DEVELOPING A POVERTY MAP OF TAJIKISTAN
A TECHNICAL NOTE

ANGELA BASCHIERI, JANE FALKINGHAM

ABSTRACT

'Poverty maps', that is graphic representations of spatially disaggregated estimates of welfare, are being increasingly used to geographically target scare resources. The development of detailed poverty maps in many low resource settings is, however, hampered due to data constraints. Data on income or consumption are often unavailable and, where they are, direct survey estimates for small areas are likely to yield unacceptably large standard errors due to limited sample sizes. Census data offer the required level of coverage but do not generally contain the appropriate information. This has led to the development of a range of alternative methods aimed either at combining survey data with unit record data from the Census to produce estimates of income or expenditure for small areas (Elbers et al. (2002)). This technical note describes the development of a Poverty Map of Tajikistan combining information from the 2003 Tajikistan Living Standards Survey (TLSS) with 2000 Census data. In order to visually present the spatially disaggregated estimates of welfare in Tajikistan, this project has also involved the production of a digital map of the country showing the administrative boundaries at the time of the 2000 Census at both the rayon (district) and jamoat (lowest administrative area) level.

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Developing a Poverty Map of Tajikistan

A Technical Note

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Tajikistan Poverty Mapping

1. Introduction

'Poverty maps', that is graphic representations of spatially disaggregated estimates of welfare, are being increasingly used to geographically target scare resources. The development of detailed poverty maps in many low resource settings is, however, hampered due to data constraints. Data on income or consumption are often unavailable and, where they are, direct survey estimates for small areas are likely to yield unacceptably large standard errors due to limited sample sizes. Census data offer the required level of coverage but do not generally contain the appropriate information. This has led to the development of a range of alternative methods aimed either at combining survey data with unit record data from the Census to produce estimates of income or expenditure for small areas (Elbers et al. (2002)). This technical note describes the development of a Poverty Map of Tajikistan combining information from the 2003 Tajikistan Living Standards Survey (TLSS) with 2000 Census data. In order to visually present the spatially disgaggregated estimates of welfare in Tajikistan, this project has also involved the production of a digital map of the country showing the administrative boundaries at the time of the 2000 Census at both the rayon (district) and jamoat (lowest administrative area) level.

2. Overview of the Methodology

The poverty mapping technique uses the strength of both the detailed information about living standards available in a household budget survey, in this case the 2003 TLSS, and the more extensive coverage of the census to derived spatially disaggregated poverty estimates of welfare. First survey data are used to derive a consumption model, employing a set of explanatory variables which are common to the survey and the census. Next, the parameters estimates from the consumption model are applied to the census to derive an imputed value for consumption. This allows us to then define a set of welfare indicators based upon consumption such as headcount poverty. Finally, the welfare indicators are constructed for geographically defined subgroups of the population using these predictions. Although the approach is conceptually simple, properly accounting for

spatial autocorrelation in the first stage model and estimating standard errors for the welfare estimates requires additional elaboration.

The method may be thought of being implemented in three. The three stages are preceded by a so called 'zero stage'. The 'zero stage' involves the selection of a set of 'comparable' variables common to both the household budget survey and the census. The zero stage is a fundamental part of the success of the poverty mapping procedure as the variables selected in this stage will determined the set of variables to be used for the consumption model, hence the explanatory power of the imputed consumption model. The first stage of analysis then involves the use of survey data to derive a model for predicting household welfare. This model is then applied to the census dataset in the final stage. Stages one and two are further elaborated below.

First Stage

In the "first stage" of analysis a model of consumption is developed using household survey data and those variables that have been selected in the zero stage.

The log of monthly consumption expenditure, y_{ch} is related to a set of observable characteristics, x_{ch} [1]:

$$\ln y_{ch} = E[\ln y_{ch} \mid x_{ch}] + u_{ch} \qquad (1)$$

Using a linear approximation, we model the observed log per capita consumption per household h as:

$$\ln y_{ch} = x_{ch}^{'}\beta + u_{ch} \qquad (2)$$

where β is a vector of parameters, and $\mathbf{u}$ a vector of disturbances, is distributed $F(0,\sum)$. The model (2) is estimated by Generalized Least Squares using data from the 2003 Tajikistan Living Standard Survey. In order to estimate by GLS model, it is first necessary to produce an estimate of $\sum$, the associated error covariance matrix. We model individual disturbances as:

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

[1] This section summarizes the discussion in Elbers et al. (2002).

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 $\sum$, we need to calculate the variance of the location component $\hat{\sigma}_{\eta}^{2}$, the location component η_c, variance of the household residuals $\hat{\sigma}_{\varepsilon,ch}^{2}$ and household residuals ${\varepsilon_{ch}}^{2}$.

To obtain those parameters we first estimate an OLS regression , and 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:

$$\hat{u}_{ch} = \hat{\eta}_c + e_{ch}$$

where $\hat{\eta}_c$ are the within-cluster means of the overall residuals, e_{ch}, household component estimates are the overall residuals net of location components.

The Elbers *et al*. (2002) procedure allows for heteroskedasticity in the household component. In the case of Tajikistan, heteroskedasticity appeared to be significant in some strata; however when we elaborated the so-called alpha model which enables us to capture the heteroskedasticity components, we did not obtain a high R-square. Moreover, as the imputed values were sensitive of the choice of the alpha model regressors, we decided not to estimate the heteroskedasticity component. Given this, we then decided to model only the location component where possible.

Second Stage

In the "second stage" the parameter estimates of the consumption model developed in the first stage are applied to data from the 2000 census of Tajikistan to obtain predicted consumption for each household within the Census.

We construct a series of simulations, where for each simulation r we draw a set of first stage parameters from their corresponding distribution estimated in first stage.

Thus we draw a set of beta and, $\tilde{\beta}^{r}$ from the multivariate normal distributions described by the first stage point estimates and their associated variance–covariance matrices. Additionally we draw $\left(\tilde{\sigma}_{\eta}^{2}\right)^{r}$ a simulated value of the variance of the location error component.

For each household we draw simulated disturbance terms, $\tilde{\eta}_{c}^{r}$ and $\tilde{\varepsilon}_{ch}^{r}$, from their corresponding distribution. We simulate a value of expenditure for each household, $\hat{y}_{ch}^{r}$, based on both predicted log expenditure, $x_{ch}^{'}\tilde{\beta}^{r}$ and their disturbance terms: $\hat{y}_{ch}^{r} = \exp\left(x_{ch}^{'}\tilde{\beta}^{r} + \tilde{\eta}_{c}^{r} + \tilde{\varepsilon}_{ch}^{r}\right)$. Finally, the full set of simulated per capita consumption expenditures, $\hat{y}_{ch}^{r}$ are used to calculate the estimate of the welfare measure for each spatial subgroup. We repeat this procedure 100 times drawing a new $\tilde{\alpha}^{r}$, $\tilde{\beta}^{r}$, $\left(\tilde{\sigma}_{\eta}^{2}\right)^{r}$ and disturbance terms for each simulation. For each subgroup, we take the mean and standard deviation of each welfare measure over 100 simulations.

For any given location, these means constitute our point estimates of welfare measure, while the standard deviations are the standard errors of these estimates.

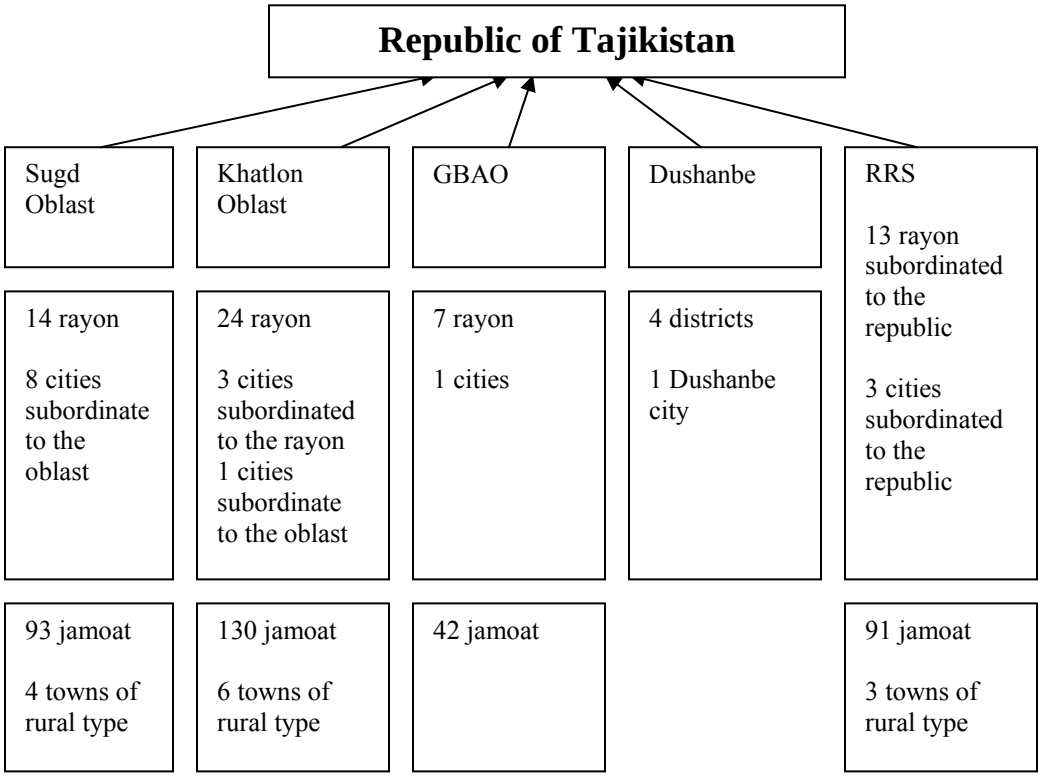
3. The Data

The technique combines the Tajikistan Living Standard Measurement Survey 2003 (TLSS 2003) collected by the State Statistical Committee of Tajikistan, in collaboration with the World Bank, and the 2000 Census of Tajikistan. The Census of Tajikistan covers around 1.6 million households and 6.5 million individuals[3]. The Republic of Tajikistan is administratively divided in 4 regions: Sodgian oblast, Khatlon oblast, Gorno-Badagakashan (GBAO), Direct Rule District commonly known as the RRS (Regional Republic Subordination which are 13 autonomous districts) and Dushanbe. There are a total of 58 rayon (districts), 4 districts of Dushanbe, 17 cities subordinated either to the republic or to the oblast. There are 356 jamoat (rural administrative areas) and 13 towns of rural type.

The TLSS 2003 provides information on food consumption, non food consumption, labour activities, agriculture and education. The sampling procedure of the TLSS 2003 allows the estimation of several poverty, education, labour force indicators for the rural and urban areas of the 4 main regions (Sugd, RRS, Khatlon, GBAO) plus Dushanbe. Sugd, Khatlon and GBAO are oblasts subordinate to the Republic, whereas the Republic of Regional Subordination are 13 districts which are directly subordinate to the republic (see Figure 1). However for the TLSS sampling design, the 13 autonomous districts were considered as a separate region. Hence the sampling design incorporates stratification for by region and urban and rural place of residence (9 strata, 4 rural, 5 urban). The sampling has been designed in two stages. In the first stage 208 sampling units representing jamoat were selected. In the second stage a random probability sample of households was drawn from each jamoat using the jamoat household book[4]. A full list of households was then drawn and a total 4157 households were interviewed[5].

[3] We consider the de facto population. Retirement homes, the institutional population and the homeless are excluded from the analysis as those groups were included in the TLSS sample design.
[4] The jamoat household book is a book of household information which is administered and updated by each jamoat office. Its contains demographic, education level and occupation for each household members. It also contains information on household ownership of cattle and possession of land. The book is updated each year and the household book is 're-built' each five years.
[5] The actual number of households interviewed were 4160, however after an initial data cleaning 3 households were excluded from the sample.

Figure 1: Administrative structure of the Republic of Tajikistan as per the census 2000.



Note: the above structure refers to the 2000 census of Tajikistan. It should be noted that several jamoat have been created or merged since 2000 (see appendix C for full list of changes occurred b/w 2000 and 2005).

4. Implementation

In the zero stage we first compared the census and TLSS questionnaires, comparing the wording of the questions and their meaning, and drew up a list of potential variables to be used in the consumption model. We then constructed those variables and compared their statistical properties in both datasets (see Table 1 in Appendix A). This second type of check is important as 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 the census. Those variables for which the census mean was within the 95 confidence interval of the mean in the TLSS were then selected for inclusion in the model.

Hence, the consumption model was derived using only those variables that were similar both in the wording and distribution across both datasets. In some strata, where the selected variables did not yield a reasonable R square, the criteria for selection of the regression variables were relaxed. From the initial stage of the analysis it became clear that poverty in rural areas was highly related to the environment and that environmental characteristics were a strong predictor of household welfare. To improve the explanatory power of the consumption model was decided to include both census mean variables and some selected environmental variables.

In order to achieve this, it was necessary to construct a digitally referenced map which followed the administrative structure used in the census and which represents the same spatial aggregation of census data. An available jamoat map drawn from the UNDP GIS coordination unit was used and modified according to the census administrative structure. The matching of each polygon in the map and the census territorial code was supervised by Mr Sulton, head of the census at the State Statistical Agency, who was responsible of the implementation of the 2000 Census of Tajikistan[6]. This facilitated the linking of geographical variables derived from a geo-referenced map to the census dataset.

In order to link both census information and the GIS map to the TLSS, it was also necessary to allocate each primary sampling unit of the survey to a census enumeration area. The household listing of the survey allowed the matching of each primary sampling unit at each settlement area (settlements within each jamoat). The matching of the PSU and census code was completed under the supervision of Mr. Sulton, who was also involved in the TLSS data collection.

Following this, several census mean variables both at settlement level and jamoat level were created and merged with both the TLSS household level data and the census data. In addition several environmental variables were created for each census jamoat area using GIS data on elevation, land cover, and road networks. These were also then linked to both the TLSS and census data sets. Tables 2 and 3 in Appendix A show the list of jamoat and settlement level mean census variables created and Table 4 shows the full

[6] The modified census map followed the administrative structure of the republic of Tajikistan at the time of the census (January 2000). It should be noted that since 2000 several changes occurred in both the number and location of jamoat (see appendix X for list of changes occurred since 2000).

list of jamoat level GIS variables. All these variables have been tested in the consumption model, but only a subset of these turn out to be significant.

A separate consumption model was estimated for each strata using the variables selected in the 'zero stage' within each strata. We then estimated the location effect, and regressed the jamoat or settlement area variables (derived either from the census data or GIS maps) to identify a subset of variables which acted to reduce this effect. The consumption model within each strata was then re-estimated, including those spatial (locational) variables which were significant at 1 % level. In few cases, we also included variables which were significant at 5 or 10 per cent level in order to increase the R square; this was particularly the case in rural areas (see Table 5 and 6 Appendix A).

The results of the OLS regressions in Tables 5 and 6 in Appendix A show that the regression models were quite successful in explaining the variation in monthly consumption expenditure in urban areas, with R-square values ranging from 26 per cent to 50 per cent. The models were less well specified in rural areas, where the R-square values range from 20 per cent to 31 per cent. This is mainly due to the fact that consumption expenditure is highly related to the characteristics of the environment of where people live. The R square of the consumption models in rural areas was even lower without the inclusion of GIS variables.

The parameters estimates derived in the first stage modelling, were then applied to the census data to impute consumption expenditure using the methodology described above. In order to derive community estimates of headcount poverty, two alternative poverty lines were employed a) an absolute poverty line of 47.06 Somoni per month, and b) a relative poverty line of the bottom 40% percentile (corresponding to 33.37 Somoni per month).

