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Collecting High Frequency Panel Data in Africa Using Mobile Phone Interviews

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Abstract

As mobile phone ownership rates have risen in Africa, there is increased interest in using mobile telephony as a data collection platform. This paper draws on two pilot projects that use mobile phone interviews for data collection in Tanzania and South Sudan. The experience was largely a success. High frequency panel data have been collected on a wide range of topics in a manner that is cost effective, flexible (questions can be changed over time) and rapid. And once households respond to the mobile phone interviews, they tend not to drop out: even after 33 rounds of interviews in the Tanzania survey, respondent fatigue proved not to be an issue. Attrition and non-response have been an issue in the Tanzania survey, but in ways that are related to the way this survey was originally set up and that are fixable. Data and reports from the Tanzania survey are available online and can be downloaded from: www.listeningtodar.org.

Collecting high frequency panel data in Africa

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1. Introduction

Timely, high quality information about well-being, service delivery, income, security, health and many other topics is not readily available in Africa. One reason why this is the case is because such data are typically collected by nationally representative, face-to-face household surveys. Such surveys are expensive and time-consuming and are, for this reason, not implemented very frequently.

Needless to say that there is huge (latent) demand for up-to-date welfare information, and the provision of such data should be an essential cornerstone of any modern statistical system. Decision makers need timely data to monitor the situation in their country. How else can they know, for example, whether reports about a looming crisis are overblown extrapolations based on (newspaper) stories, or signs of an emerging disaster? Statisticians too, will benefit from more frequent information, for instance to estimate changes in employment or to validate GDP estimates with farmer-based crop forecasts and price information. Program managers, too, stand to benefit from rapid feedback on the success of their activities, while civil society can put representative information on service delivery to good use by demanding better services or improved policies.

The scientific community could equally take advantage from high frequency panel surveys. Their availability opens a new field of research and offers opportunities to assess the trajectory of effects in impact evaluations. It would also offer opportunities to make impact evaluations more efficient. McKenzie (2012), for instance, argues that when outcome measures are relatively noisy and weakly auto-correlated, such as is the case with business profits, household incomes and expenditures, and episodic health outcomes, impact evaluations that use smaller samples and multiple follow-ups are more efficient than the prototypical baseline and follow-up model.

This paper presents an approach to collect a wide range of data related to household welfare at high frequency and at low cost. The approach combines a standard baseline survey with regular interviews (weekly, every two weeks, monthly) conducted over the mobile phone. During the mobile phone interview a wide range of questions can be asked, including questions that are comparable to those asked in the baseline (to track changes) or questions never asked before to collect data on emerging issues.

This paper is not the first to suggest that a mobile phone platform can be used to collect high quality panel data. Brian Dillon (2009) for instance, used mobile phones to carry out 14 rounds of interviews (every three weeks) to track how farmer expectations of their upcoming harvest change with time. This paper draws from two mobile phone panel surveys one implemented in South Sudan and the other in Dar es Salaam, Tanzania. Of these, the survey in Tanzania has been running longest (33 rounds to date), while the survey in South Sudan is the one that operates under the more difficult conditions. These two surveys –though quite successful in their own right, are pilots for a much bigger initiative. The Africa Region in the World Bank intends to roll out mobile phone panel surveys to a large number of countries in Africa in an exercise that data users refer to as 'Listening to Africa' and data producers as 'Meeting the high frequency data challenge'.

The structure of the paper is as follows. In section 2 we explain how mobile phone surveys work. Section 3 discusses the Listening to Africa initiative, following which section 4 presents some results from mobile phone panel surveys in Tanzania and South Sudan. Section 5 discusses non-response and attrition, while section 6 discusses the representativeness of the Tanzania survey. Section 7 talks about other aspects of data quality. Section 8 discusses experiences with data dissemination and their use for accountability purposes, drawing particularly from the Tanzania experience. Section 9 discusses the costs of mobile phone surveys after which conclusions are presented in section 10.

2. Mobile phone surveys

Conducting surveys by phone is standard practice in developed countries, but has typically not been done in poor countries because phone ownership rates are too low (especially in the pre-mobile phone era). In Tanzania, for example, just 1% of households own a landline phone (DHS 2010). However, the rapid rise of mobile telephony in Africa has changed this. In Tanzania, mobile phone ownership increased from 9% of all households in 2004-05, to 28% in 2007-08. By 2010, this number had almost doubled again, to 46% of households. [2] Unsurprisingly phone ownership is particularly high in urban areas: it is was 28% in 2004-05, increased to 61% in

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[2] This figures are from the 2004/5 DHS, the 2007-08 Tanzania HIV/AIDS and Malaria Indicator Survey and the 2010 DHS.

2007-08 and reached 78% by 2010. In the baseline survey for the mobile phone survey in Dar es Salaam, mobile ownership was found to be as high as 83%.

Cell phone ownership is widespread, and also poor households have access to mobile phones. In Tanzania, again, one in every three households in the poorest wealth quintile owns a mobile phone (Figure 1).

Figure 1: Cell phone ownership in Tanzania in 2010/11, by wealth quintile
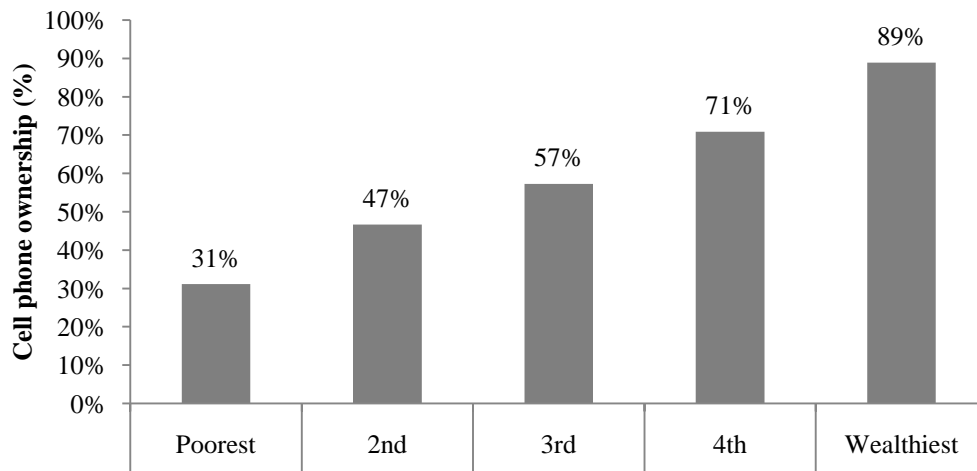
Source: Tanzania National Panel Survey 2010/11.

