REPOA *Brief*

RESEARCH ON POVERTY ALLEVIATION

CHANGES IN HOUSEHOLD NON-INCOME WELFARE INDICATORS - CAN POVERTY MAPPING BE USED TO PREDICT A CHANGE IN PER CAPITA CONSUMPTION IN TANZANIA OVER TIME?

BRIEF 4

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In recent years a technique has been developed to obtain generate poverty estimates for small geographical areas where the available data is not representative. This estimation method, in popular terms called poverty mapping, combines data sources of the population in total, with data from surveys of household income and consumption. A population wide census covers the entire population but only provides a limited amount of information, while data from household surveys provide detailed information, but only for of a limited sample.

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It is possible to obtain poverty estimates based on a household survey, however the level of disaggregation is limited by the survey's sample size. This means that poverty estimates based on the 1991 Household Budget Survey (HBS) for Tanzania are limited to Dar es Salaam, larger towns, small cities and rural areas. For the data collected during 2000/01, poverty estimates were generated for urban and rural areas for each of the regions. Using the small area estimation method (poverty mapping), the 2005 Poverty and Human Development Report (PHDR)[1] published the first attempt to obtain poverty estimates below the regional level for Tanzania, being at the district level[2]. To generate these estimates the 2000/01 Household Budget Survey was used in conjunction with the 2002 Population Census.

While the poverty mapping technique was originally developed to obtain poverty estimates at lower levels of spatial aggregation, it is can also being used to obtain estimates over time. The latter entails combining a survey with containing consumption information with other surveys at different points in time. The high costs involved in Household Budget Surveys limits the frequency of collecting information on household expenditure, making it appealing to use survey-to-survey poverty mapping to obtain poverty trends. The survey-to-survey small area estimation method was applied by the International Food and Policy Research Institute (IFPRI)[3] (2006) for Tanzania. This study combined the 1991/92 Household Budget Survey with four different Demographic and Health Surveys (DHS)[4].

The main assumption of the IFPRI approach is that '*the model for predicting income based on household characteristics is valid over a range of years covered by the DHS surveys*' (IFPRI 2006). This discussion paper assesses the validity of this assumption.

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[1] The Research and Analysis Working Group, (United Republic of Tanzania), *Poverty and Human Development Report 2005* (PHDR), Mkuki na Nyota, Dar es Salaam

[2] The 2002 Population and Housing Census had basic demographic information for the full 100% of the population, but more detailed population and household information was collected for a 20% sample. This led to just having poverty estimates at district level, and not as preferred at division or ward level.

[3] International Food and Policy Research Institute (2006), *Poverty and malnutrition in Tanzania*: *New approaches for examining trends and spatial patterns*, Total Design, Dar es Salaam

[4] In the IFPRI study the 1991/92 and the 1996 Demographic and Health Survey, the 1999 Reproductive and Child Health Survey and the 2003 Tanzania HIV/AIDS Indicator Survey were used. The last survey was not an actual demographic and health survey, but methodology, sampling, as well as basic questions were similar to the other surveys used.

THE NEED FOR CONSTANT BETAS

To assess trends in poverty using survey-to-survey poverty mapping, we need to have data over time for variables that are correlated with poverty. For example, if from the Household Budget Survey ownership of a radio was strongly correlated with household consumption, then we would want to be able to monitor changes in ownership of radios as a predictor for changes in household consumption expenditure. In order to be able to do so, the relationship between ownership of radios and household consumption expenditure should itself not change over time so that a change in consumption can be explained by a change in the ownership of radios. This assumption is undermined when the relationship changes between the ownership of radios and consumption. This could happen, for example, if there was a substantial drop in the price of radios.

To test the validity of this constant relationship (constant betas) in the IFPRI study, data from the Household Budget Surveys of 1991/92 and 2000/1, were used.

The next section elaborates the methodology used to test for changes in the relationship of a set of variables correlated with consumption that are generally used in poverty mapping. The correlates were tested independently, without controlling for other variables.

METHODOLOGY

- Data from the 1991/92 and 2000/01 Household Budget Surveys (HBS) were pooled and the variables involved were recoded in order to make them comparable.

