the working of a poverty trap mechanism).⁸ The magnitude of these effects can be determined by evaluation of the relevant first term of equation (4).

4. DATA

The data come 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 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 capital city (Asmara), other Highland towns (Nacfa, Keren, Mendefera, Dekemhare, Adikeyih, and Ghindae), the Western Lowlands (Barentu, Akurdar, and Tesseney), Assab and Massawa. The National Statistics Office selected a sample size of 5061 households. Of that total, 4644 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 of systematic differences between response and non-response households. The dataset 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 dataset of 3712 households.

5. THE DETERMINANTS OF POVERTY—DOGEV MODEL RESULTS

This section presents the results from the estimation of the DOGEV model. The dependent variables were the welfare categories, and the explanatory

⁸Though the concept of a “poverty cycle” 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. The relationship to the “poverty trap” concept is that the cyclical nature of poverty (as it is repeated and reinforced over time and across generations) is caused by self-reinforcing mechanisms that deter exit from that condition and thus “trap” individuals within poverty. This cyclical attribute of poverty may be observable, to some degree, in cross-sectional data in the form of an inexplicable “preference” for poverty or what we call here “persistence.”

variables were a set of variables typically assumed to be correlates of poverty. The results support the use of the DOGEV specification over its nested sub-models because there is evidence of ordering/correlation in the observed poverty outcomes (significant ρ parameter between one and zero) and a captivity element for both poverty categories (significant θ parameters). Those attributes, of ordering and captivity (presented in Table 2), will be discussed shortly. It should be noted too, that this model also has more explicit (and more nuanced) results than those of the probit specification in Table A5 (Appendix).

One method of evaluating the fit of such discrete choice models is the so-called hit/miss table, which compares predicted outcomes (based on the maximum probability rule), with actual outcomes. The results of this exercise are presented in Table A4. Note that, for comparison, we also present the hit/miss table for the simpler MNL model. For the three welfare categories (non-poor, moderate poor, and extreme poor) the percentage of households correctly predicted from our preferred specification were 53%, 47%, and 60%, respectively. In total 53% of observations are correctly predicted. Compared to the MNL model, we see that the DOGEV specification predicts marginally better overall (53% compared to 51%); but performs significantly better in predicting the extreme poor (60% versus 55%). If we were to randomly assign individuals according to sample proportions, we would have the prediction in the hit/miss table entitled "Random Assignment." Indeed, such an exercise can be considered benchmark that any well-performing econometric model should surpass. This random assignment would only correctly predict (overall) 34% of observations, 30% of non-poor observations, 39% of moderate observations, and 31% of extreme poor observations. On this basis, we can conclude that our model has reasonable to good predictive power.

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 (derived) marginal effects (for the measured correlates of poverty) when the captivity parameter for the non-poor category is constrained to be zero (the restricted model).

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 (Grootaert, 1997; Datt and Jolliffe, 1999; Datt *et al.*, 2000; Mukherjee and Benson, 2003; Geda *et al.*, 2005). These include: the age of household head (which was only very weakly significant); the gender of the household head (poverty is strongly female); minority status (minority groups are concentrated near the bottom of the income ladder); household size (poorer households are generally larger); regional employment level (the employed are less likely to be poor); and home ownership (which is low among the poor). 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.

