Data Quality Issues in Surveys of the International Comparison Program for Africa (ICP-Africa)

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Summary:
The paper addresses the issues of data quality within the context of the International Comparison Program for Africa (ICP-Africa). The quality of the data is as good as the quality of the operation at each stage of the data collection process and rests on the control of the total survey error comprising sampling and non sampling errors. The components of the total survey error and possible sources of those errors in the context of the ICP price surveys are presented. Some guidelines on how to reduce errors at each stage of the survey operations are proposed. Quality monitoring indicators to be used for taking corrective actions while the survey is ongoing if necessary are also presented. Using those indicators to quantify measurement errors may be expensive and often difficult to implement. For that reason and because it is good practice, more emphasis should be put on controlling the sources of measurement error through good planning and implementation of the survey.

Key words: *Total survey error, sampling error, measurement error, pre-survey, data quality.*

Résumé:
L'article aborde les questions de qualité des données dans le contexte du Programme de Comparaison Internationale pour l'Afrique (PCI-Afrique). La qualité des données dépend essentiellement de la qualité de la mise en œuvre de chaque étape du processus de collecte des données et passe par le contrôle de l'erreur totale d'enquête qui comprend l'erreur d'échantillonnage et l'erreur qui ne dépend pas de l'échantillonnage. Les composantes de cette dernière et les sources possibles de cette erreur dans le contexte du PCI-Afrique sont présentées. Des propositions pour réduire les erreurs à chaque étape de l'enquête et des indicateurs de suivi de qualité pour faire des corrections pendant que l'enquête est en cours sont aussi présentés. L'utilisation de ces indicateurs pour quantifier les erreurs de mesure pourrait être chère et difficile à mettre en œuvre. Pour ces raisons et comme c'est une bonne pratique, l'accent devrait être mis pour contrôler les erreurs de mesure par une bonne planification et mise en œuvre de l'enquête.

Mots clés: *Erreur totale d'enquête, erreur d'échantillonnage, plan de sondage, pré-enquête, qualité des données.*

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1. Introduction

In any survey, the reliability and accuracy of the estimates of the parameters of interest depend mainly on the quality of data used to compute them and the International Comparison Program for Africa (ICP-Africa) surveys will not be an exception. The data in turn are only as good as the quality of the operation at each stage of the data collection process. To ensure the quality of the ICP-Africa survey data, the regional and the national coordination teams have implemented systematic data validation procedures. Data validation is part of quality assurance procedures which should go beyond simple control mechanisms and should put in place an ongoing process throughout the survey operations from preparation and elaboration of survey framework to data collection, editing and validation, and reporting. The procedures should also aim at improving the capacity of countries to implement price surveys in line with the capacity building component of the ICP-Africa.

Systematic quality assurance procedures should be put in place in collaboration with all ICP-Africa partners within a given framework. The aim of that framework should not be to audit the survey implementation but rather to provide guidelines to improve quality standards with regard to the implementation of the survey especially on matters like reducing the bias due the non-probability selection of outlets, seasonality issues, the elaboration of robust measures of reliability and checks for comparability of the data within and across countries.

Setting up procedures to quantify measurement errors is expensive and often difficult to implement. For that reason and because it is good practice, more emphasis should be put on attempting to control the sources of measurement error through good planning and implementation practices. To that end quality assurance guidelines and/or best practices that are feasible to implement should be identified for all steps of the survey: (i) defining the objectives, (ii) creation of sampling frames, (iii) sampling, (iv) training, (v) data collection (measurement), (vi) data entry, editing and validation, reporting and (vii) PPP estimation. The paper proposes some guidelines for each of the steps of the survey operations. The components of the total survey error and possible sources of those errors in the context of the ICP price surveys are presented. Some guidelines on how to reduce errors at each stage of the survey operations are proposed in the third part of the paper. The fourth part presents a quality monitoring indicators to be used for taking corrective actions while the survey is undergoing if necessary.