In Kenya, the Sub-Saharan country that is leading in terms of mobile phone ownership, the Afrobarometer survey of November 2011 shows that households own on average 2.4 mobile phones and that 80% of Kenyan adults have their own mobile phone. Phones are actively used: only 7% report that they never use a mobile phone while 81% make at least one daily call using their mobile.[3]

With such high rates of mobile phone ownership, representative household surveys using mobile phones become an option. Phone ownership rates above 80% are at or beyond the threshold at which reliable survey research can be conducted: for example, only 80% of US households own a landline, but political polling typically uses landline samples only. The point estimates

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[3] 61% send or receive a text message at least once a day and a remarkable 23% sends or receives money or pays a bill via mobile phone at least once a day.

provided by these surveys are widely considered reliable when corrected by re-weighting.[4] This suggests that phone ownership in Kenya or in urban Tanzania is already high enough for reasonable inferences to be made from surveys that exclusively rely on mobile phones. In many rural settings, mobile phone surveys could equally be used provided one ensures that a representative sample owns or has access to a mobile phone. This is affordable as reliable phones can be bought for $20 or less, so that respondents selected for participation in a mobile phone survey and who do not own a phone, can be given one. Only respondents living in areas not covered by a mobile phone signal would be left out of such surveys, but even these respondents could be included if, for instance, use was made of a local enumerator who visits the respondents, collects their responses and then finds a place with a cell phone signal to relay the responses to the survey administrators.

Another reason to consider using mobile phones for household surveys is because mobile phone interviews have been found to produce quality data. Lynn and Kaminska (2011) investigated whether data collected through interviews using mobile phones differs from data collected using landlines. They started by identifying four reasons why the quality of data collected using mobile and fixed phone interviews might differ: line quality, the extent of multi-tasking amongst survey respondents, the extent to which survey respondents are distracted from the task of answering questions, and the extent to which other people are present and able to overhear what the survey respondent is saying. The authors evaluated the extent to which differences in these features affect survey measures by analyzing data from a randomized experiment. In the experiment, a sample of people who had both mobile and fixed phones were randomly assigned to be interviewed either on their mobile phone or on their fixed phone. They found only few and small differences in survey measures between mobile phone interviews and fixed phone interviews. The few differences that were found suggest that data quality may be higher with mobile phone interviews. This they attribute to survey respondents having greater control over whether other people are within earshot and whether others can listen in from another line. When other people can hear the responses being given – which may be more likely when responding on a fixed line

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[4] Blumberg et al, "Wireless Substitution: Early Release of Estimates from the National Health Interview Survey, July-December 2008." Atlanta, GA: Centers for Disease Control. For an example of a reputable survey firm applying these approaches see: http://www.ipsos-na.com/download/pr.aspx?id=11397.

– respondents may have a tendency to censor their responses to avoid socially undesirable answers.

One aspect to be aware of is that mobile phone panel surveys, that give phones to respondents and that incentivize respondents with call credit after the completion of an interview are, by their very nature, an intervention. Particularly for respondents that did not own a phone prior to participation on the survey, their ability to access information and to connect with others changes significantly. Moreover, all respondents are asked to consider aspects of their lives and state facts or opinions about it at a frequency that is much higher than in ordinary (panel) surveys. In future research we intend to explore the degree to which this empowers respondents and changes their behavior. A randomized experiment in which some respondents in the baseline participate in the mobile phone panel and others don't, followed by a second face-to-face interview a year later, would be a good way to assess the impact of participation in a mobile phone panel survey.

3. Listening to Africa

There are two ways to set-up a representative mobile phone panel survey. One approach exclusively relies on mobile phone interviews and creates a representative sample by calling potential respondents to assess their core characteristics (location, gender, age, education, wealth etc.) and their willingness to participate in the survey. This requires high mobile phone penetration rates and the availability of a data base of telephone numbers from which an unbiased sample can be drawn. Another, more conventional approach does not exclusively rely on phone interviews but combines face-to-face interviews during a baseline survey with mobile phone interviews.

Both approaches are feasible but with the current penetration rates of mobile phones (particularly in rural areas and amongst poor households), Listening to Africa prefers the second approach that makes use of a baseline survey. This baseline will often be a new survey, but it could be that households from an existing survey are revisited. The latter may seem a good way to reduce cost but as households need to be revisited in any case, to select the respondent (Listening to Africa aims to create representative samples of the (adult) population thus necessitating the random identification a respondent within the household), to obtain permission for participation, to familiarize respondents with the mobile interview and to agree on a good time for phone

interviews, the cost advantage of using an existing survey is likely to be small. The baseline survey is also the time to distribute phones and, in locations with limited access to electricity, solar chargers. Alternatively, a village kiosk owner who provides phone charging services could be contracted to offer free phone charging to participating households.

Mobile phones offer a multitude of opportunities to obtain feedback. Life interviews carried out by a mobile phone enumerator is one way. SMS, WAP, IVR and USSD are other approaches.[5] Listening to Africa intends to collect its data using life interviews, whereby enumerators in a call center call respondents, ask the relevant questions and enter the responses into a database using a CATI (computer aided telephone interview) system. The decision to rely on call centers for mobile phone data collection is informed by experiences with WAP, IVR and USSD in the early stages of the Dar es Salaam mobile phone survey. The flexibility life interviews offer to conduct interviews in different languages, to vary questions from one round to the next, the ability to ask complex questions (which may require explanation), the possibility to accommodate illiterate respondents and respondents owning low end phones without internet connectivity, makes life interviews the technology of choice for most of sub-Sahara Africa. Moreover, good enumerators can build rapport with the respondent, supervisors can re-call (instead of revisit) respondents for quality control purposes, and life interviews offer the opportunity to ask in-depth (qualitative) questions if this were desired.

Reliance on voice to collect data does not mean that other opportunities offered by mobile phones remain unexploited. Respondents can be alerted that an interview is due through SMS, and following the successful completion of an interview, respondents can receive phone credit that is transferred directly to their mobile phone. Another way to motivate respondents is by keeping them informed about how data they provided is being used: in Tanzania, for instance, respondents are notified by SMS when newspapers report stories based on information provided by the respondents.

Listening to Africa is not only about collecting quality data. It embraces open data principles and is committed to releasing all (anonymized) data within four weeks of its collection. Where possible, Listening to Africa will integrate its data collection into national statistical systems and

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[5] Smith et al. (2011) provide an overview of different ways to gather data using mobile phones.

work with national steering committees to oversee data collection, dissemination and the identification of questions. More information about these or other aspects of Listening to Africa can be obtained from the corresponding author. Finally by implementing mobile phone panel surveys in many countries in Africa, Listening to Africa aims not only data that is country specific, it equally intends to collect comparable data that allows cross country comparisons.