- The per adult equivalent consumption obtained from the 1991 HBS was inflated with a factor 2.49 (National Bureau of Statistics, 2002), to compensate for the inflation in Tanzania between 1991 and 2000.

- A dummy variable was created, which was given the value '1' for observations from the 2000/01 HBS, and given the value '0' for observations from the 1991 HBS.

- The variables which correlated with the consumption expenditure were multiplied by the dummy variable mentioned above.

- For each of these variables regressions were run using:
  - Log transformed per adult equivalent consumption as a dependent variable[5].
  - As explanatory variables:

  - The dummy variable. This variable was included to detect differences in consumption levels between 1991 and 2000.

  - The variables that correlated with consumption.

  - The variables correlated with consumption multiplied by the dummy variable. These interaction terms took the original value for observations from 2000/01 and assigned zeros to observations from the 1991/92 dataset.

- The coefficients in the resulting regressions, betas, related to these variables indicated the following:

  – Beta (1) measured the differences in consumption levels between 1991 and 2000.

  – Beta (2) measured the extent of the relationship between the variable tested and consumption.

  – Beta (3) measured the additional effect of the tested variable for observations from the 2000/01 survey only, thus indicating possible differences in the variables' relationship with the dependent consumption variable that occurred between 1991 and 2000/01.

[5] In the rest of the document consumption will refer to log transformed per adult equivalent consumption.

RESULTS

The following tables (Tables 1A to C) provide an overview of the relationship between the different variables and consumption, together with the possible additional effect estimated from the HBS of 2000/01. The possible changes in parameter estimates (betas) were assessed for:

- Dar es Salaam (shown in Table 1A),

- Other Urban Areas (see Table 1B), and

- Rural Tanzania (Table 1C).

The analysis focuses on those variables also available from the Demographic and Health Surveys, since these surveys were conducted at regular intervals and were part of the pool of variables used by IFPRI (2006) in assessing changes in poverty from 1991 to 2003.

In Table 1A, Dar es Salaam, the parameter estimate for household size for 1991/92 and 2000/01 combined was statistically significant with a negative effect of 0.119 and with an additional significant positive effect of 0.017 for 2000/01. This means that by not taking into consideration the difference in beta this would lead to an increasing under-estimation of consumption as household size increased.

On the other hand, looking at Table 1B, Other Urban Areas, and 1C, Rural Tanzania, again without taking in consideration changes in betas, the consumption is increasingly overestimated for increasing household sizes.
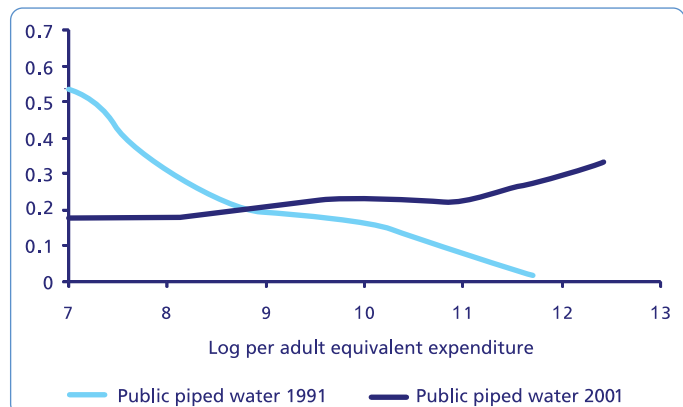
Figure 1A shows the relationship between household size and consumption for the two HBS surveys in rural areas.

Figure 1A Household Size by Log-transformed per Adult Equivalent Consumption Expenditure, Rural Areas