2. Specification of the Estimation Problem

If the definition of the objectives and/or the analysis of the problem at hand leads to an estimation of parameter(s), then four points are essential and should be clearly understood: (i) the specification of the parameter to estimate, (ii) the estimator of the parameter, (iii) the variance of the estimator, (iv) an estimate of the variance of the estimator of the parameter. The points (ii) and (iv) require using data to compute the estimates of the parameter and its estimated variance. The quality of the estimate is assessed in terms of its precision, which traditionally is measured by its estimated variance (sampling errors). However errors inherent to the data collection and processing procedures do occur. For example errors that are different from sampling errors may accumulate if the field work carried out to collect the price data is poor, and/or the survey instruments have not been tested. Sampling error and non sampling error constitute the total survey error, which needs to be controlled and reduced to a level at which it does not hinder the usefulness of the final results. Errors are usually controlled through the design used to select the sampling units and a good implementation of the survey operations.

Possible sources of non-sampling errors are:

- incomplete and inconsistent product specifications: a specification error occurs when relevant and appropriate characteristics have not been used to describe the product, leading to the identification of non comparable products during price collection;
- noncoverage of outlets: failure to include in the frame some types of outlets which represent a portion of the market will exclude products and or some price categories, thus distorting the market reality;
- measurement errors: concern the measurement at the individual item level (the measurement device or technique, wrong price quotations, inadequate instructions to field staff, bargaining ability of the data collector);
- lack of trained and experienced data collectors;
- lack of good quality supervision: not enough time allocated to the supervision, big ratios of data collectors to supervisor;
- errors in data processing operations such as data entry, checking and validation.

3. Quality Assurance Guidelines

The quality assurance guidelines can be used as an evaluation template to help countries in assessing quality in a systematic manner with a view of identifying areas in the survey operations that could be improved. The evaluation template is a check list as suggested by Üstun and al (2005). Guidelines are proposed for the main survey operations:

3.1 Frame

In general the quality of the data obtained from surveys depends to a large extent on the quality of the sampling frame from which the samples were selected. Unfortunately problems with sampling frames are common features of survey. Kish (1965) provides a useful classification of four frame problems and possible solutions:

(i) non-coverage: It occurs when there are units in the population of interest that have no chance of being sampled for the survey.

(ii) clusters of elements: The problem arises when a single listing on the sampling frame actually consists of multiple units in the target population.

(iii) blanks: The problem of blanks occurs when some listings in the sampling frame do not correspond to any element of the target population.

(iv) duplicate listings: The problem of duplicate listings refers to units in the target population occurring more than once in the sampling frame.

In most African countries participating to the ICP survey, there are no frames of outlets and when they do exist they present deficiencies. The absence or poor quality of listings of outlets make it necessary to first select a sample of geographic units, and then to construct lists of outlets only within those selected units. Those units need to have clearly identifiable boundaries and cover the entire target population, have data for stratification purpose and be large in number.

In ICP-Africa data collection, non-coverage is the most outstanding of the above four frame problems, as the absence of outlet frames renders the other problems null and void. If part of the outlets that are left out are dif-

ferent from those visited, there will be differences between average prices that the survey will be providing and average prices of the population of outlets. It is therefore essential to ensure that coverage of the population of interest is appropriate for the purpose of the survey.

Checklist for quality of the frame

Does a sampling frame of outlets exist? Checking and correcting the frame deficiencies: non-coverage, clusters of elements, blanks, duplicate listings. A frame does not exist and use of multi-stage sampling. Characteristics of good primarily sampling units: • Have clearly identifiable boundaries that are stable over time • Cover the target population completely and are large in number • Have a measure of size for sampling purposes especially pps sampling • Have data on possible stratification variables

3.2 Data Collection Form (Questionnaire)

The quality of survey data depends heavily on the quality of both the questionnaire and the implementation of the field operations.