5. Results

Table 1 below presents the results for the monthly consumption expenditure adjusted for regional prices, the headcount index (FGT(0)) using the absolute poverty line of 47.06 Somoni per month (2.15$ PPP) and the relative poverty line of the bottom 40 per centile (33.37 Somoni) , the FGT(1), the GINI coefficient. Comparison of the results of the census and TLSS shows that the performance of the prediction model is mixed. The

model appears to work quite well for the estimation of the *mean* monthly consumption expenditure adjusted for regional prices. However, looking at the GINI coefficient and FGT(1), there appears to be much lower degree of correspondence between the two data sources. Thus it appears that the consumption model performs less well in predicting the *distribution* of the monthly consumption expenditure. This is not usual as the imputation process is less able to replicate the outliers that occur in real life.

The imputed values for the proportion of people living in a household with a consumption expenditure below the absolute poverty line of 47.06 Somoni are more robust for urban areas than for rural areas, whereas the opposite is true for the imputation of the proportions of people living in relative poverty.

Table 1: Poverty and Inequalities in Tajikistan, by oblast (strata).

	Mean		*FTG(0)* PL=47.06 S		*FGT(1)*		*FTG(0)* PL=33.37 S		*GINI*	
	Census	TLSS	Census	TLSS	Census	TLSS	Census	TLSS	Census	TLSS
Urban										
Gbao	39.31	40.38	0.721	0.739	0.277	0.253	0.466	0.407	0.283	0.260
	(1.39)	(1.86)	(0.025)	(0.039)	(0.016)	(0.023)	(0.025)	(0.049)	(0.014)	(0.019)
Sugd	49.52	50.03	0.610	0.586	0.245	0.218	0.405	0.364	0.366	0.339
	(1.43)	(1.85)	(0.016)	(0.027)	(0.011)	(0.014)	(0.016)	(0.027)	(0.010)	(0.014)
Khatlon	36.71	37.02	0.761	0.775	0.376	0.348	0.587	0.611	0.396	0.346
	(1.59)	(1.78)	(0.018)	(0.028)	(0.015)	(0.019)	(0.020)	(0.035)	(0.022)	(0.018)
Dushanbe	56.04	59.11	0.531	0.489	0.199	0.165	0.328	0.268	0.364	0.349
	(1.44)	(1.72)	(0.017)	(0.022)	(0.011)	(0.011)	(0.016)	(0.021)	(0.007)	(0.009)
RRS	57.47	52.06	0.581	0.552	0.203	0.168	0.342	0.282	0.332	0.290
	(2.57)	(2.72)	(0.030)	(0.050)	(0.019)	(0.020)	(0.033)	(0.050)	(0.028)	(0.022)
Rural										
Gbao	33.70	32.59	0.791	0.858	0.393	0.373	0.616	0.626	0.369	0.290
	(1.51)	(1.01)	(0.022)	(0.018)	(0.011)	(0.013)	(0.019)	(0.026)	(0.023)	(0.012)
Sugd	46.80	45.1	0.620	0.663	0.222	0.223	0.373	0.368	0.307	0.288
	(1.17)	(0.93)	(0.013)	(0.017)	(0.007)	(0.008)	(0.012)	(0.018)	(0.010)	(0.007)
Khatlon	39.22	40.02	0.731	0.782	0.312	0.304	0.519	0.525	0.332	0.323
	(1.33)	(1.08)	(0.018)	(0.014)	(0.014)	(0.008)	(0.020)	(0.018)	(0.011)	(0.012)
RRS	60.66	56.54	0.457	0.436	0.154	0.135	0.251	0.214	0.335	0.279
	(1.83)	(1.25)	(0.016)	(0.022)	(0.009)	(0.009)	(0.014)	(0.019	(0.012)	(0.008)

How reliable are these results? One of the key advantages of this technique is that as well as obtaining estimates of welfare, we can also derive standard errors associated with those estimates. Using these, Figures B1- B12 in Appendix B provide a guide the reliability of the estimates of the welfare indicators. Figure B1 ranks rural rayons

(districts) by the coefficient of variation. Considering the coefficient of variation derived by the survey stratum estimate as a cut off point for the level of acceptable error, we can see that around 90 per cent of the estimates of mean consumption expenditure are below the coefficient of variation obtained from the survey. Good results are also shown for the rayon estimates of FGT(0), FGT(1) and GINI (figures B2, B3 and B4). Jamoat level estimates confirm the results obtained at the rayon level; around 80 per cent of those estimates are below the coefficient of variation for both the monthly consumption expenditure and the headcount rate (figures B5-B8). However for the urban areas, the estimates appear not to be robust for half of the cities (figures B9-B12). However, it should be noted that the urban areas include both 'cities subordinate to the oblast', which are generally large in size, and 'settlements of urban type which are subordinate to the rayon', which are much smaller in size. Disaggregating these, the results appear to be more stable for bigger cities.

The standard errors associated with those estimates do not account for possible errors due to the misspecification of the model we have used for the imputation in the census. Although the procedure technically allows estimating welfare indicators for low levels of disaggregation, the model errors associated with estimates based on areas containing below 1000 households are felt to be too high to be reliable. These problems particularly affect the jamoat level estimates in GBAO and in Tavildara Rayon where the there are frequently less than a 1,000 households within each jamoat (at the time of the 2000 Census).

One further issue which need to be adressed is whether the imputed welfare map refers to the time of collection of the survey data (2003) or the time of collection of the census (2000). A key assumption of the imputation procedure is that the two datasets refer to the same population and implicitly the same point in time, which is clearly not the case here. In determining which year the poverty map refers to, there are two aspects of the inputation procedure which deserve consideration. The variation in consumption observed in the poverty map reflects variations in the household characteristics as observed in the 2000 Census, and so from this perspective, the poverty map might be seen as referring to the Census year. On the other hand, the parameter estimates for the prediction model of the welfare are based on the household characteristics observed in

the 2003 survey. Given that the "zero" stage exercise ensured that only variables with the same meaning and distribution across the two datasets were selected for the regression, it made be inferred that the procedure is imputing 2003 consumption into the 2000 census. Thus the map can be argued to be presenting a picture of the 2003 spatial distribution of poverty.

In reality the map presents a picture of poverty in neither 2000 or 2003. During the period between the census and the survey there have been both economic growth and extensive migration. Hence both the imputed welfare regression (which comes form the household budget) and the spatial distribution of the population (which comes from the census) are likely to have changed between the two years. Thus it is best to interpret the map as providing a guide to the spatial distribution of welfare at the start of the twenty-first century i.e. over the period 2000-2003.

5.1 The spatial distribution of poverty

Bearing these caveats in mind, Figure 1 presents the jamoat level estimates of the monthly consumption expenditure for the country. Areas with less than 1,000 households are shaded to indicate their potential unreliability. The poorest region of the country is Khatlon oblast, where the majority of jamoats have a mean per capita monthly consumption expenditure of less than 40 Somoni. There are also clusters of poverty in Isfara, Roguum, Darvuz and Panjekent. Several district in RRS (Vahdat, Varzob, Rudaki, Tursanzoda, Jirgatol, ect.) and Ghafurov and Matchin districts in Sogd, and Vanj rayon in GBAO show the highest level of monthly consumption expenditure.

Using the same right hand side variables, the consumption model was re-estimated to impute monthly consumption expenditure not adjusting for regional prices, monthly food consumption and monthly food consumption expenditure not adjusting for regional prices. The results are shown in Figures 2-4 respectively.

Comparing Figure 1 and 2, there are no major differences on the ranking of the regions with these two alternative measures of consumption. Hence, it appears that adjusting for regional price differentials does not produces major differences in the ranking of the poorest and the richest jamoats.

Figure 1: Monthly consumption expenditure per capita adjusted for regional prices

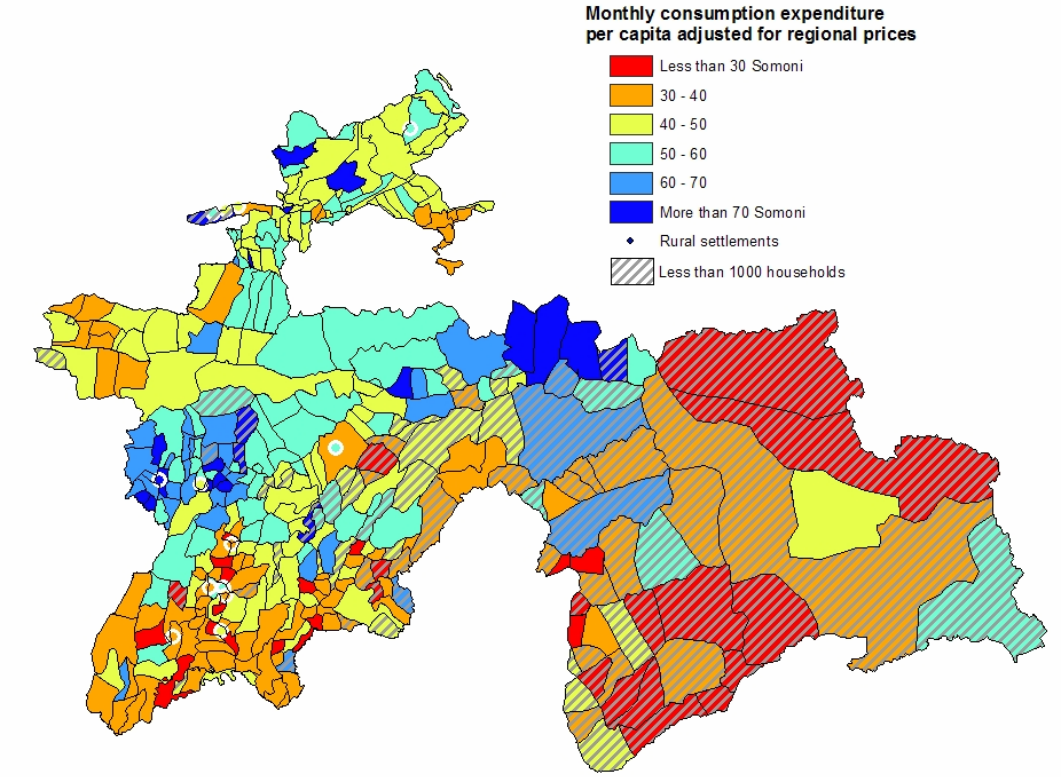


Figure 2: Monthly consumption expenditure per capita not adjusted for regional prices

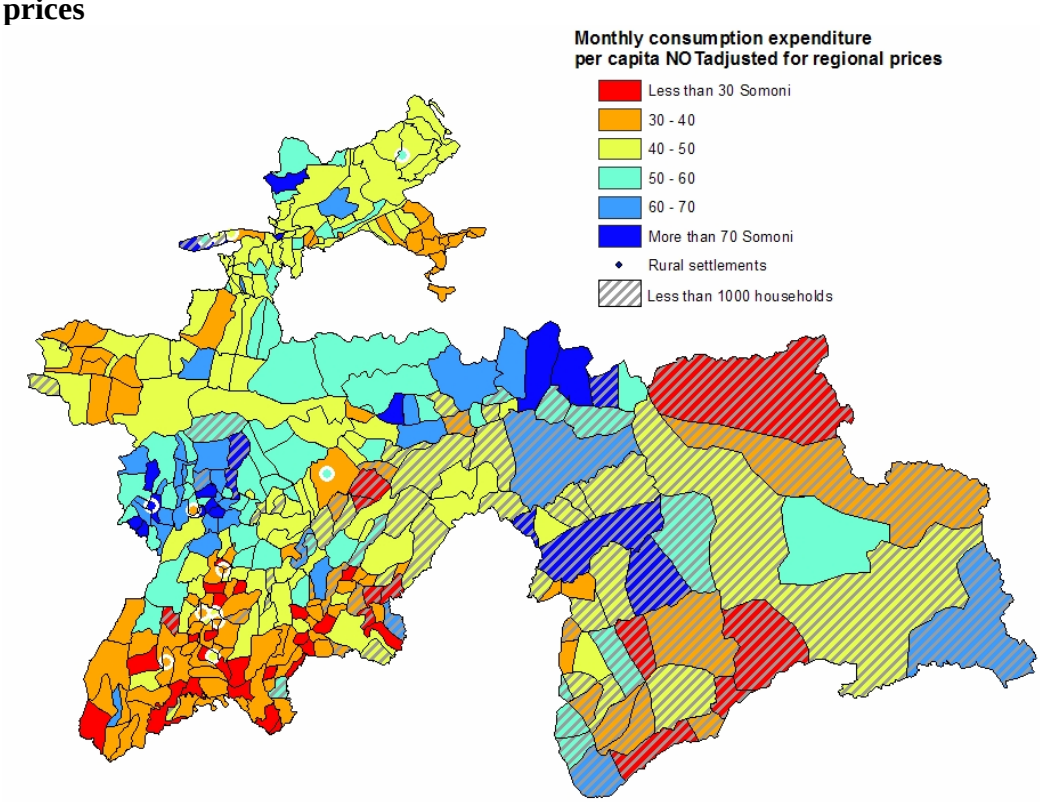


Figure 3 below shows the poverty map for the monthly food consumption expenditures. Using this measure as our welfare indicator modifies the picture somewhat. However, the jamoat in Khatlon again appear again at the bottom of the ranking, whereas the jamoat in RRS area again appears at the top end. Interesting if we do not adjust for regional prices, the monthly food consumption expenditure map changes, and some jamoat change their ranking. This is especially true for rayon in Sugd (Figure 4).

Figure 3: Monthly food consumption expenditure adjusted for regional prices

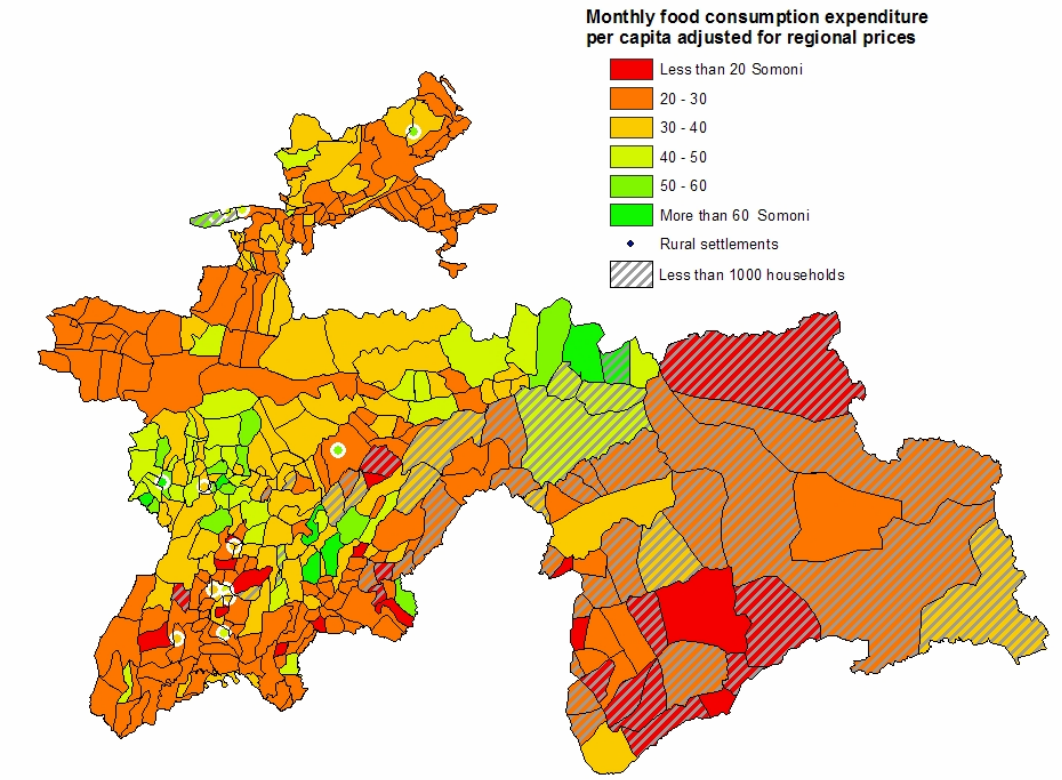
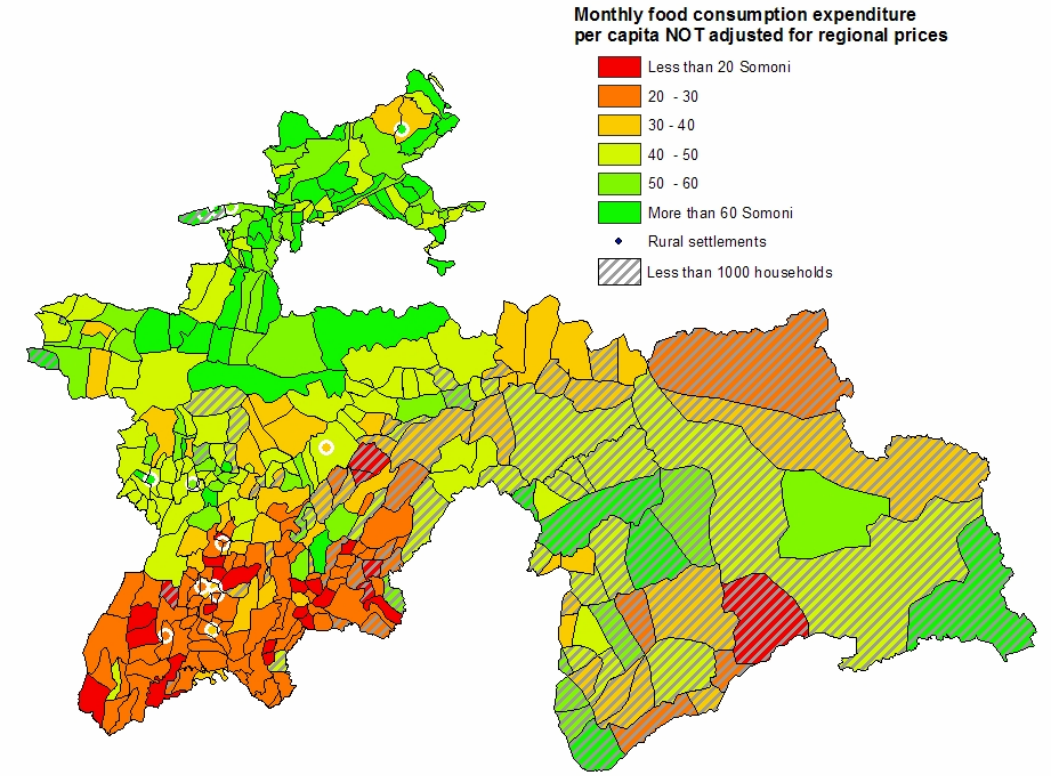