TABLE 1
MARGINAL EFFECTS FOR DOGEV MODEL: DEPENDENT VARIABLE IS WELFARE CATEGORY

	Non-Poor		Moderate Poor		Extreme Poor	
Age of household head ^a	-0.010***	(0.003)	0.016*	(0.004)	0.003	(0.003)
Age of household head squared	0.000	(0.000)	0.000	(0.000)	0.000	(0.000)
Christian household head	0.014	(0.021)	-0.008	(0.022)	-0.006	(0.018)
Household size	-0.016***	(0.006)	0.000	(0.006)	0.017***	(0.005)
Number of adults in a household	-0.058***	(0.013)	0.030**	(0.013)	0.028***	(0.010)
Non-Tigrigna (minority) ethnic group	(-0.371)	0.080)	0.223***	(0.067)	0.148***	(0.054)
Male household head ^b	0.034	(0.022)	0.013	(0.023)	-0.047***	(0.018)
Ex-EPLF member (war veteran)	0.093***	(0.028)	0.008	(0.030)	-0.100***	(0.027)
Years of schooling						
No schooling	-0.298***	(0.072)	-0.096	(0.086)	0.393***	(0.094)
1-7 years	-0.415***	(0.053)	-0.071	(0.064)	0.486***	(0.080)
8-12 years	0.343	(0.151)	-0.059	(0.063)	0.402	(0.080)
13-15 years	0.207***	(0.051)	-0.074	(0.066)	-0.281***	(0.083)
Remittance from relatives in Eritrea	0.052***	(0.007)	-0.016	(0.018)	-0.068***	(0.008)
Remittance from relatives in Diaspora	0.065**	(0.007)	-0.029***	(0.008)	-0.094***	(0.009)
Disability dummy	-0.063**	(0.032)	0.071**	(0.031)	-0.008	(0.024)
Regional unemployment rate	-0.020***	(0.002)	0.003	(0.002)	0.017***	(0.002)
Number of employed in a household	0.183***	0.018)	-0.023	(0.017)	-0.159***	(0.016)
House ownership dummy	0.243***	(0.023)	-0.083***	(0.022)	-0.160***	(0.019)
Presence of sewage services	0.032	0.036***	0.048	(0.038)	-0.080**	(0.034)

Notes: Values in parentheses are standard errors.

*Significant at the 10% level; **significant at the 5 % level; ***significant at the 1% level.

^aThe total marginal effect for age is -0.001.

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

Source: Authors' calculations from Eritrea Household Income and Expenditure Survey (EHIES) 1996/97.

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 terms of securing employment and receiving a party membership premium on their salaries). Fissuh (2003) and Arneberg and Pederson (2001) report that earnings in Eritrea indicate a huge premium to party membership.

Schooling

Education, both as human capital and as a correlate of other attributes (such as material wealth, health, and nutrition), is expected to have a strong negative

association with poverty.⁹ 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 for different education levels. The marginal effects for no schooling and minimal (primary) schooling (1–7 years) are positive and significant (at the 1 percent level) for the extreme poor category (Table 1), but negative and significant (at the 1 percent level) for the non-poor category. In short, the limited schooling of the household head increased the likelihood of being poor in general, with a strong bias toward 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 (or low levels of education) and poverty. Moreover, these results follow naturally from the fact that the reference group is those with a university education.¹⁰

The effect for vocational education (13–15 years) was negative and significant (at the 1 percent level) for the extreme poor category, and similarly significant but positive for the non-poor category. This result has two clear implications. The first is that those who have acquired vocational education were unlikely to be among the extreme poor and much more likely to be non-poor. The second is that, because the reference group is those with university education (16 or more years of education), those with vocational training were more likely to be non-poor and less likely to be extremely poor than those with a university education. Though the second implication of this result is unexpected, it is in line with the findings of Fissuh (2003) that the rate of return to vocational training in Eritrea was higher than that for university education. In effect, among all education groups, those with vocational training appear to have done best of all.

Another surprising result was the lack of significance of the coefficient for secondary education (8–12 years of schooling). None of the marginal effects for this variable were significant for any welfare category in the regression results reported in Table 1. However, given the reference group (those with university education), the implication is not that secondary education was not important. Instead, it implies that the benefits of a secondary education were not particularly differentiable from the benefits of a university education. Put differently, a university education for the household head did not help families escape poverty any more, or less, than a secondary education. This may be more reflective of the greater contextual importance of secondary education in this post-war economy than the irrelevance of a university education. (Secondary education may have been an important requirement for filling semi-skilled positions and further skill development.) The results for vocational education tend to support that interpretation.

Curiously, none of the education variables appear to be particularly important in explaining moderate poverty. These results may be indicative of the impor-

⁹Poor childhood health and nutrition, which are both correlates of childhood poverty, reduce the potential effectiveness of education by increasing the probability of poor adult health and overall cognitive ability (Case *et al.*, 2005). It is these effects that are expected to be captured by the persistence parameter.

¹⁰One would expect the very educated to be significantly less likely to be poor and more likely to be non-poor than those with limited or no education.

tance of co-requisites (such as health and social capital) in determining the ability of individuals to translate education into higher income and consumption.¹¹ We anticipate that the persistence parameter will pick up some of this limited effect of education in the absence of co-requisites.