The first recommendation is that the specifications of products should be written out in the questionnaire or in a catalogue so that the data collector can use them to easily identify the products. The descriptions should be kept as short and simple as possible using common everyday terms. More elaborate instructions and explanation of terms should be provided in a data collector manual or other supporting documents.

The questionnaire should be designed so that the data collector can record what he observes without treating the information outside the questionnaire before recording it. If additional treatment is needed before recording the information, then the extra step can produce errors and should therefore be avoided.

The training of data collectors should be used to test the questionnaire especially their understanding of the terms and adjustments made if necessary. The questionnaire should also be tested during the pre-survey.

3.3 Data Collectors

Data collectors are important links in the chain of the data collection process and are one of the possible sources of survey errors. It is therefore important to control and minimize their contribution to the survey errors.

Data collector errors can be controlled through training and supervision. A standardization of the data collection process through a training covering principles and practice of price data collection can reduce help the data collector bias.

Supervision and performance monitoring through performance statistics (response rate and achievement, rejection rate during data validation at the national level) is another component of data collector quality control.

The characteristics of the data collectors (age, sex, education, past survey experience, performance on the test after the ICP-training, language fluency) should be recorded and crossed with individual data collector performance. The results of such an analysis can be used to improve the data quality of future ICP surveys.

Checklist for the selection of data collector candidates

What is the experience of the data collector candidates?
Are they familiar with the market matters and/or have survey experience
Education level: they should have an adequate education level to be able to read and understand the survey questionnaire.
They should also be fluent in the language of the region where their data collection centre is located.

3.4 Sampling

The target population is the set of all goods and services that are acquired, used or paid for by households from outlets during the benchmark year. Thus the collection of price data requires the selection of products and the selection of outlets. Samples have to be taken for both cases but the two selection processes are different.

The selection of products in the ICP is purposive. In fact selecting individual products at random within outlets would not be feasible for ICP purposes. Different products would be selected in different outlets and in different countries so that it would be difficult to estimate national average prices and to match products and prices among countries for comparisons purposes. International comparability requires that a set of products be pre-defined for pricing. To that end the sample of products defining the regional list is the same for all participating countries and has been defined at the regional level in collaboration with the countries through a participative and interactive process using the Structured Product Description (SPD). An SPD is a systematic listing of all possible relevant price-determining characteristics for a product or a cluster of products. It provides a framework within which it is possible to specify a precise set of characteristics in view of facilitating the elaboration of product lists and price collection.

The selection of outlets is made independently in each country and a probability sample is desirable. The quality of the price data is as good as the quality of the sample of outlets used to collect them. A faulty sample design and/or bad implementation of a good sample design reduce the representativeness, leading to biased national averages. Moreover the magnitude of those biases and often their direction (underestimation or overestimation) are unknown.

In term of coverage, a sample is representative if the following three conditions are met: i) a population of interest has been defined prior to conducting the survey, ii) the units on which the information is collected are chosen in such a way that each unit in that population has a fair chance of being include in the sample, and iii) the information is collected on a number of units that is large enough to capture the variability of the information of interest and the diversity of the units. The second condition implies a sampling based on probability selection methods. Because of high costs of implementation, probability sample have not been used in most countries.

The sampling plan should be evaluated before the start of the data collection to assess the appropriateness of the stratification, adequate representation and distribution of outlets. The following checklist can be used.

Checklist for quality of the sampling of outlets

- Overview of population composition (urban/rural, oversampled localities)
- Stratification
- Sampling frame and number of stages of sampling
- Sampling unit at each stage - selection probability
- Sample size
- Probability weight of primary sampling unit
- Probability weight of outlets
- Summary report on the actual implementation, deviations, weights, etc.

3.5 Implementation

A good sample design cannot guaranty the quality of the data without a good implementation. The implementation of a survey is a key-determining factor of the quality of the data.