Log per adult equivalent expenditure

Household size 1991/92   Household size 2000/01
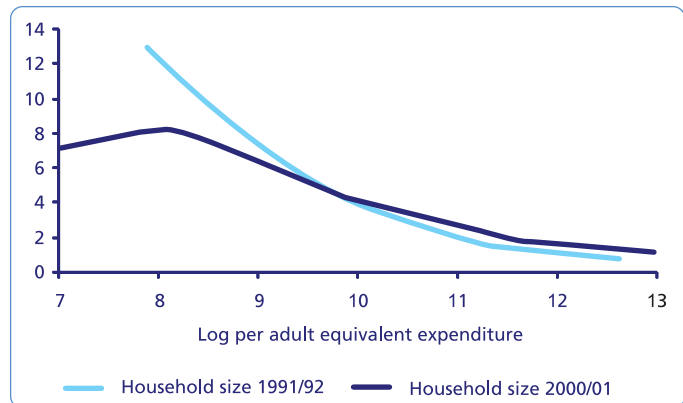
From Table 1C, the estimated relationship between access to public piped water and consumption differs significantly between 1991/92 and 2000/01, to the extent that the direction of relationship is reversed. Again, by not taking into account the change that has occurred in the nature of this relationship, and using only 1991/92 data, this will lead to the over-estimation of the consumption by those who did not have access to public piped water in 2000/01 and the under-estimation of the consumption by those with access to public piped water. This is clearly shown in Figure 1B.

Figure 1B Access to a Public Piped Source of Drinking Water by Level of Log-transformed per Adult Equivalent Consumption Expenditure, Rural Areas

Log per adult equivalent expenditure

Public piped water 1991   Public piped water 2001

Again in Table 1C the relationship between housing with a floor of earth and consumption differs strongly and significantly between 1991/92 and 2000/01, with a parameter estimate of –0.157 for both surveys combined, and an additional negative effect of this floor type of 0.222. This means that applying the parameter estimate from 1991/92 directly to 2000/01 data would result in over-estimating the consumption levels of households with an earth floor type. Figure 1C plots the relationship.

Figure 1C Housing with Floor of Earth by Log-transformed per Adult Equivalent Consumption Expenditure, Rural Areas

Log per adult equivalent expenditure

— Earth floor rural 1991/92   — Earth floor rural 2000/01
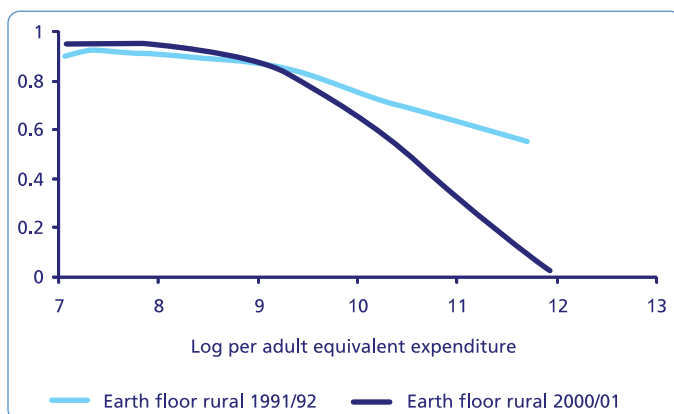
CONCLUSIONS

The three tables indicate that the assumption that, over the ten-year period examined here, there has been no change in the extent of the relationship between variables correlated with consumption and that consumption does not hold true in all cases. This is especially the case of the relationship between household size and consumption, which, within all strata examined, explains close to 30% of the variation in the log transformed per adult equivalent consumption. It is not known when these changes may have occurred - whether it was during the first part of the 1990s, the second part, or a gradual process; furthermore, due to a lack of consumption data for the mid 1990s this cannot be tested. What we can conclude is that predicting consumption expenditure and poverty levels beyond 2001, based on data from the 1991/92 household budget survey, provides an more uncertain result.

This is a preliminary assessment; the amount of consumption variation (R^2) explained by the independent variables has not been taken into consideration. However, we can conclude however that using variables that have a statistically significant relationship with consumption in 1991/92[6] (from Tables 1B-1C) in to estimating consumption beyond that time, without adjusting for the additional effects evident from the data for 2000/01, would likely lead to an over or under-estimation of consumption. We therefore suggest that any analysis using the results from this poverty mapping exercise is undertaken with caution until further work is done on this matter.

