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Some Statistical Dimensions in the Generation of Philippine Poverty Statistics

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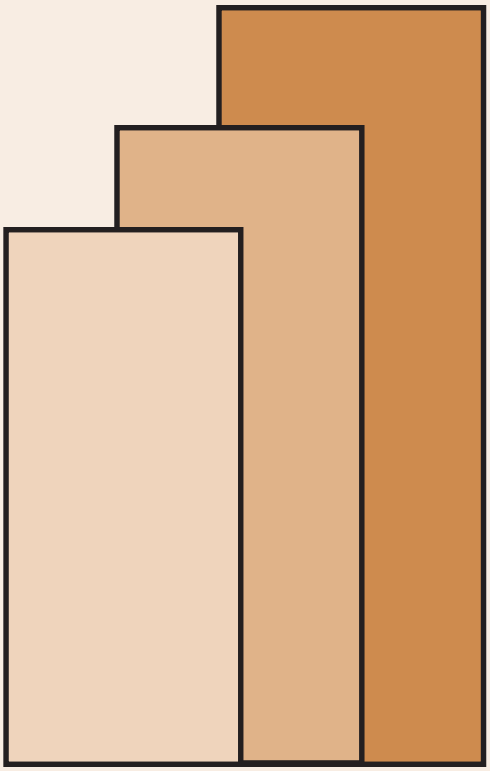

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SOME STATISTICAL DIMENSIONS IN THE GENERATION OF PHILIPPINE POVERTY STATISTICS[1]

Arturo Y. Pacificador, Jr.[2]

Abstract

This paper presents some statistical issues and possible solutions in the estimation of Philippine Poverty Statistics based on the official methodology adopted. In particular, the paper shows the effect of survey weights used in the estimation of population counts, number of households, number of poor households, and number of poor persons among others. The empirical evidence using combined data sets from the Labor Force Survey and the Family Income and Expenditure Survey shows the extent of possible underestimation of magnitudes using the official methodology and thereby necessitating a possible revision. Ultimately, the paper recommended an alternative approach in generating household weights that would yield estimates which are consistent with population projections.

Keywords: household weights, survey weights, poverty statistics, poverty magnitude, FE/TBE, Principal Person Weights

[1] This paper is part of a bigger report for the UNDP-funded project titled "Comprehensive Documentation and Analysis of the Official Poverty Estimation Methodology of the Philippines" implemented by PIDS in cooperation with the National Economic and Development Authority (NEDA) and the Technical Committee on Poverty Statistics (TCPOVSTAT).

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Introduction

This paper presents some statistical issues and possible solutions in the estimation of Philippine Poverty Statistics based on the official methodology adopted. In particular, the paper will show the effect of survey weights used in the estimation of population counts, number of households, number of poor households, and number of poor persons among others. The empirical evidence using combined data sets from the Labor Force Survey and the Family Income and Expenditure Survey shows the extent of possible underestimation using the official methodology and thereby necessitating a possible revision. It must be noted however, that this paper focuses only on the generation of the survey weights which is a vital component in the methodology.

Estimation of Philippine Poverty Statistics

As described by Virola, et.al. (2005), the generation of official poverty statistics begins with the estimation of poverty threshold. This is a function of food threshold (FT) and the ratio of Food Expenditure (FE) with Total Basic Expenditure (TBE). Details of the computations are presented in the same paper. Once poverty threshold is determined by urban-rural areas in a province, this is compared with per-capita family income. If the per-capita family income is less than the poverty threshold value, then such family is classified as poor. After such classifications of families are made, the corresponding estimates such as poverty incidence of families; total poor (non-poor) families; poverty incidence of population; and, poor population are computed. Generally, such statistics can be regarded as estimates of population totals and proportions which in general for a specific domain can be expressed respectively as:

$$\hat{X}_d = \sum_{k \in s}^{n_d} w_{dk} x_{dk} \tag{1}$$

$$\hat{p} = \frac{\sum_{k \in s}^{n_d} w_{dk} x_{dk}}{\sum_{k \in s}^{n_d} w_{dk}} \tag{2}$$

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where d denotes a domain or subdivision of the population; k denotes a family/household, w_{dk} is the survey weight appropriately generated for household k from domain k; and, x_{dk} is the value of a particular characteristic measured/observed for household k in domain d. In the case of estimating the proportion of poor families, x_{dk} is equal to 1 if the family is considered poor and 0 otherwise.

