

APPENDIX J

DETAILED RECOMMENDATIONS ON SURVEY AND SAMPLING APPROACHES

The following different survey methods are used by Member States

- a) Surveys of enterprises and establishments;
- b) Household Surveys, such as the Labor Force Survey and The Income and Expenditure Survey;
- c) Surveys of people, such as Survey of Foreign Students and Exit Surveys of Foreign Visitors.

Most of the surveys are designed and conducted by the National Statistical Offices or in collaboration with other agencies like the Labour Departments, national tourism offices and the Central Bank. The latter is however primarily responsible for the BOP.

a. Survey of Establishments

The main source of data for compiling statistics of trade in services is the survey of establishments, and one of the starting points for the establishment surveys is to identify a representative sample of the sector. Central Banks and Statistical Offices collect most of their statistics from sample surveys.

Approximately 3,000 establishments in Barbados are being analysed, 2,800 in St Lucia, 29,000 (including branches) in Trinidad & Tobago and 3,000 in St Kitts and Nevis.

In formulating guidelines for the CARICOM Member States for the compilation of trade in services statistics, as a priority, the work under this project focused on developing an approach to sampling the services industries, developing questionnaires and other survey instruments, reviewing existing procedures, and making recommendations for improvement. Some of the recommendations were implemented during the country missions and documentation of guidelines provided.

Treatment of owner-only enterprises

The improved databases will have information on the type of legal ownership; therefore, it will be possible in each country to manage a sample survey of all establishments for each sector, or to select a direct sample of owner-only establishments. If the country decides on the first option, the sample has to take into consideration the owner-only condition as an attribute. This means that the list of establishments can be organized in two strata, the owner-only and the rest of establishments.

The decision will be based on the purpose of the survey.

Correction for informal (unrecorded) services supplies

There are two options for estimating service transactions in the informal sector:

1. To incorporate in the labour force survey a one-time questionnaire

A questionnaire can be added to the ongoing labour force surveys once every year to identify more precisely activities performed by persons, with questions such as type of benefits received and more detailed type of activity.

2. To use an area sampling survey for detecting all establishments in those areas

The statistical office can identify emerging business geographical areas by marking points in those places where new business are appearing and linking these points to the statistical geographical areas already existing for census purposes. Then there is the possibility of improving coverage, control and 100% up-date of the establishments and to obtain information.

Sampling design and data collection formats of Member States

A few establishments account for perhaps 60% to 80% of the total of income received or revenues, efficient sample design can however address this skewedness of the population distribution. The impression is that some countries have a set of “some of the largest establishments”, but not a sample; and sometimes they collect information of part of the “small” establishments. Rules have to be clear and standard. A proper sample will include a high proportion of all establishments over a certain size, but there is room for bias to arise if coverage is incomplete and out of date. The risk of bias may be reduced, but cannot be avoided.

a. Probability or non-probability sample

Sampling is not a substitute for a complete study. It is a scientific method of measurement for inference to the population. Inference is the step needed to pass from the particular to the general. There are two types of approaches to sampling: probabilistic and non-probabilistic.

The first step is to consider the possibility of installing a formal probability sample in which each establishment will have a known chance of selection. Using this methodology one can be sure that establishments are selected in an impartial and objective fashion and the quality of the survey results can be measured through estimates of the standard error of the estimates. With non-probability sample, biased calculations of total, means and percentages can still result.

The objective is to select a sample that describes the characteristics of the population of establishments in the same way as if the total population had been analyzed. Different establishments in a sample can produce different results. This is known as sampling

variation. To reduce sampling variations, it is very important to select a sampling technique that will most accurately reflect the characteristics of the total population.

As it was defined, random selection may be employed in countries and in economic activities where there are large numbers of establishments and reasonably precise estimates can be made, but for some activities, only the major establishments can be selected. A rule has to be set in place to decide when to do sampling and when to select just the major establishments.

Avoid a generalization of this rule; sometimes establishments are selected based on their convenient geographical location or because they are known as friendly and to be good respondents. This is not good practice.

It is clear, that without probability selection methods, estimates of statistical accuracy are unknown. At the same time there is a high correlation between voluntary respondents and more organized establishments, and this will affect the results.