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[6] At a 10% level

Table 1A Modeling per Adult Equivalent Consumption Expenditure, Effects of Selected Correlates and Additional Effects of Correlates for 2000/01, Dar es Salaam

Variable	Parameter Estimate (Beta) 1991-2000/01 combined (A)	Significance Level (B)	Additional Effect Observed in 2000/01 (Change in Beta for 2000/01) (C)	Significance Level (D)
Household Size	-0.119	< 0.001	0.017	0.035
Household Size 1	0.827	< 0.001	-0.061	n.s.
Household Size 2-3	0.404	< 0.001	-0.341	< 0.001
Household Size 4	-0.066	n.s.	-0.017	n.s.
Household Size 5-6	-0.219	< 0.001	-0.036	n.s.
Household Size 7-9	-0.459	< 0.001	0.159	0.037
Household Size 10+	-0.737	< 0.001	0.131	n.s.
Age of Head of Household	-0.020	< 0.001	0.002	n.s.
Sex of Head of Household (Male)	-0.271	< 0.001	0.198	0.007
Education of Head of Household (in years)	0.027	< 0.001	0.030	< 0.001
Level of Education of Head of Household:				
- No education	-0.111	n.s	-0.437	< 0.001
- Primary	-0.066	n.s.	0.021	n.s.
- Secondary	-0.052	n.s.	0.135	0.065
- Post secondary	0.328	< 0.001	0.064	0.436
Education of Spouse (in years)	0.037	< 0.001	0.027	0.001
Level of Education of Spouse:				
- No education	-0.313	< 0.001	-0.151	< 0.001
- Primary	-0.052	n.s.	0.032	n.s.
- Secondary	0.167	0.019	0.199	0.034
- Post secondary	0.481	< 0.001	-0.032	n.s.
Private Piped Water	0.006	n.s.	0.224	< 0.001
Public Piped Water	-0.020	n.s.	-0.138	n.s.
Rainwater	-0.449	n.s.	0.163	n.s.
Water from Well	0.088	n.s.	-0.427	< 0.001
No Toilet	-0.042	n.s.	-0.075	n.s.
Flush Toilet	0.037	n.s.	0.263	0.004
Traditional Pit Latrine	-0.031	n.s.	-0.161	0.047
Ventilated Improved Pit Latrine	0.208	n.s.	0.065	n.s.
Earth Floor	-0.150	0.012	-0.338	< 0.001
Concrete/Ceramic Tile Floor	0.128	0.027	0.252	0.005
Electricity	0.114	0.007	0.072	n.s.
Radio	0.002	n.s.	0.197	0.003
Television	0.176	n.s.	0.107	n.s.
Refrigerator	0.143	0.081	0.179	0.052
Car	0.139	n.s.	0.290	0.049
Bicycle	-0.126	0.076	0.247	0.064

Table 1B Modeling per Adult Equivalent Consumption Expenditure,
Effects of Selected Correlates and Additional Effects of Correlates for 2000/01, Other Urban Areas

Variable	Parameter Estimate (Beta) 1991-2000/01 combined (A)	Significance Level (B)	Additional Effect Observed in 2000/01 (Change in Beta for 2000/01) (C)	Significance Level (D)
Household Size	-0.088	< 0.001	-0.012	< 0.001
Household Size 1	0.812	< 0.001	-0.200	< 0.001
Household Size 2-3	0.175	< 0.001	0.043	n.s.
Household Size 4	0.236	< 0.001	-0.265	< 0.001
Household Size 5-6	-0.371	< 0.001	0.215	< 0.001
Household Size 7-9	-0.470	< 0.001	0.036	n.s.
Household Size 10+	-0.390	< 0.001	-0.245	< 0.001
Age of Head of Household	-0.019	< 0.001	0.007	< 0.001
Sex of Head of Household (Male)	-0.047	0.0217	0.038	n.s.
Education of Head of Household (in years)	0.063	< 0.001	-0.008	0.005
Level of Education of Head of Household				
- No education	-0.406	< 0.001	0.025	n.s.
- Primary	0.068	< 0.001	-0.117	< 0.001
- Secondary	0.200	< 0.001	0.093	0.005
- Post secondary	0.315	< 0.001	0.042	0.360
Education of Spouse (in years)	0.057	< 0.001	0.009	0.025
Level of Education of Spouse				
- No education	-0.377	< 0.001	-0.085	0.007
- Primary	0.273	< 0.001	-0.148	< 0.001
- Secondary	0.291	< 0.001	0.062	n.s.
- Post secondary	0.374	< 0.001	0.034	n.s.
Private Piped Water	0.395	< 0.001	-0.114	< 0.001
Public Piped Water	-0.005	n.s.	-0.143	< 0.001
Rainwater	0.565	n.s.	-0.740	n.s.
Water from Well	-0.593	< 0.001	0.335	< 0.001
Water from Spring	-0.080	n.s.	-0.300	0.033
Surface Water	-0.271	< 0.001	0.247	< 0.001
No Toilet	-0.578	< 0.001	0.404	< 0.001
Flush Toilet	0.294	< 0.001	0.110	0.045
Traditional Pit Latrine	-0.016	n.s.	-0.282	< 0.001
Ventilated Improved Pit Latrine	0.649	0.002	-0.330	n.s.
Earth Floor	-0.471	< 0.001	0.120	< 0.001
Concrete/Ceramic Tile Floor	0.465	< 0.001	-0.119	< 0.001
Electricity	0.425	< 0.001	-0.005	n.s.
Radio	0.259	< 0.001	0.105	< 0.001
Television	0.267	0.001	0.200	0.013
Refrigerator	0.512	< 0.001	-0.081	n.s.
Car	0.468	< 0.001	0.029	n.s.
Bicycle	0.092	< 0.001	-0.074	0.005