4. Selected results from the Tanzania and South Sudan mobile phone panel surveys

The mobile phone survey in South Sudan revisited, late 2010, 1,000 respondents in 10 urban areas covered in 2009 by the National Baseline Household Survey. During the revisit respondents were identified, mobile phones were handed out (half of them with integrated solar chargers) and agreements were reached when respondents could best be called. Respondents were called on a monthly basis using a call centre operating from Nairobi using interviewers capable of speaking South Sudan's main languages. Respondents who successfully completed an interview were rewarded with an amount varying from $ 2 to $ 4.

The survey in Tanzania visited in August 2010, 550 households in Dar es Salaam, administered a new baseline survey, randomly selected an adult respondent from the household roster to be included in the mobile phone panel, and called respondents on a weekly basis (25 rounds), and later (8 rounds) every two weeks. The survey in Dar es Salaam did not distribute phones. Only recently after round 33, have some phones been distributed to selected respondents. Respondents were rewarded with phone credit varying between $ 0.17 to $ 0.42 per successful interview.[6] Both surveys are still running.

The mobile phone survey interview format does not appear to pose major limitations on what can be asked, except that the length of an interview should probably not be more than 20 – 30 minutes (Dillon's interviews lasted 27 minutes on average; interviews in the Dar es Salaam survey are generally somewhat shorter). So an elaborate consumption module or a detailed health module with birth histories are less suited for this type of survey.[7] Mobile phone surveys in South Sudan and Tanzania collect information on a wide variety of issues including on health,

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[6] Remarkably in both Sudan and Tanzania the amount of the reward did not have a discernable impact on response rates (see Table 1 for evidence from Tanzania).

[7] This raises another issue for future research: whether it is possible to track changes in consumption by using poverty mapping techniques (Elbers, Lanjouw and Lanjouw 2002) with a set of correlates that is more sensitive to changes in consumption levels than assets which is currently used in poverty mapping.

education, water, security, nutrition, travel times, prices, electricity and governance. The surveys have been used to ask perception questions on topics varying from what respondents considered the most pressing problems to be addressed by the city government to opinions about the draft constitution. They have also been used to collect baseline information for a large scale program on food fortification. One of us, Kevin Croke, used the panel to collect additional data for a research paper, when it turned out that the baseline survey lacked some variables needed to answer a particular research question.

Figure 2: In the last month, how often if ever, have you or a member of your household gone without enough food to eat?
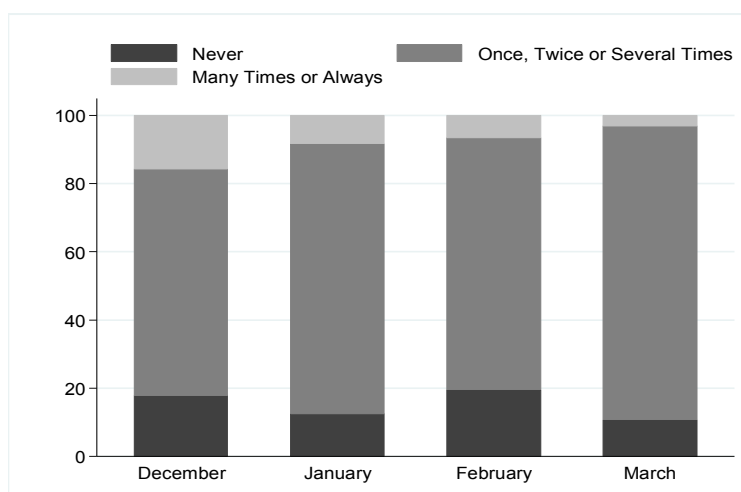

Source: South Sudan mobile phone survey, 2010-11

Data collected by the mobile phone survey can easily be used to report on a single issue (e.g. only one in ten households did experience power cuts during the seven days prior to the interview) but becomes of greater interest when the same information is tracked over time. For instance, Figure 2 shows how food security in South Sudan improved between December 2010 and March 2011.

By combining information collected during the (short) mobile phone interviews with the more elaborate information collected in the baseline more meaningful results are obtained: below results are disaggregated by wealth quintile, using an indicator that was constructed using asset information collected during the face-to-face interviews of the baseline survey. Such information

can be useful to monitor the distributional impact of large scale programs, or to track well being of the poorest in a society during a crisis.

**Figure 3: In the last week, did your child receive any homework?**
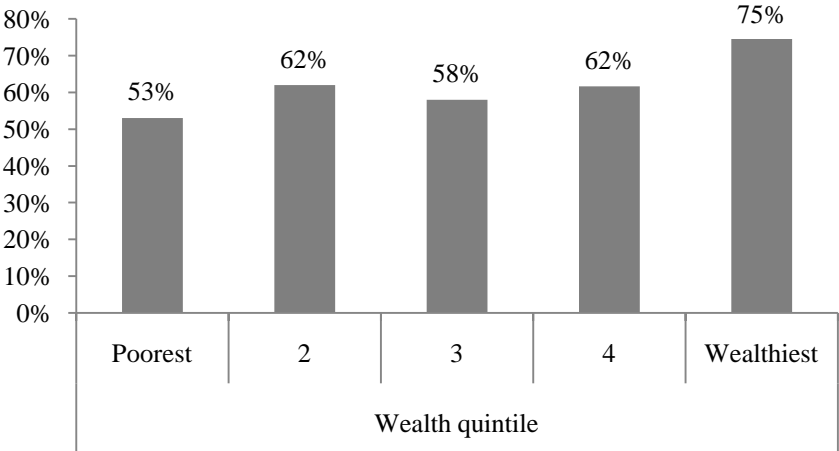
Because questions can be changed every round of the survey, it is possible to accommodate new data requests or to respond to emerging issues. After Dar es Salaam was hit by major floods in December 2011 for instance, the mobile phone survey asked questions to estimate the fraction of people that had been affected, finding that almost 7 percent of households had been forced to leave their home. Had the sample size been somewhat larger, it would even have been possible to estimate the percentage of affected households that received assistance from the government, proving real time impact on an important and salient government activity.

A recent innovation that has been successfully tried in the Dar es Salaam survey is to ask the respondent to pass the phone to someone else in the household, for questions that cannot be answered by the respondent. Figure 5, for instance, presents responses to questions asked to children attending primary school about the presence of their teacher and the use of books while at school.