In a non-probabilistic sample, the sample is selected intentionally or without standard rules. This approach excludes certain establishments from the selection process based on the preferences of the researcher, availability of the respondents, or criteria for selection. As a result, a non-probabilistic sample will only reflect the characteristics of the sample selected and the results cannot be inferred or extrapolated to reflect the characteristics of the total population. If one were faced with the task of selecting 50 establishments that represent all National Economic Accounting and Balance of Payment transactions for the country, purposive sampling will be the best approach.

Despite the reliability of probability sampling methods there will be situations where this method is not desirable. This is the case when population size is too small (less than 20 establishments) or when it is extremely difficult to get the information for small establishments and the contribution to the total income in the sector is less than 20%.

At the end, the statistical procedure will vary for each activity- sampling or non-sampling approaches will be used depending on the activities and issues.

To take the decision on where and when it will be convenient to use probabilistic or non-probabilistic sample the following information would be needed:

1. List of establishments in the population presented in three to five strata according to the number of employees (in this case three strata, large. Medium size and small)
2. The list must be based on the final EBOPS classification
3. Based on that list, define the number of establishments that are going to be selected with probability equal to one, and then the size of each remaining strata.

b. The Cut-off Method

Some countries use the cut-off method, by which, data collection is confined to the larger, better-organized establishments with better records and reporting facilities. If this method is used, it must be remembered that the results apply only to the strata of establishments from which the sample has been selected. As a result of the highly skewed size distribution of the establishments and their particular economic transactions, this information sheds no light on what is happening with the small establishments. In such cases, theoretical assumptions for estimating transactions in the strata of small establishments could be risky. Yet these small establishments contribute considerably to production and services in the countries of the region.

The cut-off method is obviously biased, as the sample does not reflect trends in the smaller establishments.

Developed countries can tolerate large errors from small establishments because they contribute little to the aggregate, but this is not the case for the CARICOM Member States. However, in such a case the cut-off method can be used when the large establishments are known to constitute more than 90% of the aggregate being measured. Finally, for regional comparisons it must be stated clearly in notes if estimates of the country are based on large establishments or on the total population.

There are at least two options for obtaining estimates:

1. Use the method of cut-off and do nothing with small establishments.
2. Estimate results for small establishments using different approaches:
 - a. Conducting sample surveys of small establishments
 - b. Obtaining information for this type of establishments using other sources of data

If sample surveys of small establishments are conducted, reliability of the estimates made from the survey depends on the quality of data collected, and unfortunately small companies tend to keep poor accounting records. The results can be improved by designing an easier and more user-friendly questionnaire and use of sampling approach.

c. Sample Size

Sample size has been defined using simple judgment. It has to be defined in technical terms as well as minimal useful sample size. A researcher must decide in advance how much information will be extrapolated from the data to determine either the size of the sample needed or the level of accuracy of the information obtained.

Barbados. Sample size (approximately 400) has to be calculated using a technical procedure. Population size for some categories need to be revisited, for instance tourism with 17 establishments.

St Lucia. Sample size (approximately 400) is being calculated as a % of the population. Sample size has to be calculated using a different procedure.

Trinidad & Tobago identified first "large" establishments and select them with probability equal to one. The rest are selected allocating sample size according to the size of the activity. Sample size is approximately 3,000.

St Kitts & Nevis. Sample size is approximately 200. Sample size has to be calculated using a different procedure. This was explained during the mission.

The following is the technical procedure to calculate sample size:

Once the sample design is decided the sample size should be calculated. Adequate information on establishments must be obtained to ensure a reliable estimate of the total population. If the elements to be measured are all alike, one element will give the same results as another. Thus, the variability of the results will affect the size of the sample. In addition, the accuracy of results sought, level of confidence in the results, and the analysis to be done with the data, are all key factors in determining the appropriate sample size needed. Thus, the following steps or activities must be taken to obtain an appropriate sample size.

