Putting Welfare on the Map in Madagascar

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Abstract

In this paper, the authors apply a recently developed small-area estimation technique to derive detailed geographic estimates of consumption-based poverty and inequality in Madagascar by combining detailed information from the 1993 household survey with the 1993 population census. In addition to generating Faritany (province) level welfare estimates that are comparable to, but more precise than, the previous survey-based estimates, the authors also provide estimates for 111 Fivondronas (districts) and 1,248 Firaisanas (communes). Some key findings are as follows: (a) despite the high overall level of poverty in Madagascar, there is considerable spatial heterogeneity in poverty levels across administrative units within provinces; (b) this heterogeneity is pronounced at the Fivondrona level but less so at the Firaisana level, and is particularly striking in urban areas; (c) while on average most of the inequality in Madagascar is attributable to inequality within communes, the vast majority of the communes—especially those in rural areas—have low rates of inequality vis-à-vis the national average

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Table of Contents

List of Tables

List of Figures and Maps

I. Introduction

Poverty maps, spatial descriptions of the distribution of poverty in any given country, are most useful to policy-makers and researchers when they are finely disaggregated, i.e. when they represent small geographic units, such as cities, towns, or villages. Unfortunately, most, if not all, household surveys are too small to be representative at such levels of disaggregation, and most census data do not contain the required information to calculate consumption-based welfare indicators of poverty and inequality.

Madagascar provides no exception to this general rule. The 1993 household survey data (Enquête Permanente auprès des Ménages - EPM) provides welfare information for six Faritany (province), stratified into urban and rural areas. On the other hand, the population census (deuxième recensement général de la population et de l'habitat), also conducted in 1993, contains basic information for each enumerated household in the country, but contains no income or expenditure information.

There are several immediate uses of a high-resolution poverty map in Madagascar. First, as the country moves to decentralize various central government activities to local levels, dissemination of welfare information to local administrations and communities can be useful for empowerment and policy-making. In fact, several local administrators and provincial representatives of the Institut National de la Statistique (INSTAT) have expressed interest in this kind of information from the center. Second, various development projects (e.g. Rural Transport Project of the World Bank), and researchers could benefit from the combination of information on local welfare, infrastructure (e.g. road networks), and the environment (e.g. deforestation). Public expenditure allocations across the country can be monitored to be equitable and its effectiveness can be assessed if welfare outcomes are known by administrative units (e.g. Galasso *et al.*, 2002).1 Finally, as in the case of a few HIPC countries, such as Nicaragua and Kenya, Madagascar could incorporate the poverty map into future updates of their PRSP document to help outline its strategy for poverty reduction.

In this paper, we estimate consumption-based welfare (poverty and inequality) measures for Madagascar at the Faritany (province), Fivondrona (district), and Firaisana (commune) levels by combining the 1993 household survey and the 1993 population census. The method we utilize to predict welfare measures for these small geographical units is described in detail in Elbers, Lanjouw and Lanjouw (2002), and is summarized in the next section. Section III describes the data, while section IV outlines the three-stage empirical approach. The results are discussed in Section V, and Section VI concludes. Mean expenditure and poverty estimates by faritany and fivondrona are presented in this paper.2

[1] Madagascar is planning to construct a second poverty map using data from the planned 2003 populations census, making such assessments more likely in the near future using 1993 figures as a baseline.

[2] For reasons of space, the inequality estimates at the fivondrona level and all welfare estimates for the 1,248 firaisanas are not presented here but complete data sets that include all welfare estimates at all levels of disaggregation are available from the authors upon request.

II. Overview of the Methodology

The basic idea behind the methodology is straightforward. First a regression model of log per capita expenditure is estimated using the survey data, employing a set of explanatory variables which are common to the survey and the census. Next, parameter estimates from that regression are used to predict log per capita expenditure for every household in the census. Finally, "welfare indicators" are constructed for geographically defined subgroups of the population using these predictions.3

While the approach is conceptually simple, properly accounting for spatial autocorrelation and heteroskedasticity in the first stage model and estimating standard errors for the welfare estimates requires additional elaboration. The method can be divided into the first stage analysis with the survey data and the second stage analysis with the census data. Additionally, there is a "zero stage" associated with defining and selecting the set of comparable variables common to the survey and the census. We defer discussion of the zero stage until Section IV, where we discuss the particular application of the methodology to data from Madagascar. Those, who are not interested in the technical details of the methodology can skip to the description of our data in section III, and our empirical approach in section IV.

First Stage

The first stage estimation involves modeling per capita household expenditure at the lowest geographic level for which the survey is representative. In Madagascar, this is at the Faritany (province) level, broken down into urban and rural sectors. The first stage begins with an association model of per capita household expenditure for a household *h* in location *c*, where the explanatory variables are a set of observable characteristics:4

$$(1) \qquad \ln y_{ch} = E[\ln y_{ch} | \mathbf{x}_{ch}] + u_{ch} .$$

The locations correspond to the survey clusters as they are defined in a typical two-stage sampling scheme. These observable characteristics must be found as variables in both the survey and the census or in a tertiary data source that can be linked to both data sets.5

Using a linear approximation to the conditional expectation, we model the household's logarithmic per capita expenditure as

$$(2) \qquad \ln y_{ch} = \boldsymbol{x}'_{ch}\boldsymbol{\beta} + u_{ch} .$$

The vector of disturbances, $\boldsymbol{u}$, is distributed F $(0,\boldsymbol{\Sigma})$. The model in (2) is estimated by Generalized Least Squares using the household survey data. In order to estimate the GLS model, we first produce an estimate of $\boldsymbol{\Sigma}$, the associated error variance-covariance matrix. We model individual disturbances as

$$(3) \qquad u_{ch} = \eta_c + \varepsilon_{ch},$$

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3 We use the term "welfare indicator" to refer to any function of the distribution of expenditure.

4 See Elbers et al (2002) for a fuller discussion of the methodology.

5 The explanatory variables are observed values and thus need to have the same definitions and the same degree of accuracy across data sources. Note that these variables need not be exogenous.

where η_c is a location component and ε_{ch} is a household component. This error structure allows for both spatial autocorrelation, i.e. a "location effect" for households in the same area, and heteroskedasticity in the household component of the disturbance. The two components are independent of one another and uncorrelated with observable characteristics.

In order to estimate **Σ**, we proceed as follows. The model in (2) is first estimated by simple OLS, weighted with the survey sampling weights. The residuals from this regression serve as estimates of overall disturbances, given by $\hat{u}_{ch}$. We decompose these into uncorrelated household and location components:

$$(4) \qquad \hat{u}_{ch} = \hat{\eta}_c + e_{ch}.$$

The estimated location components, given by $\hat{\eta}_c$, are the within-cluster means of the overall residuals. The household component estimates, e_{ch}, are the overall residuals net of location components. We also estimate $\hat{\sigma}^2_\eta$, the variance of η_c and $\hat{V}\left(\sigma^2_\eta\right)$, the variance of σ^2_η.6

We allow for heteroskedasticity in the household component, modeling e^2_{ch} using a selection of variables that best explain its variation. We choose variables, **z***ch*, that best explain variation in e^2_{ch} out of all potential explanatory variables, their squares, and interactions. We estimate a logistic model of the variance of εch conditional on **z***ch*, bounding the prediction between zero and a maximum, *A*, set equal to $(1.05) * \max\{e^2_{ch}\}$:

$$(5) \qquad \ln[\frac{e^2_{ch}}{A - e^2_{ch}}] = z^T_{ch}\hat{\alpha} + r_{ch}.$$

Letting $\exp\{z^T_{ch}\hat{\alpha}\} = B$ and using the delta method, the model implies a household specific variance estimator for εch of

$$(6) \qquad \hat{\sigma}^2_{\varepsilon,ch} = [\frac{AB}{1+B}] + \frac{1}{2} Var(r)[\frac{AB(1-B)}{(1+B)^3}].$$

These error calculations are used to produce two square matrices of dimension *n*, where *n* is the number of survey households. The first is a block matrix, where each block corresponds to a cluster, and the cell entries within each block are $\hat{\sigma}^2_\eta$. The second is a diagonal matrix, with household-specific entries given by $\hat{\sigma}^2_{\varepsilon,ch}$. The sum of these two matrices is $\hat{\Sigma}$, the estimated variance-covariance matrix for the original model given by equation (2).

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6 See Appendix 2 of Elbers et al (2002) for details.

Once this matrix has been calculated, the original model can be estimated by GLS. The GLS estimation produces a final set of first stage estimates for $\hat{\beta}_{GLS}$, the coefficients from the main equation given by equation (2). The GLS output also includes the associated variance-covariance matrix, given by $\hat{V}(\hat{\beta}_{GLS})$. In addition to these estimates, the second stage employs $\hat{\alpha}$, $V(\hat{\alpha})$, $\hat{\sigma}_{\eta}^2$, and $\hat{V}\left(\sigma_{\eta}^2\right)$.

Second Stage

In the second stage analysis we combine the estimated first stage parameters with the observable characteristics of each household in the census to generate predicted log expenditures and simluated disturbances. We conduct a series of simulations, where for each simulation *r* we draw a set of first stage parameters from their corresponding distributions estimated in the first stage. Thus we draw a set of beta and alpha coefficients, $\tilde{\boldsymbol{\beta}}^r$ and $\tilde{\boldsymbol{\alpha}}^r$, from the multivariate normal distributions described by the first stage point estimates and their associated variance-covariance matrices. Additionally, we draw $(\tilde{\sigma}_{\eta}^2)^r$ a simulated value of the variance of the location error component.[7] Combining the alpha coefficients with census data, for each census household we estimate $(\tilde{\sigma}_{\varepsilon,ch}^2)^r$, the household-specific variance of the household error component. Then, for each household we draw simulated disturbance terms, $\tilde{\eta}_c^r$ and $\tilde{\varepsilon}_{ch}^r$, from their corresponding distributions.[8] We simulate a value of expenditure for each household, $\hat{y}_{ch}^r$, based on both predicted log expenditure, $\boldsymbol{x}_{ch}'\tilde{\boldsymbol{\beta}}^r$, and the disturbance terms:

$$(7) \qquad \hat{y}_{ch}^r = \exp\left(\boldsymbol{x}_{ch}'\tilde{\boldsymbol{\beta}}^r + \tilde{\eta}_c^r + \tilde{\varepsilon}_{ch}^r\right).$$

Finally, the full set of simulated per capita expenditures, $\hat{y}_{ch}^r$, are used to calculate estimates of the welfare measures for each spatial subgroup.[9]

We repeat this procedure 100 times drawing a new $\tilde{\boldsymbol{\alpha}}^r$, $\tilde{\boldsymbol{\beta}}^r$, $(\tilde{\sigma}_{\eta}^2)^r$ and disturbance terms for each simulation. For each subgroup, we take the mean and standard deviation of each welfare measure over all 100 simulations. For any given location, these means constitute our point estimates of the welfare measure, while the standard deviations are the standard errors of these estimates.

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[7] The $(\tilde{\sigma}_{\eta}^2)^r$ value is drawn from a gamma distribution defined so as to have mean $\hat{\sigma}_{\eta}^2$ and variance $\hat{V}\left(\sigma_{\eta}^2\right)$.

[8] We allow for non-normality in the distribution of both η_c and ε_{ch}. For each distribution, we choose a Student's t-distribution with degrees of freedom such that its kurtosis most closely matches that of our first stage residual components, $\hat{\eta}_c$ or e_{ch}.

[9] Because we are interested in measures based on individual-level expenditure, these calculations are performed using household size as weights. We implicitly assume that expenditure is distributed uniformly within households. The same methodology could be applied using equivalence scales to capture alternative intrahousehold distributional assumptions.

There are two principal sources of error in the welfare measure estimates produced by this method.10 The first component, referred to as *model error* in Elbers et al (2002), is due to the fact that the parameters from the first-stage model in equation (2) are estimated. The second component, termed *idiosyncratic error*, is associated with the disturbance term in the same model, which implies that households' actual expenditures deviate from their expected values. While population size in a location does not affect the model error, the idiosyncratic error increases as the number of households in a target subgroup decreases.

III. The Data

Three principal data sources were used to estimate measures of economic welfare at low levels of spatial disaggregation for Madagascar. Firstly, the population census (deuxième recensement général de la population et de l'habitat) collected in 1993 by the Direction de la Démographie et Statistique Social (DDSS) of the Institut National de la Statistique (INSTAT). Secondly, household survey data (Enquête Permanente auprès des Ménages - EPM) collected from 4,508 households and fielded between May 1993 and April 1994 by the Direction des Statistiques des Ménages (DSM) of the Institut National de la Statistique (INSTAT). Thirdly, data obtained from CARE that provides information on spatial environmental variables at the fivondrona level, such as vegetation index, droughts, etc.

Razafindravonona *et al.* (2001) describes the dynamics of poverty in Madagascar using a comparable consumption aggregate from three surveys between 1993 and 1999. It describes the 1993 consumption module as the most complete of these three. We use the consumption aggregate used in this paper, with slight modifications: first, since we are not interested in comparisons over time, we add all the consumption items that were excluded from their aggregate to make it comparable to the 1997 and 1999 aggregates. Second, following Deaton and Zaidi (2002) we imputed the present value of household durables and add this to their aggregate. We use this modified consumption aggregate in our subsequent analysis.

IV. The Empirical Approach

The Zero Stage: Aligning the Data

In the zero stage a set of potential explanatory variables from both data sources is selected, a subset of which are then used to estimate the regression models described above in the household survey and to predict welfare measures in the census. The chief objective of the comparability assessment in this stage is to determine if the survey variable can reasonably be said to contain the same information as the corresponding census variable. Even when the survey and census questions are identically worded, subtle differences in the way the questions are asked, or different ordering of questions may cause the information content to differ between the survey and census. It is even possible that due to regional variation in interpretation, variables may be comparable in

[10] A third potential source of error is associated with computation methods. Elbers *et al.* (2002) found this component to be negligible.

some provinces and not in others. This assessment essentially involves determining whether the variables are statistically similarly distributed over households in the population census and in the household sample survey. This procedure is repeated for each of the twelve strata (6 Faritany broken into urban and rural areas)—i.e., the smallest level of dissagregation for which the survey data was designed to be representative of the population.

The set of common variables was initially identified by systematically comparing the questionnaires (and using the interviewer manuals) of the census and survey. This exercise was carried out in collaboration with an expert panel from INSTAT composed of the directors and team members of both the DDSS and DSM. Initially, we used four main qualitative criteria: (a) Are the questions and answers identically worded? (b) Are the criteria pertaining to the questions and answers identical (e.g. employment questions are asked of people 10 years and older in both data sets)? (c) Are the answer options identical? (d) Are the interviewer instructions pertaining to the questions identical?

Often common variables have to be constructed by combining information from several questions. In those cases, these criteria are critical to help determine how the variables can be constructed. Next, we investigate whether these common variables are statically similarly distributed over households in the population and those sampled by the survey. We based our comparative assessment on the following statistics for each variable obtained from both the survey and the census for each stratum: (i) the mean, (ii) the standard error, (iii) and the values for the 1st, 5th, 10th, 25th, 50th, 75th, 90th, 95th and 99th percentiles. We experimented with several comparative criteria and eventually settled on two. First, testing whether the census mean for a variable lies within the 95% confidence interval around the household survey mean for the same variable. Secondly, for dummy variables we make sure that the means are not smaller than 3% and not larger than 97%, so that the variables constructed contain some variation across households.11 Finally, we made a cross-strata comparison to assess uniformity in comparability of the variables. The variables we settled on including in the first-stage regressions are generally found to be comparable in all strata.12 A list of common variables in both the census and survey is included in Appendix C.

First Stage: Predicting Consumption from Household Data

For the *main regression* given by equation (2), we use a stepwise regression procedure in STATA to select a subset of variables from the set of "comparable" variables, which provide the best explanatory power for log per capita expenditure. We use a significance level criterion with no ceiling on the number of variables to be selected. All household survey variables that were significant at the 5% level were selected to be in the regression. These regressions and relevant diagnostics for the urban and rural strata are summarized in Tables 1 and 2 respectively.

[11] Such variables generate observations with high leverage in the first stage regressions, such as being the only household sampled in a stratum to have access to electricity.

[12] The few exceptions are mainly because of urban versus rural contrasts (e.g., "running water" is comparable in all urban strata but not in the rural strata were either this source is not available or the means are smaller than 3%). Consult Appendix C for more details.

A portion of the error component in the first stage regressions is attributable to the *location effect*. In our analysis, this location effect is modeled at the level of the fokontany. While these enumeration areas are identified in both the survey and the census, we have had difficulty in linking them due to complications with the data. We attempt to reduce the magnitude of the location effect (and thus of the errors in our final welfare measure estimates) by including, as additional explanatory variables, the means of some variables at the firaisana level—the lowest administrative level at which we could link the population census to the household survey. We have also merged tertiary data we have obtained from CARE at the fivondrona level into our household survey data set. The expectation is that the location effects at the EA level are partially explained by mean characteristics at the firaisana level and some environmental characteristics at the fivondrona level. This would be the case if, for example, a household in an area where most households have flush toilets is likely to have higher consumption than an identical (on observable household characteristics) household in another area.