The survey weights for this purpose is developed n a series of stages to compensate for unequal selection probabilities attributed to the selection of sample households (sampling design); nonresponse; and, noncoverage primarily to ensure that the sample distribution conforms to known population distribution. The first stage of weighting for unequal selection probability is determined in a straightforward manner by taking the inverse of selection probabilities (i.e. the probability that a household in a domain is included in the sample). This weight is often times referred to as the Base weights. The second stage of weighting is determined to compensate for unit nonresponse based on the implied assumption that nonresponse occurs at random. In here, nonresponse adjustment cells are created and the weighted response rates are computed for each cell. The base weights are then multiplied by the inverse of computed response rates. After adjustment for nonresponse, the last stage of weighting is performed to ensure that estimates from the sample are consistent with known population distribution for key variables such as total population and total number of households. Kalton and Flores-Cervantes (2003) points out that such adjustment often serves two purposes namely: (a) to compensate for noncoverage; and, (b) to improve the precision of the estimates. It was further noted, that when there is large extent of nonresponse and noncoverage, such adjustments to the base weights are used to reduce the bias of the survey estimates but standard errors for estimates which are not related to the adjustment variables may be increased.

The basic data that is used in the generation of official poverty statistics in the Philippines is the Family Income and Expenditure Survey (FIES). The FIES is a shuttle type survey that generates income and expenditure values of households where measurements are taken for the same of households in July and January of the reference year. The July round represents measurements for the period January to June of the reference year and the January round (immediately after the reference year) represent measurements for the period July to December. The FIES is a major module of household surveys conducted by the National Statistics Office (NSO) and is conducted once every three years beginning 1985. Starting 2003, the FIES made use of the 2003 Master Sample of the NSO. The 2003 Master Sample (MS) is a sample of households selected using a stratified multi-stage design with regions as the major domains and provinces and independent cities as major strata. In here, major domain is defined following Kish and Purcell (1990) definition that it is a subdivision of the population in which estimates of acceptable precision are desired or guaranteed. By design, the 2003 MS is approximately a self-weighting design at the region level which implies that there is expectedly a slight increase in the variance of the estimates at the region level due to variation in the base weights.

In the 2003 official methodology adapted in the generation of key poverty statistics, following are the steps undertaken in the generation of survey weights.

1. The base weights were generated by computing the inverse of selection probabilities. The selection probabilities of the sample households in the MS are properly documented and this step is straight-forward.

2. To compensate for unit nonresponse, nonresponse adjustment cells were first formed in each secondary stratum within a province. The secondary strata consist of 4 primary sampling units which is defined as a barangay or group of contiguous barangays with at least 500 households based on the 2000 Census of Population and Housing (CPH) counts. Each certainty PSU was treated as a separate stratum in each province/region. For the noncertainty PSUs, two PSUs were combined to form a nonresponse adjustment cell. The sample size was the determining factor in the determination of adjustment cells. In each nonresponse adjustment cell, the weighted response rate was computed. The inverse of such rates were multiplied to the base-weights.

3. To ensure that the weighted estimates would be consistent with the total number of households, a third weighting adjustment was performed at the province level by scaling the weights so that it becomes consistent with some projected total number of households. Unfortunately, the Philippine Statistical System has no adopted procedure in projecting the total number of households. Thus, as a solution to this problem, a crude estimate of total number of households in a province was obtained by dividing the projected population with average household size in the province computed from the 2000 CPH.

The final survey weights can be expressed as:

$$w_{pk} = (\text{Base Weigths})_{pk}\, x(1/\bar{R}_{pa})\ x \frac{(P_p / \bar{H}_{p,2000})}{\sum_{k \in s}^{n_p} (\text{Base Weigths})_{pk}\, x(1/\bar{R}_{pa})} \qquad (3)$$

where p refers to a province; a refers to a nonresponse adjustment cell; k refers to a responding sample household; $(\text{Base Weights})_{pk}$ refers to the base weight attached to household k in province p and computed as the inverse of selection probabilities; $\bar{R}_{pa}$ is the weighted response rate computed from nonresponse adjustment cell a in province p; P_p is the projected population for province p; and, $\bar{H}_{p,2000}$ is the average household size for province p from the 2000 CPH.

A major issue arising using this estimation methodology is that the estimated poor population is not consistent with projected population. Table 1 shows the differences between estimated poor population and projected population in 2003.

Table 1.
Comparison of estimated total population from 2003 Official Poverty Estimates with Projected Population