Figure 4: Questions asked early January 2012 in response to the December floods in Dar es Salaam
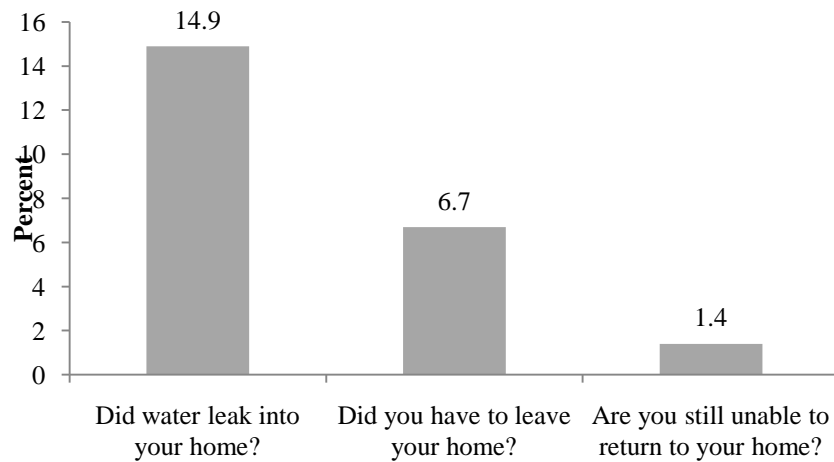
Source: Tanzania mobile phone survey, 2012

Figure 5: Questions asked to primary school children about teacher presence and use of books while in school
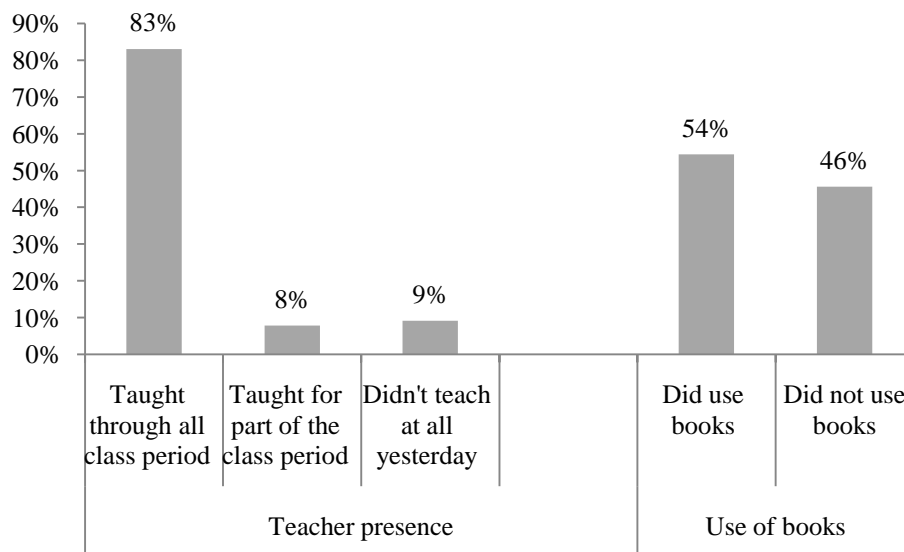
Source: Tanzania mobile phone survey, 2012

Other, as yet untried approaches can be imagined. For instance tried yet, mobile phone interviews can be used to ask screening questions to identify respondents who qualify for in-

depth interviews. In this way, qualitative and quantitative research methods can be integrated seamlessly. Or selected respondents can be asked to carry out specific monitoring tasks. What are the prices of certain goods, how much rain fell during the past week, is the water source in the village functioning or are specific drugs available at the health facilities. The possibilities are many.

5. Non-response and attrition

A key challenge for high frequency mobile phone panel surveys is non-response (a respondent participates in some but not all rounds) and attrition (a respondent drops out of the survey completely). Attrition and non-response are challenges for all panel surveys, but may be particularly an issue for mobile phone panels due to the number of times respondents are invited to participate in an interview.

In this section we rely on data from the Tanzania survey as this is the longest running mobile phone panel. In considering this survey it is important to realize that when this survey was initiated by Twaweza (one of us, Johannes Hoogeveen worked at Twaweza at the time), a main objective was to explore which technology would be most suited for a nationally representative mobile phone survey and to identify the systems needed to collect, process, analyze and disseminate survey data on a weekly basis. It explains why no mobile phones were distributed and why households without a mobile phone were allowed to drop out of the mobile part of the survey. Bearing this in mind, there is much that can be learned from this survey.

During the Tanzania baseline, households were assigned one of four technologies: Interactive voice response (IVR), USSD (an approach allowing direct transmission of questions from a phone company server to the respondent's phone; this technology also works on low-end phones), WAP (web-based mobile phone surveys, suited for high-end phones with internet capability) and voice (a call centre).[8] Following the baseline and during the first 7 rounds of the mobile phone panel there were numerous problems with the different technologies: the fraction of respondents owning internet enabled phones turned out to be very low (eliminating WAP), support from the phone company to run USSD was minimal (especially once mobile banking started to claim the available bandwidth), IVR turned out to be clumsy as questions had to be

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[8] Because of its limitations SMS was not considered.

broken down to avoid too many response options. Voice did not have any of these drawbacks. Hence after a relatively short period of time, life phone interviews became the technology of choice and all those who were reachable and had access to a mobile phone were put through a basic call centre which consisted of a group of enumerators who each had multiple phones (one for each phone network allowing cheaper within network calls) and a computer with a standard data entry screen.