Figure 4: Monthly food consumption expenditure not adjusted for regional prices



Figures 5 and 6 show the spatial distribution of absolute and relative poverty within Tajikistan and confirm the findings detailed above. Figure 7 illustrates the spatial distribution of relative food poverty.

Figure 5: Proportion of people with a consumption expenditure below the absolute poverty line of 47.06 Somoni

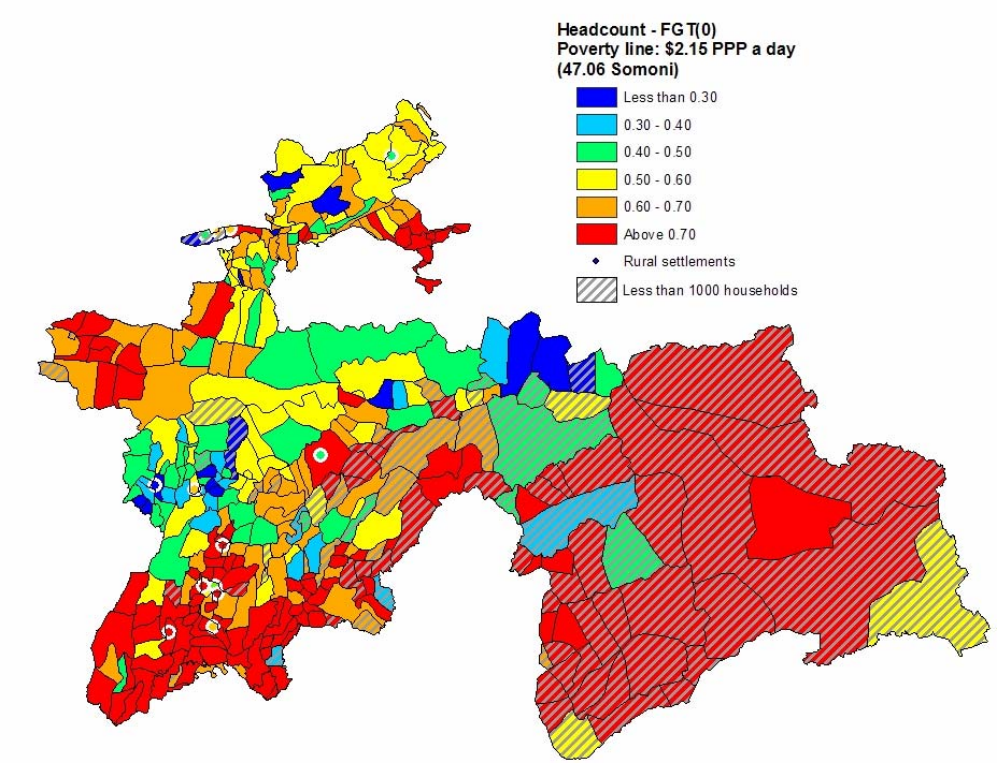


Figure 6: Proportion of people with a monthly consumption expenditure below the relative poverty line of the 40th percentile (33.37 Somoni).

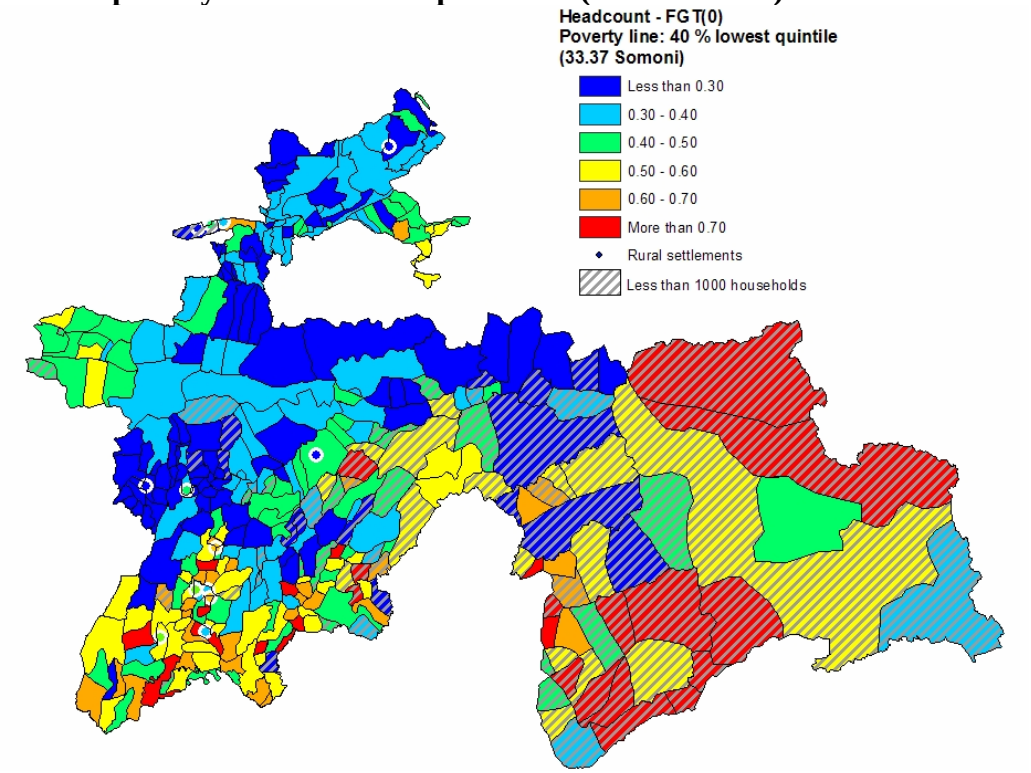
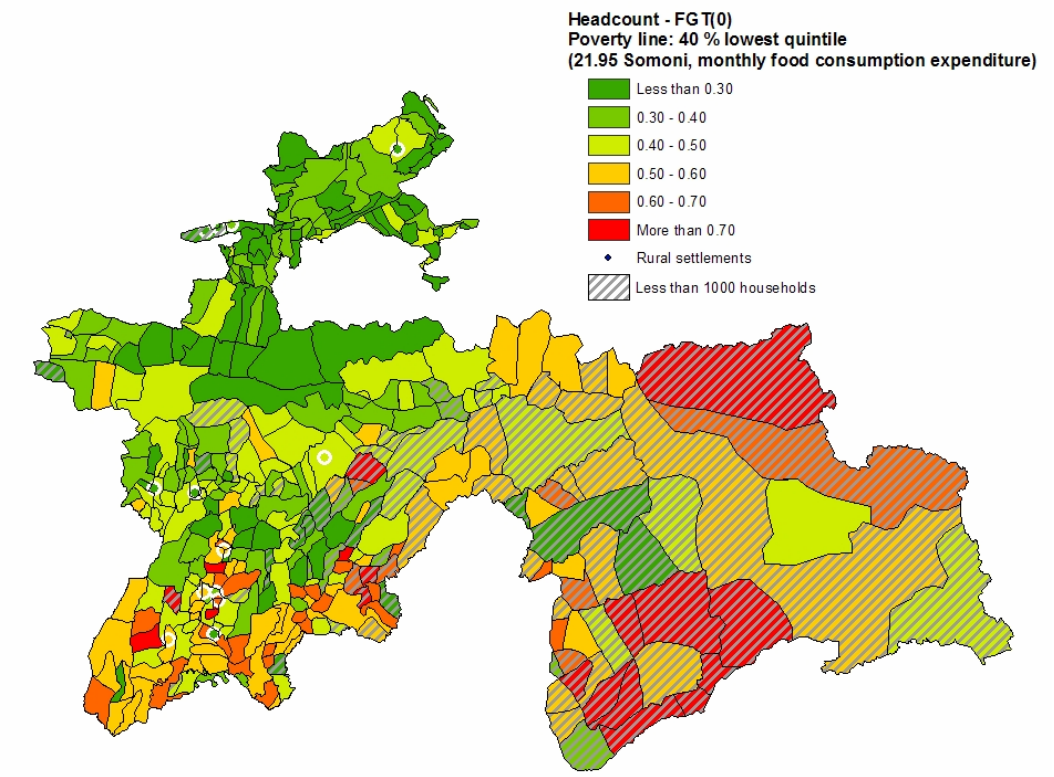


Figure 7: Proportion of people with a monthly food consumption expenditure below the relative poverty line of the 40th percentile (21.95 Somoni).



5.2 What have we learnt by increasing disaggregation?

Figure 8 presents mean per capita monthly consumption expenditure adjusted for regional prices at the rayon level. Comparing Figure 8 and Figure 1 illustrates that increasing the level spatial disaggregation increase the heterogeneity of the welfare estimate, allowing identification of relatively disadvantaged jamoats within relatively advantaged rayons.

Figure 8: Rayon map of consumption expenditure adjusted for regional prices

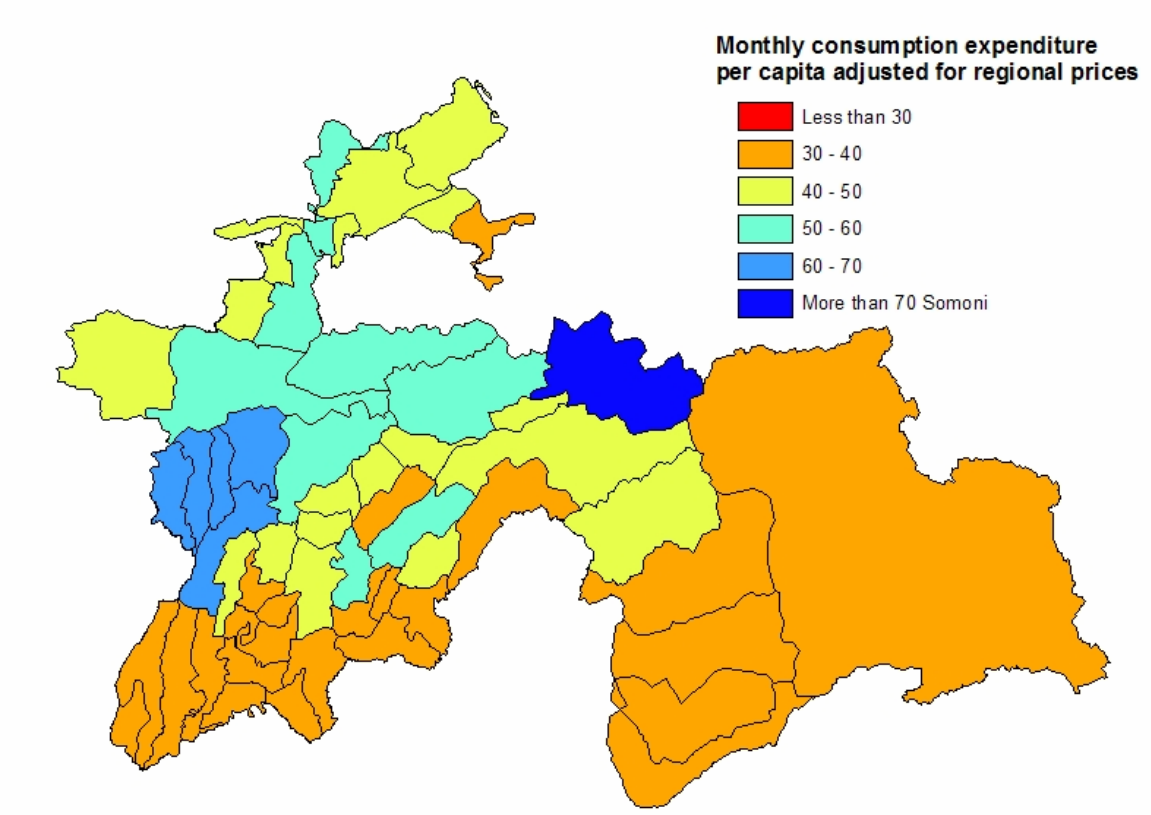


Figure C1- C6 in Appendix C shows the spatial heterogeneity of poverty at both the rayon and jamoat level for urban and rural areas. The graphs compare the estimates and their associated confidence intervals with the national value. Looking at Figures C4 and C5, we can see that spatial inequalities increase by moving from rayon level estimates to jamoat level estimates. Moreover, the graphs illustrate that using a national average masks considerable spatial heterogeneity with some rayons and jamoats experience headcount poverty rates well above the national estimate for rural areas.

*5.3 Poverty and Inequalities in urban area*s

Figures 9 and 10 show the estimates for mean monthly per capita consumption expenditure in urban areas. As discussed above, there are two types of urban areas – 'cities subordinate to the oblast' and 'settlements of urban types'. The results for urban areas show higher rates of poverty in urban area of Khatlon *and* high inequalities in Khatlon, RRS and some urban areas of Sugd.

Figure 9: Monthly consumption expenditure adjusted for regional prices, urban area.