- STEP 1. Define the precision of the expected results (degree of accuracy affects confidence interval)- Normally between 90%-95%
- STEP 2. Determine the confidence level of the results (risk of error) normally 95%
- STEP 3. Check for population size. But be careful, sample size is not related directly to the population size after a certain number
- STEP 4. Determine the variability of the estimation
- STEP 5. Use the statistical formula for the Key variables or key indicators
- STEP 6. Check level of dis-aggregation of data
- STEP 7. Avoid sample size equal 1 and be careful when sample size is less than 20 cases

The human and financial resources will be always a constraint in sample size.

$$n_0 = t^2 s^2 / e^2 \qquad n = n_0 / (1 + n_0 / N)$$

Where

- t = value of t distribution for 95%
- s = standard deviation for key variables under study
- e = acceptable error (5%)
- N = population size
- n = sampling size
- If we are estimating a %

Table 1 Sample Size Ratio and Accuracy of Results

	<i>Expected %</i>		<i>Population size</i>						
	5	10	5	10	5	7	10	20	
<i>Precision level</i>	5	3	4	6	6	7	7	7	7
	%	0	2	4	8	2	2	2	3
5%	1	3	5	1	1	1	1	1	1
	0	7	8	0	2	3	3	3	3
	%			8	2	5	6	6	7
	2	4	7	1	1	2	2	2	2
	0	2	1	6	9	3	3	4	4
	%			5	7	4	8	0	3
	3	4	7	1	2	3	3	3	3
	0	3	6	9	4	0	0	1	1
	%			6	4	3	9	3	8
	4	4	7	2	2	3	3	3	3
0	4	9	1	6	4	5	5	6	
%			2	9	3	2	6	2	
5	4	7	2	2	3	3	3	3	
0	4	9	1	7	5	6	7	7	
%			7	8	7	5	0	7	
10%	5	1	1	1	1	1	1	1	1
	%	3	5	8	8	8	8	8	8
	1	2	2	3	3	3	3	3	3
	0	0	6	2	3	4	4	4	5
	%								
	2	2	3	5	5	6	6	6	6
	0	8	8	5	8	1	1	1	1
	%								
	3	3	4	6	7	7	8	8	8
	0	1	5	9	5	9	0	0	0
%									
4	3	4	7	8	9	9	9	9	
0	2	8	8	4	1	1	1	2	
%									
5	3	4	8	8	9	9	9	9	
0	3	9	1	8	4	5	5	6	
%									

Note: Confidence level 95%

Source: Improving Family Planning Evaluation, Kumarian Press, 1992. Chapter 7. José García Núñez

If the sample size increases, the accuracy of the results is higher, this means the larger the sample, the more likely it is that the mean estimate is an accurate estimate of the population; however, there is a limit as to how much the accuracy will be affected by the size of the sample. Eventually, the size of the sample will no longer affect the accuracy of the sample results. The extent to which the elements vary will determine how large a sample that is needed to obtain the level of accuracy that is targeted.

The steps suggested for calculating sample size are:

1. Estimate sample size for the country using the guide provided
2. Identify those activities where the number of establishments in the population is less than 20 establishments and define the sampling procedure to be used for each activity.

d. Sample structure and stratification

When establishments are stratified by employment, the distribution obtained is highly skewed; e.g. there are too few large establishments and too many small ones. If the relative contribution of small establishments to value added is very low this means that a higher proportion of the larger establishments must be selected in the sample in order to minimize the variance of estimates.

Grouping similar establishments by forming strata by number of employees is based on a principle that submits that this approach will increase the efficiency of the sample by reducing the standard deviation of the estimates. Stratification also will improve response rate and give an option for treatment of non-response, but at the same time requires the use of the appropriate weighting estimation procedure. A proxy indicator (number of employees engaged) can be used.

The increase in precision of sample estimates resulting from stratification will depend on the homogeneity that is achieved within the strata. Today, surveys are designed to identify at least two strata by activity: a) "Large" establishments; and b) The rest. The problem here is the high non-response rate for "small" establishments.

Formation of strata of establishments has to be discussed for each country, because it must have at least five goals:

1. To improve accuracy of data
2. To include with certainty those establishments that account for 60% to 80% of the income or revenues of that economic activity
3. To be able to develop a "must" list of the largest establishments followed by intensive follow-up procedures to obtain responses
4. To check for those strata where after identifying the large establishments, the rest will be small in number or small in their contribution to the total income or revenue of the activity

5. To decide different selection procedures per strata, for example, doing or not doing sampling in one or the two strata; the use of different sampling fractions per strata; the use of different sampling procedures, for example, probabilistic in one and non-probabilistic.