A survey framework defining all the data collection steps and how they will be carried out and the necessary resources should be elaborated at the national level. For each data collection centre, supervisors should in collaboration with the national coordinator and in compliance with the survey framework, prepare a local implementation plan in which the details and calendar of the activities are laid out. Supervisors should set the workloads of the data collectors and review the work after each session of data collection. S/he should ensure that the relevant information has been collected and the forms are correctly filled. A logbook should be kept to monitor the progress.

Each country should conduct a pre-survey at the beginning of the data collection. The pre-survey may take three to four weeks. The pre-survey should be used to refine the survey framework in term of the selection of outlets and to test the survey instruments by collecting data. The data from the pre-survey should be rapidly analyzed to identify implementation problems and feasibility issues in view of making the necessary adjustments before the main data collection.

Before launching the data collection it is essential to test and/or evaluate the survey instruments: sampling frame, questionnaire, the product list, data entry software, communication mechanisms, and data transmission scheme. If necessary, appropriate corrective measures should then be taken for each instrument.

National coordinator should conduct supervision missions. During those missions, he should hold meeting with the local staff (data collectors, supervisors) to discuss the following points:

- Response rate and achievement during the data collection.
- Analysis of supervisors reports
- Analysis and follow up on the data collector remarks and comments, which are recorded in the filled questionnaires.
- Follow up on rejection rate at data validation and corrective measures.
- Follow up on data quality control procedures during data collection and processing.
- Elaboration of contingency plans.
- Follow up of expenses on the basis of achievements.

Checklist for review of the survey implementation

Pre-survey
Does a pre-survey survey been conducted?
Scope of the pre-survey
Documentation of the implementation and feasibility problems
Any adjustment arising from the identified problems?
Main Data collection
Number of data collectors, supervisors and local coordinators
Travel and communication arrangements
Checking the operations in the field by supervisors
Sending and receiving questionnaires to and from the data collection centres
Supervision by the national coordination team
Supervision by the ICP-Africa coordination team
Checking procedures and supervision
Data verification and editing at the national level
Monthly production report to assess the data collection process, monitor the results and ensure the implementation of the data collection
Transfer of data to the regional office
Addressing queries
Revisiting a sample of randomly selected outlets to assess the data collection process

3.6 Training

Before the implementation of the survey operations, training of the survey team should take place. In fact training must be on ongoing process and should be conducted before and during the data collection process if necessary. The training aims at ensuring an understanding of the survey objectives and a uniform application of the survey materials and use of the survey instruments, leading to an improvement of the overall quality of the data.

Training should be conducted for both supervisors and data collectors. Supervisors should be staff involved with the national CPI or are familiar with price collection procedures. The training of supervisors should include:

- Objectives of the ICP and how it is different from the CPI
- Representativity and Comparability
- ICP product specifications and photos
- Selection of outlets
- Frequencies of price collection
- Procedures when specifications cannot be met
- Procedures for disappearance and appearance of outlets/products
- Data recording, editing, validation tools

The duration of the training for data collectors is 4 to 7 days with 4 days for experienced data collectors (CPI data collectors) to review the list, the reporting procedures and training on filling the forms. The longer training period is for the newly recruited price collectors who may have some experience in other types of surveys.

Teaching aids especially the data collector manual, guidelines and any relevant ICP material should be made available to countries.

The content of the training of data collectors should include and have the following salient features:

- The training should explain the objectives of the data collection, the sources of bias, how the collected data will be used, and the importance of obtaining good quality data;
- A review of the product list and outlet visits should be carried out to ensure that the data collector are familiar with the products they have to price;

- The training should be participatory with time allowed for group discussions; furthermore practice should be given on how to complete the questionnaire, and on how to collect prices in the different types of outlets;
- More individuals than needed will be trained and subsequently tested to determine their competency in price collection. This will take the form of both a written test and practical exercise and individuals with the highest marks will be selected as price collectors and supervisors;
- Training should be carried out so that all field staff receives the same quality training. It should be repeated if necessary to accommodate the number of trainees.