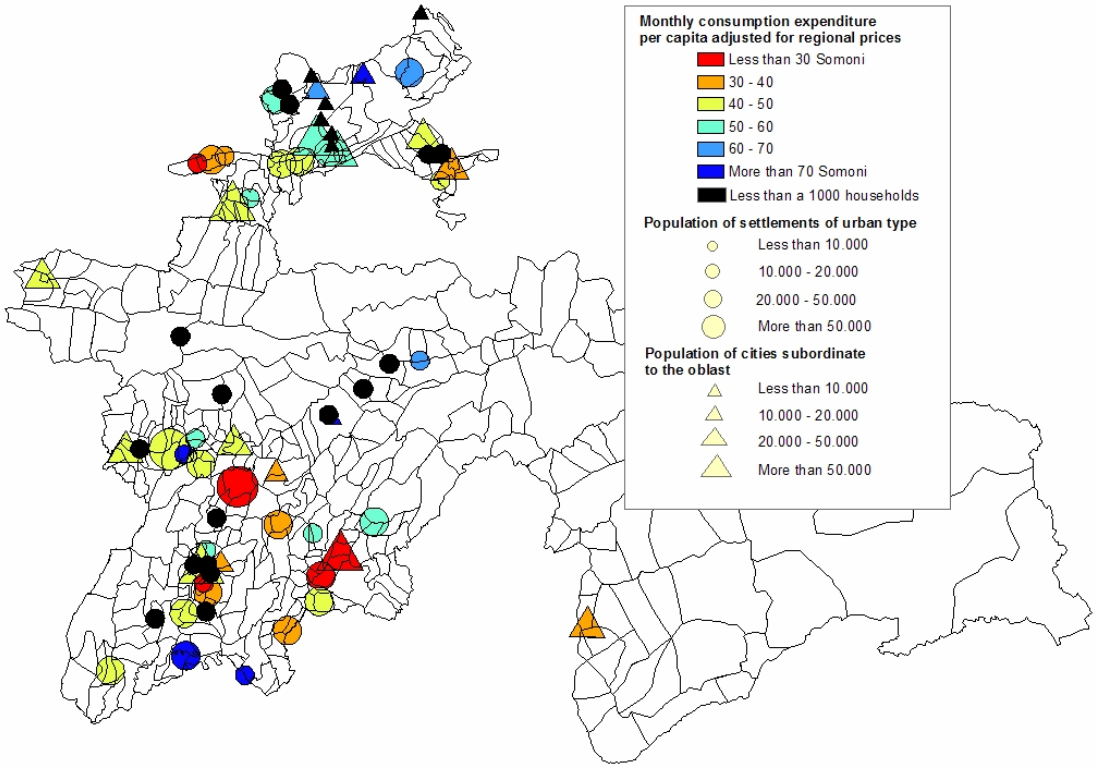
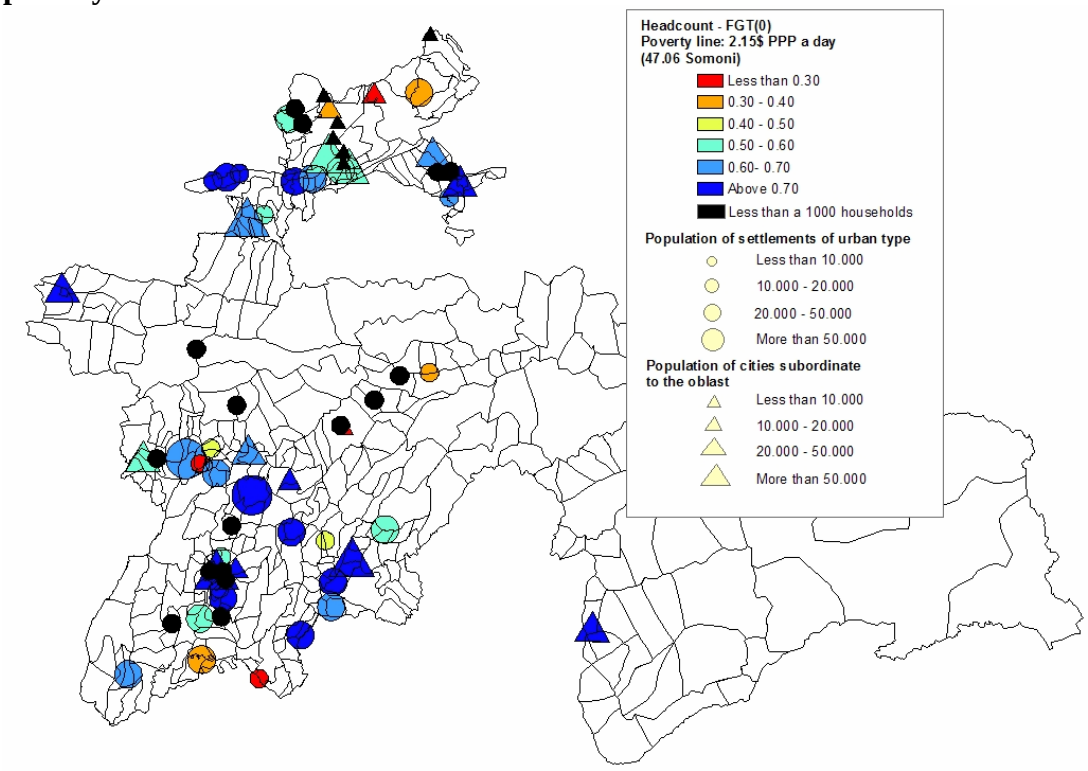


Figure 10: Proportion of people with a consumption expenditure below the absolute poverty line of 47.06 Somoni.



6. Summary

By combining information from the 2003 Tajikistan Living Standards Survey and the 2000 Census it is possible to produce spatially disaggregated estimates of welfare based on consumption at the sub-oblast level. The key findings are:

- In general, there is a higher incidence of both absolute and relative poverty in rural areas as compared to urban areas.
- However, there is a high degree of variation in poverty across urban areas, with the proportion of the population living below the absolute poverty line varying between 10 and 95 per cent.
- There is also a significant degree of variation *within* rayons, with some pockets of deprivation within more affluent areas.
- Overall, poverty rates appear to be highest in Khatlon and GBAO and lowest in RRS, which is consistent with the World Bank Poverty assessement.
- Comparing the spatial estimates of welfare derived using per capita consumption with and without regional price adjustments highlights that although absolute levels are sensitive to price adjustments, the relative ranking of jamoats is fairly robust.

It is important to note that the spatially disaggregated estimates of welfare presented here should be interpreted with caution both in terms of the robustness of the imputation model and the size of the standard errors around the point estimates. These concerns need to be borne in mind particularly when using poverty maps for geographical targeting, and it is preferable for such maps to be employed in conjunction with other targeting approaches. Nevertheless this research presents a positive step forward in the analysis of poverty in Tajikistan both by demonstrating that it is possible to produce statistically reliable estimates of poverty at the sub-rayon level and through the production of a digit map that will allow the visual representation of census results at the administrative level.

Appendix A

Table 1: Descriptive statistics, urban and rural areas.

	GBAO Urban					Sugd Urban					Khatlon Urban				
	Census 2000	TLSS 2003	l95b	u95b		Census 2000	TLSS 2003	l95b	u95b		Census 2000	TLSS 2003	l95b	u95b	
hh_size	5.782	5.850	5.444	6.271	1	5.096	4.884	4.642	5.126	1	5.857	5.940	5.560	6.310	1
hh_work	0.585	0.608	0.518	0.695	1	0.569	0.603	0.558	0.653	1	0.651	0.623	0.557	0.684	1
hh_marr	0.751	0.733	0.647	0.805	1	0.701	0.697	0.649	0.739	1	0.746	0.732	0.669	0.786	1
hh_di_se	0.032	0.000	0.000	0.000	0	0.068	0.080	0.057	0.111	1	0.057	0.032	0.015	0.065	0
hh_widow	0.156	0.267	0.195	0.353	0	0.162	0.181	0.145	0.221	1	0.157	0.218	0.169	0.278	0
hh_fem	0.240	0.183	0.124	0.263	1	0.301	0.276	0.234	0.321	1	0.245	0.264	0.209	0.326	1
sephouse	0.531	0.730	0.640	0.800	0	0.373	0.550	0.500	0.600	0	0.523	0.490	0.420	0.550	1
shahouse	0.010	0.008	0.001	0.057	0	0.072	0.038	0.023	0.061	0	0.030	0.023	0.010	0.053	1
sepapart	0.245	0.217	0.152	0.299	1	0.446	0.363	0.318	0.412	0	0.405	0.286	0.231	0.350	0
shaapart	0.108	0.033	0.013	0.086	0	0.015	0.150	0.106	0.204	0	0.033	0.000	0.000	0.000	0
dwebef60	0.182	0.117	0.070	0.187	1	0.196	0.125	0.096	0.162	0	0.207	0.146	0.105	0.199	0
dwe60_80	0.381	0.542	0.452	0.629	0	0.400	0.396	0.349	0.445	1	0.532	0.536	0.470	0.601	1
dwe80_90	0.234	0.283	0.210	0.370	1	0.197	0.323	0.279	0.371	0	0.184	0.227	0.177	0.287	1
dweaft90	0.114	0.058	0.028	0.117	1	0.059	0.155	0.123	0.194	0	0.053	0.090	0.059	0.137	0
eleoven	0.569	0.725	0.638	0.797	0	0.019	0.584	0.535	0.631	0	0.246	0.341	0.281	0.406	0
stooven	0.528	0.525	0.436	0.613	1	0.165	0.243	0.204	0.288	0	0.492	0.496	0.430	0.561	1
waterpip	0.232	0.733	0.647	0.805	0	0.603	0.672	0.624	0.716	0	0.659	0.882	0.832	0.918	0
telep	0.610	0.775	0.692	0.841	0	0.281	0.351	0.306	0.399	0	0.190	0.300	0.243	0.364	0
owndwe	0.781	0.950	0.890	0.977	0	0.749	0.850	0.811	0.882	0	0.854	0.746	0.684	0.799	0
areles	0.283	0.258	0.188	0.344	1	0.311	0.409	0.360	0.458	0	0.289	0.250	0.197	0.312	1
area40_69	0.390	0.442	0.3555	0.5315	1	0.453	0.389	0.342	0.437	0	0.426	0.473	0.408	0.539	1
areamo70	0.327	0.300	0.2248	0.3878	1	0.236	0.196	0.160	0.237	1	0.285	0.277	0.222	0.340	1
cenheat	0.058	0.083	0.0454	0.148	1	0.373	0.276	0.234	0.322	0	0.354	0.096	0.063	0.142	0
numroom	2.846	2.960	2.726	3.216	1	2.548	2.614	2.468	2.759	1	3.227	2.459	2.260	2.657	0
prwork	0.307	0.379	0.337	0.421	0	0.314	0.306	0.282	0.330	1	0.263	0.219	0.196	0.242	0
hh_none	0.013	0.050	0.022	0.107	0	0.046	0.090	0.065	0.127	0	0.017	0.077	0.048	0.120	0
hh_pri	0.071	0.058	0.028	0.117	1	0.159	0.037	0.023	0.061	0	0.126	0.140	0.101	0.193	0

	GBAO Urban					Sugd Urban					Khatlon Urban				
	Census 2000	TLSS 2003	l95b	u95b		Census 2000	TLSS 2003	l95b	u95b		Census 2000	TLSS 2003	l95b	u95b	
hh_sec	0.644	0.458	0.519	0.616	0	0.591	0.568	0.519	0.616	1	0.661	0.536	0.470	0.601	0
hh_high	0.271	0.433	0.347	0.523	0	0.202	0.303	0.260	0.350	0	0.195	0.245	0.193	0.306	1
prnone	0.100	0.182	0.151	0.213	0	0.125	0.201	0.178	0.223	0	0.144	0.323	0.293	0.352	0
proppri	0.175	0.121	0.095	0.148	0	0.220	0.104	0.087	0.120	0	0.216	0.166	0.142	0.189	0
propsec	0.463	0.488	0.442	0.534	1	0.429	0.556	0.528	0.585	0	0.396	0.428	0.397	0.458	0
prophigh	0.167	0.207	0.172	0.241	0	0.117	0.137	0.116	0.156	1	0.073	0.082	0.064	0.101	1
hh_be15	0.005	0.000	0	0	0	0.007	0.000	0.000	0.000	0	0.002	0.000	0.000	0.000	0
hh_1560	0.776	0.675	0.586	0.752	0	0.784	0.754	0.709	0.794	1	0.817	0.736	0.674	0.790	0
hh_ab60	0.219	0.325	0.247	0.413	0	0.209	0.245	0.205	0.290	1	0.181	0.263	0.209	0.325	0
prop15	0.287	0.228	0.195	0.261	0	0.285	0.287	0.266	0.309	1	0.406	0.401	0.371	0.431	1
prop1560	0.648	0.678	0.637	0.718	1	0.608	0.590	0.564	0.617	1	0.531	0.528	0.500	0.556	1
propab60	0.065	0.093	0.061	0.125	1	0.107	0.121	0.095	0.147	1	0.063	0.070	0.049	0.090	1
tthh4	0.481	0.375	0.266	0.483	1	0.570	0.453	0.383	0.523	0	0.888	0.763	0.640	0.886	1
tthh5_7	0.032	0.241	0.155	0.328	1	0.320	0.288	0.231	0.345	1	0.526	0.554	0.461	0.647	1
tthh8_14	0.915	0.758	0.605	0.911	1	0.830	0.857	0.765	0.949	1	1.193	1.177	1.030	1.323	1
tthh15_4	1.262	1.350	1.120	1.570	1	1.066	1.072	0.947	1.197	1	1.043	1.113	0.937	1.289	1
tthh25_4	1.872	1.810	1.568	2.060	1	1.479	1.318	1.219	1.417	0	1.536	1.586	1.460	1.712	1
tthh45_6	0.600	0.850	0.702	0.997	0	0.491	0.556	0.480	0.632	1	0.423	0.427	0.339	0.515	1
tthh60	0.329	0.466	0.351	0.582	1	0.340	0.338	0.280	0.396	1	0.248	0.318	0.241	0.394	1
Obs	4950	120			24	124305	399			22	65657	220			24
N of rayon	**	**				**	**				**	**			
N of city sub	1	1				8(6+1(2)+1(7))	7(5+1+1(2))				4	3			
N city in rayon	0	0				15	4				20	5			
N jamoat	**	**				**	**				**	**			
N town (rur)	**	**				**	**				**	**			
N of settlements	**	**				**	**				**	**			
N of polygons	1	1				30	12				24	8			

Table 1: Descriptive statistics, urban and rural areas, continued.