Figure 6: Number of respondents per round (starting round 8)
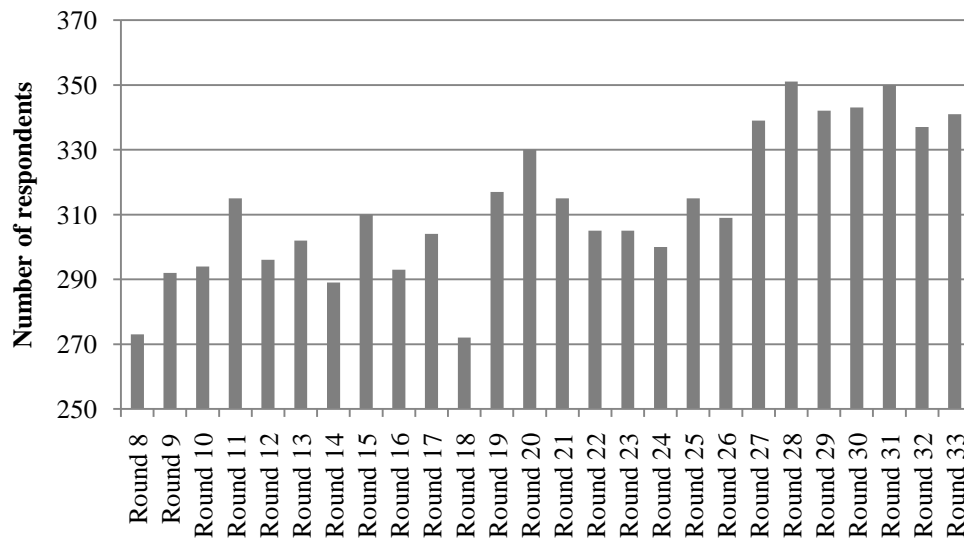
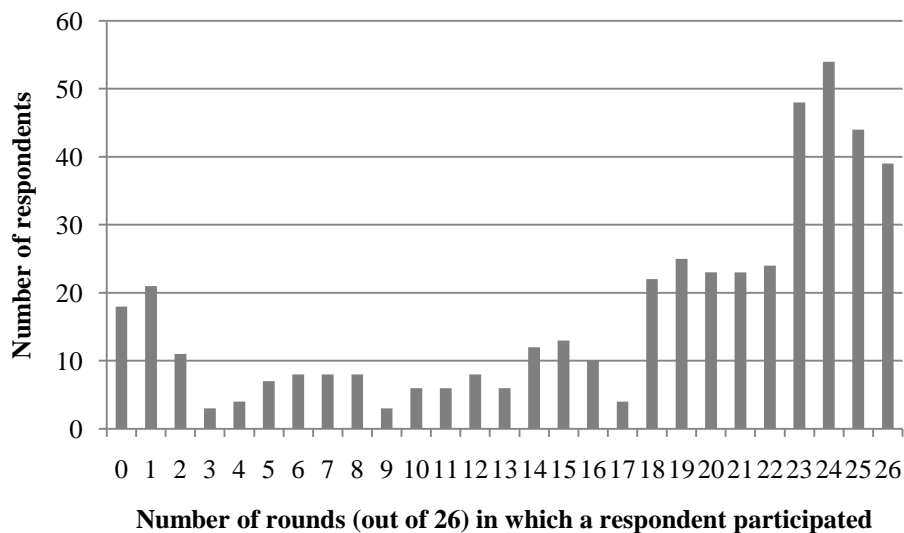**Source: Tanzania mobile phone survey, 2012**

Following this decision the survey ran for another 18 weekly rounds before it was discontinued by Twaweza.[9] Management of the survey was then transferred to the World Bank who had indicated interest in using the survey to generate feedback for its own programs. The World Bank appointed consultants who were tasked with identifying questions and making the anonymized data publicly available. Consultants were also facilitated to prepare and publish (independent) reports on the findings (Kevin Croke one of the co-authors is the lead consultant). The original survey firm, DataVision, was contracted to continue to carry out the mobile phone interviews, and after a gap of four months the survey was restarted. Under this new arrangement

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[9] Based on the experience with mobile phone surveys in Dar es Salaam, Twaweza is currently in the process of setting up a nationwide mobile phone survey.

interviews were conducted every two weeks. At the time of writing (February 2012) 7 rounds had been completed.[10]

So what does the Tanzania mobile phone survey tell us about attrition and non-response? On the negative side, there was a large initial burst of attrition. This can largely be attributed to the fact that the survey team did not hand out phones. When the team initially visited and administered the baseline survey to 550 respondents, it was found that 418 of them owned a phone, 69 had a household member who owned a phone, 6 could access a phone through a friend and 57 had no phone or access to a phone. Obviously, owning a phone is different from using someone else's phone and when the mobile phone survey switched exclusively to life interviews in round 8, it was assessed that 458 respondents could realistically be reached.[11]

Figure 7: Number of rounds respondents participated in the 26 rounds of the Tanzania mobile phone survey

Source: Tanzania mobile phone survey, 2012

Between round 8 (when the mobile phone panel began in earnest) and round 26 (before the survey was transferred to the World Bank) an average of 304 respondents, or 66%, participated

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[10] Reports and data produced, including the baseline data can be obtained from: http://monitor.public-transparency.org/

[11] Some respondents could not be reached either because their numbers had been captured incorrectly, or because they never seemed to have their phones on.

in the survey. After the survey had been put under World Bank management and oversight was tightened (but after a four months gap in interviews!) the number of respondents increased to 343 (75% of the sample).

So after 33 rounds of mobile interviews, the overall non-response rate is 25% of the 458 households in the sample that had access to phones. The rate of attrition, defined as those amongst 458 who did not respond at all to the mobile phone panel is much lower: only 4% or 18 out of the 458 households never responded to a request for a mobile phone interview.

While we are not aware of comparable cases involving mobile phone panels, the rate of non-response and attrition appear comparable to what has been attained by a number of non-mobile phone (i.e. face-to-face) panel surveys. For example, the Cebu Longitudinal Health and Nutritional survey in Philippines had almost 66% attrition (Miguel et al. 2008), while Alderman et al. (2001) note that the Bolivian Preschool Pre-School Program Evaluation Household Survey had 35% attrition. The Kenya Ideational Change survey had 28% attrition for women (and 41% for couples), over a two year interval. Panel surveys that revisit respondents after extended intervals often have relatively high attrition; for example the Kagera Health and Development Survey lost 31% of their respondents between 1994 and 2004. However, specially designed panels such as the Indonesia Family Life Panel or the Kenya Family Life panel, which place high priority on minimization of attrition (though tracking of migrants, for example), have achieved much lower attrition rates: the Indonesia panel attrition rate was only 9%-13% over 4 separate survey waves (Thomas et al. 2010), while the Kenya Life Panel Survey had 17% attrition over seven years (Miguel et al. 2010), and the South Africa KIDS survey had 16% attrition over 5 years. Dillon (2010) achieved an attrition rate of 2%. Over shorter periods of time (comparable to our survey's 1-2 year period), many recent randomized controlled trials have managed to track the vast majority of their beneficiaries from baseline to follow up.[12]

If one takes into account that there was a considerable time lag between the baseline survey and the start of the mobile phone interviews and another four months lag when management of the survey was transferred to the World Bank, the rate of non-response and attrition is not only relatively low, there is ample room for improvement. Distributing phones and enhanced

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[12] See Duflo, Glennerster, and Kremer, "Using Randomized Experiments in Development Economics Research: A Toolkit", section 6.4 for a discussion of attrition issues in randomized controlled trials.

enumerator and respondent training should make it feasible to largely avoid the initial reduction in the sample from 550 to 458. Distributing solar chargers, for instance to those with limited access to electricity would enhance response rates further: for instance those with access to electricity answered on average in 18.6 rounds versus 16.4 for those without access to electricity. Even the choice of phone provider seems to matter, as those using the premium network respondent significantly more often (20.1 times) than those using any of the other networks (16.9 times).