Barbados, St Lucia and St Kitts & Nevis. These countries are collecting information only for the first strata and for some categories. Therefore, if the exercise of subdividing other categories is repeated, the number of establishments for each sub-category will become very small. Partly because small countries have small numbers of this type of establishments, but also because the strata number has to be recalculated accordingly.

Trinidad & Tobago. Within each activity, sample surveys are designed using twelve strata according to the number of employees: 1) 0 to 1; 2) 2 to 4; 3) 5 to 9; 4) 10 to 24; 5) 25 to 49; 6) 50 to 99; 7) 100 to 249; 8) 250 to 500; 9) 501 to 999; 10) 1000 and over; 11) branches; and 12) establishments without information. This procedure facilitates reorganization of groups of establishments to be able to set a selection process and helps to improve response rate and treatment of non-response. At this moment sample allocation per strata and sample selection is not controlled, therefore the weighting estimation procedure should be reviewed.

If the proposal of subdividing categories is accepted, the list of “large” establishments for each country has to be reviewed in the light of this new classification.

Number of Strata ¹

There is a practical limit to the number of strata that can be created, since at least one unit must be included in the sample from each stratum. Very small reductions in variance may be expected by stratifying deeper and deeper.

The number of strata (L) recommended will vary from 3 to 5, but a formula can be used to optimize reduction in standard deviation of the indicator under study and the correlation to the indicator used for stratification (number of employees):

$$\sigma(\bar{y}_{st}) = \sigma(\bar{y})/L$$

With L strata created with equal size and where $W_h = 1/L$ and $n_h = n/L$. The standard deviation of the mean in stratified sampling will decrease proportionally to the number of strata, but there is a limit to the final number of strata.

Using the following formula

¹ Cochran William. Sampling Techniques. Wiley & Sons. Section 5A.7

$$\sigma(\bar{y}) = \sqrt{S^2/n [(\rho^2 / L^2) + (1 - \rho^2)]} :$$

ρ is the correlation between the two variables. It can be demonstrated that more than 5 strata will produce improvement in the standard deviation, only when the correlation coefficient is greater than 0.95.

Examples with real information were used in some countries.

Construction of strata

Once the number of strata is known, the next step is the construction of strata. In Trinidad & Tobago the following steps were taken:

1. A list of the number of establishments in each of the 12 strata now used was drawn up
2. The mean income or revenue in each strata was calculated
3. With this information, it was seen that strata 1 (100 and more employees) covers 81.1% of the total income or revenues. Then, the configuration of strata 1 was defined. (Medium size and smaller establishments can be selected at rates that decreased with decreasing size in terms of number of employees. Therefore, 2 or 3 strata based on the number of employees can be used).

Allocation of sample size to each stratum

Once sample size and stratification procedure are defined, the next step is to allocate the sample size among the five strata.

e. Selection procedure

In sampling selection the following steps are critical:

1. The list of establishments has to be organized by activity, within each activity by strata (number of employees), within each strata by number of employees, and within each strata by geographical distribution (urban and rural).
2. Identify and remove those establishments that belong to strata 1 and do the selection of the remainder establishments.
3. Identify and remove those activities where the number of establishments in the population is less than 20 establishments, and treat them independently.
4. Decide if for the remaining establishments sample selection will be for all the country or activity by activity. If different types of approaches per activity (probability or non-probability sample; different sampling fractions) are going to be used, then selection must be by activity, but keeping the same sampling sizes and sampling fractions already defined.
5. Selection can be based on using equal probability or proportional to size (pps) and with different sampling fractions defined for each strata

6. Probability proportional to size in the selection will give more chance of selection of the largest establishments, within the size of the strata, but make the estimation process more complex, because sampling fraction has to be recalculated and this will affect the methodology for estimation of the results. Thus, an unbiased estimate of the Y is obtained by multiplying each establishment in the sample by the reciprocal of its probability of selection, and adding the results.
7. Systematic selection will be used with random start

f. Combination of sampling approaches

Same general rules can be applied to the sampling process, but different types of approaches can be performed per activity and per strata:

Table 2 Per Strata Sampling Approaches

Strata 1	Strata 2	Strata 3	Strata 4
100% establishments covered	Sample of medium size establishments	Sample of small establishments	Sampling of establishments which we do not know the number of employees
Use of different sampling fraction			
	Indirect estimates for this strata		
Use other sources of data to compare & improve estimates			
Use previous information to input non-response and/or modifying weights to cover non-response			

Each case has to be treated differently, but survey approach will vary based on several factors: a) the skewedness of the distribution of large establishments; b) the number of remaining establishments with probability equal to one; the type of activity; the level of non-response.