	Dushanbe					*RRS Urban*					*GBAO Rural*				
	Census 2000	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*	
hh_size	5.481	4.600	4.396	4.803	0	5.895	5.660	5.145	6.187	1	7.003	6.416	6.161	6.671	0
hh_work	0.420	0.575	0.536	0.612	0	0.574	0.533	0.444	0.621	1	0.637	0.769	0.723	0.810	0
hh_marr	0.645	0.663	0.625	0.697	1	0.729	0.617	0.526	0.699	0	0.835	0.836	0.794	0.871	1
hh_di_se	0.068	0.067	0.050	0.089	1	0.067	0.058	0.028	0.117	1	0.013	0.000	0.000	0.000	0
hh_widow	0.119	0.226	0.196	0.260	0	0.165	0.325	0.247	0.414	0	0.134	0.144	0.112	0.184	1
hh_fem	0.312	0.318	0.283	0.354	1	0.284	0.400	0.316	0.490	0	0.119	0.131	0.100	0.170	1
sephouse	0.236	0.200	0.170	0.230	0	0.476	0.530	0.440	0.620	1	0.907	0.950	0.920	0.970	0
shahouse	0.027	0.038	0.026	0.056	1	0.063	0.008	0.001	0.057	1	0.044	0.008	0.003	0.026	0
sepapart	0.585	0.631	0.593	0.667	0	0.356	0.400	0.316	0.490	1	0.018	0.031	0.017	0.054	1
shaapart	0.014	0.000	0.000	0.000	0	0.059	0.000	0.000	0.000	0	0.016	0.000	0.000	0.000	0
dwebef60	0.211	0.242	0.210	0.276	1	0.200	0.125	0.077	0.197	0	0.128	0.080	0.061	0.120	0
dwe60_80	0.464	0.398	0.361	0.436	0	0.462	0.683	0.595	0.760	0	0.422	0.417	0.367	0.468	1
dwe80_90	0.173	0.310	0.276	0.346	0	0.216	0.142	0.090	0.216	1	0.259	0.244	0.203	0.292	1
dweaft90	0.022	0.050	0.036	0.070	0	0.050	0.050	0.023	0.107	1	0.149	0.253	0.211	0.300	0
eleoven	0.162	0.643	0.606	0.679	0	0.193	0.575	0.485	0.660	0	0.125	0.211	0.172	0.256	0
stooven	0.144	0.167	0.141	0.198	1	0.363	0.467	0.379	0.556	0	0.935	0.825	0.782	0.861	0
waterpip	0.784	0.953	0.934	0.967	0	0.677	0.950	0.893	0.977	0	0.011	0.219	0.180	0.265	0
telep	0.282	0.433	0.396	0.471	0	0.195	0.283	0.210	0.370	0	0.137	0.122	0.092	0.160	1
owndwe	0.820	0.786	0.753	0.815	0	0.849	0.892	0.822	0.936	1	0.967	0.961	0.935	0.977	1
areles	0.389	0.433	0.396	0.471	0	0.265	0.325	0.247	0.414	1	0.142	0.111	0.083	0.148	1
area40_69	0.434	0.444	0.406	0.482	1	0.416	0.475	0.387	0.564	1	0.316	0.389	0.340	0.440	0
areamo70	0.176	0.123	0.100	0.151	0	0.320	0.200	0.138	0.281	0	0.542	0.500	0.449	0.552	1
cenheat	0.557	0.336	0.301	0.373	0	0.342	0.392	0.309	0.482	1	0.005	0.000	0.000	0.000	0
numroom	4.975	1.633	1.541	1.726	0	3.039	2.516	2.251	2.782	0	2.657	3.952	3.882	4.022	0
prwork	0.214	0.254	0.235	0.274	0	0.268	0.275	0.231	0.319	1	0.333	0.457	0.431	0.482	0
hh_none	0.004	0.094	0.074	0.167	0	0.027	0.166	0.110	0.244	0	0.017	0.031	0.017	0.054	1
hh_pri	0.110	0.032	0.021	0.049	0	0.157	0.083	0.045	0.148	0	0.136	0.058	0.038	0.088	0
hh_sec	0.570	0.433	0.395	0.471	0	0.656	0.592	0.502	0.675	1	0.657	0.613	0.562	0.662	1

	Dushanbe					*RRS Urban*					*GBAO Rural*				
	Census 2000	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*	
hh_high	0.314	0.428	0.391	0.466	0	0.159	0.158	0.103	0.235	1	0.189	0.297	0.252	0.346	0
prnone	0.090	0.221	0.203	0.239	0	0.118	0.314	0.272	0.357	0	0.122	0.256	0.234	0.277	0
proppri	0.173	0.103	0.091	0.115	0	0.261	0.186	0.148	0.223	0	0.244	0.139	0.123	0.154	0
propsec	0.430	0.448	0.424	0.472	1	0.402	0.445	0.399	0.490	1	0.429	0.527	0.502	0.552	0
prophigh	0.188	0.223	0.201	0.245	0	0.071	0.053	0.029	0.077	1	0.064	0.077	0.063	0.090	1
hh_be15	0.004	0.000	0.000	0.000	0	0.006	0.000	0.000	0.000	0	0.001	0.000	0.000	0.000	0
hh_1560	0.850	0.802	0.770	0.831	0	0.822	0.783	0.700	0.848	1	0.736	0.711	0.662	0.755	1
hh_ab60	0.146	0.197	0.168	0.229	0	0.172	0.216	0.152	0.299	1	0.263	0.288	0.244	0.337	1
prop15	0.275	0.309	0.290	0.328	0	0.373	0.357	0.315	0.399	1	0.373	0.331	0.308	0.354	0
prop1560	0.644	0.579	0.557	0.601	0	0.551	0.563	0.518	0.609	1	0.547	0.574	0.551	0.597	0
propab60	0.081	0.111	0.090	0.132	1	0.076	0.078	0.043	0.114	1	0.080	0.094	0.075	0.112	1
tthh4	0.569	0.562	0.539	0.877	1	0.772	0.708	0.539	0.877	1	0.837	0.622	0.534	0.709	0
tthh5_7	0.315	0.352	0.307	0.397	1	0.472	0.391	0.290	0.493	1	0.525	0.475	0.407	0.542	1
tthh8_14	0.721	0.820	0.741	0.899	0	1.148	1.183	0.981	1.384	1	1.339	1.060	0.957	1.176	0
tthh15_4	2.022	0.875	0.785	0.965	0	1.211	1.110	0.901	1.332	1	1.459	1.466	1.311	1.622	1
tthh25_4	1.295	1.290	1.220	1.368	1	1.590	1.400	1.195	1.604	1	1.828	1.733	1.617	1.849	1
tthh45_6	0.350	0.430	0.380	0.482	0	0.422	0.575	0.444	0.705	0	0.564	0.597	0.517	0.677	1
tthh60	0.209	0.262	0.220	0.305	0	0.280	0.291	0.187	0.396	1	0.452	0.455	0.386	0.524	1
Obs	140769	658			12	33145	120			28	26414	360			21
N of rayon	**	**				**	**				7	7			
N of city sub	4	4				3	2				**	**			
N city in rayon						10	2				**				
N jamoat	**	**				**	**				42	18			
N town (rur)	**	**				**	**				0	0			
N of settlements	**	**				**	**				395	**			
N of polygons	4	4				13	4				42	18			

Table 1: Descriptive statistics, urban and rural areas, continued.

	Sugd Rural					*Khatlon Rural*					*RRS Rural*				
	Census 2000	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*	
hh_size	6.515	6.217	6.025	6.409	0	7.840	7.322	7.125	7.519	0	8.057	8.031	7.731	8.330	1
hh_work	0.710	0.681	0.650	0.712	1	0.748	0.706	0.674	0.736	0	0.677	0.591	0.551	0.631	0
hh_marr	0.834	0.805	0.776	0.829	0	0.853	0.854	0.828	0.876	1	0.825	0.816	0.782	0.845	1
hh_di_se	0.013	0.015	0.008	0.026	0	0.011	0.003	0.001	0.011	1	0.014	0.008	0.004	0.021	1
hh_widow	0.142	0.165	0.142	0.192	1	0.121	0.138	0.116	0.163	1	0.144	0.159	0.131	0.191	1
hh_fem	0.139	0.152	0.129	0.178	1	0.117	0.126	0.105	0.150	1	0.144	0.156	0.129	0.188	1
sephouse	0.829	0.920	0.900	0.940	0	0.924	0.930	0.910	0.950	1	0.811	0.930	0.900	0.950	0
shahouse	0.139	0.064	0.049	0.082	0	0.059	0.049	0.036	0.066	1	0.165	0.022	0.013	0.038	0
sepapart	0.016	0.006	0.002	0.014	0	0.007	0.005	0.002	0.013	0	0.014	0.036	0.024	0.055	0
shaapart	0.002	0.000	0.000	0.000	0	0.007	0.000	0.000	0.000	0	0.006	0.000	0.000	0.000	0
dwebef60	0.111	0.119	0.099	0.142	1	0.095	0.079	0.062	0.099	1	0.122	0.105	0.083	0.133	1
dwe60_80	0.372	0.407	0.375	0.440	0	0.425	0.366	0.334	0.399	0	0.414	0.512	0.471	0.553	0
dwe80_90	0.255	0.243	0.216	0.273	1	0.248	0.304	0.273	0.336	0	0.242	0.288	0.253	0.326	0
dweaft90	0.157	0.231	0.204	0.261	0	0.183	0.252	0.224	0.283	0	0.109	0.095	0.074	0.122	1
eleoven	0.009	0.197	0.171	0.224	0	0.033	0.218	0.191	0.247	0	0.144	0.312	0.276	0.351	0
stooven	0.641	0.705	0.673	0.734	0	0.933	0.914	0.893	0.931	0	0.808	0.888	0.860	0.911	0
waterpip	0.043	0.137	0.116	0.162	0	0.074	0.262	0.233	0.293	0	0.200	0.364	0.326	0.404	0
telep	0.024	0.051	0.038	0.068	0	0.007	0.008	0.004	0.017	0	0.011	0.053	0.038	0.075	0
owndwe	0.971	0.972	0.959	0.981	1	0.979	0.862	0.947	0.973	0	0.978	0.935	0.911	0.952	0
areles	0.210	0.221	0.194	0.250	1	0.113	0.166	0.142	0.192	0	0.141	0.062	0.045	0.085	1
area40_69	0.389	0.399	0.367	0.432	1	0.365	0.488	0.454	0.522	0	0.292	0.357	0.319	0.397	0
areamo70	0.401	0.379	0.347	0.412	1	0.521	0.344	0.313	0.377	0	0.567	0.576	0.535	0.616	1
cenheat	0.022	0.000	0.000	0.000	0	0.007	0.000	0.000	0.000	0	0.013	0.029	0.018	0.047	0
numroom	2.830	3.809	3.759	3.858	0	3.600	3.222	3.130	3.314	0	3.574	3.763	3.699	3.827	0
prwork	0.377	0.346	0.332	0.361	0	0.378	0.337	0.325	0.349	0	0.346	0.357	0.337	0.377	1
hh_none	0.057	0.092	0.074	0.113	0	0.025	0.092	0.074	0.113	0	0.040	0.167	0.139	0.199	0
hh_pri	0.176	0.029	0.020	0.043	0	0.172	0.085	0.068	0.106	0	0.213	0.116	0.091	0.144	0
hh_sec	0.641	0.664	0.632	0.694	1	0.691	0.656	0.623	0.687	1	0.641	0.506	0.466	0.547	0

	Sugd Rural					*Khatlon Rural*					*RRS Rural*				
	Census 2000	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*		*Census 2000*	*TLSS 2003*	*l95b*	*u95b*	
hh_high	0.125	0.212	0.186	0.241	0	0.112	0.166	0.143	0.193	0	0.105	0.210	0.179	0.245	0
prnone	0.165	0.251	0.237	0.265	0	0.162	0.336	0.322	0.350	0	0.134	0.318	0.302	0.334	0
proppri	0.233	0.116	0.106	0.127	0	0.245	0.158	0.146	0.169	0	0.295	0.162	0.150	0.175	0
propsec	0.400	0.563	0.546	0.580	0	0.368	0.469	0.454	0.484	0	0.364	0.465	0.448	0.482	0
prophigh	0.044	0.067	0.058	0.077	0	0.027	0.036	0.030	0.041	0	0.031	0.052	0.004	0.061	0
hh_be15	0.004	0.000	0.000	0.000	0	0.001	0.000	0.000	0.000	0	0.003	0.000	0.000	0.000	0
hh_1560	0.768	0.754	0.724	0.782	1	0.782	0.751	0.720	0.779	0	0.756	0.684	0.645	0.721	0
hh_ab60	0.229	0.245	0.217	0.275	1	0.218	0.248	0.220	0.279	0	0.242	0.316	0.279	0.355	0
prop15	0.385	0.343	0.330	0.357	0	0.458	0.415	0.401	0.428	0	0.427	0.376	0.360	0.392	0
prop1560	0.538	0.569	0.554	0.585	0	0.482	0.521	0.508	0.534	0	0.505	0.543	0.526	0.559	0
propab60	0.077	0.086	0.073	0.099	1	0.059	0.063	0.054	0.072	1	0.068	0.080	0.067	0.093	0
tthh4	0.917	0.783	0.714	0.852	0	1.297	1.000	0.933	1.083	0	1.237	1.081	0.984	1.178	0
tthh5_7	0.516	0.472	0.428	0.515	1	0.755	0.585	0.540	0.631	0	0.707	0.607	0.542	0.672	0
tthh8_14	1.204	0.998	0.928	1.069	0	1.621	1.516	1.434	1.598	0	1.615	1.499	1.388	1.601	0
tthh15_4	1.294	1.367	1.270	1.463	1	1.484	1.651	1.544	1.757	0	1.663	1.893	1.762	2.024	0
tthh25_4	1.709	1.627	1.553	1.702	1	1.813	1.569	1.498	1.640	0	1.887	1.821	1.712	1.929	1
tthh45_6	0.490	0.603	0.549	0.657	0	0.496	0.617	0.562	0.671	0	0.520	0.644	0.581	0.707	0
tthh60	0.385	0.363	0.322	0.405	1	0.374	0.375	0.331	0.418	1	0.429	0.489	0.432	0.546	0
Obs	249624	860			17	241347	840			10	172063	580			11
N of rayon	14	13				24	21				13	12			
N of city sub	**	**				**	**				**	**			
N city in rayon	**	**				**	**								
N jamoat	93	43				130	38				91	27			
N town (rur)	4	0				6	4				3	1			
N of settlements	654	**				1528	**				1225				
Nof polygons	97	43				136	42				94	28			

Table 2: Census derived Jamoat level mean variables tested in the model.

VARIABLE NAME	*Variables label*
jamoat	Jamoat code
jamopop	Total population in each jamoat
jamohh	Total number of hh in each jamoat
tot5	Total number of person 5 or less years old
tot6_10	Total number 6 to 10 years old
tot11_15	Total number 11 to 15 years old
tot16_20	Total number 16 to 20 years old
tot21_25	Total number 21 to 25 years old
tot26_30	Total number 26 to 30 years old
tot31_35	Total number 31 to 35 years old
tot36_40	Total number 36 to 40 years old
tot41_45	Total number 41 to 45 years old
tot46_50	Total number 45 to 50 years old
tot51_55	Total number 51 to 55 years old
tot56_60	Total number 56 to 60 years old
tot61_65	Total number 61 to 65 years old
totab65	Total number above 65 years old
illiterate	Proportion 17 old illiterate
primary	Proportion 17 old with primary education
secondary	Proportion 17 old with secondary education
higher	Proportion 17 old with higher education
active	Proportion of 15 years old economically active
indibasi	proportion of 15 old working on individual basic
employee	proportion of 15 old working on working as an employee
Source1	prop of 15 yrs old working as an employee at an enterprise or in organization or in institution
Source2	prop of 15 yrs old working as an employee at dekhkan farm
Source8	prop of 15 yrs old working one ancillary farm
Source10	Proportion of pensioner

Table 3: Census derived settlement level mean variables tested in the model.

VARIABLES NAME	***Variables label***
prsephh	proportion of hh living in a separate hh per village
prshahh	proportion of hh living in a share hh per village
prsaphh	proportion of hh living in a sep apart hh per village
prshaph	proportion of hh living in a share apart hh per village
Prbe60hh	prop of hh living in a house built bef 60 per village
prdw68hh	prop of hh living in a house built 60_80 per village
prdw89hh	prop of hh living in a house built 80_90 per village
prdaf90h	prop of hh living in a house built aft 90 per village
prelepvh	prop of hh living in hh which have electric oven
prstovhh	prop of hh living in hh which stone oven
prwatpih	prop of hh living in hh which water pipes
prtelehh	prop of hh living in hh which telep
prownhh	prop of hh living in hh which own d
avnuroom	average num room per hh in village
prarlesh	prop of hh living in hh which has a living area less than 40 m
prar4_8h	prop of hh living in hh which has a living area b 40 69 m2
prarmo7h	prop of hh living in hh which has a living area more than 70 m
prhh_mar	prop of hh head married per village
prhh_ds	prop of hh head divorced/separated per village
prhh_wi	prop of hh head widow per village
prhh_fem	prop of hh head female per village
prhh_wor	prop of hh head work per village
prhh_no	prop of hh head none education per village
prhh_pri	prop of hh head primary education per village
prhh_sec	prop of hh head secondary education per village
prhh_hig	prop of hh head higher education per village
prhh_b15	prop of hh head below 15 per village
prhh_156	prop of hh head below 15/60 per village
prhh_a60	prop of hh head below above60 per village
avhh_siz	average num room per hh in village
avtoarea	Average living area
tnone	proportion of village members with none education

tpri	proportion of village members with primary education
tsec	proportion of village members with secondary education
thigh	proportion of village members with higher education
prwork	proportion of village members economically active
prbe15	proportion of village members below 15 years old
pr1560	proportion of village members below 15/60
prab60	proportion of village members above 60
prentorg	prop of village members employed in enterprise organization or institution
prdenkha	prop of village members employed in dekhkan farm
prindcit	
prowndek	prop of village members employed own denkhan
prowpr	prop of village members employed own private enterprise
prind	prop of village members employed individual basis
prfament	prop of village members employed family enterprise
prancfar	prop of village members employed at one's own ancillary farm
prpensi	prop of village members employed living from pension
prumplbe	unemployment benefit
prbenef	other benefit/gov support

Table 4: GIS variables at jamoat level tested in the model.