In order to avoid overfitting, we select a subset of these firaisana-level means and variables from tertiary data sources that best explain the location effects. We regress the $\hat{\eta}_c$ values (one per survey cluster) on the full set of census means and used a stepwise procedure to select the subset that best explain the location effects. We use a 5% significance criterion, along with a ceiling for the maximum number of census means to be selected.

For the *heteroskedasticity model*, the pool of potential variables include all those available that were comparable between the census and survey, their squares, and interactions with one another and with the predicted values of log per capita expenditure. To select a subset of variables, we use e_{ch}^2 as the dependent variable in another stepwise regression. We use a significance level of 5% for selection of variables for a maximum of 10 variables to be selected.

To determine *whether to use sampling weights* in our final regression model for each stratum, we use a simple test described by Deaton (1997). We run the final regression in equation (2) one more time, but this time adding the weighted versions of the final set of selected variables to the RHS. Then, we test the joint significance of the weighted RHS variables, using a 5% significance criterion, conditional on their unweighted counterparts. If they are jointly significant, we decide that the weighting is necessary, else we continue with unweighted first-stage regressions.

We also examine the empirical distribution of the error components from equation (4) after running the final regression model for each stratum. Our program selects the closest t-distribution to the distribution of each of the error components in the household survey using kurtosis as its main criterion, and reports it as a recommendation to be used in the second-stage to simulate the error terms.

Examining Tables 1 and 2, we find that the regression models for the urban areas are more successful in explaining the variation in household expenditure than those for the rural areas. The adjusted R2 ranges from 0.445 to 0.638 in urban areas and 0.239 to

0.460 in rural areas. The explanatory power is highest in Antananarivo. In comparison, the adjusted R2 ranges from 0.27 to 0.55 in Mozambique, and 0.45 to 0.77 in Ecuador.

In general, household size, number of living rooms, education of household members, sex and the civil status of the household head, and some variables concerning housing characteristics (such as floor and wall materials) and access to services (such as principal source of energy and water) are key variables chosen in most regressions. We note that, on average, household size and head of household being female have a negative correlation with per capita household expenditure. Education and number of rooms have a positive association with household expenditures. There are a few parameter estimates, the signs of which depend on whether the model is for rural or urban areas. For example, in urban areas use of latrine is negatively associated with expenditures (with the main alternative being flush toilets), whereas the correlation is positive in rural areas (where the main alternative is no sanitary facilities). Similarly, principal light source being gasoline is negatively associated with expenditures in urban areas where the alternative is electricity, but positively correlated in most rural areas where the alternative is candles or nothing. We remind the readers here that our regressions are association models, and hence the parameter estimates of the independent variables can not be interpreted as causal effects.

Table 1. First-Stage Regression Model Selection Results (Urban Strata)

	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana
Number of observations	864	300	244	296	252	155
Number of clusters	70	24	20	23	20	13
Hausman test for weights	3.020	1.783	1.578	0.693	3.144	1.771
Regression weighted	Yes	No	No	No	Yes	No
Adjusted R2 (without location means)	0.618	0.436	0.619	0.356	0.498	0.482
Adjusted R2 (with location means)	0.638	0.445	0.619	0.478	0.523	0.495
Variables						
Constant	13.090 ** (0.191)	13.732 ** (0.160)	12.596 ** (0.119)	12.264 ** (0.191)	13.214 ** (0.235)	13.130 ** (0.237)
Demographic						
Log of household size [lnsize]	-0.526 ** (0.048)	-0.441 ** (0.056)	-0.546 ** (0.055)	-0.571 ** (0.055)	-0.602 ** (0.103)	-0.594 ** (0.080)
Household head is female [headfem]					-0.563 ** (0.181)	
Household head is married [chmarri]	0.155 ** (0.048)		0.397 ** (0.071)	0.232 ** (0.075)		0.280 ** (0.102)
Education						
% of household members that ever attended school [pschool]			0.376 ** (0.139)		0.536 ** (0.193)	
% of household members that attended secondary school or higher [psegsch]	0.539 ** (0.079)	0.410 ** (0.132)	0.691 ** (0.121)	0.504 ** (0.105)		0.436 ** (0.144)
Housing & Infrastructure						
Number of living spaces [livnb]	0.193 ** (0.021)	0.129 ** (0.032)	0.115 ** (0.025)	0.156 ** (0.033)	0.252 ** (0.066)	0.085 * (0.039)
Floors of cement in principal rooms [fcement]	0.103 * (0.050)					0.328 ** (0.095)
Outer walls constructed from bricks [wbrick]				0.180 (0.110)	-0.602 * (0.245)	
Outer walls constructed from earth [wearth]				-0.223 ** (0.076)	-0.400 * (0.182)	-0.457 ** (0.108)
Cooking with coal [ccoal]	-0.306 ** (0.097)					
Wood used for cooking [cwood]	-0.383 ** (0.119)	-0.210 * (0.082)			-0.328 ** (0.109)	
Principal light source is electricity [eleclght]			0.434 ** (0.080)		0.653 ** (0.121)	
Principal light source is gasoline [petrlght]	-0.472 ** (0.057)	-0.560 ** (0.096)				-0.457 ** (0.108)
Principal water source is a public pump [pubpump]	-0.272 ** (0.055)			-0.199 ** (0.071)		
Principal water source is a well [well]			-0.210 ** (0.081)			
House equipped with a latrine [latrine]		- 0.249 ** (0.077)				
Location Meansa						
Principal water source is running water [av_runwa]				0.805 ** (0.258)		
Households with earth floors [av_feart]	-0.564 ** (0.186)					
Flood risk in fivondrona [fld_risk]b	0.020 ** (0.004)			0.023 ** (0.003)		0.011 * (0.005)
Outer walls constructed from wood [av_wwood]					-0.785 ** (0.322)	
Outer walls constructed from earth [av_weart]		-0.257 * (0.105)				

Notes: Standard errors in parentheses and statistical significance indicated at the 5% level (*) and at the 1% level (**).
a Firaisana level means.
b Fivondrona level means from CARE GIS database.

Table 2. First-Stage Regression Model Selection Results (Rural Strata)

	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana
Number of observations	560	604	416	236	365	208
Number of clusters	35	38	26	15	23	13
Hausman test for weights	1.191	3.500	1.741	0.830	1.156	0.111
Regression weighted	No	Yes	No	No	No	No
Adjusted R2 (without location means)	0.405	0.242	0.405	0.302	0.301	0.159
Adjusted R2 (with location means)	0.460	0.324	0.439	0.321	0.373	0.239
Variables						
Constant	12.253 ** (0.157)	11.240 ** (0.274)	12.312 ** (0.116)	14.520 ** (0.415)	13.628 ** (0.247)	12.247 ** (0.251)
Demographic						
Log of household size [lnsize]	-0.526 ** (0.048)	-0.529 ** (0.053)	-0.521 ** (0.042)	-0.376 ** (0.058)	-0.603** (0.054)	-0.420 ** (0.069)
Household head is female [headfem]	-0.185 ** (0.062)	-0.329 ** (0.088)	-0.219 ** (0.070)		-0.375 ** (0.080)	-0.337 ** (0.111)
Education						
% of household members that ever attended school [pschool]	0.344 ** (0.091)	0.448 ** (0.102)	0.533 ** (0.090)			
% of household members that attended secondary school or higher [psegsch]	0.497 ** (0.103)		0.417 ** (0.162)	0.952 ** (0.205)	0.690 ** (0.195)	0.506 * (0.223)
Housing & Infrastructure						
Number of living spaces [livnb]	0.111 ** (0.019)		0.131 ** (0.022)	0.078 * (0.032)	0.160 ** (0.057)	
Floors of cement in principal rooms [fcement]			0.301 ** (0.104)			
Floors of earth in principal rooms [fearth]	-0.178 ** (0.055)			-0.344 * (0.109)		
Outer walls constructed from earth [wearth]		-0.374 ** (0.061)		-0.235 ** (0.075)		
Wood used for cooking [cwood]					-0.631 ** (0.204)	
Principal light source is gasoline [petrlght]	-0.337 ** (0.068)	0.324 ** (0.104)	0.180 * (0.075)		0.302 ** (0.092)	
Principal water source is a well [well]	0.149 * (0.067)					
House equipped with a latrine [latrine]		0.336 ** (0.081)				
Location Means[a]						
Principal water source is a well [av_well]					-0.670 ** (0.103)	
Household size [av_size]		0.354 ** (0.045)		-0.227 ** (0.083)		
Flood risk in fivondrona [fld_risk][b]	0.172 ** (0.002)		0.002 * (0.001)			0.031 ** (0.006)
Number of times the eye of a cyclone passed through the fivondrona [npc8994][b]	0.198 ** (0.053)	0.129 ** (0.034)	0.119 ** (0.025)			-0.453 ** (0.133)
Number of household members that ever attended school [av_schoo]		-0.216 ** (0.040)				

Notes: Standard errors in parentheses and statistical significance indicated at the 5% level (*) and at the 1% level (**).
a Firaisana level means
b Fivondrona level means from CARE GIS database

There are two possible reasons for the relatively low adjusted R2s that we encounter in the regression models for the rural areas. First, although there is some variation across rural households in terms of their household expenditures, variation in some observed characteristics, especially in housing and access to services is muted. For example in Mahajanga, none of the rural households have access to electricity at home, regardless of their income. 96% of the households in the top quintile of the expenditure distribution report the source of energy for cooking to be wood, while this percentage is 98% for those in the bottom quintile. Second, even when we observe significant differences in the observed characteristics in the household survey, we are not always able to use those characteristics in our models, because they might have been eliminated during our zero stage analysis for being non-comparable. Again in Mahajanga, we see significant differences in wall and floor materials (richer households use brick and cement more) and in access to latrines (22% among the top quintile vs. only 8% in the bottom quintile) across rich and poor households, but these variables were not used in our models, because the information in the census does not match the information from the household survey. Moving on to Tables 3 and 4, we note that while location effects are present in most of our regression models, with the help of location means of certain variables from the census and GIS data we are able to reduce them somewhat. The location effects are more persistent in rural areas, an observation that is consistent with our inability to explain much of the variation using infrastructure variables in rural areas, as discussed above.

Table 3. Error Component Diagnostics (Urban Strata)

	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana
Without Location Means						
Relative Importance of the Random Effect	0.138	0.160	0.008	0.242	0.198	0.082
Variance of η ($\hat{\sigma}_{\eta}^2$)	0.038	0.053	0.001	0.085	0.098	0.023
Variance of u ($\hat{\sigma}_{u}^2$)	0.278	0.329	0.196	0.352	0.494	0.271
With Location Means						
Relative Importance of the Random Effect	0.099	0.149	0.008	0.101	0.140	0.050
Variance of η ($\hat{\sigma}_{\eta}^2$)	0.026	0.048	0.001	0.029	0.066	0.013
Variance of u ($\hat{\sigma}_{u}^2$)	0.264	0.323	0.196	0.286	0.469	0.246
Distribution Diagnostics of ηc						
Skewness	1.065	0.115	0.096	0.229	0.732	-0.113
Kurtosis	5.767	2.444	2.943	3.434	2.538	2.380
Degrees of Freedom *t*-Distributiona	6	50	50	18	50	50
Distribution Diagnostics of εch						
Skewness	0.415	0.221	-0.053	0.010	-0.092	0.036
Kurtosis	4.338	4.096	3.256	4.094	3.228	3.051
Degrees of Freedom *t*-Distributiona	9	10	27	10	30	50

a *t*-Distributions with 50 degrees of freedom are approximately equivalent to the Normal Distribution.

Table 4. Error Component Diagnostics (Rural Strata)

	Antananarivo	Fianarantsoa	Taomasina	Mahajanga	Toliara	Antsiranana
Without Location Means						
Relative Importance of the Random Effect	0.210	0.376	0.255	0.180	0.263	0.221
Variance of η ($\hat{\sigma}_{\eta}^2$)	0.058	0.175	0.065	0.047	0.102	0.113
Variance of u ($\hat{\sigma}_{u}^2$)	0.277	0.466	0.256	0.263	0.389	0.511
With Location Means						
Relative Importance of the Random Effect	0.133	0.327	0.198	0.152	0.174	0.121
Variance of η ($\hat{\sigma}_{\eta}^2$)	0.033	0.136	0.048	0.039	0.061	0.056
Variance of u ($\hat{\sigma}_{u}^2$)	0.252	0.415	0.242	0.256	0.349	0.462
Distribution Diagnostics of ηc						
Skewness	-0.063	0.159	-1.151	-0.044	0.829	0.299
Kurtosis	2.464	2.773	6.311	1.936	5.139	2.455
Degrees of Freedom *t*-Distribution	50	50	6	50	7	50
Distribution Diagnostics of εch						
Skewness	0.432	1.440	0.615	-0.128	-0.044	1.246
Kurtosis	5.746	10.814	4.904	3.412	3.453	6.944
Degrees of Freedom *t*-Distribution	6	5	7	19	17	6

a *t*-Distributions with 50 degrees of freedom are approximately equivalent to the Normal Distribution

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V. Results

With a regression model for explaining household expenditures in each strata, a model for the heteroskedasticty in the household component of the error, and information on the approximate parametric distributions of both error terms, we now move on to the final stage of our welfare mapping exercise. We impute per capita expenditures for each household in the census and aggregate these to construct poverty and inequality measures for various administrative units.13 In addition, we calculate bootstrapped standard errors for these welfare estimates, taking into account the complex error structure (spatial effects and heteroskedasticity).

Using a monthly per capita household expenditure of 354,000 MGF as our poverty line for the year 1993, we estimate three measures of poverty and three measures of inequality at the faritany, fivondrona, and the firaisana levels14. Our choice of poverty measure is the familiar Foster-Greer-Thorbecke index of poverty, FGT (α), with the poverty aversion parameter, α, equal to 0, 1, and 2. We have also calculated the Gini index, and two general entropy class inequality measures, GE (c), with c equal to 0 and 1 (see Appendix B for the exact formulae and a brief discussion of these indices).

[13] We do this with the help of a SAS module (version altmap12-18-01) developed by Gabriel Demombynes from University of California at Berkeley, while a consultant at the Development Economics Research Group (DECRG-PO) of the World Bank.

[14] The poverty line is the same as the one that was uesd in Razafindravonona et al. (2001).

Table 5 presents poverty levels using the household survey estimates and the census-based predictions by faritany and sector, a level at which the household survey was designed to be representative. Across urban areas, Toliara and Fianarantsoa have the highest headcount of poverty, while Mahajanga and Antsiranana have the least. In rural areas, poverty is much more pronounced and we cannot reject the hypothesis that at least 75% of the individuals are poor in any of the provinces, except for Mahajanga and Antsiranana which are slightly less poor. Using poverty gap or poverty gap squared does not lead to significantly different qualitative judgments in the relative rankings of provinces, although there are slight differences.

Table 5. Poverty Rates by Faritany and Sector

	Headcount Index: FGT(0)		**Poverty Gap: FGT(1)**		**Poverty Gap Squared: FGT(2)**	
Province/Sector	*HH Survey*	*Census (Predicted)*	*HH Survey*	*Census (Predicted)*	*HH Survey*	*Census (Predicted)*
Urban						
Antananarivo	0.544	0.462	0.233	0.190	0.123	0.101
	(0.048)	(0.015)	(0.028)	(0.009)	(0.017)	(0.007)
Fianarantsoa	0.674	0.646	0.297	0.292	0.174	0.166
	(0.059)	(0.027)	(0.054)	(0.021)	(0.045)	(0.016)
Taomasina	0.599	0.599	0.231	0.231	0.117	0.114
	(0.086)	(0.018)	(0.043)	(0.012)	(0.024)	(0.009)
Mahajanga	0.329	0.378	0.096	0.122	0.039	0.054
	(0.072)	(0.028)	(0.022)	(0.013)	(0.011)	(0.008)
Toliara	0.715	0.713	0.381	0.403	0.252	0.273
	(0.086)	(0.036)	(0.082)	(0.036)	(0.071)	(0.034)
Antsiranana	0.473	0.344	0.143	0.121	0.061	0.058
	(0.087)	(0.031)	(0.031)	(0.015)	(0.019)	(0.009)
Rural						
Antananarivo	0.767	0.738	0.323	0.326	0.170	0.177
	(0.037)	(0.019)	(0.026)	(0.014)	(0.017)	(0.010)
Fianarantsoa	0.769	0.820	0.377	0.444	0.222	0.284
	(0.049)	(0.025)	(0.036)	(0.026)	(0.029)	(0.022)
Taomasina	0.810	0.786	0.360	0.358	0.195	0.199
	(0.035)	(0.026)	(0.035)	(0.021)	(0.030)	(0.016)
Mahajanga	0.681	0.695	0.258	0.261	0.129	0.125
	(0.065)	(0.039)	(0.041)	(0.024)	(0.026)	(0.015)
Toliara	0.817	0.800	0.437	0.394	0.274	0.235
	(0.042)	(0.027)	(0.036)	(0.024)	(0.032)	(0.020)
Antsiranana	0.613	0.581	0.252	0.250	0.129	0.141
	(0.073)	(0.046)	(0.045)	(0.029)	(0.028)	(0.020)

Notes: FGT(α) refers to the Foster-Greer-Thorbecke index of poverty. Standard errors in parentheses.