-Estimation and imputation methods

If sample selection is based on the theory of probability, then the probability of selection has to be used to estimate the results. If judgment is used in sample selection, judgment has to be used when estimating sample results. The probability of selection refers to the chances that each sample and each sample member will be selected.

Estimates can always be produced, but in order to measure the sampling error of the final estimate it is necessary to achieve almost complete response (more than 70%).

To estimate results for the total population requires that the results of each sample be extrapolated to the total population. Thus, sample results for each establishment need to be

multiplied by the inverse probability of selection in order to weight the results of each sample equally.

Estimating results is not the same as inventing results. So, researchers have to be careful when the direct estimate is not available as to what type of approach is used to replace the missing data.

Again, faulty data is better than nothing, but misuse of this principle must be avoided.

a. Direct Sampling Estimates

Direct estimates are referred to the sample estimates.

If stratified sample is used, results have to be obtained first by strata and then the data to estimate the total activity. Estimates have to be weighted by the size of the strata, and final weights have to use corrections for non-response.

A fairly obvious way of arriving at biased results is to examine the results from an initial sample to determine whether they appear acceptable and can be used or corrected. Such an approach can be utilized to obtain almost any results desired and is not the best approach. If this approach is used there must be consistency in data adjustments and it must be done carefully.

There are two approaches to extrapolating the results to the total population using direct sampling estimates:

1. Calculating weights for each stratum or for each questionnaire if a self-weighted estimator was used. In other words, this approach depends on the probability of selection of the establishments.
2. A ratio R of Y to X , such as the ratio of income of the establishments to number of employees can be calculated.

b. Comparable Estimates Over Time

Estimates are not limited to one-time-inquiry. The same population of establishments is enumerated at different points of time (example: every year, every quarter) to estimate changes that are taking place or to estimate the average over the period (example: one year).

Estimates have to be comparable among different surveys over time. This applies to all type of surveys. This means that sampling surveys have to be designed with a long-term vision, and not as independent and isolated samples. This is the case for the labour force survey and for the exit surveys conducted in some member countries.

In a comparison between two estimates, one wants to see the changes over time, but if questionnaires, procedures and sampling units are changed, and in addition the non-

response behaves differently in both samples, the difference will also be determined by those other factors. This principle becomes more important when the quality of data is improved and the size of the difference becomes smaller.

Three sampling alternatives can be considered:

- Fixed sample: The same establishments are selected on each occasion
- Partial replacement: A part of the sample is retained, the remainder being replaced for the next occasion
- Independent sample: New establishments are selected each time

Because the main objective is to estimate changes, it is best to use a combination between a fixed sample and the use of a rotation panel method. Large establishments must stay over time and a rotation panel can be designed for the remainder.

The fraction of the sample that should be replaced on each occasion depends on the strength of association between observations on the same unit at two successive occasions. If the correlation is large, a smaller fraction should be retained.

Establishment surveys are panel surveys in which data are collected from the same establishments every year. The problem could be with small establishments that sometimes stop producing or may resent the burden of responding and either do not respond or provide poor quality data.

To alleviate some of these problems some form of panel rotation can be used, maybe half of the establishments can be replaced by the next in the list. Rotation rate should be agreed.

To manage this rotation panel, the procedure is to select 2 samples (A and B), and sub divide each sample into 2 sub-sampling (A1 and B1).

c. **Use of other sources of data**

The compiler must consider several issues when choosing a method for estimating the various services component, such as, the data collection method used and other available useful information to compare the results. Such comparisons should be conducted with the objective of gaining knowledge of biases and non-random errors.

Some types of transactions may be estimated from more than one source of data. In this case, the information can be used to: a) cross-check individual establishment data and global results for some activities; b) improve non-response; c) do imputations of missing data.

Disagreements between results of a sample survey and other independent sources may be sometimes due, in whole or in part, to differences in concepts and definitions or to errors in the information from other sources.