6. Is the Tanzania mobile phone panel survey representative?

Attrition and non-response are particularly problematic when they occur in a non random manner. If attrition is truly random, then the representativeness of the post-attrition sample is comparable to that of the baseline sample, meaning that while sample size has decreased (and standard errors have increased), the point estimates of the follow up survey are still unbiased estimates of the true population mean. If attrition and non-response are *non-random* and are associated with observable characteristics of respondents which have been recorded in the baseline survey, then it is also a manageable problem, and can be addressed by re-weighting the remaining respondents by the inverse of the probability of attrition.[13] A final possibility is that attrition is non-random but associated with *unobservable* characteristics of respondents. In this case, attrition is quite harmful to the representativeness of the survey: since attrition is based on unobservable characteristics, the survey sample cannot be reweighted according to these (unknown) characteristics.[14] This is certainly possible in our survey, as in any panel survey, but it is essentially an non-testable assertion. The question that we address here is whether, given the sizeable attrition and non-response in the Tanzania mobile phone survey (at least in comparison to the baseline), the Tanzania panel can still be considered representative. Given our detailed baseline survey, we use regression analysis to assess whether attrition is closely linked to observable demographic and behavioral characteristics, or whether it appears to be largely random.

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[13] Alderman et al (2001) suggest that even where attrition is non-random, key parameter estimates are often not affected, using examples from Bolivia, Kenya, and South Africa. Fitzgerald et al (1988) draw similar conclusions from the US-based Panel Survey on Income Dynamics, as does Falaris (2003) with respect to surveys in Peru, Cote-D'Ivoire and Vietnam (cited in Thomas et al 2010.)

[14] Frankenberg et al al and Beegle, DeWeerdt, and Dercon 2008 suggest that attrition in developing country settings is likely to be related to unobservable traits, in part because attrition is often linked to migration.

Table 1 presents regression analysis of the determinants of attrition. In the three regressions presented below, the dependent variable is the number of rounds (out of 25) in which the household participated.[15] Column one presents a model including all 550 households visited in the baseline. In this model, economic status is a significant predictor of survey participation: households without a phone, those using non-premium phone providers and those in the second poorest income quintiles are significantly less likely to participate relative to households of median wealth.

Unsurprisingly for a survey that did not distribute mobile phones, wealth is found to be correlated with survey participation. In column two, when we restrict the regression to households that were identified as reachable in round 8, we find that the impact of wealth largely disappears. In this regression, location (living in rural Dar es Salaam) and using the premium provider remain significant variables.

In column 3, finally, the model is altered to include information about whether the respondent could be reached when the mobile survey started to exclusively use life interviews (during round 8). Not being reachable may reflect a lot of aspects: phone network, access to electricity, phone habits as well as issues related to enumeration. This specification is included to show that if this mobile phone survey had been able to avoid having 'unreachable' respondents at the start (through better training and protocols for instance) the remaining sample would have been representative, as no other variables show up as significant. Other observations from these regressions worth noting are that years of education, gender and even the amount given as reward do not explain non-response.

The message we take from these regressions is that with phone distribution and by paying more attention to ensuring a smooth transition from inclusion in the baseline to inclusion in the mobile survey, non-response could have been significantly reduced.

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[15] As will be explained later, in the third regression round 1 is used to determine persistence in non-response. To avoid autocorrelation, this round is omitted from the sum of rounds in which the household participated.

Table 1: Three OLS regressions on participation in the mobile phone survey. Dependent variable is the number of times a respondent participated in the last 25 survey rounds

	Regression 1	Regression 2	Regression 3
D-unreachable in round 1			**-9.63266**
			-15.5
D-male	-1.176	-0.017	-0.315
	-1.5	*0.0*	*-0.5*
D-owns phone	**6.003**	1.468	0.792
	6.3	*1.4*	*0.9*
Age	-0.008	-0.017	-0.012
	-0.3	*-0.6*	*-0.6*
Years of schooling	0.048	0.031	0.166
	0.4	*0.2*	*1.6*
D-rural	-0.640	**-1.786**	-1.011
	-0.6	*-1.7*	*-1.2*
D-house has electricity	-0.074	-0.130	-0.125
	-0.1	*-0.3*	*-0.3*
D-poorest quintile	-2.126	-0.815	-0.634
	-1.6	*-0.6*	*-0.6*
D-second quintile	**-2.181**	-1.774	-0.650
	-1.8	*-1.5*	*-0.7*
D-fourth quintile	0.890	1.164	1.048
	0.7	*1.0*	*1.1*
D-wealthiest quintile	-1.086	-0.576	0.097
	-0.8	*-0.5*	*0.1*
D-receives Tshs 300	-0.247	0.150	0.639
	-0.3	*0.2*	*0.9*
D-receives Tshs 400	-1.144	-0.635	-0.823
	-1.2	*-0.7*	*-1.1*
D-Vodacom	**5.755**	**2.016**	0.637
	4.7	*1.7*	*0.7*
D-Tigo	**2.580**	-0.907	-0.803
	2.7	*-0.9*	*-1.0*
Contant	**9.313**	**17.399**	**19.908**
	4.3	*7.5*	*10.7*
Obs	542	450	450
R-squared (adj)	0.18	0.04	0.38

T-values in *italics* underneath the coefficient. Significant coeffients (p<0.01) in bold.

Figure 8: Changing wealth composition of sample
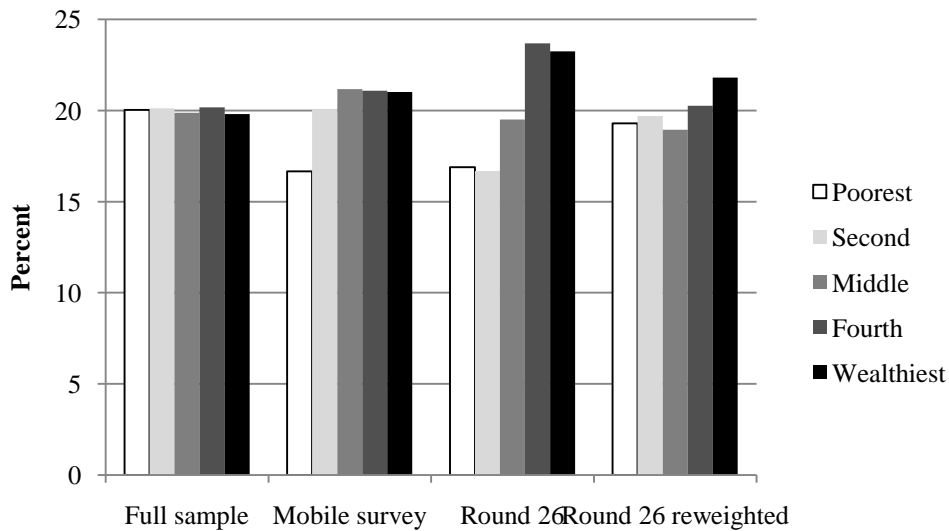

Source: Tanzania mobile phone survey, 2012

Another important conclusion is that for this survey to remain representative, it is necessary to reweight responses ex-post. Figure 8, illustrates how reweighting is able to restore the survey's representativeness by showing how the changing composition of the sample affects the percent of households allocated to different wealth quintiles. The first column presents the survey baseline (550 respondents) with the sample is divided (by definition) equally among the 5 wealth quintiles: each quintile has exactly 20% of the sample. When we look at the breakdown across the 458 respondents that were included in the mobile phone survey, one notes that poor households are underrepresented. The distribution becomes more skewed towards wealthier households in round 26 (341 respondents). The final set shows what the final distribution looks like once the mobile phone sample has been reweighted using the code presented in annex 1. It shows that the original distribution is essentially restored. One conclusion that we draw from this is that, while we can never control for selection based on unobservables, reweighting based on observables should be a standard procedure after every survey round in a mobile phone survey.