Our census-based predictions seem to perform well at this level. In none of the 12 strata, can we reject the null hypothesis that the census-based prediction is equal to the household survey mean. This pattern holds regardless which measure of poverty is used. The standard errors of our predictions at this level are quite small, in fact considerably more precise than those in the household survey at this level of disaggregation. The precision of the point estimates will decrease as we disaggregate our measures to the fivondrona and firaisana levels. This is because the household component of the error term will be higher.

Table 6: Inequality Measures by Faritany and Sector

Province/Sector	Gini Index		Mean Log Deviation:GE(0)		Theil Index: GE(1)	
	HH Survey	*Census (Predicted)*	*HH Survey*	*Census (Predicted)*	*HH Survey*	*Census (Predicted)*
Urban						
Antananarivo	0.492	0.469	0.409	0.381	0.505	0.416
	(0.027)	(0.012)	(.051)	(0.021)	(0.077)	(0.028)
Fianarantsoa	0.430	0.426	0.331	0.312	0.379	0.332
	(0.038)	(0.015)	(.073)	(0.025)	(0.126)	(0.026)
Taomasina	0.434	0.402	0.312	0.265	0.346	0.292
	(0.042)	(0.015)	(.063)	(0.021)	(0.060)	(0.025)
Mahajanga	0.371	0.392	0.229	0.257	0.237	0.353
	(0.027)	(0.016)	(.034)	(0.023)	(0.039)	(0.026)
Toliara	0.514	0.504	0.499	0.472	0.512	0.454
	(0.052)	(0.030)	(.104)	(0.069)	(0.116)	(0.065)
Antsiranana	0.362	0.433	0.223	0.325	0.227	0.337
	(0.025)	(0.039)	(.036)	(0.068)	(0.041)	(0.087)
Rural						
Antananarivo	0.376	0.404	0.236	0.273	0.277	0.328
	(0.023)	(0.015)	(.036)	(0.021)	(0.049)	(0.030)
Fianarantsoa	0.470	0.437	0.389	0.332	0.570	0.376
	(0.050)	(0.018)	(.093)	(0.029)	(0.164)	(0.031)
Taomasina	0.352	0.362	0.215	0.222	0.249	0.254
	(0.036)	(0.017)	(.050)	(0.022)	(0.078)	(0.030)
Mahajanga	0.320	0.306	0.170	0.154	0.180	0.162
	(0.026)	(0.015)	(.027)	(0.016)	(0.039)	(0.017)
Toliara	0.383	0.377	0.254	0.244	0.251	0.254
	(0.029)	(0.017)	(.039)	(0.023)	(0.037)	(0.025)
Antsiranana	0.518	0.453	0.470	0.367	0.709	0.422
	(0.110)	(0.048)	(.200)	(0.089)	(0.295)	(0.151)

Notes: GE(α) refers to the General Entropy Class measure of inequality. Standard errors in parentheses. Standard errors for the HH survey Gini Index and GE(1) measures are calculated using "ineqerr" command in STATA that uses bootstrapping to calculate standard errors using sampling weights and clustering information. Standard errors for the GE(0) estimates from the HH survey were calculated using a slightly modified version of ineqerr.ado developed by Gabriel Demombynes.

Table 6 presents the inequality measures in the same manner. Inequality is slightly more pronounced in urban areas on average, but levels of inequality in Madagascar are not very high. Toliara and Antananarivo are the provinces with high inequality in urban areas, while Antsiranana and Fianarantsoa have higher inequality than other provinces in rural areas. Again, our census-based predictions perform well, with all but two of the predictions for the Gini index falling within one standard error of the survey-based Gini estimates.

Table 7. Decomposition of the Theil Index (GE(1))

Level of Decomposition	Number of Units	Within-Group Inequality	Between-Group Inequality	% Between-Group Inequality
Urban	1	0.40	0	0
Faritany	6	0.37	0.03	7.0
Fivondrona	103	0.32	0.07	18.7
Firaisana	131	0.31	0.08	20.4
Rural	1	0.32	0	0
Faritany	6	0.31	0.01	4.4
Fivondrona	104	0.26	0.05	16.9
Firaisana	1117	0.25	0.06	19.4

Table 7 decomposes one of the general entropy class inequality measures 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, and all of it is between groups when each household is considered a separate group. But, how much of the inequality, on average, is attributable to differences in mean levels of expenditure between, say, provinces vs. the inequality within each province? GE(α) measures are decomposable in this manner and allow us to answer this question.

We see that 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 Firaisanas. Approximately, only 5% of the inequality in Madagascar is between provinces, 18% between Fivondronas, and 20% between Firaisanas. The reader should note that while this finding means that, on average, most of the inequality in Madagascar would be found within small geographical units, it does not exclude the possibility that some firaisanas have very low levels of inequality.

Figures 1 and 2 make this point for rural and urban areas of Madagascar, respectively. In each figure, firaisanas are ranked from lowest to highest inequality and plotted against the level of inequality at the national level. We observe not only that many communities have very small levels of inequality, but also that a majority of the communities have point estimates of inequality that are lower than the national level of inequality.

In Appendix D, we report estimates of mean expenditure and poverty for each fivondrona, as well as estimates for urban and rural areas separately for each fivondrona. We note that poverty is spatially heterogeneous within provinces, especially within urban areas. For example in urban Anatananarivo, where our predicted headcount index is 0.462, the headcount figures in its 19 fivondronas range from 0.363 in Antananarivo Renivohitra to 0.583 in Antanifotsy. In Antsiranana, the same figures range from 0.062 in Nosy Be to 0.786 in Vohimarina. However, every province is not highly heterogeneous in terms of its level of poverty, particularly not in rural areas. For example, the fivondrona level headcount figures for rural areas range from 0.712 to 0.883 in Toliara, from 0.704 to 0.886 in Toamasina, and from 0.711 to 0.921 in Fianarantsoa.

The standard errors increase as expected, but stay at fairly low levels. At the *fivondrona* level, the average ratio of standard error to point estimate for the headcount index is less than or equal to 5% in all but two provinces (Mahajanga and Antsiranana), for which the household survey itself produces very imprecise estimates. 63% of the fivondrona level estimates are significantly different than the faritany-level average.15

At the firaisana level, an interesting, but not entirely unexpected, picture emerges. While there is some heterogeneity in the poverty levels across firaisanas, the disaggregation down to some 1,200 firaisanas does not produce more heterogeneity in poverty than already encountered at the fivondrona level in most instances. In other

[15] If only a negligible few estimates for districts were statistically distinguishable from their province average, because the standard errors were very large, then, in our view, there would be little point in constructing a finely disaggregated poverty map.

words, most of the firaisanas have poverty estimates that are very close to the poverty estimate for the fivondrona to which they belong16.

Table 8 demonstrates this by province. Overall, only 14% of the firaisanas in Madagascar have headcount estimates that are significantly different than the fivondrona to which they belong. There is some variation by provinces, however. Over 25% of the firaisanas in Antananarivo and rural Toliara fall into this category, while in Antsiranana this percentage is zero. The percentage of *people* living in such firaisanas is significantly higher in urban areas. 30% of the individuals living in urban areas live in firaisanas that are poorer (or richer) than the fivondrona average. This percentage goes up to 64% in urban Antananarivo.

In contrast with this, a majority of the fivondronas have significantly different poverty estimates than the province to which they belong. 90% of the urban population and 55% of the rural population live in such fivondronas. Again, there is large variation in these numbers. For example, the same percentages for people living in rural Mahajanga and Toliara are 26% and 28%, respectively, while they are 77% and 64% for rural Antananarivo and Fianarantsoa. There is hardly any such variation in urban areas.

While, at first, the findings above might seem surprising, they are quite consistent with the inequality decomposition figures presented in Table 7. Remember that the shares of within-province, within-fivondrona, and within-firaisana inequality were 7%, 19%, and 20%, respectively in urban areas (4%, 17%, and 19%, respectively in rural areas), indicating that most of the inequality within fivondronas is **not** due to differences in mean consumption between firaisanas, but due to inequality within firaisanas. Consequently, on average, the value added from disaggregating poverty estimates from province to fivondrona level are significantly larger than that from fivondrona to firaisana level, and larger in urban areas than in rural ones.

Table 8. How Much Does the Headcount Index Vary with Disaggregation?

	% of geographic units		**% of the population**	
	Firiasana estimates sign. diff. from their ***Fivondrona*** estimate	***Fivondrona*** estimates sign. diff. from their ***Faritany*** estimate	***Firiasanas*** estimates sign. diff. from their ***Fivondrona*** estimate	***Fivondrona*** estimates sign. diff. from their ***Faritany*** estimate
Urban	**12.2**	**77.9**	**30.3**	**89.8**
Antananarivo	26.9	87.5	64.3	96.9
Fianarantsoa	14.3	73.9	7.0	82.7
Taomasina	9.5	94.1	11.0	96.9
Mahajanga	4.8	85.0	17.8	92.0
Toliara	8.0	50.0	4.6	69.2
Antsiranana	0.0	87.5	0.0	88.4
Rural	**13.8**	**52.9**	**12.3**	**54.9**
Antananarivo	28.1	70.6	25.3	77.2
Fianarantsoa	2.6	63.6	2.7	63.7
Taomasina	0.7	64.7	0.5	57.0
Mahajanga	14.7	30.0	11.3	25.7
Toliara	28.4	40.0	24.8	28.7
Antsiranana	0.0	50.0	0.0	41.4
Total	**13.7**	**65.4**	**16.4**	**62.8**

Notes: Differences in poverty rates that are statistically different were determined using the standard errors of the point estimate for the lower level of spatial disaggregation. Hence the standard errors of the poverty estimates for fivondronas were used for the figures in columns 1 & 3, those of faritanys for columns 2 & 4.

[16] Welfare estimates at the Firaisana level are not presented here, mainly for practical reasons, but are available from the authors upon request.

Regarding the precision of the welfare estimates at the *firaisana* level, the average ratio of standard error to point estimate is mostly in the 5-10% range, again with the exception of Mahajanga and Antsiranana for both rural and urban areas. The relatively low precision of our estimates in these two provinces is partly due to the fact that the explanatory power in the first-stage regression models for these two provinces are low, but also because these provinces have relatively low poverty estimates compared with the rest of the country. The level of precision for our firaisana-level estimates is on par with the precision of the province-level estimates from the household survey. If researchers and policy-makers are content to use the 1993 household survey (EPM 1993) in Madagascar to make comparative statements about welfare at the provincial level, then they should be equally comfortable utilising our estimates at the fivondrona, and even firaisana, levels provided that they pay proper attention to the standard errors. Although our estimates are fairly precise, not all pairwise comparisons of poverty yield statistically significant differences across districts or communes.

In Appendix A we present a set of maps that summarize and highlight some of the spatial patterns in our results. Maps 2 and 3 present our poverty headcount estimates at the Fivondrona and Firaisana level respectively. Among other things, these maps illustrate clearly that urban areas are generally less poor than rural areas, and that poverty levels are particularly high in rural Toliara, the northern rural areas of Toamasina, and in highland rural areas of the Fianarantsoa and Antananarivo provinces. Map 4 highlights the 65.4% of fivondrona's that have estimated headcount rates that are either significantly lower or higher than the headcount rate for the faritany they belong. Map 5 shows the mere 13.7 % of firaisanas in Madagascar that have headcount rates that are significantly different than the headcount rate for the fivondrona they belong. This map also highlights the significant heterogeneity in poverty headcount rates within urban areas (particularly Anstirabe, Antanarivo, Tamatave and Toliara) that are comprised of firaisana that are both significantly poorer and richer vis-à-vis the fivondrona averages. Finally, Maps 6 and 7 provide a closer look at the headcount poverty rate estimates in the provinces of Antanarivo and Toliara respectively.

VI. Conclusions

In this paper, we have estimated various measures of welfare for small administrative units in Madagascar, by combining the 1993 population census (deuxième recensement général de la population et de l'habitat) with the household survey data (Enquête Permanente auprès des Ménages - EPM) that was fielded between May 1993 and April 1994. We have also utilized data obtained from CARE in Madagascar that provides information on spatial environmental variables at the fivondrona level.

Our estimates of mean expenditure, poverty, and inequality at the province level, the level at which the household survey is representative, are comparable to those calculated using the sample survey. To our knowledge, this paper is the first of its kind to provide estimates of poverty and inequality for lower level units of administration in Madagascar. We are able to produce poverty rates that are precise enough to be of value to researchers and policy-makers alike, not only at the fivondrona level (2nd

administrative level), but also for the 1,248 firaisanas (3rd administrative level) in Madagascar.

The results suggest that, despite the high level of overall poverty that prevailed in Madagascar in 1993, there was a lot of heterogeneity within provinces (faritany). Welfare rankings of administrative units using various measures of poverty are consistent—none of the rank correlation coefficients are below 0.92. Poverty is more pronounced and less heterogeneous in rural areas than in urban areas. Regarding inequality, we conclude that while the overall level of inequality is low in Madagascar, on average most of the inequality is attributable to inequality *within* small administrative units rather than mean differences in expenditure *between* administrative units (Table 7). However, this is consistent with another finding of this paper that most of the firaisanas in Madagascar have significantly lower rates of inequality than the national level, especially in rural areas (Figures 1 & 2).

An interesting, and potentially useful for policy-makers, finding of this paper is the following. While there is considerable heterogeneity of poverty in Madagascar across administrative units, this is much more pronounced at the fivondrona level than it is at the firaisana level. Even the variation at the fivondrona level is muted in rural areas for some provinces, such as Mahajanga, Toliara, and Antsiranana. This urban-rural contrast suggests that an added emphasis to spatial targeting might be necessary in the case of urban areas. Furthermore, any effort to spatially target firaisanas rather than fivondronas must not only carefully weigh the marginal benefits against the marginal cost of this fine-tuned targeting, but also must take into account the statistical precision of the welfare estimates that are being used. Even though our welfare estimates for firaisanas are relatively precise for utilization by policy-makers, many firaisanas are, on average, simply not any better or worse of than the fivondrona to which they belong, making the value added from using disaggregated welfare estimates rather small. Of course, this is not true everywhere in Madagascar—there can be significant gains in looking at firaisana-level welfare estimates in urban Antananarivo, and to a lesser extent rural Antananarivo and Toliara.