**Table 1C Modeling per Adult Equivalent Consumption Expenditure,
Effects of Selected Correlates and Additional Effects of Correlates for 2000/01, Rural Areas**

Variable	Parameter Estimate (Beta) 1991-2000/01 combined (A)	Significance Level (B)	Additional Effect Observed in 2000/01 (Change in Beta for 2000/01) (C)	Significance Level (D)
Household Size	-0.065	< 0.001	-0.015	< 0.001
Household Size 1	0.650	< 0.001	0.048	n.s.
Household Size 2-3	0.394	< 0.001	-0.096	0.001
Household Size 4	0.123	< 0.001	-0.056	n.s.
Household Size 5-6	-0.118	< 0.001	-0.032	n.s.
Household Size 7-9	-0.293	< 0.001	-0.075	0.017
Household Size 10+	-0.404	< 0.001	-0.075	0.078
Age of Head of Household	-0.004	< 0.001	0.000	n.s.
Sex of Head of Household (Male)	-0.013	n.s.	-0.043	n.s.
Education of Head of Household (in years)	0.039	< 0.001	0.000	n.s.
Level of Education of Head of Household				
- No education	-0.185	< 0.001	-0.028	n.s.
- Primary	0.126	< 0.001	-0.038	n.s.
- Secondary	0.330	< 0.001	0.146	0.057
- Post secondary	0.473	< 0.001	0.139	n.s.
Education of Spouse (in years)	0.051	< 0.001	-0.020	< 0.001
Level of Education of Spouse				
- No education	-0.297	< 0.001	0.106	< 0.001
- Primary	0.259	< 0.001	-0.086	0.003
- Secondary	0.491	< 0.001	-0.082	n.s.
- Post secondary	0.555	0.053	-0.241	n.s.
Private Piped Water	-0.052	n.s	0.390	< 0.001
Public Piped Water	-0.170	< 0.001	0.201	< 0.001
Rainwater	0.518	n.s	-0.074	n.s
Water from Well	-0.001	n.s	-0.035	n.s
Water from Spring	0.115	< 0.001	-0.266	< 0.001
Surface Water	0.094	< 0.001	-0.093	0.005
No Toilet	-0.045	n.s.	-0.160	< 0.001
Flush Toilet	-0.159	n.s.	0.971	< 0.001
Traditional Pit Latrine	0.056	0.097	0.060	n.s.
Ventilated Improved Pit Latrine	-0.074	n.s	0.323	0.075
Earth Floor	-0.157	< 0.001	-0.222	< 0.001
Concrete/Ceramic Tile Floor	0.224	< 0.001	0.173	< 0.001
Electricity	0.144	0.021	-0.001	n.s.
Radio	0.217	< 0.001	-0.008	n.s.
Television	0.184	n.s	0.203	n.s
Refrigerator	0.551	0.039	0.341	n.s.
Car	0.328	0.020	0.282	n.s.
Bicycle	0.053	0.023	0.018	n.s

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