POVERTY AND INEQUALITY MAPPING IN THE COMMONWEALTH OF DOMINICA*

Francesca Ballini
Gianni Betti
Università di Siena

Samuel Carrette
Government of the Commonwealth of Dominica

Laura Neri
Università di Siena

Resumen: Los mapas espaciales de la distribución de la pobreza y desigualdad son más útiles para investigadores y gobiernos cuando están detalladamente desagregados, o cuando representan pequeñas unidades geográficas como: ciudades, municipios, distritos u otras divisiones administrativas. Para producir mapas de la distribución de la pobreza y desigualdad se combinan econométricamente encuestas de nivel de vida, que cubren ingreso y consumo, con datos de censos u otras encuestas lo suficientemente grandes para permitir la separación de los cálculos de pobreza y desigualdad.

Abstract: Poverty and inequality maps - spatial descriptions of the distribution of poverty and inequality - are most useful to policy-makers and researchers when they are finely disaggregated, that is when they want to represent small geographic units, such as cities, municipalities, districts or other administrative partitions of a country. In order to produce poverty and inequality maps, living standard surveys covering income or consumption are econometrically combined with data from censuses or other sample surveys large enough to allow disaggregation of the poverty and inequality estimates.

Clasificación JEL: I32, C21, C81

Palabras clave/keywords: poverty mapping, transfer schemes, Commonwealth of Dominica, mapas de la pobreza, proyectos de traspaso.

Fecha de recepción: 15 XI 2007 *Fecha de aceptación: 4 XI 2008*

* ballini@unisi.it, betti2@unisi.it, sam285@hotmail.com, neri@unisi.it

1. Introduction

Poverty and inequality maps are spatial descriptions of the distribution of poverty and inequality. For their construction, living standard information covering income and/or consumption are needed. Generally, censuses do not collect income or expenditure information so poverty estimates are not computable, even in the census year. On the other hand, living standard surveys cover generally income or consumption, but do not normally permit sufficiently fine disaggregation because of the limited sample size. In order to fill this gap, the World Bank has recently invested in a methodology for generating small area poverty and inequality measures, thereby permitting the construction of poverty and inequality maps. The methodology, developed by Elbers, Lanjouw and Lanjouw (2003, henceforth ELL), has been applied to a substantial number of developing countries, and in many cases the results obtained have been used by governments to allocate financial resources.

The idea is to estimate an econometric model on the basis of a small and rich sample data set and use the estimated parameters to adequately simulate consumption distributions in a larger data set of statistical units, normally the data set from the a housing census. In this way, appropriate measures of poverty and inequality can be calculated, not only at the national or regional level, but also at a very disaggregated level, so as to permit the construction of poverty and inequality maps. These are most useful to policy-makers and researchers when they are finely disaggregated, that is when they represent small geographic units, such as cities, municipalities, districts or other administrative partitions of a country.

Three important aspects of this methodology should be noted at the outset. First, information from the census is required at micro (household and individual) level; however micro-level linkage between census and survey data is not required. Second, the vector of covariates used in the regression model implies that those variables have to be present in both sources. Third and most importantly, the common variables in the sources must be sufficiently comparable. Thus, sources must use the same concepts, definitions and measurement procedures.

Assessing and mapping poverty is an important step in the fight against poverty but it should not end at that level. A clearer and better understanding of who the poor are and where and how they live should facilitate programme and project design involving the poor, as well as resource mobilization.

The present work is an empirical application of the ELL methodology, conducted in order to produce finely disaggregated maps, which describe the spatial distribution of poverty and inequality in the Commonwealth of Dominica.[1]

However, the unique feature of the present work consists of a participatory assessment conducted in order to verify the information derived from the quantitative assessment. The assessment is in the form of a field test, visiting households in some poor villages in order to verify whether it is reasonable to consider them as poor. The precision of the measures obtained, even at the household level, has also permitted proposing a potential transfer scheme targeting the poorest households.

This paper is made up of nine sections. Following this introduction, section 2 describes the theory concerning the models involved in the poverty mapping, models which are then estimated in section 4. The two sources of data used in the poverty mapping are described in section 3. Sections 5 and 6 report poverty and inequality measures and maps disaggregated at national and parish levels and village and enumeration district levels respectively. Section 7 describes how poor households have been identified and how a participatory assessment has been conducted: moreover, some validations of the results are reported. Those results have been the base of policy recommendations to the Government of the Commonwealth of Dominica, which are summarised in section 8: here we have simulated a possible transfer scheme targeting parishes, villages, districts and even households. Finally, in section 9 the policies adopted by the government are fully described.

2. Poverty Mapping

The basic idea of the ELL methodology can be explained in a simple way. With data from a smaller and a richer data-sample such as a sample survey and a census; a regression model of the target household-level variable, given a set of covariates based on the smaller sample, can be estimated. Restricting the set of covariates to those that can also be linked to households in the larger sample, the estimated distribution can be used to generate the distribution of

[1] We thank Peter Lanjouw who, personally, sent us the PovMap 1.2. release 4, and answered our questions when we first began to apply it. Now, the version 2.0 Beta release can be downloaded from http://iresearch.worldbank.org/Povmap.

consumption expenditures (y_h) for the population or sub-population in the larger sample, given the observed characteristics. Therefore the conditional distribution of a set of welfare measures can now be generated and the relative point estimates and standard errors can be calculated.

Practically, the methodology follows two steps:

a) the survey data is used to estimate a prediction model for consumption (stage one);

b) simulation of the expenditure for each household of the census, and poverty/inequality measures are derived with their relative prediction errors (stage two).

It is assumed that the model estimated from the survey data applies to census observation. Of course, the assumption is most reasonable if the survey and census years are the same. Unfortunately, this is not our case, so when interpreting results we need to consider that the poverty estimates obtained refer to the census year.

2.1. *Stage One: A Prediction Model for Consumption*

This step (stage one) consists in developing an accurate empirical model of a logarithmic transformation of the *per-capita* household consumption expenditure (rent and health expenditure excluded). Denoting by $\ln y_{ch}$ the logarithm consumption expenditure of household h in cluster c, a linear approximation to the conditional distribution of $\ln y_{ch}$ is considered:

$$\ln y_{ch} = E\left[\ln y_{ch} | x_{ch}^T\right] + u_{ch} = x_{ch}^T \beta + u_{ch} \tag{1}$$

where x_{ch}^T is the transposed (T) vector of the explanatory variables for the household h in cluster c, β is the vector of the parameters and u_{ch} is the error term of the model.

Previous experience with survey analysis suggests that the proper model being specified should have a complex error structure, in order to allow for a within-cluster correlation in the disturbances (a 'location effect' common to all the households in the same area) as well as heteroskedasticity in the household component of the error term. To allow for a within-cluster correlation in disturbances, the error component is specified as follows:

$$u_{ch} = \eta_c + \varepsilon_{ch} \tag{2}$$

where η and ε are independent of each other and not correlated with the matrix of explanatory variables.

Consistent estimation of β is clearly not sufficient for the estimation of poverty and inequality measures, which are functions of y and not of the distribution of the conditional expectation $x_{ch}^T\beta$. For this reason, once β has been estimated using OLS or feasible GLS, the ELL method uses a simulation procedure to recreate the conditional distribution of y by adding to each estimated fitted value $x_{ch}^T\hat{\beta}$ simulated values of the cluster error η_c and of the household error ε_{ch}. Because the errors u_{ch} are not *i.i.d.*, the simulated draws must take into account the clustering and heteroskedasticity. Although several different methods have been proposed for this, we consider the approach proposed in the original ELL (2003) paper: once $\hat{\beta}$ has been estimated, the first-stage residual can be decomposed into uncorrelated components as follows

$$\hat{u}_{ch} = \hat{u}_{c.} + (\hat{u}_{ch} - \hat{u}_{c.}) = \hat{\eta}_c + e_{ch}$$

Estimates of the household residual component e_{ch} are then calculated as $\hat{u}_{ch} - \hat{\eta}_c$. The variance of the ε_{ch} component is then estimated imposing an auxiliary model for heteroskedasticity.

Elbers, Lanjouw and Lanjouw (2003) propose adopting a logistic model (called Alpha Model) of the variance of the ε_{ch} conditional on a vector z of covariate (bounding the prediction between zero and a maximum A equal to $(1.05)^* \max(\varepsilon_{ch})$.

$$\ln\left[\frac{e_{ch}^2}{A - e_{ch}^2}\right] = z'_{ch}\alpha + r_{ch} \tag{3}$$

Let $\exp(z'_{ch}\alpha) = B$. Using the delta method, the household specific variance is estimated as:

$$\hat{\sigma}_{ch}^2 = \left[\frac{AB}{1+B}\right] + \frac{1}{2}\mathrm{var}(r)\left[\frac{AB(1-B)}{(1+B)^3}\right] \tag{4}$$

The point estimates and corresponding variances of $\hat{\beta}$ and the heteroskedasticity parameters, together with the empirical distributions of the error components, are the inputs of the simulation stage.