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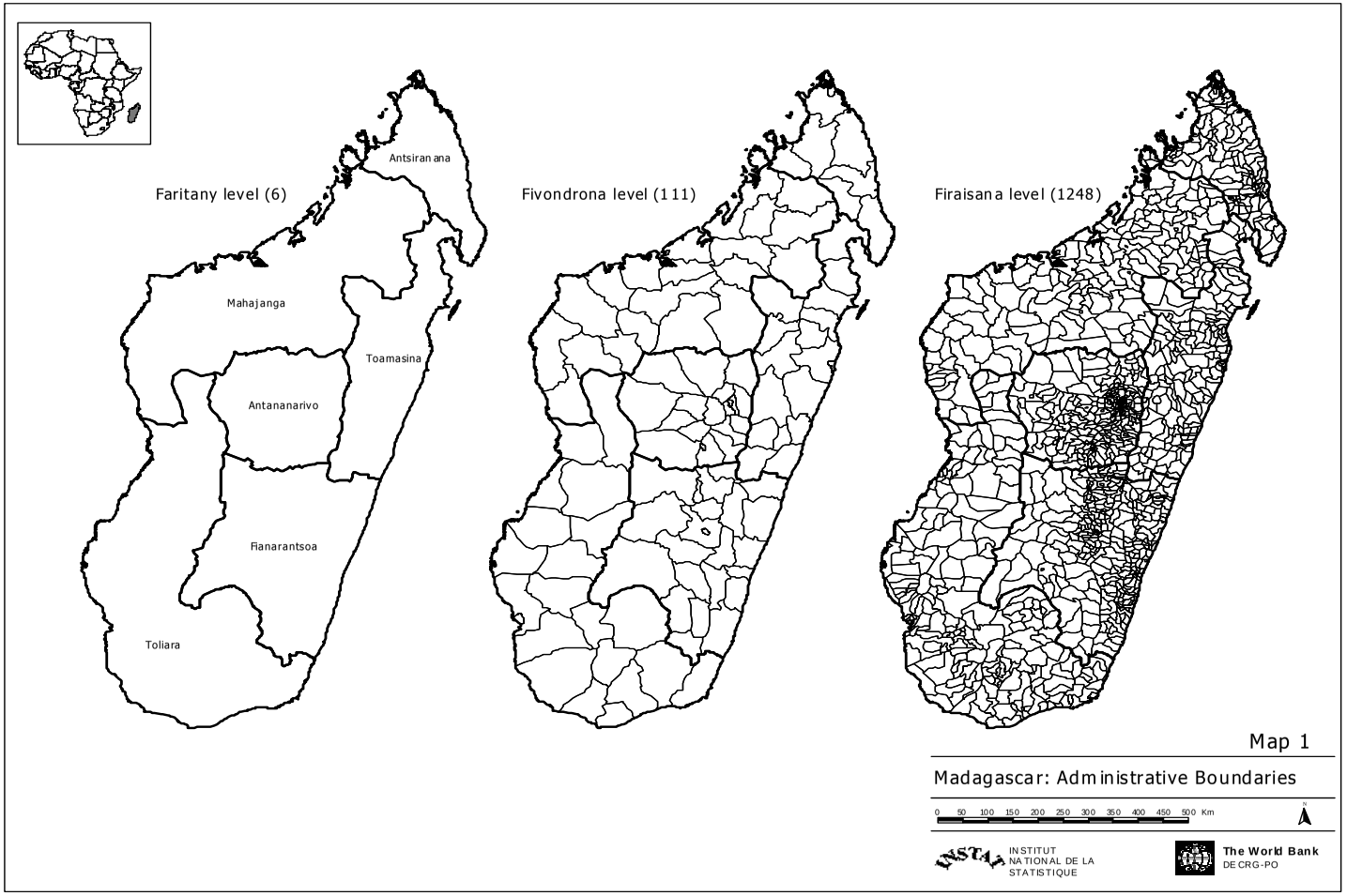
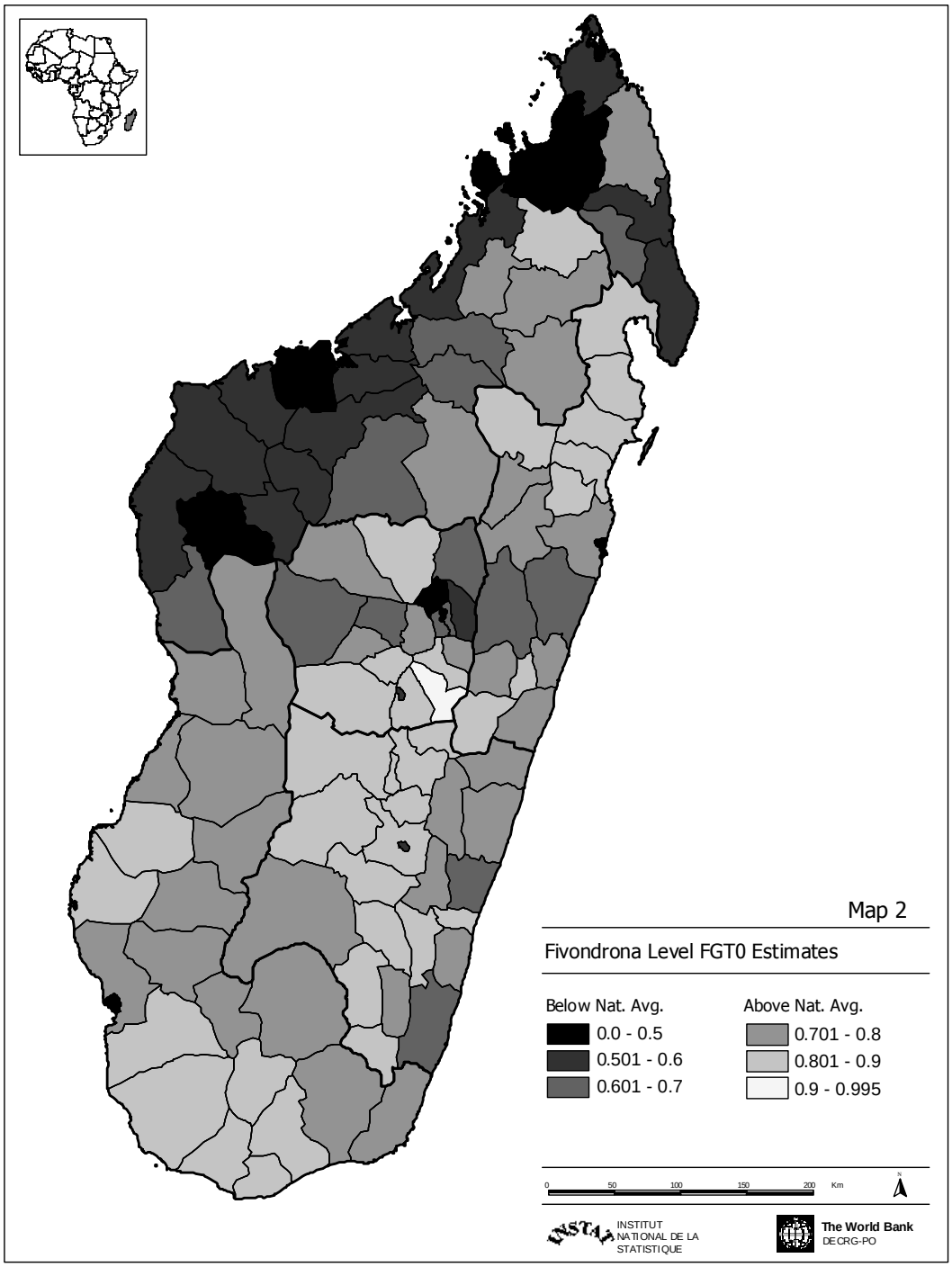
Appendix A. Poverty Maps

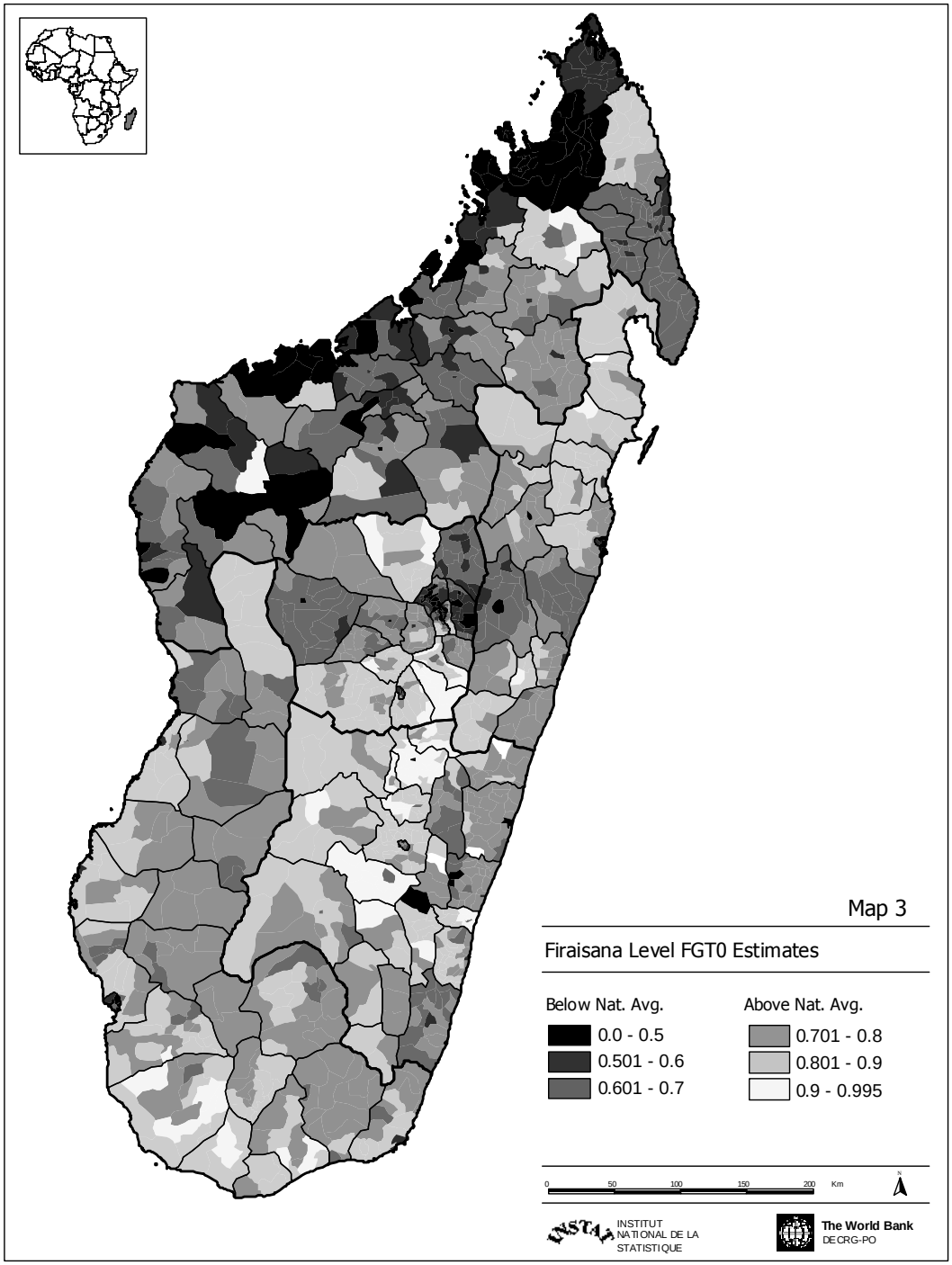
Map 1. Madagascar: Administrative Boundaries