Remittance from Relatives

Remittance from relatives means 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 (Table A1), and thus more capable of helping the extreme poor (as well as the moderate poor) to move directly up to the non-poor status. By comparison, the smaller contributions from relatives in Eritrea might only have been sufficient to move recipients up one welfare category. Thus its neutral effect on the moderate poor likely derives from the fact that it both added to that category (by shifting up some of the extreme poor individuals to the moderate poor category) and subtracted from it (by shifting some of the moderate poor to non-poor status).

6. INDICATIONS OF “PERSISTENCE”

It is our contention that, beyond the welfare status suggested by observed personal and household characteristics, individuals will tend to show an additional predisposition to poverty—a reflection of latent or unobserved factors (likely related to earlier life, or cross-generational, experiences or social capital endowment) that perpetuate the condition. If this is, in fact, the case, these effects should be captured, at least to some degree, by the captivity parameters of the DOGEV—justifying its use over simpler models. Justification for the DOGEV model also comes from the presumption that neighboring poverty categories are correlated. This is picked up by the ρ 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.¹² 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 corre-

¹¹The argument is that those with some education but few co-requisites would take only limited advantage of their education, while those with several co-requisites but little education would take maximum advantage of their limited education. Both groups would tend to end up in the median income group (moderately poor category)—leading to statistical noise, and hence the statistical insignificance of education variables for that category.

¹²In effect, extreme poverty was defined as a consumption level of less than \$1 a day and moderate poverty was defined as a consumption level of more than \$1 but less than \$2 a day.

TABLE 2
CAPTIVITY ELEMENTS AND ROBUSTNESS TEST

Parameter	Using Regional Poverty Lines		Using Dollar-a-Day Poverty Lines	
	Unrestricted	Restricted	Unrestricted	Restricted
θ_0	0.003 (0.024)	— —	0.015* (0.09)	— —
θ_1	0.088*** (0.03)	0.086*** (0.047)	0.058*** (0.013)	0.085** (0.04)
θ_2	0.037*** (0.005)	0.059*** (0.005)	0.08*** (0.005)	0.061*** (0.004)
ρ	0.528*** (0.214)	0.453*** (0.135)	0.653*** (0.077)	0.515*** (0.254)

Notes: Values in parentheses are standard errors.

*Significant at 10% level; **significant at 5% level; ***significant at 1% level.

Source: Authors' calculations from Eritrea Household Income and Expenditure Survey (EHIES) 1996/97.

lation 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 ρ). With respect to 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 10 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 1.¹³

Focusing on the restricted version using regional poverty lines (our preferred specification because we take the regional poverty line approach to be more precise), the estimated value of ρ was significantly different from both 0 and 1 at 0.453—corresponding, 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. Indeed, such correlation was found for both restricted and unrestricted specifications, and regardless of the poverty lines 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 are “consigned” to a poverty category significantly more often than their personal, household, and regional characteristics suggest they should be. This is also true irrespective of the poverty line used, and whether, or not, θ_0 has been restricted to zero.

Using equation (4) the amount of captive probability to moderate poor is 0.086, representing 17.2 percent of the total probability of this welfare category (evaluated at sample means). On the other hand, the captivity component of the

¹³In any case, the results of the restricted and unrestricted specifications were not significantly different.

extreme welfare category is 0.059, representing 21.9 percent of the total probability of that 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.

Of course we must consider the possibility that these “captive parameters” are not pure measures of poverty persistence, but instead are mongrel measures of some captivity effects combined with, and perhaps dominated by, omitted variable effects.¹⁴ In order to ascertain whether that might be a more reasonable interpretation (than our preferred interpretation that they capture mostly captivity effects) we conducted a quasi-omitted variable test. Since education (across all levels) was a highly significant variable, by re-estimating the captivity parameters with education as a (purposely) omitted variable and comparing the resulting (without education) estimates with the original (with education) estimates, we could get a better feeling for whether these parameters are unduly affected by omitted variables. The results suggest that, while dropping education affected the size of the parameters, the effect was not overly large and, more importantly, was in opposite directions for the two captivity parameters. More specifically, the captivity parameters for the moderate poor category increased from 0.086 to 0.110 but that for the extreme poor category decreased from 0.037 to 0.028 and both parameters remained significant.¹⁵ Clearly the omitted variables had some effect on the parameters, which could lead to the conclusion that they reflect omitted variable effects. However, the fact that they are affected in opposite directions (the size of one parameter increases and another decreases) weakens such an argument considerably and makes it more likely that these changes merely reflect the usual omitted variable effects common to all parameters rather than a fundamental change in the magnitude of what they are measuring.¹⁶ We can, therefore, have confidence that our interpretation of these parameters as measures of persistence is a reasonable one.