2.2. *Stage Two: Simulation*

The parameter estimates obtained from the previous step are applied to the census data to simulate the expenditures of each household in

the census. For each simulation a set of beta and alpha coefficients are drawn from the multivariate normal distributions described by the 'stage one' point estimates and their associated variance-covariance matrices.

As far as the simulation of the residual terms $\hat{\eta}_c$ is concerned, the assumption of any specific distributional form is generally avoided by drawing directly from the estimated residuals: for each cluster in the census the residual drawn is $\tilde{\eta}_c$.[2] For each household in the census a component error $\tilde{\varepsilon}_{ch}$, obtained from the empirical distributions of the errors, is assigned.

Finally, the simulated values of the household expenditure are generated as:

$$\hat{y}_{c,h} = \exp\left(x_{c,h}^T \tilde{\beta} + \tilde{\eta}_c + \tilde{\varepsilon}_{c,h}\right) \tag{5}$$

The simulation procedure is repeated, drawing a new set of coefficients, as well as new disturbance terms. For any given area, the mean across the simulations for a given statistic provides the point estimate of that statistic for that area, while the standard deviation serves as an estimate of the standard error.

2.3. *Critics of the ELL Methodology*

A recent criticism of the ELL methodology by Tarozzi and Deaton (forthcoming) states that the original paper on Poverty Mapping (ELL, 2003) does not provide either a characterization of the general properties of the procedure or a consideration of the consequences of the assumptions failure. In this critical paper a Monte Carlo simulation analysis was conducted to illustrate that there are conditions under which the ELL method can yield too optimistic precision (too small standard error). The condition under investigation in the paper is the conditional independence (CI) or area homogeneity assumption, which requires that the conditional distributions of y given x_c in a small area A is the same as in the larger region R on which the model

[2] This approach does not take into account the possible correlation among observations belonging to different clusters, and will therefore overstate the precision of the estimates. Elbers, Lanjouw and Lanjouw (2002) argue that when the inter-cluster correlation is small such conservative estimates on the standard errors will be only marginally different from those that assume no inter-cluster correlation. Demombynes, *et al.* (2007) discuss how to modify the original ELL approach.

is estimated.[3] Critics argue that in practise, a model of income or expenditure estimated using household survey data at the level of region, R, is unlikely to be valid for predicting welfare at the level of a small area A, unless the region R happens to be quite homogenous. Ideally one could estimate a separate model for each area A. However no sample survey is representative at the small area level. Thus the ELL approach, in order to capture area heterogeneity, inserts a set of variables aggregated at the small area level into the model covariates, which are calculated from the census, or obtained from ancillary data source. To validate the success of the method in this respect, Elbers, Lanjouw and Leite (2008) examine the accuracy of the poverty estimates and assess whether the confidence intervals produced are correct. In the paper mentioned a real validation task was possible, on the basis of the information provided by the Census.

We retain that, in general, the CI assumption seems to be a demanding assumption. We believe however that the empirical setting of the poverty mapping is fundamental in the discussion of such a hypothesis. It could happen that the spatial correlation of welfare is at least partially captured by observable household and location characteristics. Consequently, it is not obvious that area heterogeneity would result in a large spatial correlation of unobservable location effect.

3. Data Sources

3.1. *The 2001 Census*

The poverty and inequality mapping in the Commonwealth of Dominica was conducted in the period December 2005 - February 2006; the reference year is 2001, the year of the collection of the *Population and Housing Census*, and is based on 22,359 households and 68,646 individuals.

The Census data set has been revised since the Country Poverty Assessment (CPA, June 2003), and the Central Statistical Office (CSO)

[3] According to Tarozzi and Deaton (forthcoming), in the estimation of small area statistics the CI assumption is demanding, due to the many possible sources of heterogeneity in the relationship between the potential predictors and y across different areas. For example, local labour markets, local rental markets, relative prices, environmental differences etc. could be responsible for the heterogeneity.

of the Commonwealth of Dominica released the final version in December 2005. For the present work, the authors had indirect access to the Census data through the Central Statistical Office during the two visits in the month of December 2005 and February 2006.

Table 1 reports the official population in the Commonwealth updated in December 2005 and in the 10 parishes and the capital, Roseau.

Table 1

Population in Dominica, Census 2001, revised version as of December 2005

Partition	*Number of Households*	*Number of Individuals*
Dominica	22,359	68,646
Urban	5,261	16,946
Semi-urban	5,442	15,734
Rural	11,656	35,966
Roseau	4,416	14,224
Rest of St. George	1,636	5,165
Parish of St. John	1,908	5,276
Parish of St. Peter	527	1,421
Parish of St. Joseph	2,103	5,636
Parish of St. Paul	2,664	8,325
Parish of St. Luke	540	1,558
Parish of St. Mark	617	1,873
Parish of St. Patrick	2,667	8,269
Parish of St. David	1,949	6,743
Parish of St. Andrew	3,332	10,156

Source: Central Statistical Office.

3.2. *The 2002 Survey of Living Conditions*

The Survey of Living Conditions was conducted in 2002, the sample frame used was that from the 2001 Census. A systematic sample of

one in every ten occupied households in May 2001 was drawn from this sample frame for every second enumeration district (ED). Half the EDs were therefore sampled: this is also because it was considered impractical for logistic reasons to sample all EDs. The original sample size consisted of 1,182 households, which yielded 938 valid questionnaires. Response and sampling rates varied between EDs and parishes; for this reason a 2-stage weighting process was adopted that involved the successive calculation of ED and parish weights (CPA, 2003).

The questionnaire consisted of a single questionnaire with three sections (CPA):

Section 1 was concerned with basic housing characteristics (Part 1), household information (Part 2) and data on the demographic and economic characteristics of persons living in the household (Part 3);

Section 2 (the most important) collected data on household expenditure including food expenses (Part 1), consumption of home production (Part 2), other recurrent household expenses (Part 3), clothing (Part 4), travel and transportation (Part 5), education and health (Part 6), recreation and leisure (Part 7), housing and household furnishing (Part 8), and other spending (Part 9);

Section 3 collected data on household income from employment, business, support from family, friends and government pensions.

Also for the SLC, the CSO revised the data set releasing an updated version in December 2005. This final version used in the present poverty mapping exercise was based on 938 households. A full description of the construction of the final data set is reported in Betti, Ballini and Neri (2006).

The two sources of data should be fully analysed in order to identify the common concept and to construct the common variable to be compared. The original Census and SLC variables should be transformed in order to get comparable variables.

In principle, some variables collected in the SLC survey may present some missing values; in such cases it is useful to impute them in order to avoid the loss of statistical units (and therefore degrees of freedom) in the estimation of the linear regression model with variance components. The imputation procedure proposed here is based on the 'Sequential Regression Multivariate Imputation' (SRMI) approach adopted by the imputation software (IVE-ware, Raghunathan, *et al.* (2001)).

4. Implementation of the Method

4.1. *A Prediction Model for Consumption*

This step consists in estimating the logarithm consumption expenditure model (1) (named Beta Model) using a feasible Generalized Linear Model.

It is important to emphasise that the ELL approach, and thus our application, depends on the model specification that is chosen from the set of matched[4] variables between the survey and the census, including also, local level variables, in order to capture small area heterogeneity. At first, separate regression models were estimated for the urban/semi-urban area and for the rural area, in order to avoid forcing the parameter estimates to be the same for the whole country. Specifying the different models, the whole procedure of poverty mapping wasperformed. The results obtained were not reasonable, maybe because of the insufficient sample size in each partition. After this previous analysis it was decided to perform the analysis considering one model for the whole sample survey.

Since the specification of the model is affected by the choice of weighting/not weighting, the decision on whether or not to use the weighting system is an important one. In computing this test, under the null hypothesis, it is assumed that the regressions are homogeneous across strata, and that weighted and unweighted OLS estimators are unbiased, so the difference between them has an expectation of zero. After computing the variance-covariance matrix of the difference between the weighted and the unweighted OLS estimator, the test can be implemented. However, the easiest way to test the hypothesis is to run an "auxiliary" regression, where the covariates are the original covariates X and the product between the covariates and the weights ($WX = W^*X$), and to use an F statistic to test the hypothesis $H_0 : g = 0$ (where g is the vector parameter of the WX matrix). This test is a special case of the Hausman test described in Deaton (1997); it has been applied using the encompassing model

[4] The definition of the covariates of the Beta Model is a fundamental task in the poverty mapping. The aspects to take into account before the specification of the model are: i) the vector of potential covariates to use in the regression model, which have to be present in both the survey and the census data; ii) the common covariates require the use of common concepts, definitions and measurement procedures; and iii) the common covariates belonging to both data source must have a similar distribution.