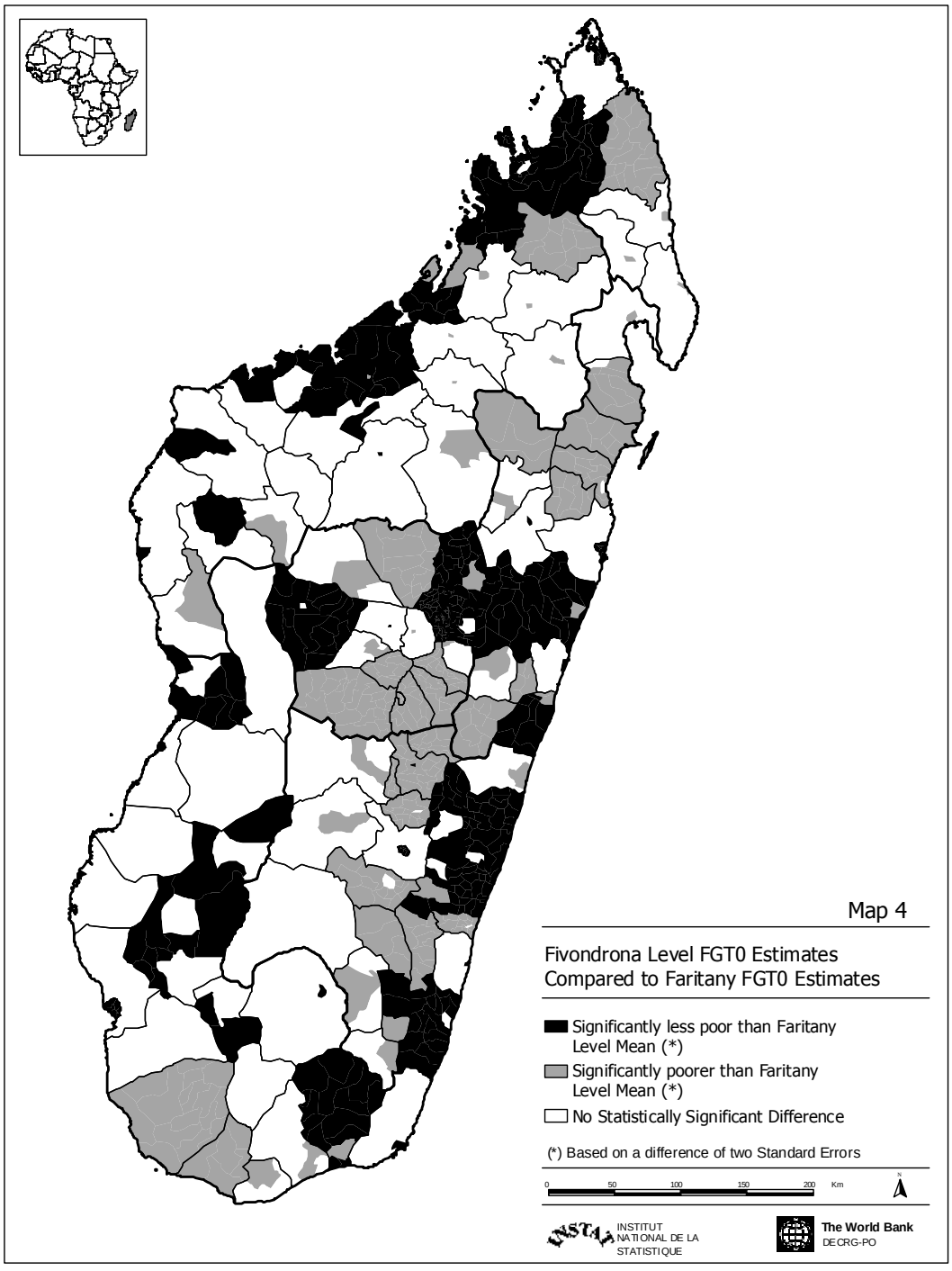
Map 2. Fivondrona Level FGT0 Estimates



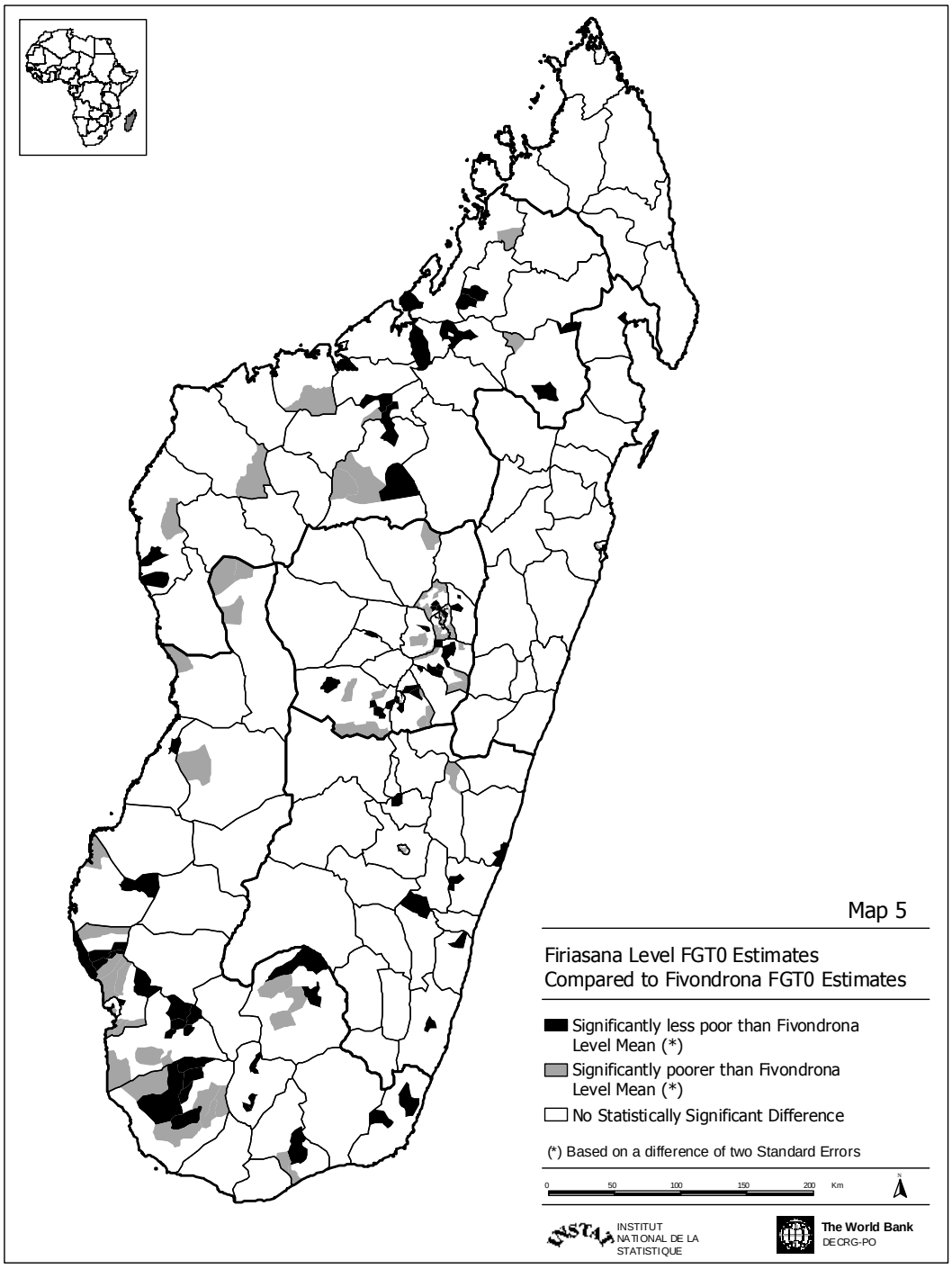
Map 3. Firaisana Level FGT0 Estimates



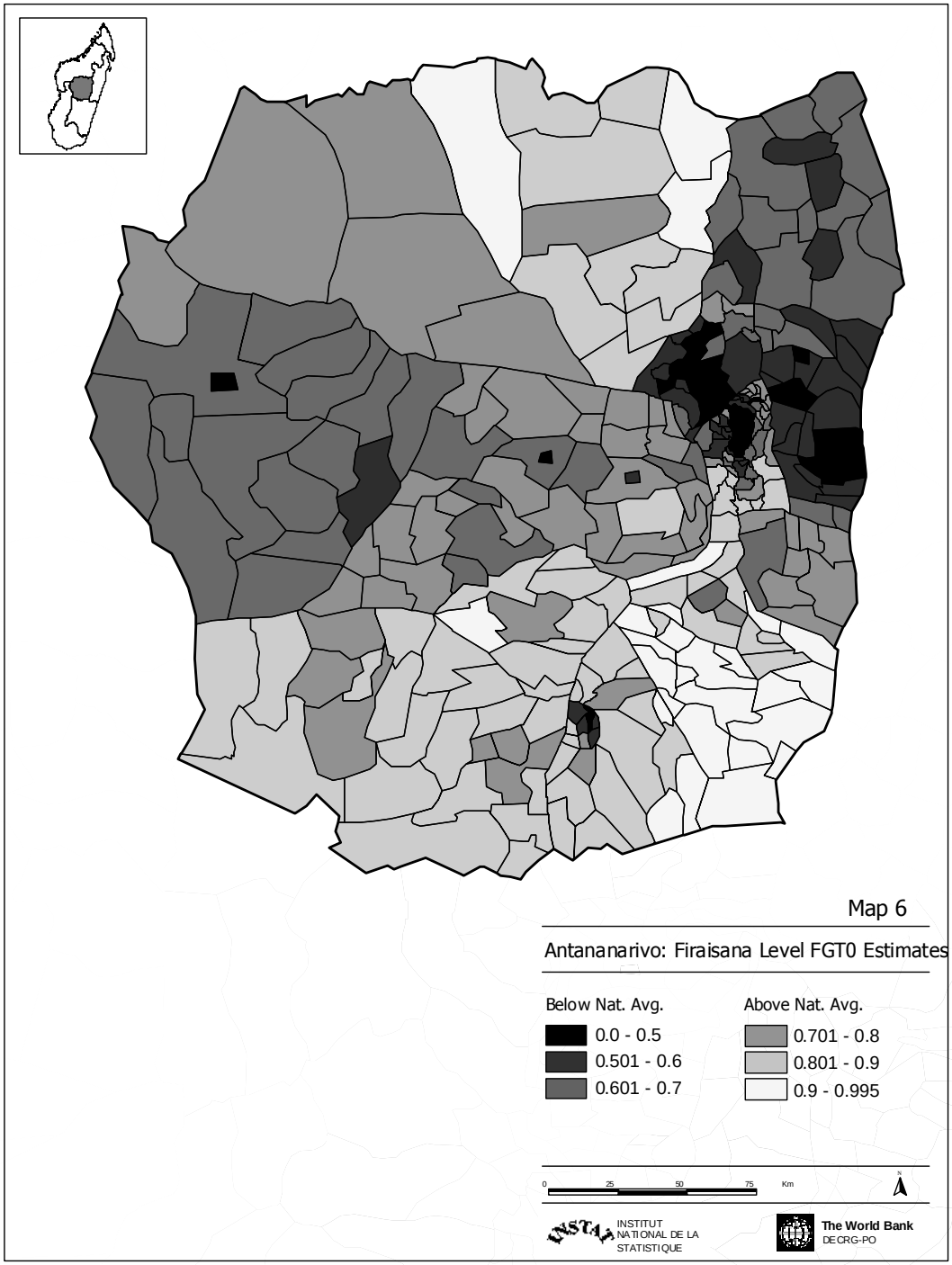
Map 4. Comparison of FGT0 Estimates: Fivondrona versus Faritany



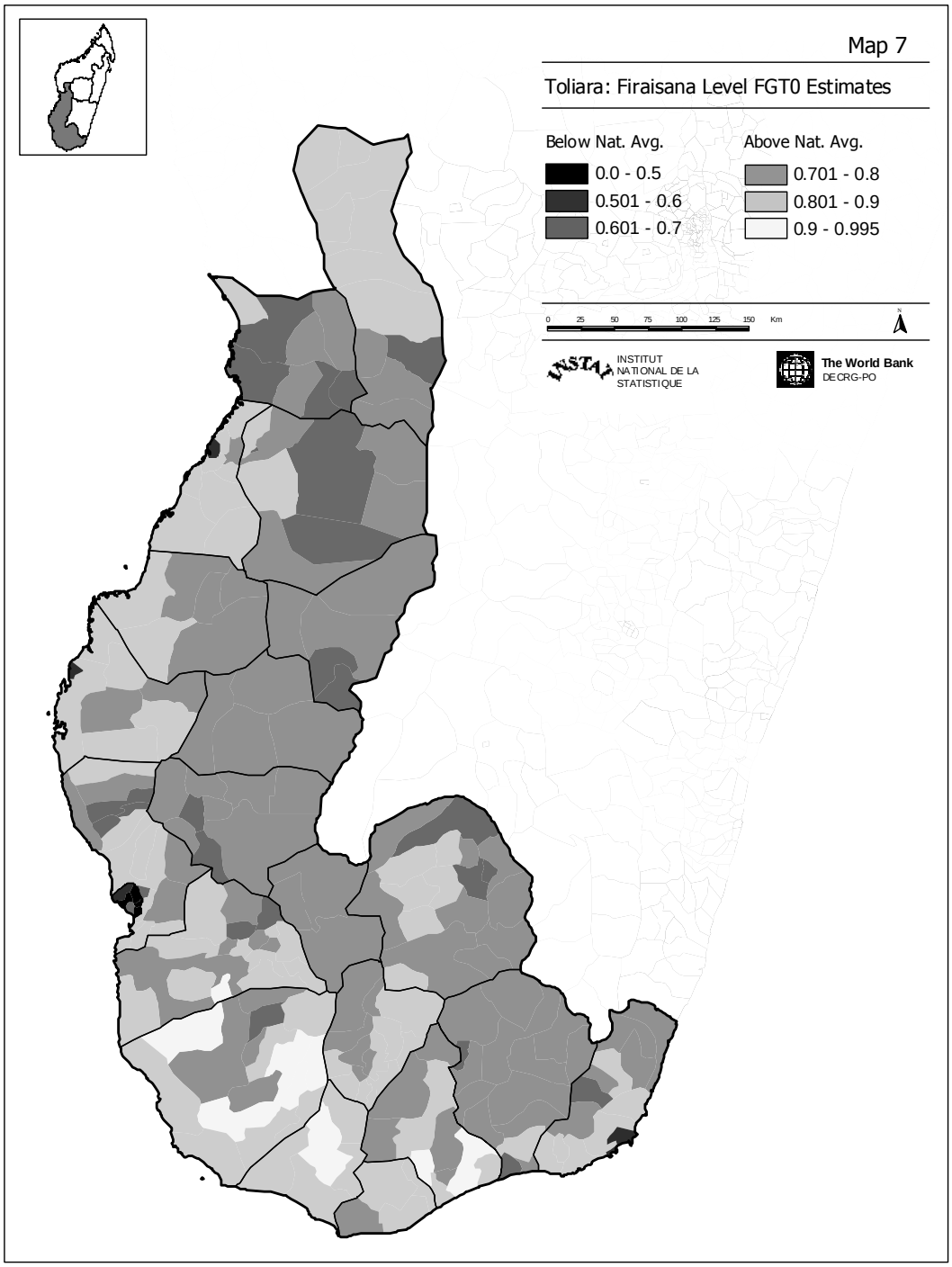
Map 5. Comparison of FGT0 Estimates: Firaisana versus Fivondrona



Map 6. Antanarivo: Firaisana Level FGT0 Estimates



Map 7. Toliara: Firaisana Level FGT0 Estimates



Appendix B. Poverty and Inequality Measures

Poverty Measures

We compute and report the Foster, Greer and Thorbecke (usually referred to as FGT) class of poverty measures.17 The FGT class of measure is generally denoted as P(α) and defined as:

$$P(\alpha) = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{z - y_i}{z}\right)^{\alpha} I(y_i \le z)$$

where *N* is the population size for which the measure is computed, *yi* is the level of individual welfare (real per capita consumption in this paper) of the *i*th individual, *z* is the poverty line, *I(.)* is an indicator function that maps a value of 1 when the constraint is satisfied and 0 otherwise, and α is the poverty sensitivity indicator. When the latter is set equal to zero, the FGT measure reduces to the headcount ratio. The depth of poverty can be measured by letting α=1 and the poverty severity index is computed when α=2.

Inequality Measures

Inequality means different things to different people and there are many ways of measuring inequality. In this paper inequality refers to the dispersion of the distribution of our (estimated) consumption aggregate. We use two measures in this paper. First, the Gini Index:

$$Gini = \frac{1}{2n^2\bar{y}}\sum_{i=1}^{n}\sum_{j=1}^{n}\left|y_i - y_j\right|$$

where $\bar{y} = \sum_{i=1}^{n}\frac{y_i}{n}$. Secondly, we also report two measures belonging to the Generalized Entropy class of decomposable inequality measures:

$$GE(0) = \frac{1}{W}\sum w_i \log\frac{y_i}{\bar{y}} \quad \text{and}$$

$$GE(1) = \frac{1}{W}\sum w_i \frac{y_i}{\bar{y}} \log\frac{y_i}{\bar{y}}.$$

For more details on these inequality measures, please see

http://www.worldbank.org/research/inequality/index.htm

17 Ravallion (1994) provides a comprehensive overview of the concepts and methods of poverty analysis, including a detailed treatement of approaches to poverty measurement.

Appendix C. Zero-Stage Comparison Tables

Table C1. Zero-Stage Comparisons of Census and Survey Means (Urban Strata)

	Antananarivo					Fianarantsoa					Taomasina					Mahajanga					Toliara					Antsiranana				
	cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b	
Demographic																														
size	4.950	5.169	4.998	5.413	0	5.220	5.419	4.492	5.827	1	4.750	4.967	4.348	5.585	1	4.600	4.483	3.975	4.991	1	4.870	5.480	4.609	6.351	1	4.010	4.493	3.855	5.097	1
headfem	0.200	0.180	0.140	0.231	1	0.230	0.243	0.159	0.324	1	0.240	0.331	0.245	0.417	0	0.230	0.254	0.141	0.368	1	0.240	0.221	0.141	0.301	1	0.320	0.395	0.308	0.486	1
chmarri	0.740	0.768	0.721	0.804	1	0.700	0.709	0.643	0.807	1	0.690	0.682	0.623	0.741	1	0.700	0.689	0.592	0.787	1	0.700	0.683	0.622	0.744	1	0.590	0.543	0.456	0.626	1
Education & Employment																														
school	3.810	3.936	3.808	4.079	1	3.230	3.348	2.968	3.741	1	3.120	3.533	3.001	4.066	1	2.690	2.652	2.213	3.091	1	2.160	2.836	2.133	3.539	1	2.790	3.275	2.746	3.776	1
nevsch	0.310	0.304	0.196	0.473	1	0.970	0.944	0.241	1.292	1	0.730	0.495	0.280	0.709	0	1.020	0.800	0.283	1.317	1	1.750	1.361	0.826	1.895	1	0.530	0.515	0.337	0.699	1
segsch	1.930	1.700	1.323	2.011	1	1.340	1.298	0.859	1.794	1	1.200	1.361	0.781	1.941	1	1.230	1.131	0.758	1.505	1	0.920	1.134	0.752	1.496	1	1.310	1.351	0.931	1.758	1
student	0.910	0.804	0.667	0.929	1	0.720	0.697	0.445	1.019	1	0.690	0.954	0.705	1.203	0	0.610	0.490	0.260	0.721	1	0.510	0.565	0.311	0.819	1	0.720	1.019	0.714	1.315	1
Housing & Infrastructure																														
livnb	1.950	1.888	1.779	2.005	1	2.030	1.959	1.675	2.415	1	1.790	2.020	1.650	2.391	1	1.620	1.683	1.545	1.820	1	1.580	1.597	1.435	1.758	1	1.860	2.159	1.768	2.551	1
pclivnb	0.511	0.464	0.412	0.484	0	0.522	0.552	0.382	0.763	1	0.512	0.561	0.429	0.632	1	0.489	0.513	0.445	0.585	1	0.460	0.411	0.358	0.497	1	0.650	0.640	0.495	0.788	1
wcement	0.120	0.022	0.006	0.036	0	0.040	0.056	0.010	0.095	1	0.052	0.035	-0.009	0.079	1	0.130	0.082	0.015	0.149	1	0.076	0.043	0.002	0.085	1	0.170	0.124	0.013	0.236	1
wearth	0.420	0.241	0.172	0.348	0	0.480	0.277	0.149	0.585	1	0.160	0.088	-0.024	0.201	1	0.350	0.479	0.261	0.698	1	0.290	0.240	0.051	0.429	1	0.016	0.055	-0.045	0.156	1
wbrick	0.400	0.707	0.609	0.772	0	0.110	0.224	0.069	0.330	1	0.035	0.113	-0.019	0.245	1	0.030	0.121	-0.021	0.262	1	0.018	0.115	-0.029	0.259	1	0.004	0.004	-0.005	0.014	1
wwood	0.030	0.027	0.011	0.041	1	0.020	0.019	0.000	0.037	1	0.110	0.163	0.060	0.265	1	0.020	0.023	0.001	0.045	1	0.270	0.160	0.002	0.319	1	0.100	0.076	-0.001	0.154	1
fearth	0.290	0.359	0.241	0.477	1	0.410	0.279	0.171	0.492	1	0.066	0.058	-0.003	0.119	1	0.370	0.523	0.325	0.720	1	0.460	0.592	0.452	0.731	1	0.024	0.084	0.037	0.132	0
fcement	0.300	0.284	0.206	0.352	1	0.170	0.207	0.106	0.285	1	0.220	0.276	0.130	0.422	1	0.500	0.469	0.271	0.666	1	0.270	0.322	0.208	0.436	1	0.540	0.443	0.198	0.693	1
eleclght	0.470	0.434	0.310	0.534	1	0.180	0.182	0.072	0.278	1	0.190	0.249	0.110	0.388	1	0.240	0.180	0.071	0.289	1	0.110	0.129	0.027	0.230	1	0.370	0.327	0.146	0.511	1
petrlght	0.400	0.465	0.353	0.610	1	0.770	0.774	0.668	0.862	1	0.760	0.697	0.557	0.836	1	0.720	0.788	0.663	0.913	1	0.820	0.755	0.615	0.896	1	0.600	0.669	0.483	0.851	1
runwater	0.230	0.214	0.133	0.272	1	0.090	0.127	0.023	0.468	1	0.070	0.102	0.008	0.197	1	0.160	0.168	0.036	0.299	1	0.090	0.130	0.043	0.216	1	0.220	0.285	0.116	0.458	1
pubpump	0.510	0.580	0.453	0.671	1	0.260	0.203	0.075	0.317	1	0.190	0.216	0.059	0.374	1	0.370	0.290	0.122	0.459	1	0.270	0.506	0.305	0.707	0	0.330	0.299	0.093	0.508	1
well	0.060	0.031	0.014	0.048	0	0.150	0.197	0.014	0.308	1	0.170	0.210	-0.017	0.437	1	0.270	0.324	0.159	0.489	1	0.310	0.077	0.007	0.148	0	0.320	0.342	0.079	0.610	1
ccoal	0.580	0.595	0.427	0.708	1	0.230	0.278	0.116	0.425	1	0.270	0.406	0.223	0.590	1	0.390	0.378	0.175	0.581	1	0.210	0.308	0.126	0.490	1	0.460	0.344	0.138	0.552	1
cwood	0.270	0.341	0.217	0.528	1	0.700	0.715	0.564	0.881	1	0.630	0.530	0.318	0.742	1	0.510	0.600	0.396	0.805	1	0.720	0.684	0.497	0.871	1	0.390	0.600	0.375	0.821	1
latr1e	0.720	0.718	0.631	0.813	1	0.380	0.405	0.284	0.714	1	0.520	0.649	0.478	0.821	1	0.340	0.353	0.181	0.525	1	0.200	0.349	0.171	0.527	1	0.310	0.396	0.250	0.535	1

Notes: cs=census mean, hhs=household survey mean, lower (l95b) and upper (u95b) bound of the 95% confidence interval aroundhhs.