Data entry staff should attend the data collectors training to familiarize themselves with the product list and the types of outlets where prices will be collected. In addition they should be trained on the data entry software with an emphasis on the data entry screen.

Checklist for review of the training

Number of training sessions
Number of days of training
Expertise of trainers in price statistics
Documentation used
Practical component
Problems encountered in training
Evaluation of the training session

3.7 Data Entry

A crucial task for any survey is entering the data, "cleaning" them and putting them in a form that is ready for analysis. It is essential to carry out the data entry as soon as possible after its collection. Entering the data immediately after collection allows the correction of errors and any inconsistency at a subsequent outlet visit. For quality purposes it is important to:

- Ensure that the questionnaires are sent to (and from) the data collection centres (to the national coordination) when they are due. If not it is necessary to find out the reason and take appropriate action to get them;
- Do the checking of the data collection forms (by supervisors) prior to data entry;

- Avoid having data collectors doing the data entry and preliminary validation;
- Avoid doing manual copying of data;
- Do data entry with a data entry program, which has quality check features (tests on value range, allowed values for some fields, specific formats for some fields, etc);
- Conduct double data entry to avoid data typing errors;
- Submit the data to the Regional Coordination monthly or at the frequency of the data collection
- Send feedback to countries after regional checking of data.

Checklist for review of data entry

Number and training of the data entry staff
Division of labour between price collection and data entry and validation
Double data entry
Checking the filled questionnaires before data entry
Number of forms per person per day
Errors and consistency checking procedures
Supervision of data entry
Error rate per data entry staff

3.8 Data Editing and Validation

One of the major pillars of data quality is data editing and validation, which needs to be carried out at both the national and the regional levels:

National Level

Individual price observation are edited and checked at the national level in view of identifying extreme values and outliers subsequently. To that end data editing software like the Semper Validation Software or the ICP Tool Pack are used. The Semper Validation Software is an integrated application developed by the African Development Bank. It is designed for editing price data collected in the context of ICP-Africa. It checks the surveys constants (product codes, name, quantity, unit of measurement and other product characteristics), convert the observed quantity to the reference quantity if necessary and identify errors and outliers using graphical tables. The ICP Tool pack is a comprehensive software package developed by the World Bank for collecting, validating and processing price and expenditure data. Editing softwares use descriptive statistics to identify extreme

values. Possible descriptive statistics to be used in that identification of extreme values are:

- Minimum-Maximum ratio $\frac{X_{\min}}{X_{\max}}$

- Variation (standard deviation) $S = \left[\frac{1}{n-1}\sum (X_i - \overline{X})^2\right]^{\frac{1}{2}}$

- Relative variation (coefficient of variation) $CV = \frac{S}{\overline{X}} * 100$

- Ratio of the deviation of individual observation from the mean to the standard deviation $t^* = \frac{X_i - \overline{X}}{S}$

- Studentized deviation $St = \frac{X_i - \overline{X}}{\left[S^2 (1 - \frac{1}{n})\right]^{\frac{1}{2}}}$

Extreme values are not necessarily outliers. National experience and national market knowledge should be used to explain extreme values and identify outliers.

Regional Level

While individual price observations are examined for possible errors at the national level, estimated national averages need to be edited at the regional level. It entails comparing the average prices for the same product in different countries. To that end the following tools can be used:

- Quaranta tables (QT): they are used to convert estimated national averages into a common unit of currency using exchange rate and/or PPP, and to screen them for possible errors. Those errors are examined through regional consistency of the individual national averages.
- Dikhanov tables (DT): they can be used at different levels of aggregation. Country Product Dummy (CPD) residuals and their standard errors

at different levels (overall, product and country) are used to identify extreme values and errors. The CPD computations can be done at the basic heading, class or GDP levels.
- Multivariate data analysis techniques like principal component analysis (PCA) can be used to study the overall variability at the basic heading level across the countries.