(the model having as regressors all the available variables, taking the problem of multicollinearity into account). Performing the Hausman test leads to the rejection of the null hypothesis, so we decided to use the household weights in the model specification.

The results of this estimation step are in table 2. The adjusted R square coefficient is quite satisfying, about 0.62. The high level of the adjusted R square is quite surprising, considering that in the final model only household covariates have been inserted.[5] In that model the null hypothesis of homoskedastic errors (White, 1980) has been tested and the hypothesis has not been rejected. In order to have more proof of the homoskedasticity of the error component, residual plots have been analysed and the test results have been confirmed. It follows that the estimation of the model for the variance of the idiosyncratic part of the disturbance σ^2_{ch} has been skipped.

With regard to the estimation of variance $\text{var}(\sigma^2_\eta)$, it is important to note that in order to estimate the variance of the location effect it is necessary to have more than two households within each cluster, because otherwise it is not possible to estimate the variance within each cluster. This is why, at the beginning of the procedure, we decided to re-define the cluster with more than four households per cluster.

Any location effect found in either the estimation or the simulation phase is assumed to be entirely a cluster level effect.[6] This is an optimistic assumption that rules out any correlation at a higher level.

[5] In the specification of the final Beta Model there are no location covariates, because none of them appeared to be significant. The results appeared immediately strange, so another analysis was conducted before accepting these results. We considered some indicators of development computed at the cluster level, and the mapping of these values show, effectively, a little heterogeneity among different areas.

[6] In principle there can be many levels at which a location effect occurs, so one could specify the error of the model distinguishing the area level effect (for example village level), the cluster level effect (enumeration district level), alongside the household level effect. If this is the case, then Tarozzi and Deaton (forthcoming) draw on Monte Carlo evidence to show that even a small location effect could result in a major widening of the confidence interval around each parish level estimate. The ELL approach does not permit separating the overall location effect into the area level effect and the cluster level effect, and in general just a single location effect can be computed. In order to justify such an assumption, Elbers, Lanjouw and Leite (2008) examined this issue with data from Brazil and found little evidence of a location effect extending beyond the cluster level, once adequate cluster level covariates are included in the Beta Model. However the issue is clearly empirical and may vary from country to country.

We can observe that the estimated share of the location component with respect to the total residual variance represented by $Rho = \frac{\sigma_\eta^2}{\sigma_u^2}$ accounts for less than 6 percent of the total variance. Thus it was decided to eliminate the location effect, reducing the total residual to $u_{ch} = \varepsilon_{ch}$. Concluding Stage 1, it is worth looking at the estimated coefficient parameters (table 2), in order to understand the effect of the covariates on the transformed equivalent expenditure.

The covariate effects are quite reasonable: the parameters of the dummy variables from DEC4 to DEC10 (from the fourth to the tenth decile of the income distribution[7]) are very significant and have a positive value (most significant are the coefficients of DEC6-DEC10).

Table 2

Beta Model: Parameter Estimates, Standard Errors and Significance Levels

Variable	*Parameter Estimate*	*Standard Error*	*Significance Level a/*
Intercept	8.0000	.098	***
DEC4	.1718	.065	***
DEC5	.1630	.066	**
DEC6	.2776	.067	***
DEC7	.2834	.070	***
DEC8	.4595	.072	***
DEC9	.3963	.082	***
DEC10	.4830	.109	***
URBAN_D	.0425	.054	
OWNER_A	.1357	.060	**

[7] Both the Census and SLC collected some limited information on income; in both surveys the question "What was your total household income for the last 12 months?" was asked to the household head, showing a flash card with 17 income groups. From those income groups an income distribution has been empirically estimated and the values have been converted into income deciles. This information is not fully reliable, but there is enough correlation between income deciles and consumption expenditure to validate the use of income as regressor in the model.

Table 2
(*continuación*)

Variable	*Parameter Estimate*	*Standard Error*	*Significance Level a/*
OWNER_B	.1594	.072	**
WALL_A	.2077	.045	***
WALL_B	.1561	.055	***
FUEL_A	.1465	.053	***
ROOMS_5	.0859	.062	
TV	.1682	.051	**
STOVE	.1554	.061	***
TELEPHONE	.2593	.049	***
WASHING	.0988	.043	**
VEHICLES	.3381	.057	***
SEX	-.0863	.042	**
CL_AGE_55_64	-.1536	.052	***
EDU_UNI	.4038	.092	***
WORK_PENS	.2677	.055	***
SIZE	-.2032	.031	***
SIZE2	.069	.003	**
NUM_0_5	.054	.036	
NUM_WORK	-.047	.029	
NUM_PENS	-.1391	.044	***
ELDEST_SON_AGE	-.0042	.002	**
TYPE_FAMD2	.2190	.068	***
PARISH_17	-.1590	.109	
PARISH_19	-.2623	.067	***
DEC10_ROOMS_5	.3034	.128	**
DEC9_TYPE_FAMD2	.4900	.186	***
DEC10_PARISH_17	-.9144	.559	***
DEC9_PARISH_19	.9181	.331	***

Table 2
(*continuación*)

Variable	*Parameter Estimate*	*Standard Error*	*Significance Level a/*
DEC10_NUM_0_5	.2447	.090	***
URBAN_D_ VEHICLES	.1709	.92	*
Observations	**938**	**Clusters**	**117**
R-squared	**.6382**	**Adj-R-squared**	**.6229**
Sigma eta	**.1271**	**RMSE**	**.5235**
Rho	**.0589**	$var(\sigma_\eta^2)$	**.000054**

Note: a/ ***p-value < 0.01, **0.05 < p-value < 0.01, *0.1 < p-value < 0.05.

Being owner or renter of the house (OWNER_A, OWNER_B) has a positive effect on housing expenditures. Having a house built with brick blocks, wood and concrete (WALL_A and WALL_B), as well as having five or more rooms (ROOMS_5), also has a positive effect on housing expenditures, as well as having gas, LPG or cooking gas (FUEL_A). Furthermore,a set of durable goods has a significant positive effect on expenditures, particularly: a TV, a dish washer, a telephone, a washing machine, or a vehicle.

With regard to the head of household characteristics, being female (SEX), as well as belonging to the age class 55-64 years old (CL_AGE_55_64) has a negative effect on expenditures; on the other hand, a head of household having a university education (EDU_UNI) has a reasonably positive effect on expenditures as does a head of household working or having a pension (WORK_PENS).

With regard to the household characteristics, the expenditure increases as the household size increases (the variable AGE^2 is also significant, but the parabola has a maximum in AGE equal to 14.7). Expenditures also increase if the number of household members who are less than five years old increases. The increase in the number of retired person (NUM_PENS) reduces expenditures (the effect is probably connected to the age of the retired persons). The increasing age of the eldest son (ELDEST_SON_AGE) has also the same effect.

Concluding with the household typology, being single and less than 65 years old makes expenditures increase (TYPE_FAMD2). As far as the administrative partitions are concerned, living in St. David Parish (PARISH_19) reduces equivalent expenditures. This is reasonable given that the Carib territory is enclosed in this parish.

Let us consider now the interaction variables with positive effects:

- belonging to the tenth decile of the income distribution and having housing with five or more rooms (DEC10_ROOMS_5);
- belonging to the ninth decile of the income distribution and being single and less than 65 years old (DEC9_ROOMS_5 _ TYPE_FAMD2);
- living in Parish 19 means belonging to the ninth decile of the income distribution (DEC9_PARISH_19);
- living in an urban area and having a vehicle at one's disposal (URBAN_D_VEHICLES).

In the set of the interaction variables, the variable indicating a household belonging to the upper tail of the income distribution and living in Parish 17 has a negative effect (DEC10_PARISH_17: the significance level of the coefficient is 90%, p-value =0.10).

4.2. *Simulation of Consumption Expenditure*

The parameter estimates obtained from the previous step are applied to the census data so as to simulate the expenditure for each household in the census. The simulated values are based on both the predicted logarithm of expenditure $x'_{ch}\tilde{\beta}$, and on the disturbance terms $\tilde{\eta}_c$ and $\tilde{\varepsilon}_{ch}$ using bootstrapped methods:

$$\ln \hat{y}_{ch} = \exp\left(x_{ch}^T \tilde{\beta} + \tilde{\eta}_c + \tilde{\varepsilon}_{ch}\right) \tag{6}$$

where $\tilde{\beta} \sim N(\hat{\beta}, \hat{\Sigma}_\beta)$.

In the simulation step, the Beta coefficients, are drawn from a multivariate normal distribution with mean $\hat{\beta}$ and variance covariance matrix equal to the one associated to $\hat{\beta}$. For each household the disturbance terms[8] are drawn from the empirical distribution estimated from the survey data.