Table C2. Zero-Stage Comparisons of Census and Survey Means (Rural Strata)

	Antananarivo					Fianarantsoa					Taomasina					Mahajanga					Toliara					Antsiranana				
	cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b		cs	hhs	l95b	u95b	
Demographic																														
size	5.180	5.198	4.910	5.449	1	5.350	4.961	4.661	5.390	1	4.820	4.952	4.523	5.382	1	4.760	4.965	4.614	5.350	1	4.480	4.601	4.209	5.020	1	4.280	4.215	3.750	4.680	1
headfem	0.160	0.150	0.114	0.179	1	0.180	0.156	0.116	0.195	1	0.170	0.150	0.088	0.213	1	0.184	0.185	0.119	0.242	1	0.200	0.206	0.149	0.254	1	0.260	0.308	0.237	0.379	1
chmarri	0.780	0.796	0.758	0.841	1	0.740	0.742	0.683	0.795	1	0.740	0.768	0.694	0.842	1	0.750	0.755	0.705	0.811	1	0.730	0.743	0.683	0.810	1	0.660	0.600	0.526	0.674	1
Education & Employment																														
school	3.280	3.353	3.059	3.602	1	2.280	2.248	1.843	2.646	1	2.310	2.600	2.251	2.948	1	1.800	2.236	1.782	2.730	1	0.900	1.330	0.798	1.864	1	2.050	2.326	1.939	2.713	1
nevsch	0.790	0.681	0.511	0.840	1	1.850	1.617	1.292	2.040	1	1.400	1.208	0.894	1.522	1	1.840	1.663	1.063	2.255	1	2.600	2.245	1.740	2.769	1	1.290	0.938	0.676	1.199	0
segsch	0.620	0.747	0.493	0.978	1	0.340	0.303	0.206	0.391	1	0.350	0.341	0.160	0.521	1	0.290	0.393	0.222	0.567	1	0.200	0.271	0.062	0.485	1	0.340	0.422	0.277	0.568	1
student	0.510	0.420	0.301	0.521	1	0.260	0.211	0.134	0.270	1	0.330	0.349	0.237	0.460	1	0.230	0.281	0.163	0.406	1	0.110	0.176	0.075	0.276	1	0.320	0.366	0.271	0.460	1
Housing & Infrastructure																														
livnb	2.060	1.977	1.793	2.161	1	1.770	1.670	1.468	1.829	1	1.360	1.457	1.297	1.617	1	1.400	1.698	1.442	1.959	0	1.260	1.213	1.124	1.301	1	1.370	1.685	1.443	1.928	0
pclivnb	0.520	0.470	0.427	0.508	0	0.434	0.443	0.373	0.489	1	0.399	0.390	0.340	0.441	1	0.415	0.454	0.386	0.483	1	0.407	0.358	0.317	0.382	0	0.480	0.630	0.480	0.773	1
wcement	0.012	0.028	-0.026	0.084	1	0.003	0.003	-0.001	0.008	1	0.005	0.008	-0.001	0.017	1	0.011	0.000	0.000	0.000	0	0.013	0.015	-0.017	0.048	1	0.023	0.026	-0.021	0.073	1
wearth	0.830	0.503	0.395	0.607	0	0.490	0.395	0.228	0.517	1	0.180	0.187	0.057	0.316	1	0.660	0.738	0.568	0.901	1	0.500	0.449	0.234	0.668	1	0.010	0.013	-0.003	0.029	1
wbrick	0.130	0.448	0.332	0.566	0	0.026	0.097	0.019	0.181	1	0.030	0.066	0.013	0.119	1	0.010	0.068	-0.060	0.197	1	0.020	0.087	-0.034	0.202	1	0.000	0.000	0.000	0.000	1
wwood	0.003	0.007	-0.001	0.015	1	0.012	0.010	0.001	0.019	1	0.046	0.038	0.014	0.062	1	0.021	0.018	-0.009	0.046	1	0.110	0.144	0.012	0.279	1	0.052	0.049	0.006	0.093	1
fearth	0.700	0.673	0.574	0.792	1	0.500	0.480	0.312	0.618	1	0.070	0.194	0.058	0.329	1	0.850	0.886	0.799	0.969	1	0.590	0.924	0.867	0.979	0	0.024	0.047	0.009	0.086	1
fcement	0.100	0.139	0.056	0.219	1	0.016	0.009	0.001	0.020	1	0.058	0.064	0.008	0.120	1	0.067	0.092	0.013	0.174	1	0.048	0.057	0.007	0.108	1	0.081	0.139	-0.010	0.289	1
eleclght	0.070	0.085	0.027	0.134	1	0.002	0.004	-0.001	0.013	1	0.007	0.004	-0.002	0.010	1	0.005	0.000	0.000	0.000	0	0.004	0.004	-0.003	0.012	1	0.008	0.026	-0.003	0.055	1
petrlght	0.860	0.844	0.774	0.920	1	0.940	0.915	0.871	0.964	1	0.940	0.884	0.816	0.951	1	0.970	0.986	0.976	1.002	0	0.920	0.841	0.723	0.956	1	0.970	0.974	0.945	1.003	1
runwater	0.016	0.017	0.002	0.033	1	0.001	0.026	-0.001	0.004	1	0.002	0.002	-0.002	0.005	1	0.003	0.017	-0.018	0.053	1	0.003	0.000	0.000	0.000	0	0.004	0.000	0.000	0.000	0
pubpump	0.066	0.077	0.001	0.143	1	0.016	0.010	-0.008	0.031	1	0.040	0.022	-0.024	0.067	1	0.020	0.095	-0.046	0.239	1	0.025	0.007	-0.009	0.023	0	0.040	0.000	0.000	0.000	0
well	0.130	0.133	0.055	0.217	1	0.110	0.101	0.027	0.192	1	0.130	0.104	-0.008	0.216	1	0.360	0.191	0.037	0.344	0	0.410	0.532	0.349	0.711	1	0.270	0.411	0.090	0.732	1
ccoal	0.088	0.126	0.027	0.226	1	0.006	0.004	0.000	0.010	1	0.014	0.022	0.000	0.044	1	0.018	0.018	0.004	0.032	1	0.010	0.019	-0.009	0.048	1	0.002	0.050	0.003	0.097	0
cwood	0.830	0.857	0.754	0.957	1	0.950	0.996	0.990	1.000	0	0.940	0.978	0.956	1.000	0	0.930	0.982	0.968	0.996	0	0.950	0.976	0.946	1.005	1	0.920	0.950	0.903	0.997	1
latr1e	0.560	0.605	0.499	0.701	1	0.150	0.119	0.035	0.160	1	0.290	0.324	0.173	0.475	1	0.030	0.106	0.020	0.195	1	0.030	0.022	-0.008	0.053	1	0.150	0.121	0.021	0.220	1

Notes: cs=census mean, hhs=household survey mean, lower (l95b) and upper (u95b) bound of the 95% confidence interval aroundhhs.

Appendix D. Fivondrona Level Expenditure and Poverty Estimates by Faritany

Table D1. Antananarivo: Mean Per Capita Expenditure and Poverty Estimates

		All					Urban					Rural			
Id	*Fivondrona*	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2
1	Antananarivo	3,500,039	399520	0.655	0.285	0.154	1,039,022	576469	0.461	0.189	0.101	2,461,017	324813	0.737	0.326	0.177
			(12358)	(0.014)	(0.010)	(0.007)		(23944)	(0.014)	(0.009)	(0.006)		(14377)	(0.019)	(0.014)	(0.010)
101	Antananarivo Renivohitra	676,490	670202	0.363	0.131	0.064	676,490	670202	0.363	0.131	0.064	0	N/A	N/A	N/A	N/A
			(30366)	(0.018)	(0.009)	(0.005)		(30366)	(0.018)	(0.009)	(0.005)					
102	Antananarivo Avaradrano	159,009	381471	0.664	0.285	0.152	0	N/A	N/A	N/A	N/A	159,009	381471	0.664	0.285	0.152
			(37416)	(0.040)	(0.028)	(0.019)							(37416)	(0.040)	(0.028)	(0.019)
103	Ambohidratrimo	176,501	569554	0.473	0.168	0.080	6,149	802911	0.340	0.127	0.064	170,352	561131	0.478	0.169	0.081
			(42835)	(0.032)	(0.016)	(0.009)		(10357)	(0.044)	(0.022)	(0.013)		(44224)	(0.033)	(0.016)	(0.009)
104	Ankazobe	84,196	250638	0.846	0.400	0.224	9,766	355063	0.702	0.320	0.180	74,430	236936	0.865	0.410	0.229
			(17749)	(0.027)	(0.031)	(0.024)		(42129)	(0.049)	(0.040)	(0.029)		(19301)	(0.030)	(0.034)	(0.027)
105	Arivonimamo	198,521	330909	0.724	0.295	0.150	13,500	524982	0.513	0.210	0.111	185,021	316749	0.740	0.301	0.153
			(14930)	(0.023)	(0.016)	(0.011)		(48044)	(0.041)	(0.029)	(0.020)		(15631)	(0.025)	(0.017)	(0.011)
106	Manjakandriana	155,620	454767	0.563	0.208	0.101	20,633	586933	0.469	0.180	0.091	134,987	434565	0.577	0.212	0.103
			(26993)	(0.032)	(0.018)	(0.010)		(60367)	(0.050)	(0.028)	(0.018)		(29720)	(0.037)	(0.020)	(0.012)
107	Anjozorobe	111,761	384928	0.619	0.228	0.111	12,195	383997	0.652	0.293	0.165	99,566	385042	0.615	0.220	0.104
			(27404)	(0.044)	(0.023)	(0.013)		(50638)	(0.060)	(0.043)	(0.031)		(30128)	(0.049)	(0.026)	(0.014)
108	Antsirabe I	120,425	431789	0.581	0.246	0.131	120,425	431789	0.581	0.246	0.131	0	N/A	N/A	N/A	N/A
			(36370)	(0.037)	(0.024)	(0.016)		(36370)	(0.037)	(0.024)	(0.016)					
109	Betafo	233,692	264977	0.818	0.366	0.198	19,394	299080	0.760	0.353	0.199	214,298	261891	0.823	0.367	0.198
			(10862)	(0.018)	(0.017)	(0.012)		(33545)	(0.047)	(0.043)	(0.033)		(11449)	(0.020)	(0.018)	(0.013)
110	Ambatolampy	168,120	235555	0.863	0.427	0.246	18,728	368619	0.644	0.282	0.154	149,392	218874	0.890	0.445	0.258
			(10406)	(0.014)	(0.018)	(0.015)		(42361)	(0.051)	(0.038)	(0.028)		(10437)	(0.015)	(0.020)	(0.016)
111	Tsiroanomandidy	164,051	393180	0.631	0.240	0.119	15,961	631216	0.454	0.185	0.098	148,090	367525	0.650	0.246	0.121
			(23578)	(0.037)	(0.022)	(0.013)		(68550)	(0.045)	(0.027)	(0.018)		(25053)	(0.040)	(0.024)	(0.014)
112	Miarinarivo	138,047	349608	0.694	0.279	0.143	7,105	738829	0.345	0.133	0.069	130,942	328488	0.713	0.287	0.147
			(19163)	(0.031)	(0.022)	(0.014)		(78771)	(0.047)	(0.026)	(0.017)		(19745)	(0.033)	(0.023)	(0.015)
113	Soavinandriana	113,059	341049	0.704	0.285	0.146	25,713	412785	0.624	0.258	0.135	87,346	319932	0.728	0.293	0.149
			(17259)	(0.027)	(0.019)	(0.012)		(41110)	(0.048)	(0.033)	(0.023)		(18779)	(0.032)	(0.023)	(0.015)
114	Antanifotsy	218,433	180478	0.935	0.526	0.329	46,549	175675	0.934	0.539	0.344	171,884	181779	0.935	0.522	0.325
			(11963)	(0.013)	(0.026)	(0.024)		(29295)	(0.033)	(0.064)	(0.061)		(12968)	(0.014)	(0.028)	(0.026)
115	Andramasina	107,754	326099	0.726	0.298	0.154	9,016	282624	0.796	0.381	0.218	98,738	330068	0.719	0.291	0.148
			(17794)	(0.028)	(0.020)	(0.013)		(36255)	(0.050)	(0.049)	(0.038)		(19134)	(0.030)	(0.021)	(0.014)
116	Faratsiho	129,318	244317	0.855	0.409	0.230	24,491	317046	0.748	0.350	0.199	104,827	227325	0.880	0.422	0.237
			(17897)	(0.026)	(0.032)	(0.026)		(37205)	(0.051)	(0.044)	(0.033)		(20295)	(0.031)	(0.039)	(0.031)
117	Antananarivo Atsimondrano	220,627	414589	0.620	0.260	0.137	0	N/A	N/A	N/A	N/A	220,627	414589	0.620	0.260	0.137
			(43655)	(0.042)	(0.027)	(0.017)							(43655)	(0.042)	(0.027)	(0.017)
118	Antsirabe II	261,051	235196	0.865	0.422	0.241	0	N/A	N/A	N/A	N/A	261,051	235196	0.865	0.422	0.241
			(12105)	(0.018)	(0.021)	(0.017)							(12105)	(0.018)	(0.021)	(0.017)
119	Fenoarivo Afovoany	63,364	304788	0.747	0.318	0.170	12,907	322619	0.718	0.338	0.196	50,457	300227	0.755	0.313	0.163
			(27295)	(0.046)	(0.035)	(0.024)		(53301)	(0.075)	(0.060)	(0.044)		(31448)	(0.055)	(0.042)	(0.028)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Table D2. Fianarantsoa: Mean Per Capita Expenditure and Poverty Estimates