VARIABLE NAME	*label*
aveheig2	Average height, buffer for settlements 200
lan0_202	Proportion of land between 0-5 ° slope, buffer for settlement 200
ln5_202	Proportion of land between 5_20 ° slope, buffer for settlement 200
lnab202	Proportion of land above 20 ° slope, buffer for settlement 200
aveheig5	Average height, buffer for settlements 200
lan0_205	Proportion of land between 0-5 ° slope, buffer for settlement 500
ln5_205	Proportion of land between 5_20 ° slope, buffer for settlement 500
lnab205	Proportion of land above 20 ° slope, buffer for settlement 500
aveheig1	Average height, buffer for settlements 200
lan0_201	Proportion of land between 0-5 ° slope, buffer for settlement 1000
ln5_201	Proportion of land between 5_20 ° slope, buffer for settlement 1000
lnab201	Proportion of land above 20 ° slope, buffer for settlement 1000
aveheigk	Average height, buffer for settlements 200
lan0_20k	Proportion of land between 0-5 ° slope, buffer for settlement 1500
ln5_20k	Proportion of land between 5_20 ° slope, buffer for settlement 1500
lnab20k	Proportion of land above 20 ° slope, buffer for settlement 1500
avedist	Average distance to road
cr_oth15	Prop of cropland, ‘other’ cat within jamoat or 1,5k buffer around set
cr_unk15	Prop of cropland, ‘unknown’ cat within jamoat or 1,5k buffer around settlement (might correspond to cotton)
cr_dry15	Prop of cropland, ‘dry’ category within jamoat or 1,5k buffer around set
gr_gra15	Prop of grassland, ‘grass’ cat within jamoat or 1,5k buffer around set
gr_scr15	Prop of grassland, ‘scrub’ cat within jamoat or 1,5k buffer around set
tundra15	Prop of tundra within jamoat or 1,5k buffer around set
tr_eve15	Prop of trees, ‘evergreen’ cat within jamoat or 1,5k buffer around set
tr_mix15	Prop of trees, ‘mixed’ cat within jamoat or 1,5k buffer around set
tr_dec15	Prop of trees land, ‘deciduous’ cat within jamoat or 1,5k buffer around set
cr_oth1	Prop of cropland, ‘other’ cat within jamoat or 1k buffer around set
cr_unk1	Prop of cropland, ‘unknown’ cat within jamoat or 1k buffer around settlement (might correspond to cotton)
cr_dry1	Prop of cropland, ‘dry’ category within jamoat or 1k buffer around set
gr_gra1	Prop of grassland, ‘grass’ cat within jamoat or 1k buffer around set
gr_scr1	Prop of grassland, ‘scrub’ cat within jamoat or 1k buffer around set
tundra1	Prop of tundra within jamoat or 1k buffer around set
tr_eve1	Prop of trees, ‘evergreen’ cat within jamoat or 1k buffer around set
tr_mix1	Prop of trees, ‘mixed’ cat within jamoat or 1k buffer around set
tr_dec1	Prop of trees land, ‘deciduous’ cat within jamoat or 1k buffer around set
cr_oth5	Prop of cropland, ‘other’ cat within jamoat or 0,5k buffer around set

cr_unk5	Prop of cropland, 'unknown' cat within jamoat or 0,5k buffer around settlement (might correspond to cotton)
cr_dry5	Prop of cropland, 'dry' category within jamoat or 0,5k buffer around set
gr_gra5	Prop of grassland, 'grass' cat within jamoat or 0,5k buffer around set
gr_scr5	Prop of grassland, 'scrub' cat within jamoat or 0,5k buffer around set
Tundra5	Prop of tundra within jamoat or 0,5k buffer around set
tr_eve5	Prop of trees, 'evergreen' cat within jamoat or 0,5k buffer around set
tr_mix5	Prop of trees, 'mixed' cat within jamoat or 0,5k buffer around set
tr_dec5	Prop of trees land, 'deciduous' cat within jamoat or 0,5k buffer around set
cr_oth2	Prop of cropland, 'other' cat within jamoat or 0,2 k buffer around set
cr_unk2	Prop of cropland, 'unknown' cat within jamoat or 0,2 k buffer around settlement (might correspond to cotton)
cr_dry2	Prop of cropland, 'dry' category within jamoat or 0,2 k buffer around set
gr_gra2	Prop of grassland, 'grass' cat within jamoat or 0,2 k buffer around set
gr_scr2	Prop of grassland, 'scrub' cat within jamoat or 0,2 k buffer around set
Tundra2	Prop of tundra within jamoat or 0,2 k buffer around set
tr_eve2	Prop of trees, 'evergreen' cat within jamoat or 0,2 k buffer around set
tr_mix2	Prop of trees, 'mixed' cat within jamoat or 0,2 k buffer around set
tr_dec2	Prop of trees land, 'deciduous' cat within jamoat or 0,2 k buffer around set

Table 5: OLS regression for the urban strata.

Urban strata:	*GBAO*	*Sugd*	*Khatlon*	*Dushanbe*	*RRS*
Demographic variables					
hh_size		-0.091	0.003		
		(7.84)***	(0.16)		
tthh4	-0.154			-0.089	-0.180
	(2.61)**			(3.64)***	(4.27)***
tthh5_7	-0.139				
	(1.94)*				
tthh8_14	-0.129				
	(3.23)***				
tthh15_4	-0.101		-0.118		
	(3.77)***		(2.49)**		
tthh25_4	-0.097			0.033	
	(3.87)***			(0.69)	
sqth25_4				-0.022	
				(2.34)**	
tthh60			-0.152		
			(1.91)*		
hh_fem			0.179		
			(2.01)**		
prop1560		0.331			
		(2.58)**			
prop15			-0.761		0.366
			(2.65)***		(1.76)*
Socio-economic variables					
hh_pri	-0.371				
	(2.74)***				
hh_sec					0.167
					(2.03)**
propsec	-0.612				
	(3.92)***				
hh_work		0.133			
		(2.32)**			
prwork				0.833	0.385
				(6.61)***	(2.13)**
prophigh		0.868	1.004	0.637	1.456
		(5.50)***	(3.41)***	(5.67)***	(4.09)***
Household characteristics					
dwe80_90	-0.181				
	(2.06)**				
stooven	-0.234			0.112	
	(3.15)***			(1.89)*	
are40_69	0.131			-0.164	-0.153
	(1.91)*			(2.54)**	(2.06)**
aremo70		0.144			
		(2.13)**			
sepapart					0.327
					(3.03)***
dweaft90					0.331
					(2.08)**
areles			-0.162	-0.296	
			(1.83)*	(4.31)***	
Census mean variables					

Urban strata:	*GBAO*	*Sugd*	*Khatlon*	*Dushanbe*	*RRS*
active		-18.555		4.155	
		(1.87)*		(2.97)***	
indibasi		19.805		-3.336	
		(1.86)*		(2.34)**	
employee		22.055			
		(1.86)*			
source1		-4.103			
		(2.47)**			
source8		15.975			
		(2.18)**			
prstovhh			3.038		0.772
			(4.34)***		(3.12)***
prdw89hh					1.262
					(2.20)**
prtelehh			1.453		
			(1.90)*		
prwatpih			0.793		
			(2.86)***		
avnuroom			-1.299		
			(3.46)***		
prarlesh			6.695		
			(4.84)***		
prhh_mar			10.462		
			(3.96)***		
Constant	4.614	3.813	-4.039	2.776	2.912
	(34.60)***	(9.45)***	(2.12)**	(6.72)***	(15.25)***
Observations	120	399	220	658	120
R-squared	0.50	0.28	0.33	0.26	0.43

Absolute value of t statistics in parentheses
significant at 10%; ** significant at 5%; *** significant at 1%

Table 6: OLS regression for the rural strata.

Rural strata:	*Gbao*	*Sugd*	*Khatlon*	*RRS*
Demographic variables				
hh_size		-0.101	-0.107	-0.116
		(5.88)***	(5.21)***	(6.78)***
hhsize2		0.003	0.003	0.004
		(3.35)***	(2.80)***	(5.77)***
tthh5_7	-0.054			
	(1.51)			
tthh15_4	-0.076			
	(4.51)***			
tthh25_4	-0.093			
	(4.30)***			
tthh60	-0.183			
	(2.86)***			
prop1560		0.285		
		(3.20)***		
propab60	0.551	0.302		
	(1.64)	(2.07)**		
hh_1560	-0.153			
	(1.91)*			
hh_fem		-0.150		
		(3.15)***		
hh_marr				0.143
				(2.61)***
Socio economic variables				
hh_sec			-0.137	
			(3.90)***	
prophigh	0.898			
	(3.98)***			
Household characteristics				
are40_69		0.114		
		(2.38)**		
aremo70		0.231		0.150
		(4.74)***		(3.23)***
stooven			-0.174	
			(3.05)***	
owndwe			0.269	
			(2.88)***	
Census mean variables				
prsephh	-1.874			
	(4.40)***			
avnuroom	-0.386			0.054
	(4.20)***			(2.04)**
prhh_wor	1.328	0.623		
	(4.07)***	(3.05)***		
prancfar	-2.670		-3.022	
	(2.46)**		(4.50)***	
prdw68hh	-1.546			0.691
	(4.20)***			(2.41)**
prhh_fem	-2.366	3.633	2.104	
	(4.67)***	(3.90)***	(3.29)***	
prshahh	-2.736			1.429

Rural strata:	*Gbao*	*Sugd*	*Khatlon*	*RRS*
	(4.52)***			(5.32)***
prtelehh	0.481	-1.499		
	(1.60)	(3.45)***		
prbe60hh	-2.664		0.977	1.269
	(3.64)***		(5.86)***	(3.68)***
tnone		5.273		
		(4.11)***		
prbe15		-2.662		
		(2.96)***		
prentorg		-0.833	-1.339	
		(5.34)***	(4.08)***	
prsaphh		-0.847		
		(6.02)***		
prelepvh		2.685		0.382
		(1.91)*		(4.22)***
prwatpih		1.043		
		(3.93)***		
prhh_ds		-4.250		
		(2.45)**		
prhh_wi		-3.075		
		(2.99)***		
prstovhh			0.677	-0.382
			(2.33)**	(2.67)***
prhh_pri				1.614
				(4.02)***
jamohh				0.000
				(2.22)**
avhh_siz				-0.175
				(4.45)***
prwork				0.354
				(3.60)***
prarlesh				-1.621
				(4.51)***
prhh_hig				1.113
				(2.23)**
prhh_156			1.485	
			(3.32)***	
active			2.793	
			(6.24)***	
employee			-2.672	
			(6.02)***	
tsec			-2.177	
			(3.49)***	
prdenkha			-1.304	
			(3.29)***	
totter			0.000	
			(2.38)**	
GIS mean variables				
ln5_205			-1.088	
lan0_205			-1.101	
			(3.55)***	
aveheig2			-0.000	
			(2.71)***	
cr_dry1			0.410	
			(3.81)***	

Rural strata:	*Gbao*	*Sugd*	*Khatlon*	*RRS*
avedist	0.000			
	(3.61)***			
aveheigk	-0.000			
	(3.03)***			
Constant	7.858	3.919	4.334	4.767
	(9.89)***	(10.68)***	(5.40)***	(11.30)***
Observations	360	859	840	580
R-squared	0.31	0.21	0.25	0.20
Loc effect modeled	NO	NO	YES	NO

Appendix B

Rural area: rayon estimates.

Figure B1: Standard error as percentage of point estimate: rayon estimates of mean consumption expenditure adjusted for regional prices.

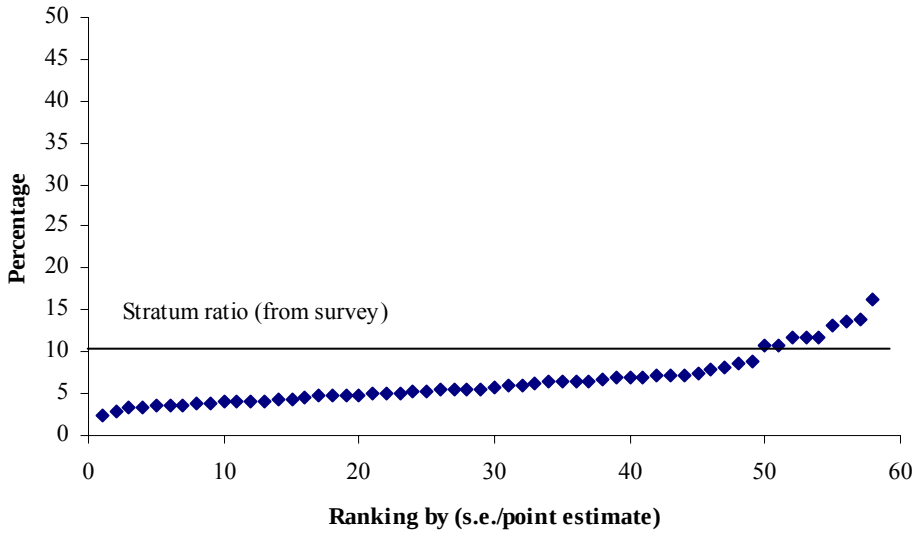


Figure B2: Standard error as percentage of point estimate: rayon for the headcount rate.

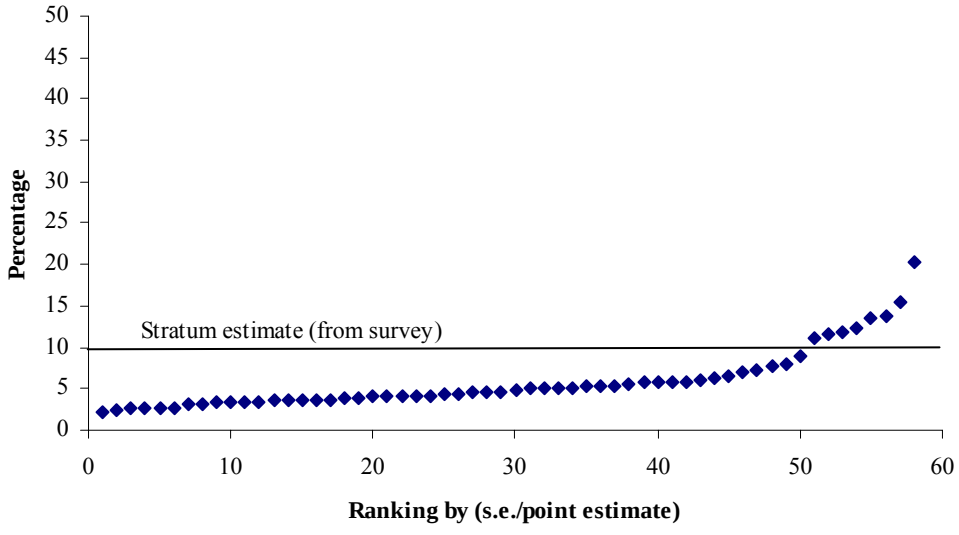


Figure B3: Standard error as percentage of point estimate: rayon for the headcount rate.