Another possibility is that these parameters are simply picking up the effect of negative economic shocks. In that case, individuals in households hit by negative economic shocks would be classified as poor more often than their profile would suggest they should be, thus leading to the results above. However, this interpretation is not consistent with Eritrea’s economic reality for the survey period. Both 1996 and 1997 were, in economic terms, exceptionally good years for Eritrea (with growth rates of 9.3 and 7.9 percent for 1996 and 1997, respectively, after only 2.9 percent growth in 1995).¹⁷ Thus, while it is quite likely that some households suffered negative economic shocks, the economic conditions suggest that signifi-

¹⁴We thank an anonymous referee for pointing this out.

¹⁵Full results from the test are available from the authors on request.

¹⁶Or at least makes it highly contestable.

¹⁷Data derived from the World Development Indicators (Online), The World Bank.

cantly more households suffered positive economic shocks. In this case, insignificant estimates for the persistence parameters are the more likely results—quite different from the results above.

7. CONCLUSIONS

This study used 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 latent (and, of course, unmeasured) attributes that perpetuate poverty across generations and lifespans as well as contemporaneously (i.e., poverty trap mechanisms) can be, at least partially, 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.

With respect to the measurable attributes of poverty, the model suggests that female headship, ethnic minority status, and large households were strongly associated with poverty. On the other hand, being an ex-fighter, 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 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 for vocational education was strongly and positively associated with being non-poor and negatively associated with extreme poverty. The opposite was true for the coefficients for no schooling and primary schooling. The coefficient for secondary education was not significant for any of the welfare categories. Given that the reference group was members households whose heads had a university education, the implication is that those in households with vocationally trained heads did better than those with university educated heads, while those in households with heads that had only secondary education did just as well. This may be reflective of the post-war, reconstruction, situation in the Eritrea of 1996/97, which likely placed a premium on skilled and semi-skilled occupations.

With respect to the measures of poverty persistence, the estimated parameters were statistically significant for the moderate and extreme poverty categories but insignificant for the non-poor category. These parameters, besides indicating the presence of a predisposition to poverty, also allowed us to measure the proportional contribution of that predisposition (to the extent that it could be measured) to the predicted level of poverty. In that regard, the persistence attribute appeared to explain 17.2 percent of moderate poverty and 21.9 percent of extreme poverty. Moreover, the fact that these measures of “persistence” were significant only for the poverty categories (and largely indistinguishable from zero for the non-poor category), lends strong support to the presumption that these measures relate to resistance to upward (but not downward) mobility.

It should be noted, however, that in the absence of longitudinal data that would allow verification of the “poverty trap” effect that the persistence measure attempts to identify, these results do not constitute “proof” of poverty persistence in Eritrea. It will require further application of this model, across more countries and using more extensive datasets, to establish the reliability of this result, and therefore the potential value added of this estimation method. What can be said, at this point, is that the model’s presumption of a persistence element in poverty (that is additional to the influence of its correlates and orthogonal to omitted variable effects) has been quite well supported by the data.

APPENDIX

TABLE A1
DESCRIPTIVE STATISTICS FOR CORRELATES OF POVERTY

Variable	Mean	Std Dev	Variance	Minimum	Maximum
Age of household head	4.5617	1.5801	2.4967	1.5	9.8
Remittance from within Eritrea	0.78	1.7002	2.8907	0	36.7636
Remittance from Diaspora	0.9254	3.4686	12.0311	0	87.6101
Household size	4.247	2.4255	5.8833	1	16
Ex-EPLF member	0.1156	0.3198	0.1022	0	1
Number of employed per household	0.9596	0.7823	0.612	0	6
Regional unemployment rate	12.6665	4.3348	18.7904	7	20
Home ownership	0.496	0.5001	0.2501	0	1
Presence of sewage service	0.059	0.2357	0.0555	0	1
No formal schooling	0.4898	0.5	0.25	0	1
Education: grade 1–7	0.2988	0.4578	0.2096	0	1
Education: grade 8–12	0.1377	0.3446	0.1187	0	1
Education: above 12 grade	0.0498	0.2176	0.0474	0	1
Married household head	0.6315	0.4825	0.2328	0	1
Widowed household head	0.1546	0.3616	0.1308	0	1
Christian household head	0.3494	0.4768	0.2274	0	1
Tigrigna household head	0.6633	0.4727	0.2234	0	1

Note: The following manipulations were done to ease computation by Gauss: Age/10; Remittance from abroad/1000; Remittance from Diaspora/1000.