7. Other aspects of data quality

One concern one might have about mobile phone interviews is that the respondent could change from one wave to the next. Evidence of validation data suggests that this does not happen. Respondents identified during the baseline are the same as the respondents answering the phone.

Figure 9 presents data comparing respondents' age, 4 rounds into the survey. It demonstrates that apart from white noise, respondents are the same.

Figure 9: Comparing respondent ages as given in the baseline survey and in the mobile phone survey
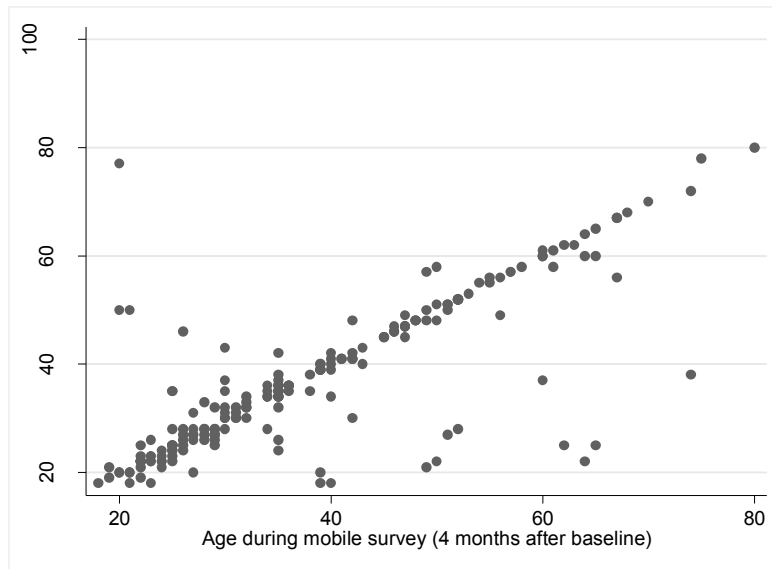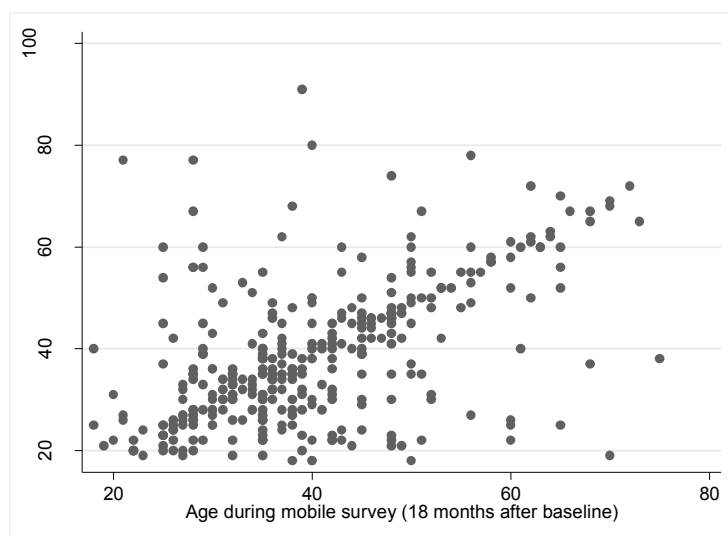

Source: **Dar es Salaam baseline survey and round 4 of the mobile phone survey**

However, when the same exercise was repeated in round 32, 18 months into the survey, the amount of white noise had increased considerably, suggesting a need for more quality control by the call center to ensure that the respondent selected during the baseline is answering the phone call. It is a good illustration of how high frequency surveys provide opportunities to identify data quality issues and to correct them in subsequent survey rounds. In this instance, the survey firm has been instructed to be more careful about who is the respondent and to change the beginning of the interview to ensure that the original respondent answers the phone (when available) or to clearly indicate that we are dealing with a another adult replacing the original household member. In round 35 of the survey, this exercise will be repeated to assess whether the change in protocol has been successful.

A change of respondents, by the way, does not necessarily affect the representativeness of the survey. When questions are asked about household characteristics such as access to electricity or water, for example, any adult should be able to answer. Since insisting that the same respondent

always answers the questions is likely to lead to non-response, there is a trade-off between non-response and insisting that the same respondent always answers. In fact, as long as a change of respondent is captured in the data, it could make sense for a mobile phone survey protocol to allow the original respondent to be replaced by another adult household member.

Figure 10: Comparing respondent ages as given in the baseline survey and in the mobile phone survey

Finally, it is worth stressing that respondents also make errors. This is illustrated with responses to questions about food fortification in the Tanzania survey. In this round of the panel, baseline information was collected in preparation of a large food fortification program. In Dar es Salaam, almost all salt on sale is fortified (iodized) while wheat flour, maize flour and cooking oil are not. But when asked about whether each of these foods was fortified, significant fractions of responses stated that cooking oil (23%), wheat (9%) and maize flour (12%) were fortified, while in fact they are not. In the case of salt, few respondents mistakenly claimed that salt was not fortified (0.3%). Interestingly, no significant differences in errors could be observed between respondents with primary or secondary education, or between respondents who had and had not heard about food fortification. It re-affirms the need to remain vigilant when interpreting survey results.