Both QT and DT can be computed using the ICP Tool Pack. Quaranta tables can also be computed using ELFA, an application developed by the African Development Bank.

Those intra and inter country data validations should be conducted by national and regional ICP-Africa teams through country visits, retreats, subregional and regional workshops. In addition to those validations, consistency (over time) analysis should be carried out as data is collected over a period of time. For monthly ICP-Africa data collection, in the simplest case of an increase of r% of the average price of an item from one month to the next, it can be shown that the relative variation of the 12 month data measured by the coefficient of variation (CV) of that item is the same as that of the series:

$$(1 + r)^1 \text{ for } i = 0, 1, 2, ..., 11. \qquad (1)$$

From equation (1), given r values, different CV values can be computed in view of determining a threshold value of the CV to be used in the consistency analysis.

In the process of data editing and validation, it should be noted that: (i) variation in the data needs to be explained and controlled and (ii) getting rid of the whole variation of a data set is equivalent to taking out its essence and as result the data set is of no value.

Also a successful data editing and validation requires a close collaboration among all the stakeholders. The process should be conducted at both national and regional levels through an iterative process between the two levels.

4. Indicators of Quality

As indicated earlier, the price data are subject to two kinds of errors: sampling error and non-sampling errors. The quality insurance guidelines are proposed to deal and minimize those errors. It is useful to summarize the

quality assurance by ways of indicators. The indicators can then be used to evaluate the quality of the survey. In case of probability sampling, the main indicator of a survey's quality in terms of sampling error is the estimated standard error for the estimated quantities. Non-sampling errors deserve as much attention as sampling errors but there has not been a systematic set of indicators proposed to quantify them in view of monitoring the quality of a survey. This is partly due to the fact it is very difficult to use quantitative measures to assess non-sampling errors. Some of these non-sampling errors lend themselves to measurement and quantifications:

4.1 Non-observation Bias

The main objective of the ICP is to use PPPs to convert or deflate annual expenditure data from the national accounts. To that end, the scope of the survey should be the entire country in the reference year. Prices should be collected from a national sample of outlet and during the entire reference year. National annual prices of goods and services in participating countries are needed. For given country and product suppose the product is available in N outlets, N_{nc} of whom are not covered by the sampling frame. Lepkowsky (2005) quantified the non-observation bias in a general survey situation. For the case of ICP, let the national average (the price mean of the product in the N outlets) be $\overline{Y}$, $\overline{Y_c}$ the price mean of the product in the outlets covered by the frame and the price mean of the product in the outlets not covered by the frame. The error of non-coverage is referred to as non-coverage bias of the sample mean $\overline{Y_c}$, which in fact is estimating $\overline{Y_c}$ rather than $\overline{Y}$.

The bias of the sample mean $\overline{y_c}$, i.e. the difference between $\overline{Y_c}$ and $\overline{Y}$can be shown to be equal to:

$$\frac{N_{nc}}{N}(\overline{Y_c} - \overline{Y_{nc}}) \qquad (2)$$

The bias depends on two components, the proportion N_{nc}/N of the units not covered and the difference between the means of the price of the product in the covered outlets and not covered outlets.

Agriculture products are usually cheaper in rural areas than in urban areas while the opposite trend is observed for manufactured products. Thus in ICP surveys if price are collected in urban areas only to estimate national average prices of products, then the estimates will be heavily biased. Differences in outlet prices between urban and rural areas should be considered

when comparing countries in which the shares of the population living in rural and urban areas differ significantly. The PPPs derived from such prices may be seriously biased if prices are only collected in urban areas.

4.2 Rejection Rate

The rejection rate is defined as the proportion of prices that are rejected during the editing and validation process. A low rejection rate indicates a good understanding of the survey operations (product specifications, use of questionnaire to record the prices, data entry software, etc.) and as such is a composite quality indicator.