[8] Using PovMap 1.2 release 4, the user must analyse the residuals manually, in order to identify the best fitted distribution. In our analysis we consider only the

The simulation procedure was repeated 100 times, each time drawing a new set of coefficients and disturbance terms and finally the simulated consumption expenditure. At the end of the procedure the final data set contains, for each household in the census, one hundred simulated household equivalent incomes.

Disaggregating the final dataset for any given location (parish, village) a set of poverty and inequality measures was calculated, one for each of the simulated consumption expenditure distributions. Now, the means of the measures, calculated across the simulations, constitute the point estimates of the measures, while the standard deviations across the simulation constitute the standard errors of these estimates.

5. Results: Maps at National and Parish Level

5.1. *Introduction*

The procedure for estimating the poverty and inequality measures has been applied for the whole of Dominica and disaggregated at four levels:

a) Rural - urban level;

b) The 10 parishes and the City of Roseau;

c) The 118 villages;

d) The 295 enumeration districts;

For any given location, the means constitute the point estimates, while the standard deviations are the bootstrapping standard errors of these estimates. Tables 3 and 4 report poverty and inequality measures and their bootstrapping errors for the whole of Dominica and are disaggregated at urban, semi urban and rural levels, and by the ten parishes and the town of Roseau. The disaggregations are very useful for comparing these results to those obtained by the revised version of SLC (Betti, Ballini, Neri (2006)).

---

idiosyncratic component $\hat{\varepsilon}_{ch}$. Computing a Kolmogorov-Smirnov test of normality, the normality hypothesis is accepted at the 5 percent level (p-value=0.0429). However it seems much more reasonable to avoid parametric distribution and draw the error component from the empirical residual distribution.

5.2. *Results at National Level*

The incidence of poverty in the Commonwealth of Dominica is very high. About 31 percent of households (table 1) and 37 percent of individuals (table 3) are below the poverty line. These results are in line with those obtained from the Survey of Living Conditions officially calculated in the Country Poverty Assessment, where the corresponding values were 29 percent for households and 39 percent for individuals. As expected, the poorest households are also those with more family members. This gap between household and individuals in the population (census) seems to be smaller than in the survey. It is clearly evident that the incidence of poverty in Dominica is one of the highest in the Caribbean area. However, the head count ratio index (HCR) simply measures the proportion of the population below the poverty line, but does not take the intensity and the severity of poverty into account.

A measure of the intensity of poverty, the Poverty Gap Ratio - FGT(1) - is about 11 percent for households and 14 percent for individuals. This figure locates Dominica in an average position among the Caribbean countries; this could be interpreted as meaning that many of the poor families and individuals in Dominica are just below the poverty line. This is confirmed by the severity index (FGT(2) = Poverty Gap squared) which is about 5 percent for households and 7 percent for individuals, and by the Gini concentration index among the poor which is about 20 percent for both households and individuals.

Bearing this information in mind, policy makers should propose anti-poverty strategies so as to bring those many individuals just above the poverty line: noting the figures in tables 3 and 4, these strategies should be quite inexpensive. For further details see section 8 on policy recommendations. On the other hand, all the inequality measures (Gini, General Entropy, Atkinson and the Gini among the poor - Ginipov) show large inequality in the consumption distribution, underlining considerable differences between the poor and the non-poor in the country. When disaggregating the country into urban, semi-urban and rural areas, the incidence, intensity and severity of poverty is increasing from urban to non-urban areas. However, inequality in urban areas is still high, showing the presence of the majority of the very rich households and individuals.

Table 3

Poverty and Inequality Indices at the Household Level (%)

Census, 2001

Partition	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
Dominica	30.91	10.96	5.33	43.99	19.05	8.76	33.58	34.13	51.87	7286
	5.01	2.32	1.32	0.92	1.08	2.26	1.50	1.78	1.39	878
Urban	19.89	6.32	2.86	43.18	17.09	4.53	32.38	32.54	52.74	9432
	4.16	1.61	0.82	1.08	1.04	1.35	1.66	1.99	1.52	1257
Semi urban	27.53	9.29	4.36	43.12	18.06	7.19	32.12	32.64	53.35	7703
	4.98	2.15	1.17	0.97	1.03	2.03	1.50	1.84	1.41	922
Rural	37.46	13.83	6.90	42.81	19.76	11.72	31.61	32.20	53.89	6123
	5.58	2.80	1.66	0.83	1.16	2.93	1.32	1.53	1.32	724
St. George	21.24	6.79	3.08	42.87	17.18	4.94	31.80	32.20	53.50	8938
(Roseau)	4.39	1.71	0.88	1.08	1.06	1.47	1.64	2.00	1.53	1181
Rest of	21.50	7.08	3.28	43.85	17.68	5.14	33.64	33.45	51.31	9322
St. George	4.05	1.71	0.92	1.31	1.24	1.46	2.04	2.52	1.74	1168
St. John	27.77	9.37	4.39	41.89	17.95	7.25	30.32	30.37	54.86	7440
	5.06	2.27	1.26	1.17	1.29	2.14	1.79	2.06	1.81	893
St. Peter	31.53	10.75	5.06	39.96	18.10	8.64	27.30	27.43	58.26	6450
	5.77	2.56	1.42	1.30	1.43	2.55	1.83	2.36	1.96	785
St. Joseph	30.04	10.20	4.81	41.71	18.17	8.10	29.92	30.26	55.50	6999
	5.39	2.34	1.28	1.05	1.09	2.29	1.60	1.87	1.61	843

Table 3
(*continued*)

Partition	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
St. Paul	22.45	7.40	3.42	44.36	17.62	5.41	34.33	34.39	50.91	9199
	4.21	1.72	0.91	1.19	1.03	1.50	1.90	2.25	1.69	1153
St. Luke	27.92	9.23	4.26	40.82	17.63	7.17	28.54	28.83	56.91	7126
	5.27	2.25	1.21	1.35	1.49	2.11	1.93	2.32	2.14	832
St. Mark	36.33	13.41	6.72	42.15	19.90	11.29	30.78	30.75	54.15	6174
	5.73	2.81	1.65	1.28	1.39	2.89	1.93	2.37	1.96	747
St. Patrick	40.90	15.29	7.70	41.27	20.01	13.37	29.27	29.63	56.11	5511
	5.97	3.02	1.81	0.90	1.22	3.30	1.37	1.60	1.49	655
St. David	49.86	20.03	10.55	42.31	21.35	18.72	30.61	31.93	55.48	4737
	6.32	3.66	2.34	1.16	1.34	4.27	1.77	2.29	1.72	572
St. Andrew	37.75	13.69	6.75	41.75	19.35	11.64	29.88	30.41	55.73	5938
	5.80	2.87	1.68	0.87	1.19	3.01	1.33	1.62	1.37	699

Table 4

Poverty and Inequality Indices at the Individual Level (%)

Census, 2001

Partition	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
Dominica	36.68	13.87	7.07	44.18	20.44	11.69	34.01	34.36	51.28	6438
	5.32	2.69	1.62	0.94	1.17	2.80	1.53	1.78	1.41	786
Urban	24.82	8.28	3.87	43.05	17.94	6.25	32.15	32.39	53.03	8230
	4.86	2.01	1.07	1.13	1.16	1.82	1.73	2.09	1.63	1106
Semi urban	32.17	11.48	5.62	43.08	19.18	9.30	32.20	32.38	52.99	6936
	5.28	2.46	1.41	0.95	1.13	2.46	1.48	1.74	1.42	844
Rural	44.23	17.56	9.22	43.29	21.32	15.72	32.43	32.93	53.00	5376
	5.76	3.21	2.02	0.84	1.26	3.57	1.36	1.50	1.36	644
St. George	26.41	8.85	4.16	42.58	18.05	6.81	31.34	31.80	53.98	7768
(Roseau)	5.12	2.13	1.15	1.07	1.18	1.98	1.62	1.96	1.59	1031
Rest of	26.03	9.11	4.40	43.82	18.79	6.92	33.75	33.25	51.00	8289
St. George	4.46	2.04	1.15	1.31	1.40	1.83	2.07	2.36	1.93	1048
St. John	34.48	12.38	6.06	42.12	19.08	10.20	30.61	30.78	54.73	6432
	5.63	2.77	1.64	1.09	1.47	2.83	1.64	1.87	1.67	773
St. Peter	36.17	12.80	6.19	39.73	18.76	10.74	27.08	27.34	58.55	5846
	6.52	2.96	1.68	1.55	1.58	3.14	2.15	2.93	2.27	717
St. Joseph	34.18	12.30	6.05	41.99	19.36	10.16	30.52	30.56	54.58	6447
	5.62	2.58	1.48	1.03	1.18	2.66	1.59	1.84	1.68	785

Table 4
(*continued*)