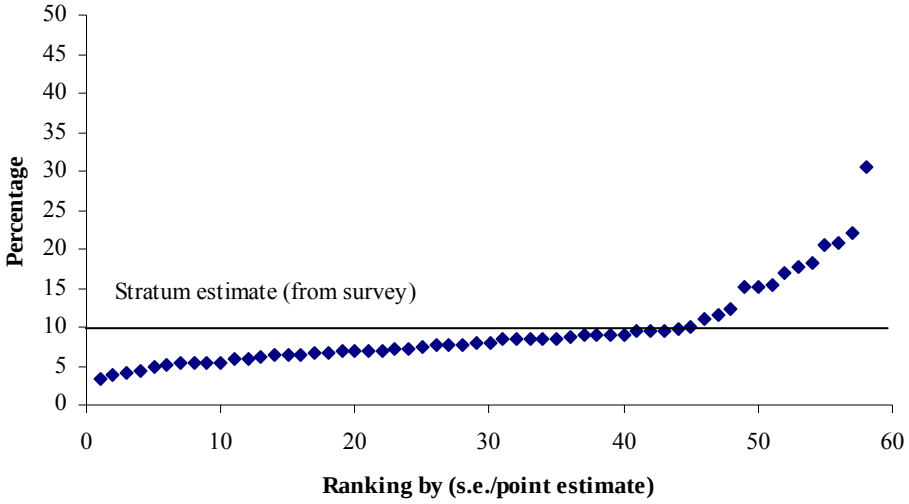
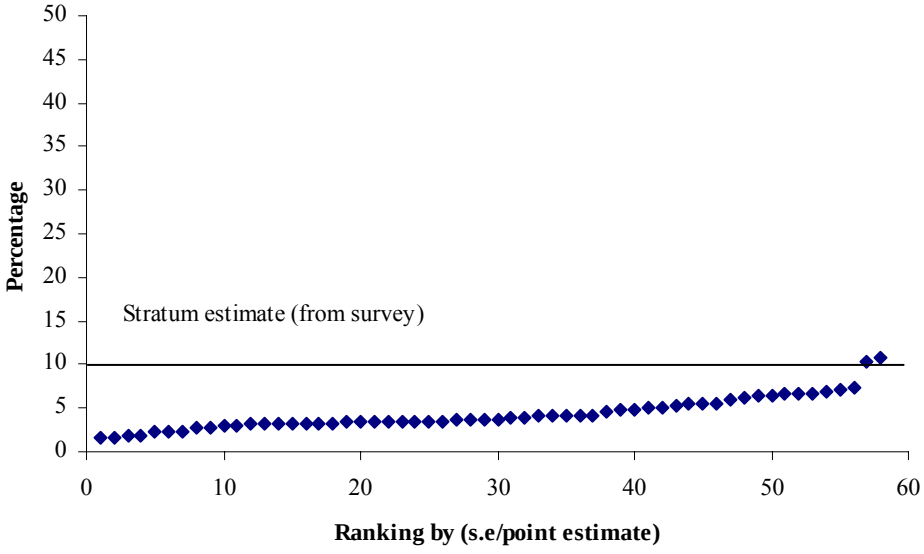


Figure B4: Standard error as percentage of point estimate: rayon for the headcount rate.



Rural area: Jamoat estimates

Figure B5: Standard error as percentage of point estimate: jamoat estimates of mean consumption expenditure adjusted for regional prices.

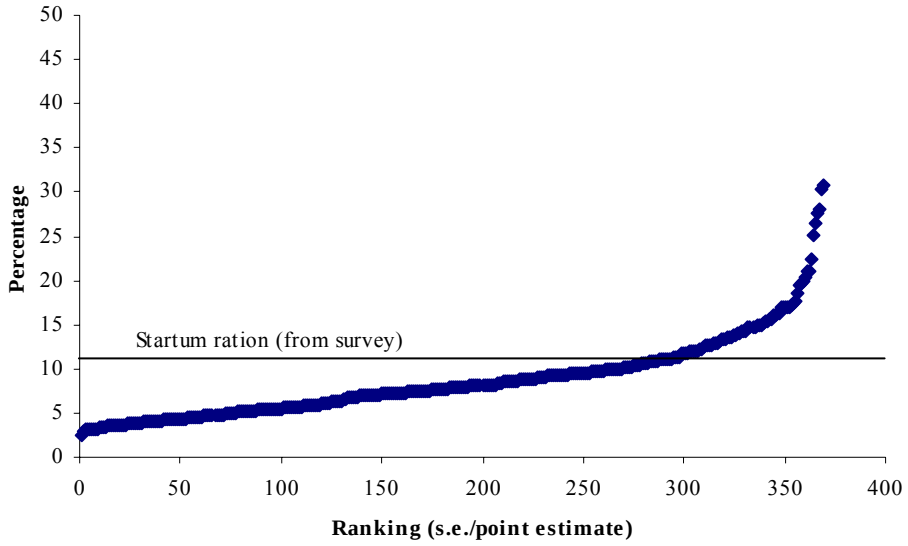


Figure B6: Standard error as percentage of point estimate: jamoat estimates of headcount rate.

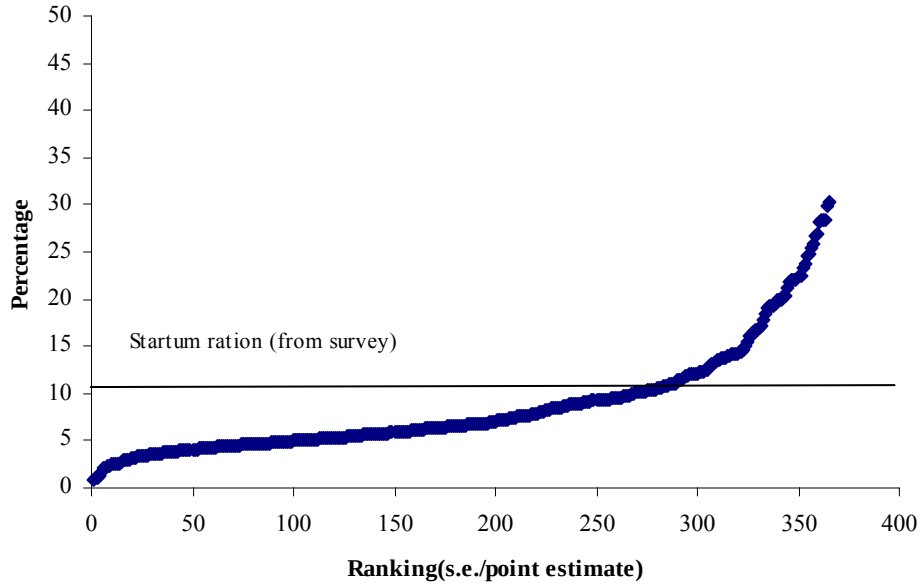


Figure B7: Standard error as percentage of point estimate: jamoat estimates of FGT (1).

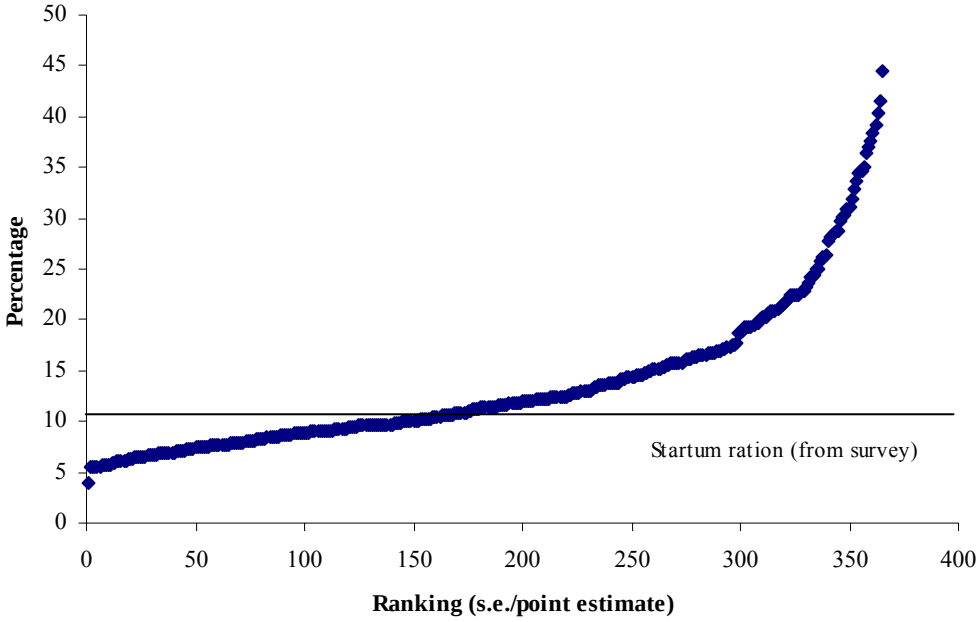
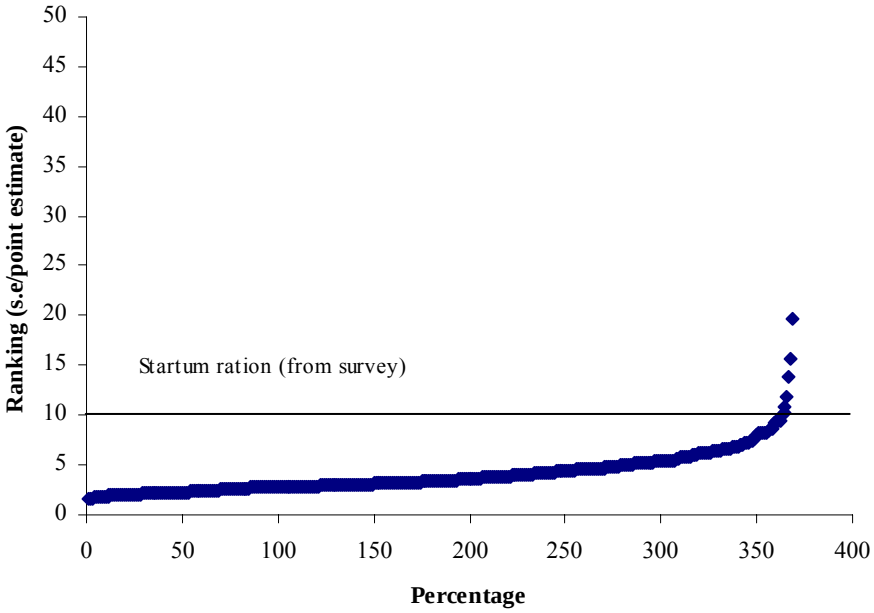


Figure B8: Standard error as percentage of point estimate: jamoat estimates of GINI.



Urban area: city subordinate to the oblast or to the republic and city within rayon.

Figure B9: Standard error as percentage of point estimate: urban area estimate of the mean consumption expenditure adjusted for regional prices.

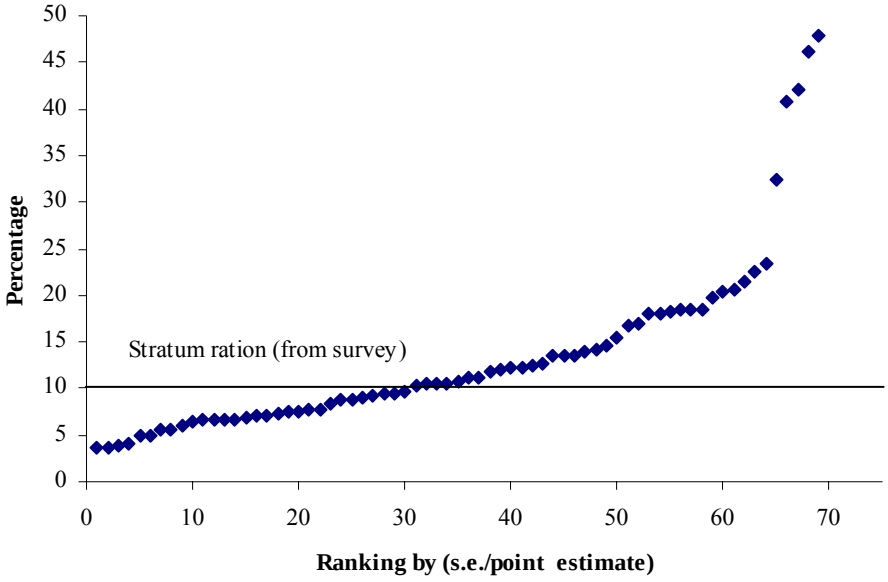


Figure B10: Standard error as percentage of point estimate: urban area estimate of headcount.

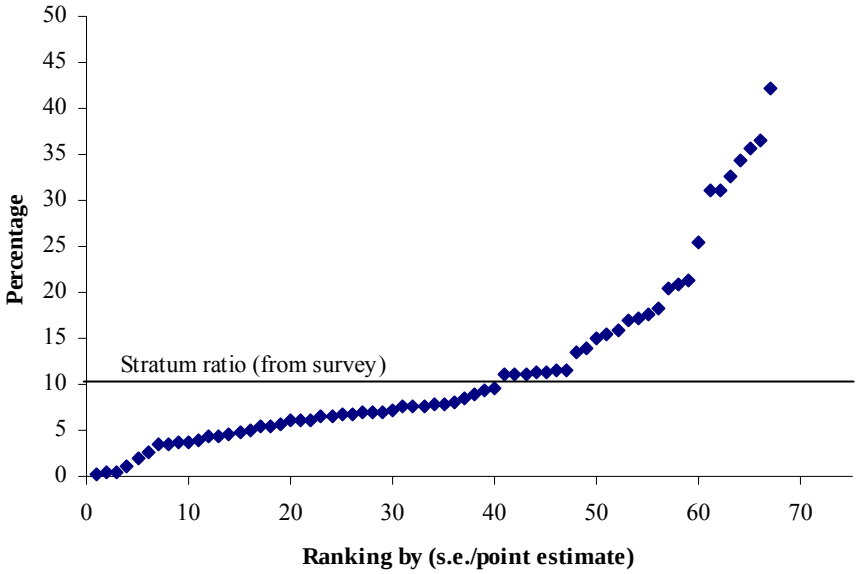


Figure B11: Standard error as percentage of point estimate: urban area estimate of FGT(1).

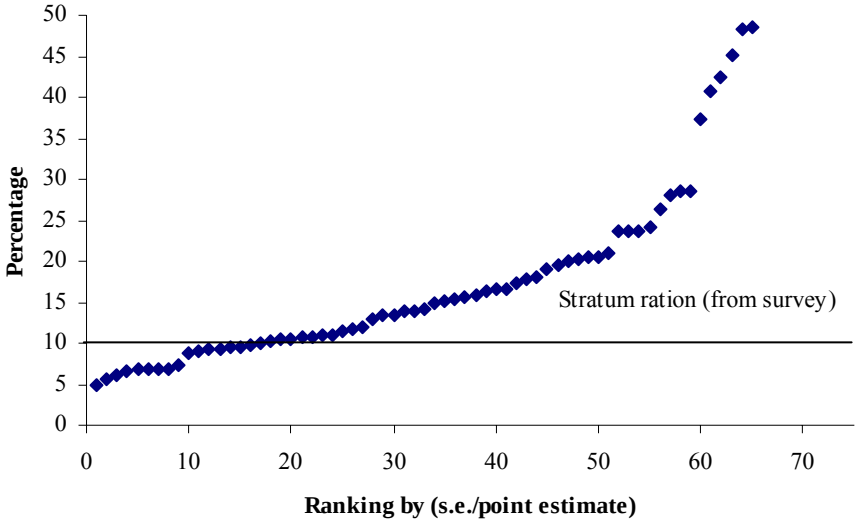
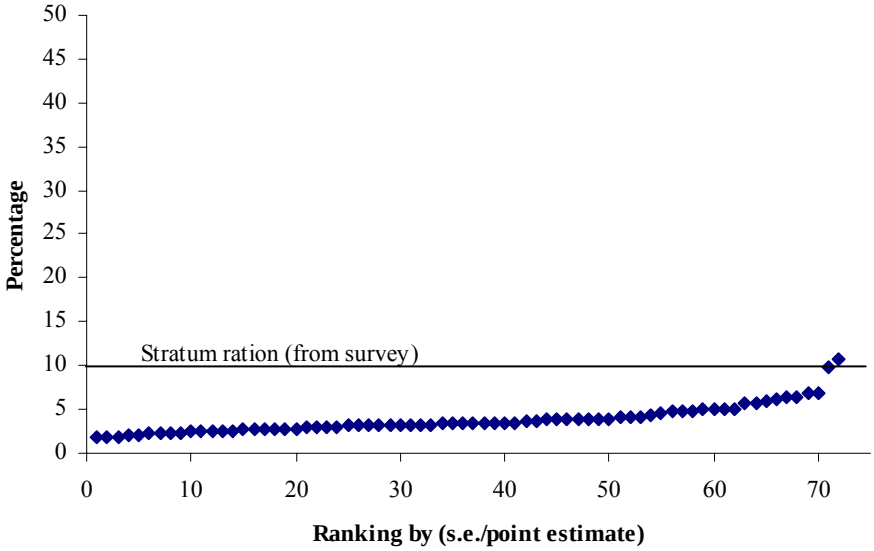


Figure B12: Standard error as percentage of point estimate: urban area estimate of GINI.