		All					Urban					Rural				
Id	***Fivondrona***	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**
2	Fianarantsoa	2,496,750	270748	0.791	0.419	0.264	400,655	372437	0.646	0.291	0.165	2,096,095	251311	0.819	0.443	0.283
			(15588)	(0.021)	(0.021)	(0.018)		(21877)	(0.026)	(0.021)	(0.016)		(18090)	(0.024)	(0.025)	(0.022)
201	Fianarantsoa I	100,090	438241	0.565	0.241	0.131	100,090	438241	0.565	0.241	0.131	0	N/A	N/A	N/A	N/A
			(36032)	(0.038)	(0.024)	(0.017)		(36032)	(0.038)	(0.024)	(0.017)					
202	Ambatofinandrah	85,664	250724	0.824	0.442	0.279	17,756	307705	0.731	0.373	0.231	67,908	235826	0.848	0.460	0.291
			(25875)	(0.033)	(0.039)	(0.034)		(47047)	(0.060)	(0.049)	(0.039)		(30234)	(0.039)	(0.048)	(0.042)
203	Ambositra	170,926	216083	0.860	0.522	0.361	20,714	476238	0.497	0.189	0.094	150,212	180208	0.910	0.568	0.397
			(23471)	(0.024)	(0.042)	(0.042)		(42887)	(0.042)	(0.023)	(0.014)		(26045)	(0.027)	(0.048)	(0.048)
204	Fandriana	140,446	200859	0.882	0.543	0.378	21,611	315609	0.734	0.352	0.205	118,835	179991	0.909	0.578	0.410
			(26982)	(0.028)	(0.046)	(0.046)		(32736)	(0.042)	(0.036)	(0.028)		(31328)	(0.032)	(0.054)	(0.054)
205	Ambalavao	139,911	198448	0.888	0.529	0.357	18,408	334399	0.694	0.335	0.199	121,503	177852	0.918	0.558	0.380
			(17913)	(0.020)	(0.034)	(0.033)		(34853)	(0.043)	(0.035)	(0.027)		(19939)	(0.022)	(0.038)	(0.037)
206	Ifanadiana	102,521	326327	0.712	0.330	0.190	12,098	326224	0.694	0.294	0.157	90,423	326340	0.715	0.334	0.195
			(30122)	(0.042)	(0.033)	(0.024)		(31996)	(0.054)	(0.038)	(0.026)		(33883)	(0.047)	(0.037)	(0.027)
207	Nosy Varika	133,123	273353	0.787	0.386	0.231	25,519	277625	0.770	0.346	0.192	107,604	272340	0.791	0.396	0.240
			(25139)	(0.037)	(0.037)	(0.029)		(25585)	(0.045)	(0.039)	(0.030)		(30504)	(0.045)	(0.044)	(0.036)
208	Ambohimahasoa	146,435	221227	0.865	0.498	0.330	5,758	392281	0.617	0.278	0.157	140,677	214226	0.875	0.507	0.337
			(22336)	(0.025)	(0.035)	(0.032)		(50156)	(0.057)	(0.040)	(0.029)		(23159)	(0.026)	(0.036)	(0.033)
209	Mananjary	174,626	315697	0.730	0.342	0.197	18,864	502581	0.493	0.191	0.097	155,762	293064	0.759	0.360	0.209
			(30168)	(0.045)	(0.039)	(0.030)		(54462)	(0.053)	(0.031)	(0.020)		(33173)	(0.050)	(0.044)	(0.033)
210	Manakara Atsimo	173,952	345723	0.686	0.303	0.168	22,628	466379	0.516	0.194	0.096	151,324	327681	0.711	0.319	0.179
			(32884)	(0.047)	(0.035)	(0.025)		(43349)	(0.052)	(0.031)	(0.019)		(37241)	(0.054)	(0.040)	(0.028)
211	Ikongo	80,501	307365	0.740	0.350	0.204	22,026	270635	0.782	0.369	0.212	58,475	321201	0.724	0.344	0.201
			(31111)	(0.040)	(0.031)	(0.022)		(21394)	(0.035)	(0.033)	(0.026)		(42064)	(0.054)	(0.041)	(0.029)
212	Vohipeno	74,368	208467	0.875	0.503	0.332	7,141	384964	0.614	0.247	0.128	67,227	189719	0.902	0.530	0.354
			(25761)	(0.030)	(0.050)	(0.048)		(47484)	(0.068)	(0.044)	(0.028)		(28047)	(0.033)	(0.055)	(0.053)
213	Farafangana	154,379	276481	0.784	0.392	0.236	15,945	458394	0.524	0.199	0.099	138,434	255528	0.814	0.414	0.252
			(40103)	(0.058)	(0.062)	(0.052)		(41352)	(0.052)	(0.033)	(0.021)		(44468)	(0.064)	(0.070)	(0.058)
214	Vangaindrano	156,853	345409	0.681	0.297	0.164	15,618	358781	0.650	0.266	0.139	141,235	343930	0.684	0.300	0.167
			(38265)	(0.056)	(0.038)	(0.026)		(42857)	(0.066)	(0.045)	(0.031)		(42232)	(0.062)	(0.042)	(0.029)
215	Midongy Atsimo	19,603	286861	0.765	0.384	0.235	7,249	271790	0.777	0.414	0.264	12,354	295705	0.757	0.367	0.218
			(32894)	(0.047)	(0.043)	(0.034)		(39290)	(0.054)	(0.050)	(0.042)		(46828)	(0.067)	(0.061)	(0.047)
216	Ihosy	78,230	288445	0.770	0.386	0.234	10,404	367032	0.653	0.293	0.164	67,826	276391	0.788	0.400	0.244
			(44159)	(0.061)	(0.059)	(0.047)		(38530)	(0.046)	(0.033)	(0.024)		(50589)	(0.070)	(0.068)	(0.054)
217	Vondrozo	70,109	221557	0.858	0.470	0.301	13,942	283710	0.761	0.341	0.189	56,167	206130	0.882	0.502	0.328
			(30849)	(0.039)	(0.057)	(0.053)		(26254)	(0.046)	(0.039)	(0.029)		(37951)	(0.047)	(0.070)	(0.065)
218	Ivohibe	25,800	219470	0.854	0.493	0.329	8,850	271889	0.774	0.414	0.266	16,950	192101	0.895	0.535	0.363
			(27942)	(0.034)	(0.049)	(0.046)		(39094)	(0.053)	(0.050)	(0.043)		(37313)	(0.043)	(0.069)	(0.067)
219	Ikalamavony	41,795	245912	0.830	0.461	0.299	10,646	262807	0.785	0.428	0.277	31,149	240137	0.846	0.472	0.306
			(26541)	(0.032)	(0.038)	(0.033)		(36852)	(0.051)	(0.049)	(0.043)		(33310)	(0.040)	(0.048)	(0.042)
220	Fianarantsoa II	318,987	250993	0.830	0.450	0.286	0	N/A	N/A	N/A	N/A	318,987	250993	0.830	0.450	0.286
			(38575)	(0.049)	(0.054)	(0.045)							(38575)	(0.049)	(0.054)	(0.045)
221	Iakora	22,657	257793	0.806	0.424	0.265	7,380	258538	0.791	0.439	0.289	15,277	257433	0.814	0.416	0.253
			(30816)	(0.044)	(0.044)	(0.036)		(39419)	(0.054)	(0.048)	(0.041)		(41546)	(0.061)	(0.061)	(0.050)
222	Befotaka	17,838	250859	0.817	0.422	0.260	4,986	312032	0.712	0.321	0.181	12,852	227127	0.857	0.461	0.291
			(30896)	(0.043)	(0.052)	(0.045)		(32372)	(0.052)	(0.036)	(0.026)		(41002)	(0.056)	(0.070)	(0.061)
223	Manandriana	67,936	192577	0.890	0.552	0.385	13,022	283516	0.761	0.397	0.249	54,914	171012	0.920	0.589	0.418
			(22745)	(0.023)	(0.041)	(0.041)		(37237)	(0.050)	(0.045)	(0.037)		(26717)	(0.026)	(0.049)	(0.051)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Table D3. Taomasina: Mean Per Capita Expenditure and Poverty Estimates

		All					Urban					Rural				
Id	***Fivondrona***	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**
3	Toamasina	1,933,550	308728	0.746	0.330	0.181	411,445	417822	0.599	0.230	0.113	1,522,105	279239	0.785	0.357	0.199
			(12891)	(0.020)	(0.017)	(0.012)		(15406)	(0.018)	(0.012)	(0.008)		(15838)	(0.025)	(0.021)	(0.016)
301	Toamasina I	127,865	565205	0.402	0.131	0.058	127,865	565205	0.402	0.131	0.058	0	N/A	N/A	N/A	N/A
			(27017)	(0.020)	(0.009)	(0.005)		(27017)	(0.020)	(0.009)	(0.005)					
302	Nosy-Boraha	12,241	337461	0.694	0.290	0.152	7,582	345170	0.687	0.277	0.140	4,659	324914	0.704	0.311	0.172
			(19783)	(0.031)	(0.024)	(0.017)		(10454)	(0.018)	(0.014)	(0.011)		(49115)	(0.076)	(0.059)	(0.043)
303	Maroantsetra	127,758	263028	0.812	0.373	0.207	15,231	364348	0.673	0.278	0.144	112,527	249314	0.831	0.386	0.216
			(12629)	(0.022)	(0.020)	(0.015)		(29891)	(0.040)	(0.030)	(0.020)		(13756)	(0.024)	(0.022)	(0.017)
304	Mananara	80,513	250655	0.830	0.387	0.217	25,652	299199	0.759	0.315	0.161	54,861	227956	0.863	0.421	0.243
			(12307)	(0.020)	(0.023)	(0.018)		(9890)	(0.020)	(0.017)	(0.013)		(17459)	(0.028)	(0.033)	(0.027)
305	Fenoarivo	182,766	248795	0.832	0.397	0.226	12,931	427427	0.584	0.226	0.112	169,835	235195	0.850	0.410	0.235
			(17556)	(0.029)	(0.032)	(0.025)		(30635)	(0.039)	(0.025)	(0.016)		(18748)	(0.031)	(0.034)	(0.027)
306	Vohibinany	120,666	352174	0.674	0.268	0.136	16,018	369840	0.641	0.239	0.115	104,648	349470	0.679	0.272	0.140
			(35214)	(0.055)	(0.036)	(0.023)		(12740)	(0.022)	(0.014)	(0.009)		(40558)	(0.064)	(0.042)	(0.027)
307	Vatomandry	97,967	294247	0.764	0.331	0.177	6,814	488471	0.503	0.176	0.082	91,153	279729	0.783	0.342	0.184
			(20690)	(0.036)	(0.030)	(0.021)		(22560)	(0.024)	(0.012)	(0.007)		(22173)	(0.039)	(0.032)	(0.023)
308	Mahanoro	154,403	312131	0.734	0.348	0.204	24,245	279783	0.787	0.331	0.171	130,158	318156	0.724	0.351	0.210
			(52615)	(0.072)	(0.060)	(0.046)		(11573)	(0.023)	(0.019)	(0.014)		(62378)	(0.085)	(0.072)	(0.055)
309	Marolambo	89,646	238643	0.852	0.392	0.217	16,090	282818	0.779	0.312	0.155	73,556	228980	0.868	0.410	0.230
			(14828)	(0.026)	(0.028)	(0.022)		(10686)	(0.023)	(0.019)	(0.013)		(17920)	(0.031)	(0.034)	(0.027)
310	Toamasina II	127,191	273811	0.789	0.350	0.191	0	N/A	N/A	N/A	N/A	127,191	273811	0.789	0.350	0.191
			(16463)	(0.029)	(0.024)	(0.017)							(16463)	(0.029)	(0.024)	(0.017)
311	Antanambao	35,013	228582	0.869	0.408	0.227	9,050	258566	0.821	0.342	0.174	25,963	218130	0.885	0.431	0.246
			(13840)	(0.023)	(0.027)	(0.022)		(11377)	(0.024)	(0.021)	(0.016)		(18238)	(0.030)	(0.036)	(0.029)
312	Amparafaravola	156,544	268209	0.793	0.351	0.190	31,578	290965	0.753	0.304	0.153	124,966	262459	0.803	0.362	0.199
			(17487)	(0.032)	(0.027)	(0.020)		(14450)	(0.028)	(0.022)	(0.015)		(21599)	(0.039)	(0.034)	(0.025)
313	Ambatondrazaka	174,803	335567	0.705	0.297	0.157	25,501	557268	0.437	0.151	0.070	149,302	297700	0.750	0.322	0.172
			(16598)	(0.027)	(0.020)	(0.015)		(29626)	(0.023)	(0.011)	(0.007)		(18763)	(0.031)	(0.024)	(0.017)
314	Moramanga	162,636	406100	0.617	0.243	0.124	17,705	588515	0.387	0.125	0.055	144,931	383816	0.645	0.257	0.132
			(44781)	(0.060)	(0.037)	(0.024)		(31813)	(0.023)	(0.010)	(0.005)		(50101)	(0.068)	(0.042)	(0.027)
315	Vavatenina	114,154	243409	0.838	0.394	0.223	22,516	294497	0.757	0.303	0.151	91,638	230857	0.858	0.417	0.240
			(14225)	(0.023)	(0.027)	(0.021)		(11121)	(0.023)	(0.019)	(0.014)		(17508)	(0.029)	(0.033)	(0.027)
316	Andilamena	30,087	260509	0.806	0.363	0.200	11,861	303906	0.730	0.288	0.143	18,226	232268	0.855	0.412	0.236
			(13206)	(0.023)	(0.023)	(0.018)		(12557)	(0.025)	(0.016)	(0.011)		(20210)	(0.034)	(0.036)	(0.029)
317	Anosibe	64,224	272059	0.795	0.341	0.180	16,420	279199	0.787	0.335	0.174	47,804	269607	0.798	0.343	0.181
			(16921)	(0.031)	(0.027)	(0.020)		(11543)	(0.022)	(0.020)	(0.015)		(22385)	(0.042)	(0.036)	(0.026)
318	Soanierana	75,073	236538	0.851	0.406	0.231	24,386	275046	0.793	0.331	0.170	50,687	218012	0.878	0.442	0.261
			(12783)	(0.020)	(0.024)	(0.020)		(10261)	(0.022)	(0.019)	(0.014)		(18278)	(0.028)	(0.035)	(0.029)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Table D4. Mahajanga: Mean Per Capita Expenditure and Poverty Estimates

		All				Urban					Rural				
Id	***Fivondrona***	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**	**Population**	**Mean Y**	**FGT_0**	**FGT_1**	**FGT_2**
4	Mahajanga	1,317,004	373838	0.630	0.232	0.111	266,271	580774	0.377	0.121	0.054	1,050,733	321397	0.694	0.260	0.125
			(16689)	(0.031)	(0.019)	(0.011)		(31024)	(0.027)	(0.013)	(0.007)		(19385)	(0.039)	(0.023)	(0.014)
401	Mahajanga I	99,041	657613	0.320	0.097	0.041	99,041	657613	0.320	0.097	0.041	0	N/A	N/A	N/A	N/A
			(50122)	(0.036)	(0.015)	(0.008)		(50122)	(0.036)	(0.015)	(0.008)					
402	Besalampy	29,697	439802	0.549	0.218	0.113	7,074	833949	0.118	0.027	0.009	22,623	316556	0.684	0.278	0.145
			(32329)	(0.039)	(0.023)	(0.016)		(11164)	(0.048)	(0.013)	(0.005)		(24129)	(0.050)	(0.030)	(0.021)
403	Soalala	21,215	391295	0.585	0.222	0.110	7,197	572409	0.294	0.081	0.033	14,018	298309	0.734	0.295	0.149
			(27460)	(0.040)	(0.025)	(0.016)		(61913)	(0.064)	(0.023)	(0.011)		(26771)	(0.051)	(0.036)	(0.024)
404	Maevatanana	80,810	361728	0.639	0.232	0.109	8,471	644260	0.285	0.080	0.033	72,339	328643	0.681	0.249	0.117
			(18707)	(0.035)	(0.021)	(0.012)		(65309)	(0.056)	(0.021)	(0.010)		(19448)	(0.039)	(0.023)	(0.014)
405	Ambato Boina	81,320	387516	0.587	0.214	0.102	13,774	632962	0.259	0.068	0.026	67,546	337465	0.654	0.243	0.117
			(22665)	(0.041)	(0.024)	(0.015)		(53640)	(0.046)	(0.016)	(0.007)		(24999)	(0.049)	(0.029)	(0.018)
406	Marovoay	88,334	378049	0.585	0.202	0.092	18,643	424170	0.529	0.183	0.085	69,691	365711	0.601	0.207	0.094
			(25740)	(0.047)	(0.025)	(0.014)		(38970)	(0.055)	(0.028)	(0.016)		(30915)	(0.058)	(0.031)	(0.018)
407	Mitsinjo	41,369	433721	0.498	0.178	0.086	7,516	531166	0.345	0.097	0.039	33,853	412086	0.532	0.196	0.097
			(39992)	(0.061)	(0.027)	(0.015)		(52910)	(0.067)	(0.025)	(0.012)		(47438)	(0.073)	(0.033)	(0.018)
408	Tsaratanana	74,272	316839	0.710	0.265	0.126	10,920	407470	0.532	0.178	0.081	63,352	301217	0.741	0.280	0.134
			(20720)	(0.042)	(0.028)	(0.017)		(37437)	(0.064)	(0.032)	(0.018)		(23419)	(0.049)	(0.032)	(0.020)
409	Boriziny (Port-	79,592	340447	0.657	0.245	0.118	6,263	491850	0.469	0.161	0.074	73,329	327515	0.673	0.252	0.122
			(22912)	(0.045)	(0.026)	(0.016)		(42814)	(0.053)	(0.027)	(0.016)		(24599)	(0.048)	(0.028)	(0.017)
410	Mandritsara	158,543	295649	0.748	0.295	0.146	8,918	438313	0.531	0.192	0.092	149,625	287146	0.761	0.301	0.149
			(16191)	(0.033)	(0.024)	(0.016)		(40480)	(0.053)	(0.031)	(0.019)		(16986)	(0.035)	(0.025)	(0.017)
411	Analalava	68,409	380272	0.577	0.203	0.094	7,473	449611	0.473	0.151	0.066	60,936	371768	0.590	0.209	0.098
			(29926)	(0.055)	(0.027)	(0.015)		(50735)	(0.074)	(0.034)	(0.018)		(33014)	(0.061)	(0.030)	(0.017)
412	Befandriana Ava	129,843	312176	0.720	0.247	0.110	4,286	422861	0.538	0.195	0.094	125,557	308398	0.726	0.249	0.110
			(23502)	(0.056)	(0.031)	(0.017)		(46868)	(0.068)	(0.038)	(0.023)		(24251)	(0.058)	(0.032)	(0.018)
413	Antsohihy	82,438	309910	0.730	0.277	0.133	13,324	411212	0.556	0.204	0.098	69,114	290381	0.763	0.291	0.140
			(17073)	(0.037)	(0.024)	(0.015)		(36798)	(0.054)	(0.029)	(0.018)		(19089)	(0.043)	(0.029)	(0.018)
414	Bealanana	77,404	259746	0.826	0.350	0.179	11,279	365040	0.614	0.225	0.108	66,125	241786	0.863	0.371	0.191
			(22308)	(0.042)	(0.043)	(0.032)		(37665)	(0.066)	(0.038)	(0.023)		(25310)	(0.048)	(0.050)	(0.037)
415	Mahajanga II	36,035	396084	0.545	0.179	0.079	0	N/A	N/A	N/A	N/A	36,035	396084	0.545	0.179	0.079
			(41215)	(0.075)	(0.036)	(0.020)							(41215)	(0.075)	(0.036)	(0.020)
416	Kandreho	9,319	408765	0.537	0.166	0.069	4,957	474787	0.419	0.125	0.052	4,362	333736	0.671	0.212	0.088
			(29303)	(0.054)	(0.026)	(0.014)		(44628)	(0.063)	(0.027)	(0.014)		(36705)	(0.090)	(0.047)	(0.025)
417	Ambatomainty	15,341	416927	0.531	0.191	0.091	8,933	520911	0.346	0.096	0.038	6,408	271970	0.788	0.323	0.164
			(26575)	(0.040)	(0.021)	(0.013)		(41990)	(0.057)	(0.022)	(0.010)		(24923)	(0.054)	(0.041)	(0.028)
420	Antsalova	23,262	338853	0.659	0.252	0.124	7,630	415573	0.518	0.173	0.078	15,632	301406	0.727	0.291	0.146
			(17726)	(0.033)	(0.022)	(0.014)		(32164)	(0.051)	(0.024)	(0.014)		(21199)	(0.042)	(0.030)	(0.020)
421	Maintirano	40,870	455543	0.567	0.212	0.103	6,977	104826	0.112	0.027	0.010	33,893	333529	0.661	0.250	0.122
			(34798)	(0.041)	(0.024)	(0.015)		(16223)	(0.051)	(0.016)	(0.007)		(25404)	(0.048)	(0.029)	(0.018)
422	Morafenobe	15,794	623804	0.390	0.146	0.071	8,015	926229	0.085	0.018	0.006	7,779	312204	0.704	0.278	0.139
			(70594)	(0.036)	(0.020)	(0.013)		(13580)	(0.043)	(0.011)	(0.004)		(31060)	(0.060)	(0.039)	(0.026)
423	Mampikony	64,096	362540	0.620	0.219	0.101	5,580	411320	0.557	0.201	0.096	58,516	357889	0.626	0.221	0.102
			(31017)	(0.057)	(0.030)	(0.017)		(44289)	(0.067)	(0.037)	(0.022)		(33711)	(0.062)	(0.032)	(0.019)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Table D5. Toliara: Mean Per Capita Expenditure and Poverty Estimates