Partition	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
St. Paul	26.34	9.06	4.31	44.06	18.35	6.89	33.89	33.81	51.28	8242
	4.69	2.03	1.11	1.30	1.14	1.87	2.08	2.41	1.90	1063
St. Luke	32.67	11.30	5.40	40.19	18.43	9.19	27.78	27.94	57.60	6332
	5.92	2.66	1.49	1.41	1.65	2.64	2.04	2.25	2.45	745
St. Mark	43.60	17.28	9.10	42.52	21.41	15.44	31.52	31.76	53.36	5338
	6.10	3.32	2.08	1.40	1.59	3.65	2.17	2.65	2.34	662
St. Patrick	47.36	19.05	10.11	41.87	21.64	17.51	30.33	30.42	54.78	4905
	5.99	3.38	2.17	1.05	1.38	3.90	1.63	1.83	1.72	595
St. David	58.53	25.49	14.14	42.49	22.99	25.17	30.82	32.19	55.43	4013
	6.22	4.19	2.89	1.14	1.50	5.09	1.77	2.17	1.81	490
St. Andrew	43.66	16.92	8.74	42.14	20.76	15.11	30.58	31.01	54.88	5312
	5.96	3.22	2.00	0.87	1.33	3.58	1.36	1.56	1.46	632

5.3. *Results at Parish Level*

Even if measures of the incidence of poverty are quite high in every parish in Dominica, those measures show quite a high local heterogeneity: the head count ratio ranges from 21-22 percent in St. George and St. Paul (26 percent for individuals) to 50 percent in St. David (58 percent for individuals). These figures are, in some cases, different from the figures from SLC and are reported in the Country Poverty Assessment: the main reason could be the fact that estimates based on the Survey are affected by an enormous sampling error, since the sample size is significant for estimates at country level, but not at the level of the parish. In fact, in some parishes, the sample size is just above 20 households, so that the confidence interval of the head count ratio can be so large as to invalidate any inference exercise. Another source of diversity is due to the different reference year: the estimates reported in the present report are based on Census data and therefore refer to the 2001; while there can be little difference between the head count ratio at country level from 2001 and 2002, probably larger differences can occur when disaggregating at parish level, since the economic situation changes according to different parishes.

Measures of poverty intensity and severity (FGT(1) and FGT(2)) give the same picture of the parishes as the measure of incidence (head count ratio). On the other hand, the three Parishes of St. George (including Roseau), St. John and St. Paul show quite a high inequality with all the measures calculated. This confirms the fact that rich areas are still characterised by high inequality and therefore are still in a process of transition towards further development.

Figure 1 shows maps of the percentage of households and individuals in poverty at parish level. In each map in this section and in section 6, the parishes (or enumeration districts) are divided into four groups: the central threshold is usually indicated by the national average, so that it is possible to distinguish the parishes (or enumeration districts) that are better off from those that are worst off. Moreover the other two thresholds (the upper and the lower) have been found so that a similar number of parishes (or enumeration districts) is located in the better or lower group.

6. Maps at Village and Enumeration District Level

The procedure for estimating the poverty and inequality measures has been applied for the whole of the country, for the parishes and

then disaggregated at village level and enumeration district (ED) level. The Central Statistical Office has provided the authors with the software for producing maps at ED level. As in the case of Dominica and parishes, for any given village, the mean of the 100 simulations constitutes the point estimate, while the standard deviation is the bootstrapping standard error of these estimates. Moreover, the indicators have been computed at the household and at individual level.

Figure 1
Percentage of Households and Individuals in Poverty at Parish Level

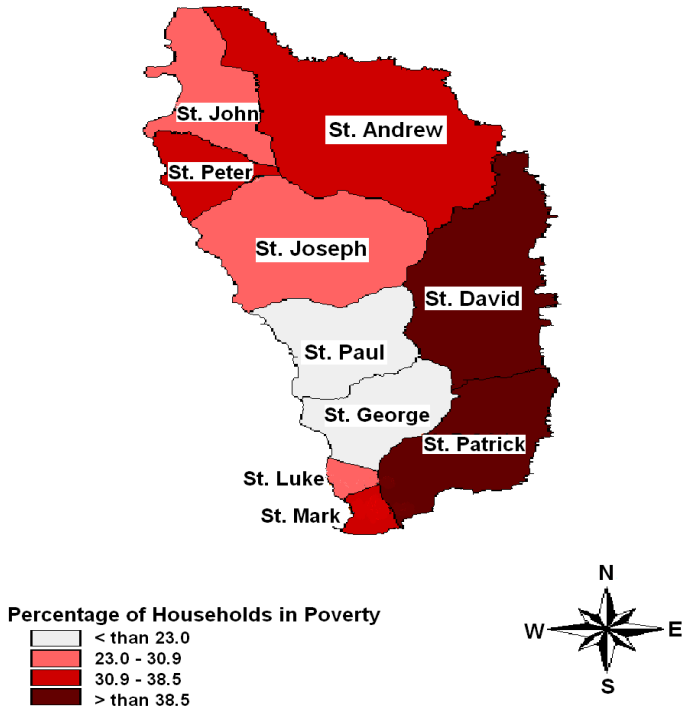

Figure 1
(*continued*)

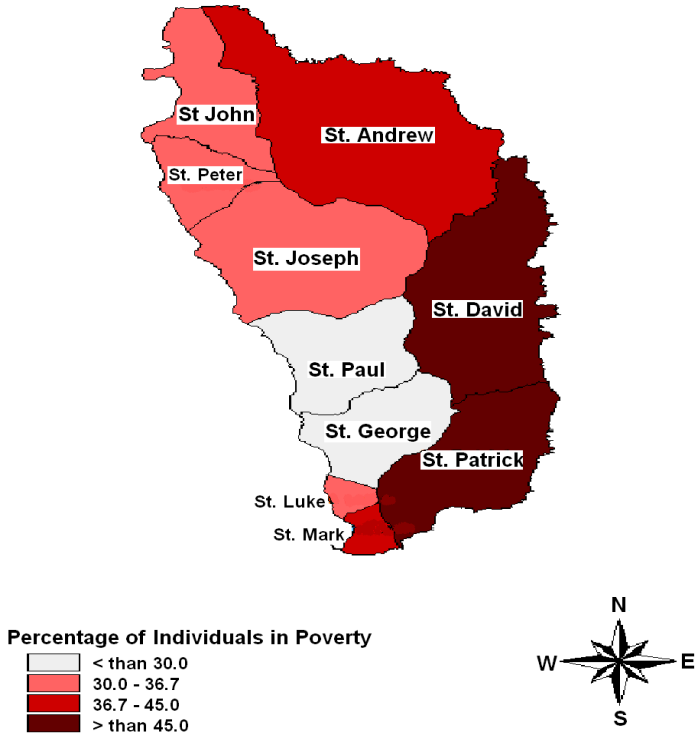

Table 5 reports poverty and inequality measures at household level for villages in the Parish of Roseau. For sake of space the estimates for villages in other parishes are not reported here; anyway, the most important outcomes are taken into account later so as to better target anti-poverty actions proposed in section 8 regarding policy recommendations.

Table 5 shows how limited the standard errors of poverty and inequality measures still are even when they are based on a few hundred households in the census.

Table 5

Household Estimates and Standard Error: Roseau

Village (Hhs per village)	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
Bath Estate/	15.45	4.44	1.86	42.15	15.33	3.01	30.35	31.32	55.58	10165
Elmshall (528)	4.01	1.33	0.62	1.82	1.57	1.03	2.70	3.38	2.62	1329
Citronier,	15.08	4.51	1.95	43.68	16.72	3.12	32.92	33.11	52.58	11012
Castle Comfort	4.16	1.38	0.69	3.13	2.67	1.10	4.66	6.10	3.92	1570
(seaside) (157)										
Fond Cole	29.01	9.81	4.62	40.61	18.11	7.75	28.28	28.47	57.09	6897
(407)	5.95	2.58	1.42	1.55	1.65	2.46	2.22	2.65	2.44	916
Fortune/Melville	23.81	7.49	3.40	38.72	18.82	5.95	25.54	24.58	59.57	7539
Battery (62)	6.45	2.49	1.34	3.54	4.09	2.06	4.56	5.19	4.87	1104
Goodwill	15.60	4.62	2.00	41.26	16.06	3.17	29.43	29.30	55.52	10146
(640)	3.92	1.34	0.65	1.48	1.48	1.07	2.16	2.76	2.16	1395
Gutter Village	29.96	9.19	3.99	38.59	16.31	7.39	24.88	25.29	61.72	6544
(in city of Roseau)	6.90	2.84	1.59	3.19	2.79	2.73	4.14	5.33	4.38	899
(91)										
Kingshill	21.75	6.74	2.99	41.05	16.62	4.94	28.78	29.26	56.86	8272
(481)	4.98	1.83	0.94	1.47	1.58	1.62	2.11	2.70	2.10	1131
Louisville/Silver	28.43	11.13	5.81	48.04	21.53	8.72	41.68	39.64	43.52	9104
Lake (102)	5.25	2.65	1.71	3.21	2.64	2.49	5.68	6.60	4.37	1391