Appendix C:

Comparing national average value and estimate value for rural area and urban area

Figure C1: Distribution of monthly consumption expenditure by rayon, rural area.

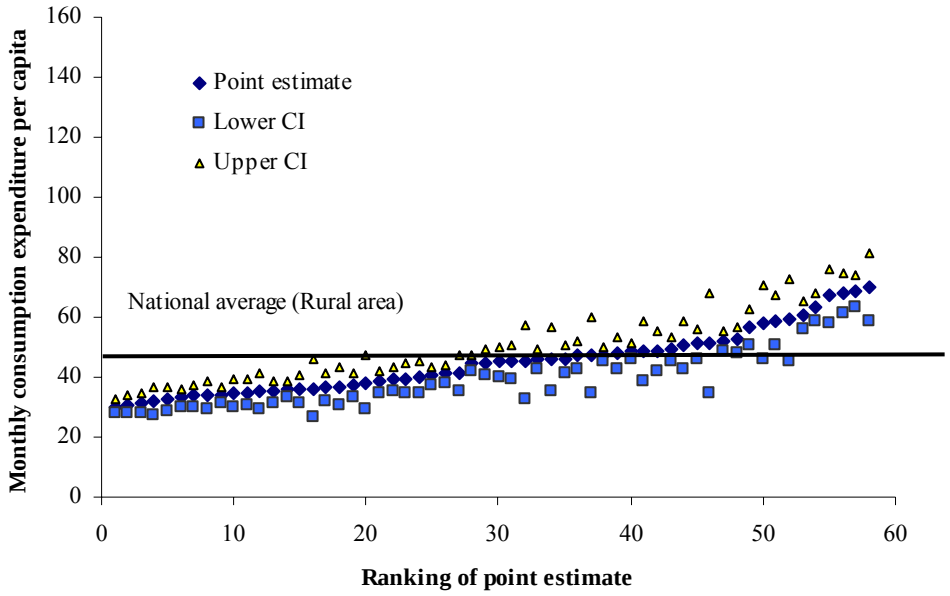


Figure C2: Distribution of monthly consumption expenditure by jamoat, rural area.

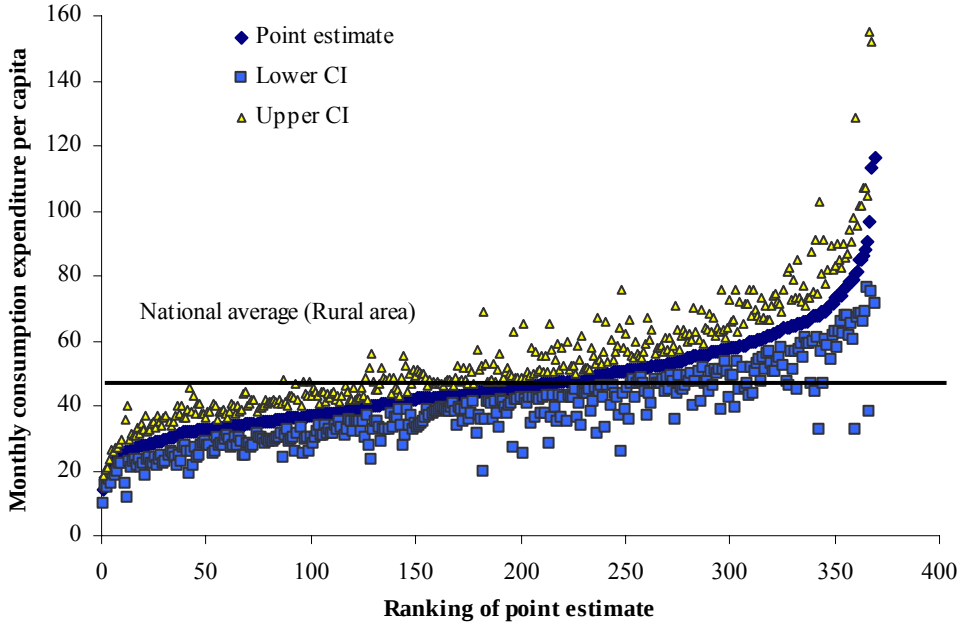


Figure C3: Distribution of monthly consumption expenditure in urban area.

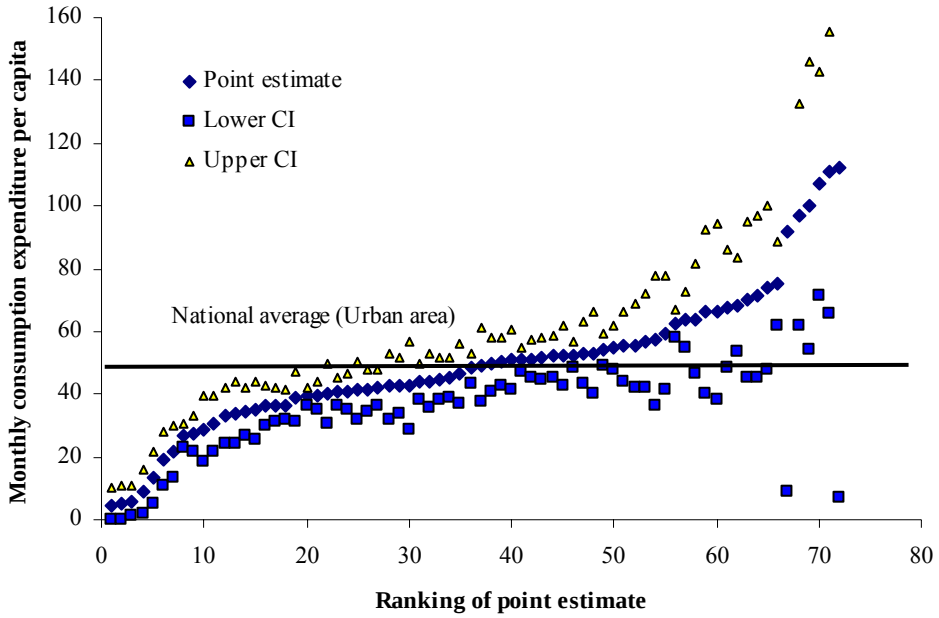


Figure C4: Distribution of headcount rate at rayon level, rural area.

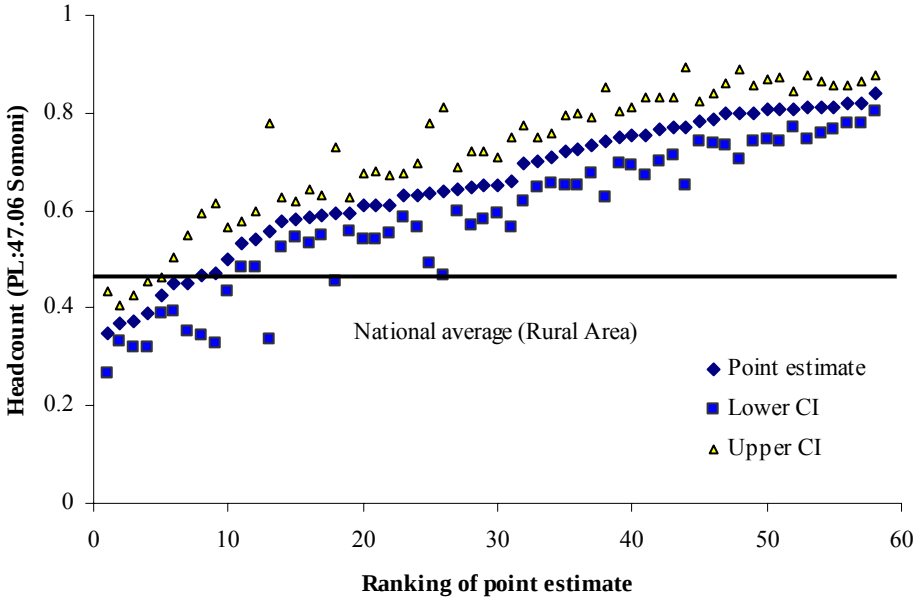


Figure C5: Distribution of headcount rate at jamoat level, rural area.

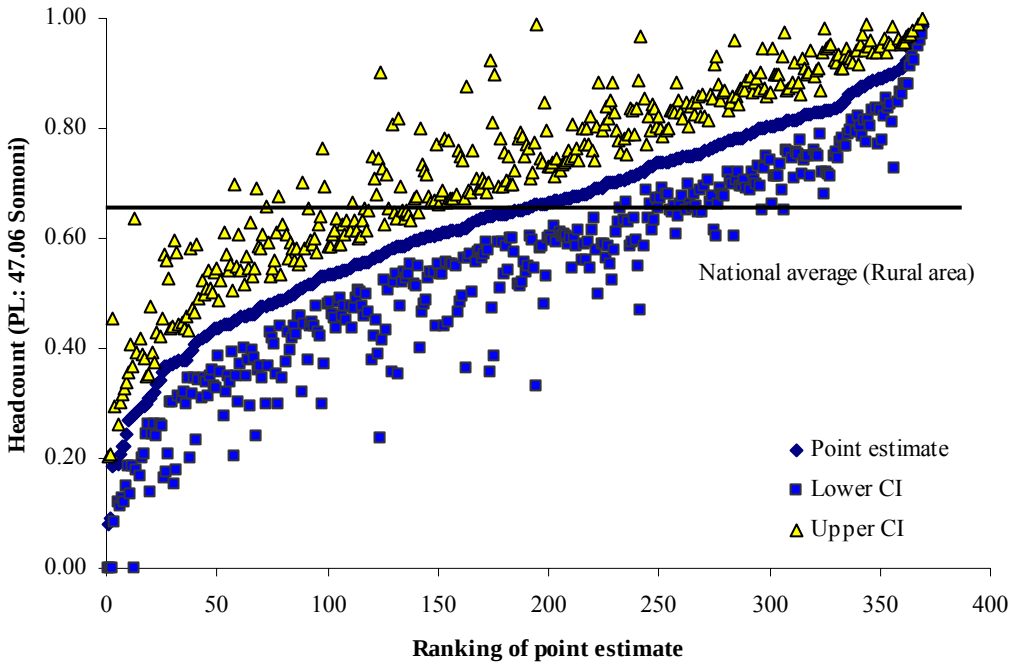
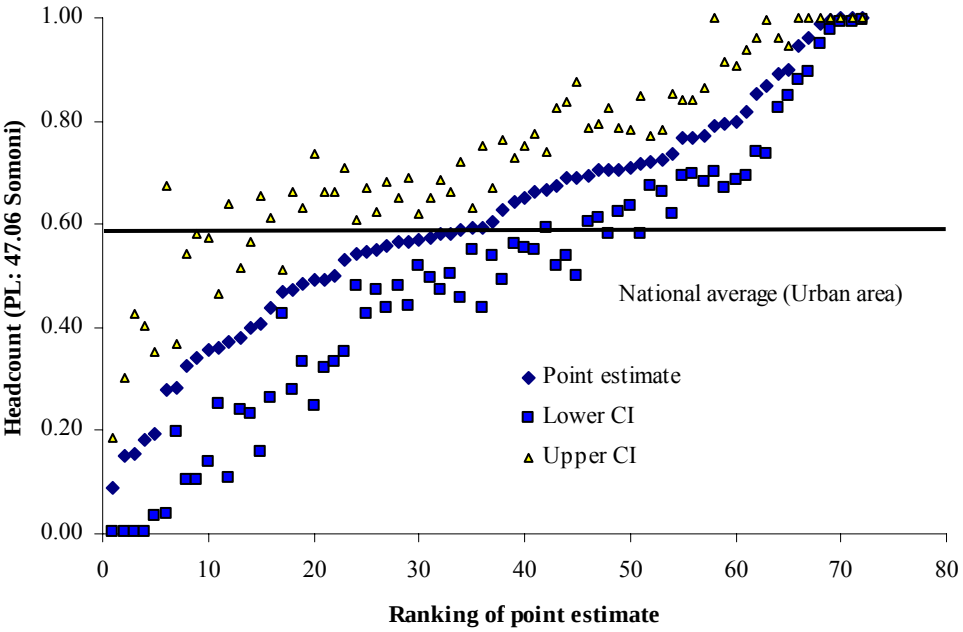


Figure C6: Distribution of headcount rate in urban area.



Appendix C:
Changes in the administrative structure from the 2000 Census of Tajikistan.
The following changes are as the September 2005.
Gbao region:

- In ИШКАШИМСКИЙ РАЙОН a new jamoat was set up: ПТУП
- In РОШТКАЛИНСКИЙ РАЙОН the jamoat ОКТЯЪРЬ has been renamed МИРСАИД МИРШАКАР
- In РУШАНСКИЙ РАЙОН the jamoat ВАХРУШАН has been renamed НАЗАРШО ДОДХУДОЕВ

Sogd region:

- The НАУСКИЙ РАЙОН has been renamed СПИТАМЕН РАЙОН
- There has not been any change in the numbers of name of the jamoat.

Khatlon region:

- The ВЕШКЕНТСКИЙ РАЙОН has been renamed НОСИРИ ХУСРАВ РАЙОН
- ГОЗИМАЛИКСКИЙ РАЙОН has been renamed ХУРОСОН РАЙОН

In this district the jamoat ОВИКИИК has been renamed ГАЛЛАОБОД

- ДЖИЛИКУЛЬСКИЙ РАЙОН has been renamed ГАРДИ ГУЛМУРОДОВ РАЙОН
- КАБОДИЁНСКИЙ РАЙОН has been renamed КУБОДИЁНСКИЙ РАЙОН
- МОСКОВСКИЙ РАЙОН has been renamed МИР САЙИД АЛИИ ХАМАДОНИ РАЙОН
- СОВЕТСКИИ РАЙОН has been renamed ТЕМУРМАЛИК РАЙОН
- ХОДЖАМАСТОНСКИЙ РАЙОН has been renamed АБДУРАХМОНИ ДЖОМИ РАЙОН
- In ЯВАНСКИЙ РАЙОН the jamoat НАВКОРАМ has been renamed ГУЛСАРА АБДУЛЛОЕВА

Dushanbe:

- ЖЕЛЕЗНОДОРОЖНЫЙ РАЙОН has been renamed ШОХМАНСУР РАЙОН
- ОКТЯБРСКИИ РАЙОН has been renamed ИСМОИЛИ СОМОНИ РАЙОН
- ЦЕНТРАЛЬНЫИ РАЙОН has been renamed ФИРДАВСИ РАЙОН
- ФРУНЗЕНСКИЙ РАЙОН has been renamed СИНО РАЙОН

RRS:

- КОФАРНИХОН РАЙОН has been renamed ВАХДАТ

In this district the jamoat КОФАРНИХОН has been renamed АБДУЛЛО АБДУЛВОСИЕВ
ХОДЖАБАЙКУЛ has been renamed РАДЖАБ ИСМОИЛОВ
ЭСКИГУЗАР has been renamed ДУСТИ
ЯНГИБАЗАР has been renamed БОЗОРБОЙ БУРУНОВ
ЛЕНИНСКИЙ РАЙОН has been renamed РУДАКИ РАЙОН

- ГАРМСКИЙ РАЙОН has been renamed РАШТСКИЙ РАЙОН

There are two new jamoat:

-АСКАЛОН

-ЯСМАН

- In РОГУНСКИЙ РАЙОН

There is a new jamot СИЧАРОГ

- ФАЙЗАБАДСКИЙ РАЙОН

There was a rural district center that now is a settlement of urban type

П. ФАЙЗАБАД

There is a new jamoat ЧАШМАСОР