		All					Urban					Rural				
Id	*Fivondrona*	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2
5	Toliary	1,713,708	273056	0.780	0.395	0.243	373,279	321602	0.712	0.402	0.272	1,340,429	259537	0.799	0.393	0.234
			(14497)	(0.022)	(0.020)	(0.016)		(32192)	(0.036)	(0.036)	(0.033)		(16222)	(0.026)	(0.024)	(0.019)
501	Toliary I	71,649	531782	0.475	0.208	0.118	71,649	531782	0.475	0.208	0.118	0	N/A	N/A	N/A	N/A
			(68545)	(0.052)	(0.031)	(0.021)		(68545)	(0.052)	(0.031)	(0.021)					
502	Manja	43,445	256408	0.807	0.411	0.250	7,988	320026	0.724	0.387	0.251	35,457	242076	0.826	0.416	0.250
			(23619)	(0.032)	(0.033)	(0.027)		(87265)	(0.092)	(0.081)	(0.067)		(21237)	(0.033)	(0.036)	(0.030)
503	Beroroha	29,169	283406	0.754	0.364	0.218	12,178	256420	0.781	0.434	0.288	16,991	302747	0.734	0.314	0.167
			(28959)	(0.043)	(0.039)	(0.032)		(55263)	(0.076)	(0.074)	(0.063)		(30046)	(0.051)	(0.041)	(0.030)
504	Morombe	74,328	254130	0.807	0.427	0.268	6,533	415829	0.598	0.278	0.164	67,795	238548	0.827	0.441	0.278
			(18895)	(0.026)	(0.027)	(0.023)		(64474)	(0.068)	(0.049)	(0.036)		(19762)	(0.028)	(0.029)	(0.025)
505	Ankazoabo Atsim	36,847	292584	0.742	0.358	0.214	16,783	286461	0.741	0.400	0.260	20,064	297705	0.743	0.324	0.175
			(31241)	(0.045)	(0.038)	(0.030)		(59092)	(0.079)	(0.070)	(0.058)		(29128)	(0.049)	(0.039)	(0.028)
506	Betioky Atsimo	127,268	250828	0.807	0.426	0.269	19,690	284539	0.751	0.418	0.278	107,578	244658	0.818	0.428	0.267
			(16144)	(0.023)	(0.023)	(0.020)		(51662)	(0.064)	(0.060)	(0.051)		(16594)	(0.025)	(0.025)	(0.022)
507	Ampanihy	161,583	211427	0.858	0.487	0.323	17,291	189049	0.875	0.543	0.385	144,292	214108	0.856	0.480	0.315
			(14227)	(0.020)	(0.024)	(0.023)		(34143)	(0.045)	(0.058)	(0.055)		(15398)	(0.022)	(0.026)	(0.025)
508	Morondava	59,178	316106	0.723	0.381	0.241	23,204	416935	0.583	0.280	0.170	35,974	251069	0.812	0.446	0.288
			(30236)	(0.033)	(0.028)	(0.023)		(62143)	(0.062)	(0.043)	(0.033)		(29450)	(0.036)	(0.036)	(0.031)
509	Mahabo	65,762	296245	0.748	0.342	0.193	5,713	333736	0.676	0.333	0.204	60,049	292678	0.754	0.343	0.191
			(24478)	(0.038)	(0.032)	(0.023)		(70156)	(0.093)	(0.071)	(0.054)		(25962)	(0.041)	(0.034)	(0.025)
510	Belon'i Tsiribi	38,761	323200	0.705	0.320	0.182	15,211	326788	0.694	0.353	0.220	23,550	320882	0.712	0.299	0.158
			(27460)	(0.039)	(0.030)	(0.023)		(51427)	(0.064)	(0.053)	(0.041)		(30651)	(0.049)	(0.037)	(0.026)
511	Miandrivazo	62,419	277558	0.776	0.376	0.221	12,474	325883	0.695	0.355	0.224	49,945	265489	0.796	0.381	0.220
			(19709)	(0.029)	(0.025)	(0.020)		(62546)	(0.082)	(0.068)	(0.053)		(19045)	(0.031)	(0.027)	(0.021)
512	Sakaraha	52,718	305987	0.726	0.331	0.189	14,400	297145	0.729	0.394	0.258	38,318	309310	0.725	0.308	0.163
			(26458)	(0.040)	(0.032)	(0.024)		(65163)	(0.082)	(0.074)	(0.061)		(26932)	(0.046)	(0.035)	(0.025)
513	Beloha	49,795	184372	0.897	0.531	0.361	15,037	139242	0.931	0.642	0.488	34,758	203896	0.883	0.483	0.306
			(18640)	(0.024)	(0.037)	(0.037)		(48857)	(0.057)	(0.100)	(0.106)		(16321)	(0.025)	(0.030)	(0.027)
514	Tsihombe	51,360	215987	0.854	0.468	0.303	20,162	173840	0.894	0.570	0.411	31,198	243224	0.829	0.402	0.234
			(20282)	(0.031)	(0.036)	(0.032)		(34288)	(0.044)	(0.063)	(0.062)		(24978)	(0.042)	(0.043)	(0.034)
515	Taolagnaro (F-D	164,777	286515	0.770	0.367	0.212	28,423	430784	0.587	0.277	0.165	136,354	256442	0.808	0.385	0.222
			(17249)	(0.027)	(0.025)	(0.019)		(51847)	(0.051)	(0.039)	(0.029)		(17824)	(0.031)	(0.029)	(0.023)
516	Ambovombe Andro	144,132	219844	0.845	0.465	0.306	44,205	150360	0.918	0.627	0.474	99,927	250581	0.813	0.394	0.231
			(22139)	(0.031)	(0.039)	(0.038)		(59204)	(0.070)	(0.111)	(0.114)		(18270)	(0.032)	(0.030)	(0.023)
517	Betroka	103,713	288146	0.759	0.350	0.198	8,396	398539	0.617	0.303	0.187	95,317	278422	0.772	0.354	0.199
			(21531)	(0.034)	(0.028)	(0.021)		(92353)	(0.100)	(0.074)	(0.056)		(21970)	(0.036)	(0.030)	(0.022)
518	Bekily	97,564	256810	0.806	0.387	0.225	6,417	287276	0.743	0.399	0.261	91,147	254665	0.811	0.386	0.222
			(18391)	(0.030)	(0.029)	(0.023)		(68708)	(0.092)	(0.082)	(0.068)		(19083)	(0.032)	(0.031)	(0.024)
519	Amboasary Atsim	118,343	273034	0.773	0.367	0.216	23,448	177615	0.890	0.567	0.409	94,895	296611	0.745	0.318	0.169
			(25473)	(0.042)	(0.037)	(0.029)		(52303)	(0.067)	(0.093)	(0.090)		(29020)	(0.050)	(0.041)	(0.029)
520	Toliary II	140,816	270322	0.784	0.394	0.240	0	N/A	N/A	N/A	N/A	140,816	270322	0.784	0.394	0.240
			(18131)	(0.027)	(0.025)	(0.020)							(18131)	(0.027)	(0.025)	(0.020)
521	Benenitra	20,081	299497	0.735	0.338	0.192	4,077	277386	0.751	0.410	0.269	16,004	305130	0.731	0.319	0.173
			(25567)	(0.039)	(0.032)	(0.024)		(58990)	(0.078)	(0.073)	(0.061)		(28343)	(0.044)	(0.035)	(0.026)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Table D6. Antsiranana: Mean Per Capita Expenditure and Poverty Estimates

		All					Urban					Rural				
Id	*Fivondrona*	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2	Population	Mean Y	FGT_0	FGT_1	FGT_2
7	Antsiranana	930,036	486964	0.539	0.227	0.125	165,189	693161	0.343	0.120	0.057	764,847	442431	0.581	0.250	0.140
			(48078)	(0.038)	(0.023)	(0.016)		(93436)	(0.031)	(0.015)	(0.009)		(54868)	(0.045)	(0.028)	(0.020)
710	Antalaha	146,104	408980	0.593	0.249	0.136	22,530	506703	0.469	0.176	0.087	123,574	391163	0.615	0.263	0.145
			(35038)	(0.046)	(0.031)	(0.021)		(35493)	(0.037)	(0.022)	(0.014)		(40918)	(0.054)	(0.036)	(0.025)
711	Sambava	189,063	403779	0.598	0.251	0.137	21,568	466925	0.510	0.196	0.098	167,495	395648	0.609	0.258	0.142
			(36310)	(0.047)	(0.031)	(0.021)		(31869)	(0.038)	(0.022)	(0.014)		(40779)	(0.053)	(0.034)	(0.024)
712	Andapa	116,445	395752	0.607	0.256	0.140	13,967	419503	0.564	0.221	0.112	102,478	392515	0.613	0.260	0.143
			(34854)	(0.045)	(0.030)	(0.021)		(27413)	(0.038)	(0.025)	(0.016)		(39428)	(0.051)	(0.034)	(0.023)
713	Antsiranana II	55,417	436110	0.551	0.222	0.118	0	N/A	N/A	N/A	N/A	55,417	436110	0.551	0.222	0.118
			(48169)	(0.060)	(0.036)	(0.023)							(48169)	(0.060)	(0.036)	(0.023)
715	Antsiranana I	57,081	709557	0.265	0.084	0.037	57,081	709557	0.265	0.084	0.037	0	N/A	N/A	N/A	N/A
			(59061)	(0.036)	(0.014)	(0.007)		(59061)	(0.036)	(0.014)	(0.007)					
716	Vohimarina	134,208	271963	0.785	0.415	0.263	6,647	527163	0.432	0.155	0.074	127,561	258665	0.804	0.429	0.273
			(57057)	(0.080)	(0.080)	(0.066)		(39729)	(0.042)	(0.022)	(0.013)		(59994)	(0.084)	(0.084)	(0.070)
717	Ambilobe	107,367	517420	0.384	0.118	0.051	8,888	761525	0.242	0.073	0.031	98,479	495389	0.397	0.122	0.053
			(63455)	(0.092)	(0.040)	(0.021)		(11132)	(0.069)	(0.027)	(0.013)		(68449)	(0.101)	(0.044)	(0.023)
718	Nosy Be	28,543	221637	0.062	0.017	0.007	15,289	150231	0.104	0.030	0.013	13,254	304008	0.014	0.002	0.000
			(11385)	(0.068)	(0.023)	(0.010)		(85921)	(0.116)	(0.041)	(0.019)		(22425)	(0.062)	(0.014)	(0.004)
719	Ambanja	95,808	529516	0.381	0.117	0.051	19,219	697911	0.287	0.090	0.039	76,589	487259	0.404	0.124	0.054
			(57934)	(0.084)	(0.036)	(0.019)		(10148)	(0.073)	(0.031)	(0.016)		(67851)	(0.103)	(0.045)	(0.024)

Notes: Standard errors in parentheses and 'Not Applicable' (N/A) implies there are no areas classified as urban or rural in the Fivondrona.

Figure D1. Rural Firaisana-Level GE(0) Inequality Distribution

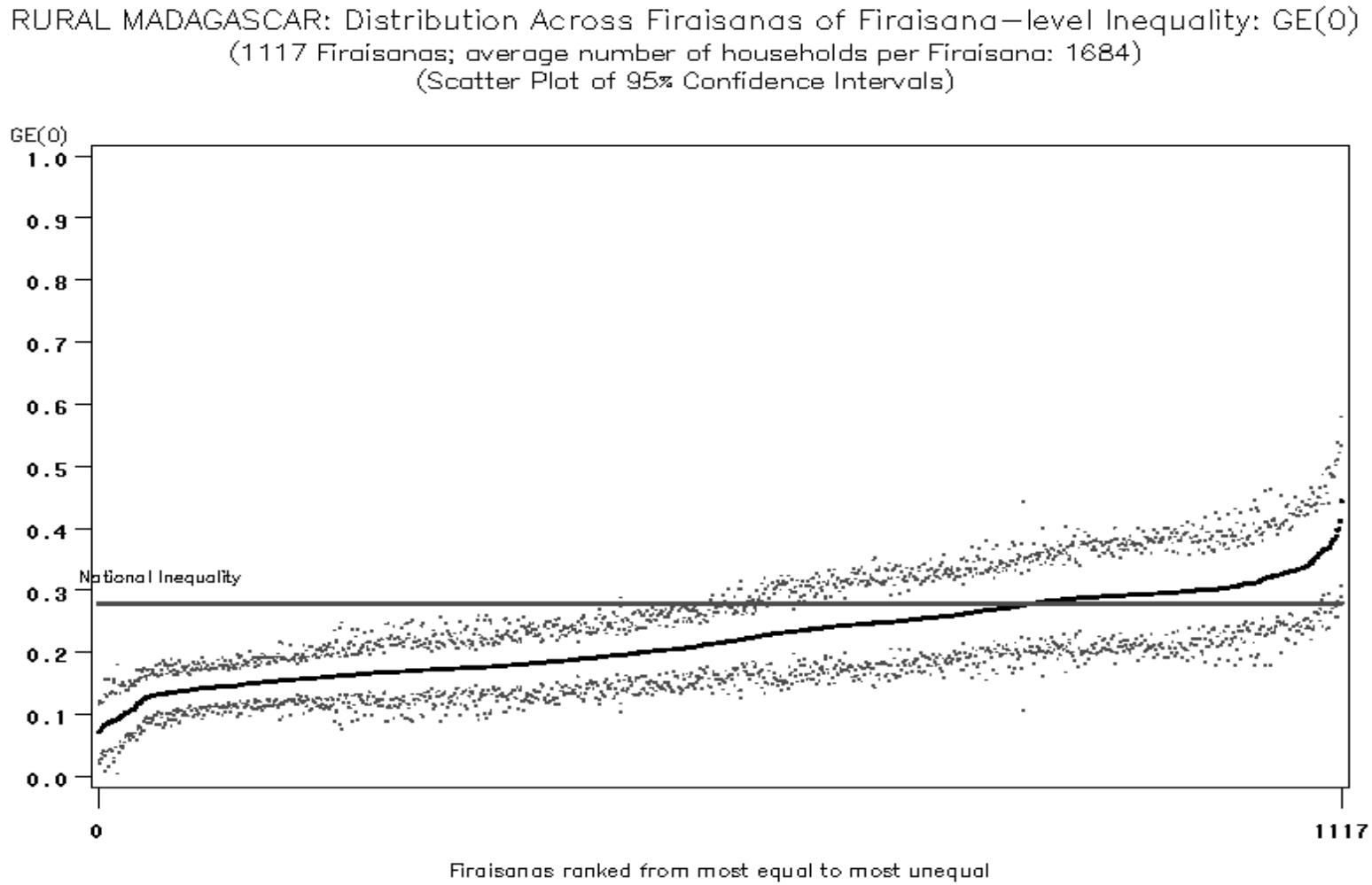


Figure D2. Urban Firaisana-Level GE(0) Inequality Distribution