4.3 Data Collectors' Bias

Quantifying measurement errors due to data collectors, questionnaire and method of data collection requires taking additional steps. For ICP-Africa, emphasis will be on data collectors given the simplicity of the questionnaire and data collection through outlet visits. The understanding of the questionnaire and its proper use to collect prices can easily be achieved through training.

During the first and second quarters of data collection, randomly selected 5% to 10% of the total number of outlets in each collection center should be visited and data collected a second time by different data collector(s), a supervisor and an independent experienced data collector immediately after the planned visits. Prices are collected a second time in the same outlets to ensure that the initial price collection has been done properly and to identify data collectors who falsify data or data collectors who misunderstand procedures and require remedial training.

The second collection of data should be carried out using a controlled experiment. Suppose we have p outlets and n data collectors including the supervisor and the independent data collector. The n data collectors take turns to visit and collect data independently in each of the p outlets. The turns of visit of the data collectors in any of the p outlets are randomized. For a given product, the variation among np prices can be analysed using a two way analysis of variance. The hypothesis of the equality of the price means of data collectors (H_0) versus the hypothesis that at least two of the means are not equal (H_a) can be tested with an F test with (n-1) and (n-1)*(p-1) degrees of freedom. The observed F is equal to the ratio of the data collectors' mean squares to the residual mean squares.

$$H_0 : \mu_{DC1} = \mu_{DC2} = \cdots = \mu_{DCn} \quad (3)$$

$$H_a : \text{at least two of the means are not equal} \quad (4)$$

$$F_{obs} = \frac{MS_{DataCollectors}}{MS_{\text{Re}sidual}} \quad (5)$$

The rejection of the hypothesis of the equality of price means is based on the observed significance level, which in this case is equal to:

$$\hat{\alpha} = \Pr ob(F_{(n-1)*(p-1)}^{(n-1)} \geq F_{obs}) \quad (6)$$

The observed significance level is measure of evidence to support or not to support the hypothesis of equality of means. The smaller, the more we are inclined to reject H_0.

If H_0 is rejected, mean comparisons can be carried out with orthogonal contrasts or using multiple comparison methods for pair-wise comparisons. Using one of the methods of multiple comparisons, the Least Significance Difference (LSD), price means of a product collected by two data collectors A and B is declared significant at the 95% level if

$$\left|\overline{X}_A - \overline{X}_B\right| \geq LSD_{0.95}, \text{ where } \quad LSD_{0.95} = t_{(n-1)*(p-1),(0.95)} \sqrt{2\frac{MS_{\text{Re}sidual}}{p}} \quad (7)$$

and $t_{(n-1)*(p-1),(0.95)}$ is the 95th percentile of the t distribution with (n-1)*(p-1) degrees of freedom.

Conclusion and Recommendations

In reporting survey results, parameters estimates are often presented without estimates of their errors. When an attempt is made, only sampling errors are considered. However the total survey error is composed of sampling and non-sampling errors. In price surveys, the latter is composed of mis-specification, non-coverage, questionnaire and data collector biases, and implementation errors.

Quality assurance procedures should be implemented through out the data collection, editing, validation analysis and dissemination in view of improving the quality of the data. The process should not be on a post hoc basis but should be continuous. To that end, the source of errors should be identified at each step of the survey and the overall quality of the survey should be monitored while the survey is still ongoing.

The checklists used to assess the quality of the frame, the questionnaire, the sampling, the training, could be used to allocate a numerical value on a given scale to the operation/instrument. The allocation should be done by an expert independent of the process and should be carried out by visiting the countries and reviewing the different steps of the data collection. The allocated scores can then be used to assess the quality of the survey.

The reports of the supervision missions, the statistics used in the editing and validation steps specially the QT and DT tables and the PCA analysis, the analysis of the randomised experiments should be used to continuously monitor the quality of the data in view of taking corrective actions while the survey is ongoing.

The overall aim of the procedures is to provide support to improve the quality rather than to audit the data collection and processing operations.

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