Figure 11: Responses to questions about food fortification
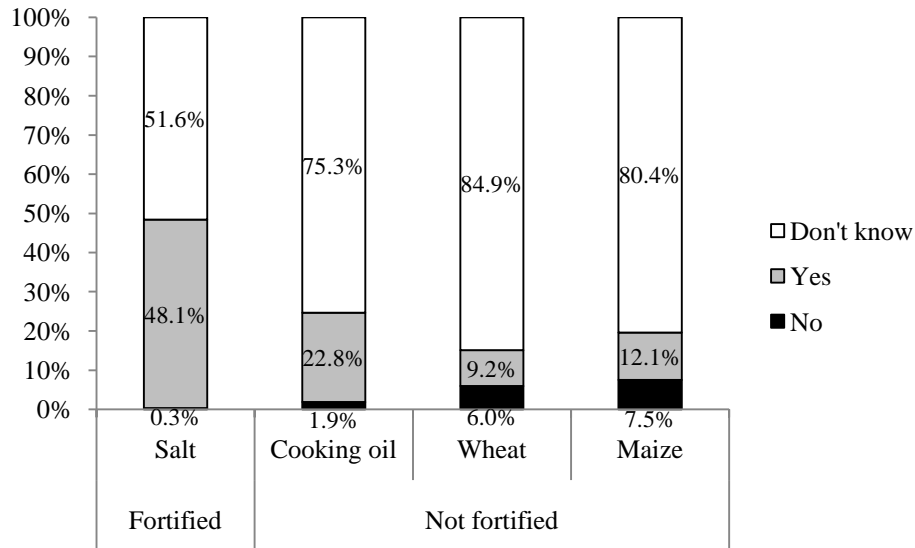
Source: Tanzania mobile phone survey, 2012.

8. Use of the mobile phone survey data

Ever since management of the Tanzania survey was transferred to the World Bank, active efforts have been made to disseminate the data widely to ensure that the survey results were used by decision makers or for accountability purposes. Questions are carefully identified for their interest to program managers as well as for their potential use as 'accountability tools'. Once the data are collected, easy to understand, factual reports are prepared presenting the findings. These reports are disseminated through a dedicated website from which all survey data, baseline survey as well as data from the mobile phone interviews can be downloaded (www.listeningtodar.org). The reports are shared by email using a distribution list that includes journalists and other potentially interested parties. A twitter account broadcasts the main findings (www.twitter.com/darmobilesurvey).

So does it work? The website itself attracts limited traffic and few people download the data available on the site. More successful have been attempts to get media attention. Reports produced have been discussed on blogs[16] and in academia[17], they have been re-broadcast

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[16] E.g. http://blog.daraja.org/2012/02/independent-monitoring-of-dars-water.html
[17] E.g. http://www.viewtz.com/2012/02/13/world-bank-cause-of-economic-hardships/

integrally[18], and have led to various newspaper articles. It is hard to assess what happens once information is published, but there are indications that the information is 'received' by those responsible for results. For instance, the managing director of Tanzania's electricity company felt compelled to explain to the media why so many households connected to electricity are experiencing power cuts and what his company is doing about them.[19]

Once published, information travels fast and far. A brief about food price increases, was used in a front page article in Tanzania's the Citizen newspaper, was picked up by others the Rwandan Times[20] and is ended up in the World Bank's 2012 Global Monitoring Report.

Information also tends to go in unexpected directions. A brief about the limited increase in water connections in Dar es Salaam despite a large scale investment program, received media attention because of the discrepancy it showed between the data reported by the mobile phone survey and official government statistics.[21]

So what lessons can we draw from actively disseminating 8 rounds of data? One lesson is that providing access to the raw data is not sufficient. Say's Law, suggesting that supply will create its own demand, does not seem to hold for the data produced by the Tanzania mobile phone survey. Another lesson is that good analysis and easy to access reporting on the data does make dissemination much easier. The uptake of the data from the last 8 rounds of interviews is encouraging, especially as much more can be done. The website could be promoted more vigorously. Facebook remains an unexploited tool, press conferences can be organized, the email list expanded and the twitter account could become more active. All this is needed if the objective is to ensure that the data, once collected, is utilized by a wide range of people.

9. Cost effectiveness of mobile phone surveys

How cost effective are mobile phone surveys? Our data give some indication of the marginal cost of a mobile phone survey. The call center contracted to implement 12 survey rounds, does so at a rate of $1,400 per round. If one adds the cost for consultants to maintain a website,

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[18] http://godfreynnko.blogspot.com/2012/02/most-citizens-do-not-know-if-their-food.html
[19] http://www.ippmedia.com/frontend/index.php?l=39618 and
http://www.ippmedia.com/frontend/index.php?l=39551.
[20] http://www.newtimes.co.rw/news/index.php?i=14892&a=11334
[21] E.g. http://www.thecitizen.co.tz/sunday-citizen/-/20105-govt-figures-on-access-to-clean-water-inflated

supervise data collection and to analyze the data, the marginal cost per round increases to $2,500. Given that these rounds averaged 343 respondents, this comes to about $4.10 - $ 7.30 per interview. Dillon (2010) notes a relatively similar marginal cost per survey: $6.98.

In addition to these marginal costs, one needs to include the cost of a baseline, which will often be between $ 50 and $ 150 per respondent, depending on the complexity of the survey and the distances that have to be covered.

Whether this is cost effective or not depends a lot on the purpose of the survey. The ability to carry out an entire survey in Dar es Salaam and to report on its results for $ 2,500 is remarkably cost effective. But if one keeps in mind that the typical round in the Dar es Salaam survey asks 17 questions (with a maximum of 44), then the cost per question is about $ 0.42. This is relatively high, so if the intention is to ask many questions it may be more cost effective to opt for a face-to-face interview.

10. Conclusion

The evidence presented demonstrates that mobile phone panel surveys have great potential to provide rapid feedback and to address existing data gaps at limited expense. Mobile phone panel surveys should not be considered substitutes for household surveys; rather they will often make use of an existing household survey to serve as baseline. Moreover mobile phone surveys are not the right platform for lengthy interviews; when interviews are lengthy, face-to-face interviews are probably more cost effective.

The evidence from the Tanzania and Sudan surveys suggests that mobile phone surveys can collect quality data in a timely manner. The Tanzania panel survey pointed towards the importance of putting in place mechanisms that avoid attrition right from the implementation of the baseline. Much attrition in the Tanzania survey can be explained by choices made in the organization of the survey (such as not to distribute mobile phones) and the work by Dillon, demonstrates that it is feasible to get low initial drop out. Our work suggests that once households are included in the mobile phone survey, they are likely to remain in the survey: respondent fatigue was not found to be an issue, even after 33 rounds of interviews. The work also suggests that because of their high frequency, quality control of mobile phone surveys is dynamic and issues identified in one round can be corrected in the next.

Finally, the success of mobile phone panels will not only be measured by whether relevant and quality data is being produced in a timely manner, but also by how many people actually use the results from the surveys. Our work suggests that making the data publicly available is not sufficient. Analysis and active dissemination are needed to ensure that data finds its way into the public domain.

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Annex 1: **Stata code to reweight the sample**

*new weights (iwt2) using participation in week 26

logit week26_dum poor average rich richest sex age rural voda tigo electricity years_school

predict ps

xtile deca=ps, nq(10)

bys deca: egen ac=mean(ps)

replace ac=(1/ac)

gen iwt2=iwt*ac