Table 5
(*continued*)

Village *(Hhs per village)*	*HCR*	*FGT(1)*	*FGT(2)*	*Gini*	*Ginipov*	*SEN*	*GE(0)*	*GE(1)*	*Atk*	*Eq_con*
Newtown	33.09	11.15	5.25	40.82	18.21	9.21	28.34	29.18	57.61	6388
(266)	6.20	2.66	1.46	1.93	1.62	2.66	2.71	3.61	2.73	832
Pottersville	19.99	6.33	2.85	42.78	17.16	4.55	31.62	31.78	53.61	9224
(318)	4.36	1.65	0.86	1.94	1.86	1.38	2.91	3.68	2.83	1305
Roseau	21.85	6.96	3.16	40.48	17.15	5.11	28.24	28.15	56.80	8189
(671)	4.67	1.87	0.98	1.32	1.48	1.61	1.86	2.29	1.93	1080
Simon Bolivar	9.34	2.38	0.92	39.30	23.62	2.02	26.09	26.31	59.97	11722
Housing Scheme	4.42	1.48	0.68	2.85	21.88	0.80	3.92	4.88	4.43	1806
(92)										
St. Aroment	4.81	1.22	0.47	39.53	24.14	0.95	26.91	26.44	58.02	15843
(192)	2.27	0.64	0.30	2.34	27.59	0.36	3.28	3.84	3.76	2592
Stock Farm	30.61	10.47	4.92	43.32	18.12	8.36	31.95	33.06	54.39	7158
(189)	6.50	2.81	1.56	2.57	2.17	2.76	3.77	4.94	3.34	1094
Tarish Pit	28.33	9.44	4.38	40.61	17.80	7.40	28.07	28.30	57.64	7016
(133)	5.85	2.55	1.46	2.51	2.47	2.38	3.42	4.33	3.48	990
Yam Piece	31.93	10.93	5.18	40.49	18.65	8.96	27.89	27.57	57.66	6537
(87)	6.92	3.10	1.78	3.56	2.62	2.91	5.07	6.02	5.22	1001

For sake of space we present the analysis on enumeration districts only with respect to the head count ratio (HCR) at the household level, parish by parish. A general consideration is due: in Roseau and in the rest of St. George, in the parishes of St. Peter and St. Paul there are districts presenting very low HCR levels (below 10 percent), while in the Parishes of St. Luke, St. Mark, St. Patrick, St. David and St. Andrew the minimum HCR at district level is greater than 20 percent.

Figure 2 shows the maps corresponding to the percentage of poor households and individuals at the ED level. Other poverty and inequality measures can be provided by the authors upon request.

Figure 2
Percentage of Households and Individuals in Poverty at ED *Level*

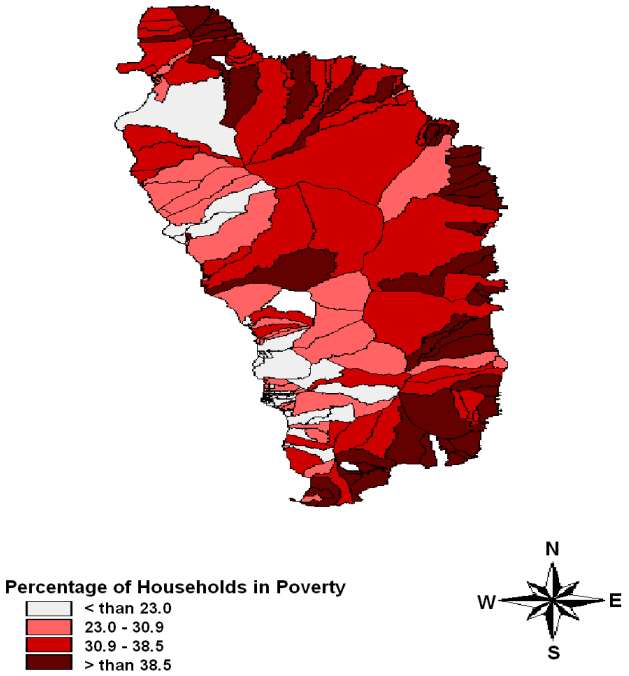

Figure 2
(*continued*)

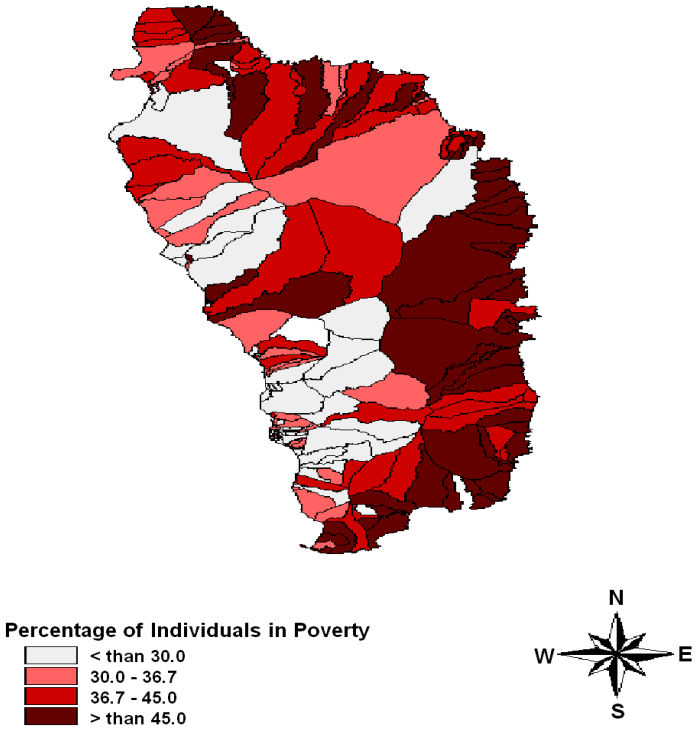

Table 6 reports decomposition of one of the general entropy class inequality measures (GE(1), Theil Index) into its within area and between area components at various levels of aggregation. By definition, all of the inequality is within group when the group in question is the whole country or is the rural area or urban area, and all of it is between groups when each household is considered as a separate group. GE(1) index is decomposable so that we are able to distinguish among the inequality due to differences between a certain level of disaggregated areas (parishes, villages, enumeration districts, etc.) and the inequality due to the differences between households present in the

disaggregated area. From table 6 we can see that in the whole country and in both rural and urban areas, a large portion of the inequality is due to within-group inequality, even when the groups are relatively small, such as enumeration districts. Approximately 8 percent of the inequality in Dominica is between parishes, 13.6 percent between villages, and 17.2 percent between enumeration districts.

Table 6

Decomposition of the GE(1) inequality index (Theil)

Level of Decomposition	Number of Units	Within-Group Inequality	Between-Group Inequality	% Between-Group Inequality
Dominica	**1**	**34.36**	**0**	**0**
Urban - semi urban - rural	3	32.63	1.73	5.0
Parishes	10	31.68	2.68	8.0
Villages	118	29.68	4.68	13.6
Enumeration Districts	295	28.43	5.93	17.2

7. Identification of Poor Households and Partecipatory Assessment

7.1. *Identification of Poor Households and Individuals*

Poverty and inequality measures have been presented for different levels of disaggregation: at the rural – urban level, at the level of the parish, at the level of the village and finally at level of the enumeration district. The method proposed here allows a finer level of disaggregation to be reached, up to the household level: in fact the method provides simulated household equivalent consumption expenditure for each household of the Census.

Having a set of simulated household equivalent consumption for each household, we are able to compute the average household equivalent consumption for each household; if this value is below the poverty

line we can conclude that the household is poor. For the average household equivalent consumption we are able to compute the bootstrap standard error. Of course the greater the level of disaggregation considered, the greater the value of the standard error will be. Therefore at the household level we can expect to have the largest standard error possible.

7.2. *Participatory Assessment*

In order to verify the information derived from the quantitative assessment a participatory assessment was conducted. This was in the form of a field test, so as to test the methodology also at the household level. The idea of the test was to visit households in some poor villages in the Parishes of St. David (Carib territory) and St. Mark in order to check whether it was reasonable to consider them as poor.

In order to conduct these field tests, the consultants randomly selected a set of households classified as poor in the quantitative assessment from each village. The selected units were visited at home by the consultants as well as by a local researcher from the Ministry of Finance and the National Statistical Office. Fifty households wereselected from each of the two parishes. The results of the participatory assessment were absolutely consistent with the results of the quantitative assessment: all but one of the households visited showed a real status of poverty. However, the members of this household explained that the living conditions had recently changed because some members had found a new job. In conclusion, the field test gave very satisfying results even at the household level.