TABLE A2
DISTRIBUTION OF HOUSEHOLDS BASED ON THE WELFARE INDEX

	Welfare Category			Total
	Non-Poor	Moderate Poor	Extreme Poor	
Frequency	1108	1433	1171	3712
Percentage	29.85	38.60	31.55	100

Source: Authors’ calculations from EHIES 1996/97.

TABLE A3
DISTRIBUTION OF ATTRIBUTES BY POVERTY CATEGORY

Variable	Poverty Category		
	Non-Poor	Moderate Poor	Poor
Age of household head	44	45	48
Non-Tigrigna ethnic group	0.31	0.33	0.38
Household size	4.07	4.28	4.38
Number of adults in a household	2.32	2.33	2.28
Male of household head	0.60	0.56	0.51
Regional unemployment rate	11.47	12.62	13.86
Disability dummy	0.14	0.19	0.23
Ex-EPLF member	0.16	0.12	0.07
No schooling	0.03	0.02	0.02
1–7 years schooling	0.37	0.47	0.63
8–12 years schooling	0.30	0.32	0.27
12 or more years schooling	0.20	0.14	0.07
Remittance from relatives in Eritrea	0.92	0.82	0.60
Remittance from relatives in Diaspora	1.78	0.80	0.27
Number of employed in a household	1.17	0.94	0.78
House ownership dummy	0.57	0.46	0.46
Presence of sewage services	0.06	0.07	0.05
Number of observations	1108	1433	1171

Source: Authors' calculations from EHIES 1996/97.

TABLE A4
HIT AND MISS TABLES AND DOGEV SUMMARY PROBABILITIES

DOGEV Model				
Actual	Predicted			Total
	Non-Poor	Moderate Poor	Extreme Poor	
Non-poor	582	383	143	1108
Moderate poor	340	670	423	1433
Extreme poor	102	365	704	1171
Total	1024	1418	1270	3712
Random Assignment				
Non-poor	331	428	350	1108
Moderate poor	428	553	452	1433
Extreme poor	350	452	369	1171
Total	1108	1433	1171	3712
MNL Model				
Non-poor	526	434	148	1108
Moderate poor	321	710	402	1433
Extreme poor	111	410	650	1171
Total	958	1554	1200	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' calculations from EHIES 1996/97.

TABLE A5
MARGINAL EFFECTS FROM A PROBIT MODEL OF POVERTY

	Coefficient	Standard Error
Age of household head	0.080***	(0.029)
Age of household head squared	-0.008***	(0.003)
Christian household head	0.008	(0.028)
Household size	0.013***	(0.005)
Number of adults in a household	0.043***	(0.011)
Tigrigna ethnic group	0.009	(0.028)
Male household head	-0.011	(0.020)
Ex-EPLF member	-0.087***	(0.027)
Years of schooling		
No schooling	0.175***	(0.032)
1–7 years	0.339	(0.035)
8–12 years	0.241	(0.028)
13–15 years	-0.144***	(0.029)
Remittance from relatives in Eritrea	-0.034***	(0.006)
Remittance from relatives in Diaspora	-0.026***	(0.007)
Disability dummy	0.042**	(0.025)
Regional unemployment rate	0.018***	(0.002)
Number of employed in a household	-0.141***	(0.015)
House ownership dummy	-0.217***	(0.018)
Presence of sewage services	-0.041	(0.035)
Observations	3712	
Observed P	0.70	
Predicted p	0.73	
Wald chi ²	477.73	

Notes: Values in parentheses are standard errors.

*Significant at 10% level; **significant at 5% level; ***significant at 1% level.

Dependent variable is a dummy variable which takes a value of 1 if poor and 0 if non-poor.

Source: Authors' calculations from EHIES 1996/97.

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