7.3. *Validation of the Results*

To substantiate the surprising results of the field test, another check was conducted. This additional test consists in assessing how well village poverty measures can be "explained" in a regression on variables estimated at the level of the village on the basis of Census data sources. This type of analysis was conducted at the level of the village as well as at that of the enumeration district, considering the mean equivalent consumption and the head count ratio (HCR) as dependent variables of the model. The results satisfy our expectations; in fact, as can be seen from table 7, the R- square coefficient is always greater than 0.9.

Table 7

Value of the R- square Coefficients

	Mean Eq_Con	*HCR*	*Log(HCR)**
Village Level	0.93	0.92	0.93
ED Level	0.90	0.92	0.91

Note: *The model for Log(HCR) has been estimated also in order to avoid heteroskedasticity problems found in the specification of the model for HCR.

8. Policy Recommendations to the Government of Dominica

Even though the poverty and inequality exercise was completed in February 2006, one should bear in mind that the reference year for the results is the year 2001, i.e. when the Census information was collected. For this reason the results cannot be used in monitoring poverty and in evaluating the framework for poverty reduction proposed in the Country Poverty Assessment (2003), undertaken by the Government of the Commonwealth of Dominica, and included in the Growth and Social Protection Strategy (GSPS). The CPA and GSPS have indicated the individual and household categories at risk of poverty and have proposed anti-poverty policies for those categories. The added value of the poverty mapping exercise consists in assessing WHO those individuals and households are and WHERE they live.

8.1. *Integration of Poverty Reduction Policies and Programmes*

The poverty mapping work could be useful for proposing anti-poverty policies or for integrating policies already proposed and undertaken by Poverty Reduction Policies and Programmes. Those policies or programmes could be implemented at least at three levels:

- ◇ short term: to individuals or households through economic/ monetary support;
- ◇ medium term: to enumeration districts and villages (projects at local level);
- ◇ long term: via structural changes in the country (education, training, investments with an eye on the sustainable growth).

8.1.1. Short Term Policies and Programmes

At present, the public assistance programme (PA) is co-ordinated by the Social Welfare Division (SWD) and provides support to those individuals who live in households below the Household Indigent Line (HIL). For the year 2002, under this programme, recipients obtained 100EC$ per month per family and 85EC$ per month per child. A process of eligibility exists that includes a home visit and other examinations by SWD staff to ensure that applicants satisfy SWD criteria. Even though the CPA report has estimated that in Dominica about 10,000 individuals are indigent, this programme covers not more than 2,500 people (CPA: 107).

In order to improve the SWD criteria and to ensure widespread-coverage of the programme among the indigent, results from the poverty mapping could be used:

- ◇ first of all, to require that, be eligible for the programme, an individual should belong to a household with an estimated consumption expenditure below the HIL;
- ◇ second, to conduct an informative campaign to better inform potentially indigent people how, when and where to apply.

Alternatively, given its fiscal realities (GSPS) the Government could launch a new programme, the Household Direct Support Programme (HDSP), which would consist in supplyinghot meals to the 1,000 - 2,000 households with very low consumption estimated with the poverty mapping exercise (after checking by means of a visit by government authorities) and with a large number of children present.

8.1.2. Medium Term Policies and Programmes

Given the rich set of poverty and inequality measures provided by the poverty mapping, which are disaggregated at the levels of the village and enumeration district, the Government of the Commonwealth of Dominica could launch a new programme, the village (or enumeration district) Direct Support Programme (VDSP or EDDSP):

- ◇ single out the 10 - 20 poorest villages (or enumeration districts) according to the HCR estimates produced by the poverty mapping exercise;

- ◇ single out the main characteristics and problems of the area (i.e. lack of schools, high unemployment rate, etc.) on the basis of information collected in the Census data or in other alternative sources; and
- ◇ propose *ad hoc* projects for each village (ED) according to the characteristics of the area.

The information from the poverty mapping could also be used to monitor programmes undertaken by the Government. In fact some programmes target some well-defined areas on the basis of criteria or socio-economic indicators not necessarily related to poverty or simply not up to date.

One example is the Small Project Assistance Team (SPAT), a community development NGO that has been providing support for socio-economic projects for the past 25 years, with some discontinued periods.

In 2001 SPAT's main programme, the Community Animation Programme (CAP), was still covering four communities with socio-economic indicators (updated in 1996) below the national average: Petite Savanne, Dublanc/Bioche, Grand Fond and Grand Bay. According to the poverty mapping 2001 HCR estimates (see section 6 above), Petite Savanne, Grand Fond and Grand Bay villages experienced more than 50 percent of individuals in poverty, whereas in the Village of Dublanc/Bioche less than one individual out of four lives in poverty.

The recommendation of this report is to invite the SPAT to continue its activities and to take into account the results produced by the poverty mapping at the levels of the village and enumeration district in order to launch new small projects.

Another medium-term Programme should also aim at attracting back into Dominica young people who have been educated abroad, so as not to loose this investment in human resources. With the coming into effect of the Caribbean Single Market and Economy (CSME), Dominica will need to retain and attract highly skilled individuals. It will not only need those to function now in this competitive environment but will also need their specialised knowledge as it moves towards a knowledge-based economy.

8.1.3. Long Term Policies and Programmes

Long term policies and programmes should be based on structural

changes in the country, particularly in education, training, employment and investments, with an eye to sustainable growth.

This should be in line with the most important strategy to be implemented by the GSPS: the promotion of (sustainable) economic growth and job creation.

The Government should therefore continue to undertake the Basic Needs Trust Fund (BNTF) with the support of the Caribbean Development Bank. The BNTF plays a very important role with regard to:

- ◇ the economic and social infrastructure necessary for development;
- ◇ basic services or their enhancement; and
- ◇ skills training to increase productivity and income.

This role will continue to be important in the future. Everything possible should also be done to implement the Dominica Social Investment Fund (DSIF). DSIF will not only provide direct cash support to individuals, households and communities at risk of poverty, but will also provide opportunities for employment and sustainable development.

8.2. *Proposed Transfer Schemes*

The aim of this section is to discover to what extent the availability of poverty and inequality measures at the local level as well as information on reliable consumption estimates at the level of the household can guide policy makers in reducing poverty and inequality given a fixed, limited budget B. The benchmark situation corresponds to the case of no information available, where the Government can only distribute the budget by transferring the amount B/N to the entire population of size N.

Taking into account poverty measures at the local level can help reaching an optimal allocation of a scarce budget. A theoretical description of such an allocation can be found in Kanbur (1987), Ravallion and Chao (1988), Glewwe (1992), Ravallion (1993), Baker and Grosh (1994).

Elbers, Lanjouw and Leite (2008) demonstrate that an optimal allocation can be reached by ranking local areas by FGT(1) and transferring a lump-sum to each household of the poorest area until the

poverty gap of that area is equal to the poverty gap of the next poorest one, and so on, until the scarce budget is completely distributed.

The original contribution of this paper consists also in proposing a policy or scheme which also takes into account the distribution of average consumption estimated at the level of the household; in this way we try to make an optimal allocation of the budget by distributing different amounts to the poorest households.

In our exercise we consider a scarce budget of about 3Million EC$,[9] which corresponds to an average transfer of about 45EC$ per person. This choice has been made for two reasons: *i*) the need for targeting is much more evident when there is not much money to be allocated to the population, and *ii*) this size of the budget is similar to the budget of other policies recently undertaken in the Commonwealth of Dominica.

In table 8 we compare the four schemes of optimal allocation with the benchmark uniform transfer and with the pre-transfer situation of table 4. The optimal allocation seeks to reduce the poverty gap squared measure FGT(2), but the table also reports the other usual poverty and inequality indices.

A uniform transfer reduces the severity of poverty FGT(2) from 7.07 to 6.71, while targeting at the local level further reduces the index to about 6.45-6.50, according to the level taken into account. Observing those figures it can be seen that in practice there is not much difference in targeting the poorest parish, the poorest villages (15) or the poorest enumeration districts (22): transferring the same amount to all the individuals in the areas can only partly reduce poverty and has practically no impact on inequality.

Taking into account the accurate estimates of consumption expenditure can further improve the situation. From table 8 we observe that the largest reduction in the FGT(2) index (to 5.89) was obtained by making transfers to the households that were identified by the study as being the poorest. Note that this type of transfer was accompanied by a strong reduction in the Gini concentration index among the poor and of the Sen index. Moreover the fact that the HCR index has not diminished –compared to the pre transfer situation– means that most of the transfers reached the very poor households and individuals.[10]

[9] The exact amount of the budget is 3,100,080EC$. This corresponds to 20% of the hypothetical budget that would have been necessary to completely eradicate poverty, i.e. the sum of the gaps between the average individual per-capita consumption (averaged over the 100 replications) and the poverty line (3,400EC$).

[10] In the case of "perfect" poverty mapping, i.e. when the consumption esti-

Table 8
Comparing Different Transfer Schemes

Targeting	Receivers	HCR	FGT(1)	FGT(2)	Gini	Ginipov	SEN	GE(0)	GE(1)	Eq_con
Pre transfer	0	36.68	13.87	7.07	44.18	20.44	11.69	34.01	34.36	6438
		5.32	2.69	1.62	0.94	1.17	2.80	1.53	1.78	786
Uniform transfer	68646	36.07	13.39	6.71	43.87	19.89	11.19	33.35	33.88	6483
		5.30	2.62	1.55	0.94	1.12	2.71	1.52	1.77	786
Parish (1)	6743	35.97	13.14	6.50	43.69	19.46	10.95	32.93	33.63	6483
		5.34	2.61	1.52	0.94	1.11	2.68	1.50	1.77	786
Villages (15)	5610	35.90	13.08	6.47	43.65	19.48	10.93	32.88	33.58	6483
		5.36	2.61	1.52	0.94	1.12	2.69	1.50	1.77	786
Enumeration Districts	5574	35.92	13.07	6.45	43.64	19.42	10.91	32.84	33.57	6483
(22)		5.37	2.61	1.52	0.94	1.12	2.69	1.50	1.77	786
Households (1194)	6319	36.29	12.65	5.89	43.37	17.61	10.33	31.85	33.20	6483
		5.45	2.64	1.49	0.96	1.13	2.67	1.49	1.78	786

mates at the household level have no errors, an optimal allocation to the poorest households would have had no effect on the head count ratio FGT(0), because none of the beneficiaries of the transfer would have crossed the poverty line.

In conclusion, when the poverty mapping leads to very accurate estimates of consumption expenditure even at household level, this information should be taken into account in order to better allocate a scarce budget aimed at fighting poverty.

9. Strategies Undertaken by the Government

Since conducting the Country Poverty Assessment (CPA) in 2002, the Dominica Government has had to enter into a Structural Adjustment Programme (SAP) with support from the International Monetary Fund, the World Bank, other members of the donor community and regional organizations and governments. This is because the economy suffered a very serious economic contraction of about 10% during 2001 - 2003. As part of the SAP the government was forced to control public expenditure especially through reductions in the public sector wage bill and improvements in revenue collection. Many ancillary agencies were privatized and a new valued added tax was introduced replacing consumption and sales tax. In spite of the SAP the Government endeavoured to protect social service expenditures, which remained above 6 percent of the Gross Domestic Product. In order to furthercushion the negative impact of the SAP, the government also implemented a Social Protection Programme (SPP). That programme provided employment, skills training and micro credit to rural people, especially displaced banana farmers.

The Government also increased its Public Sector Investment Project (PSIP) budget allocation from 8 percent of GDP in 2003 to 13.4 percent in 2007. There were also efforts to monitor the impact of projects on employment creation and to focus on projects of rural employment creation. Investments also focus on modernizing agriculture through green house technology and irrigation. These would contribute to alleviating rural unemployment by encouraging farmers who had left agriculture to return and by providing opportunities for youth to enter the sector. Efforts also focused on increasing community participation in, and benefits from,the tourism sector through the implementation of a Community-Tourism Development Programme. That project involved extending, improving and providing community tourism facilities in conjunction with Community Based Organizations .

Beyond these macro economic and sectoral measures, the Dominica Government in 2006 completed its Growth and Social Protection Strategy (GSPS). This strategy, which will serve as the country's

Poverty Reduction Strategy Proper, has received local and international endorsement. The GSPS provides a framework that informs the medium-term macro-economic parameters and targets, the structural reform agenda, the medium term public investment programme and the annual budgets to be presented to parliament. The GSPS was formally launched in January 2007, although it already influenced policy programmes and targets for the fiscal year 2006/2007. In 2006 the country attained GDP growth of 4 percent, compared to 3.5 percent in 2005 and 3 percent in 2004. In 2007 the Government also launched the Growth and Social Protection Technical Assistance Credit with funding from the World Bank. This project has four core objectives:

- ◇ making the public sector more efficient and effective;
- ◇ improving the investment climate;
- ◇ reforming the regulatory framework for the energy sector, and
- ◇ improving social protection.

The project will finance many of the structural measures contained in the GSPS.

The Basic Needs Trust Fund (BNTF), funded by the Caribbean Development Bank and the Government of Dominica was completely reoriented after the results of the poverty map were published. Prior to the poverty map BNTF took a universal approach to allocation of projects using mainly demographic data to decide on locations to be targeted for projects. The poverty map provided the weapon that BNTF needed to launch a direct attack on poverty to help fulfil the countries mandate to the Millennium Development Goals. BNTF now uses the poverty map to target poor communities, neighbourhoods and households.

The National Council for Early Childhood Education also used the poverty map, to determine whether government assisted preschools were to be located in some of the poorest neighbourhoods in Dominica. That evaluation has influenced decisions on resource allocation to the neighbourhoods that are in greatest need. Furthermore many medium to large social infrastructural projects were developed on the basis of data provided by the poverty map. A sanitation project targeting poor households who have no access to sanitation was developed. The data was used to verify the capacity of households in that community to pay for connection to the sewage system. Households unable to meet the cost of secondary lines to the main

system and the amount for connection have been identified. Supported by the data from the poverty map, they are being targeted for assistance. Second, a housing project was developed for a poor urban community targeting persons who need better housing conditions but are unable to undertake housing improvements on their own. By physically visiting the communities, families were identified for assistance. The poverty map data was used to verify the ability of the identified households to pay for their improvements.

Finally in August 2007 the Dominica Social Investment Fund (DSIF) was launched. The DSIF aims at reducing poverty and social vulnerability in Dominica by carefully targeting the poor and the vulnerable.

In conclusion, much use has already been made of the results of the CPA and the poverty map; not just by the state but by civil society organizations. In fact, the DSIF has proceeded to test the accuracy of the poverty map by visiting the households and verifying the data by way of brief interviews. The staff of DSIF has indicated 99 percent accuracy, an amazing result. Work has commenced on another Country Poverty Assessment for Dominica. It will determine whether the poverty measures undertaken by government and civil society organizations are achieving the needed reduction in the level of poverty for the country. Dominica is a signatory to the United Nations Millennium Development Goals and is determined to achieve all its targets.

References

Baker, J. and M. Grosh (1994). Poverty Reduction Through Geographic Targeting: How Well Does it Work?, *World Development*, 22, 983-995.

Betti, G., F. Ballini, and L. Neri (2006). *The Survey of Living Conditions in the Commonwealth of Dominica: A Revision*, Working Paper no. 65, Università di Siena.

Central Statistical Office (2001). *Population and Housing Census 2001*, Ministry of Finance and Planning, Commonwealth of Dominica.

Country Poverty Assessment (2003). *Final Report*, Caribbean Development Bank, Government of the Commonwealth of Dominica.

Deaton, A. (1997). *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*, John Hopkins Press and The World Bank.

Demombynes, G., *et al.* (2007). *How Good a Map? Putting Small Area Estimation to the Test*, Policy Research Working Paper no. 4155, The World Bank.

Elbers, C., J. O. Lanjouw, and P. Lanjouw (2003). Micro-level Estimation of Poverty and Inequality, *Econometrica*, 71, 355-364.

—— (2002). *Micro-level Estimation of Welfare*, Policy Research Working Paper no. 2911, The World Bank.

Elbers, C., J. O. Lanjouw, and P. G. Leite (2008). *Brazil within Brazil: Testing the Poverty Map Methodology in Minas Gerais*, Policy Research Working Paper no. 4513, The World Bank.

Glewwe, P. (1992). Targeting Assistance to the Poor, *Journal of Development Economics*, 38, 297-321.

Kanbur, R. (1987). Measurement and Alleviation of Poverty, *IMF Staff Papers*, 34, 60-85.

Raghunathan, T. E., *et al.* (2001). A Multivariate Technique for Imputing Missing Values Using a Sequence of Regression Models, *Survey Methodology*, 27, 85-95.

Ravallion, M. (1993). Poverty Alleviation Through Regional Targeting: A Case Study of Indonesia, in A. Braverman, K. Hoff, and J. Stiglitz (Eds.), *The Economics of Rural Organization: Theory, Practice and Policy*, World Bank and Oxford University Press.

—— and K. Chao. (1988). Targeted Policies for Poverty Alleviation Under Imperfect Information: Algorithms and Applications, *Journal of Policy Modeling*, 11, 213-224.

Tarozzi, A. and A. Deaton (2009). Using Census and Survey Data to Estimate Poverty and Inequality for Small Areas, *Review of Economics and Statistics*, (forthcoming).

The World Bank (2008). *User Manual for PovMap*, Development Research Group, Washington, http://iresearch.worldbank.org/Povmap/.

White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity, *Econometrica*, 48, 817-838.