Region	PUBLISHED ESTIMATES			Projected Population	Diff	%Diff
	Estimated Total Poor Population	Estimated Total Non-Poor Population	Estimated Total Population			
	(1)	(2)	(3)	(4)	(5)=(3)-(4)	(6)=(5)/(4)
1 - Ilocos	1,262,799	2,915,796	4,178,595	4,540,906	-362,311	-8.0
2 - Cagayan Valley	659,667	2,036,958	2,696,625	3,005,931	-309,306	-10.3
3 - Central Luzon	1,535,784	7,243,100	8,778,884	8,910,542	-131,658	-1.5
4A - CALABARZON	1,899,827	8,426,323	10,326,150	10,283,133	43,017	0.4
4B - MIMAROPA	1,163,867	1,256,315	2,420,182	2,545,344	-125,162	-4.9
5 - Bicol	2,332,720	2,476,660	4,809,380	5,041,583	-232,203	-4.6
6 - Western Visayas	2,374,772	3,680,002	6,054,774	6,678,626	-623,852	-9.3
7 - Central Visayas	1,652,316	4,188,759	5,841,075	6,167,057	-325,982	-5.3
8 - Eastern Visayas	1,619,731	2,143,310	3,763,041	3,899,648	-136,607	-3.5
9 - Zamboanga Peninsula	1,427,722	1,471,618	2,899,340	3,060,336	-160,996	-5.3
10 - Northern Mindanao	1,567,963	1,992,261	3,560,224	3,798,710	-238,486	-6.3
11 - Davao	1,346,269	2,537,983	3,884,252	3,921,476	-37,224	-0.9
12 - SOCCKSARGEN	1,319,562	2,114,356	3,433,918	3,524,104	-90,186	-2.6
13 - NCR	742,549	9,943,808	10,686,357	10,546,706	139,651	1.3
14 - CAR	445,036	937,143	1,382,179	1,479,124	-96,945	-6.6
15 - ARMM	1,373,620	1,225,632	2,599,252	3,062,117	-462,865	-15.1
16 - CARAGA	1,111,901	946,797	2,058,698	2,252,621	-193,923	-8.6
PHILIPPINES	23,836,104	55,536,820	79,372,924	82,717,965	-3,345,041	-4.0

SOURCE OF BASIC DATA: 2003 Family Income and Expenditure Survey and Medium Assumptions Population Projection January 1, 2004.

The results in table 1 shows that the estimate of total population using the official methodology is about 4% lower than the projected population or in absolute numbers about 3.3 million persons. The underestimation of population counts was consistently observed across regions except in to of the most populous regions (CALABARZON and NCR) where there was an observed slight overestimation. The results shown in Table 1 is not totally unexpected as similar problems were also observed elsewhere particularly in countries where there is already an establish system in place for the generation of weights at the individual level such as the case of the Labor Force Surveys (LFS) (Lemaitre and Dufour, 1986). As such, careful study must be made in the generation of household weights.

Generation of Household Weights

As mentioned by Lemaitre and Dufour (1986), most household surveys has for its major component and perhaps it main mandate is the generation of estimates at the individual or person level such as the labor force characteristics. In such instances, data on inter-censal changes in population are readily available in the form of population projections based on widely accepted methodologies. Often the change in population is broken down with respect to other demographic characteristics such as gender, age and in some countries race/ethnicity and geography (province, regions). Such information is vital in the generation of person-level weights to ensure that the estimates conform or are consistent with know population distributions. For such purpose, different weighting methods can be applied such as those presented in Kalton and Flores-Cervantes (2003).

The situation is more complicated for family or household level data. In most systems, administrative records that tracks and measures changes on the number of families/households in between census years is incomplete or totally lacking and there is no system in place that allows the projection of the number of households similar to the case of populations.

What is available are person-level weights usually determined to be consistent or preserve known population totals. Given such weights, the challenge in developing household weights is to use this as basis in determining appropriate household weights so that when such household weights are used to replace person-level weights, the estimates of totals would be consistent or close to known population totals thereby minimizing the occurrence of inconsistencies such as those presented in Table 1.

A common approach in the generation of household weights given person level weights is to select a weight of a reference person in the same household. Such approach is referred to as the Principal Person Weight where the weight of the so-called principal person is regarded as a characteristic of a household. Any member of a household can be chosen as the principal person. In the initial implementation of this approach to household weighting adopted for the American Community Survey, the first person listed in the questionnaire is chosen as the reference or principal person (Albright, Navarro and Asiala, 2004). However, the results showed that such choice for household weight from given person-level weights has failed to make survey estimates consistent with known population totals.

Another approach in the determination of household weights using person-level weights is to find a weight, say w_k^* that minimizes some form of distance function $d(w_{kl} - w_k^*)$ at the household level (Alexander and Roebuck, 1986). That is, the weight is determined so that the difference between household weight and person weight is as small as possible.

Proposed Household Weights for the Generation of Official Poverty Statistics

Given the limitations in the determination of the household weights in the official methodology, some proposed methods of determining household weights are considered. The proposed procedures require person-level weights. To facilitate this, it is necessary to merge the January 2004 round of the Labor Force Survey (LFS) files (NSO, 2004) with the 2003 FIES files (NSO, 2003). The purpose of merging these files is to allow the integration of person-level files into households covered in the FIES. It must be noted though, that as result of merging these files, the final FIES file will not be the same as the FIES files used in the generation of official poverty statistics. After performing an exact match of the two files with the corresponding base weights and household weights after adjusting nonresponse, the following steps were performed in the generation of person-level and household weights.

1. From the merged files, two separate files were created – one for the LFS and the other for the FIES component. From the LFS component, the final person weights were determined using raking-ratio adjustment procedure adopted by the NSO using the January 2004 medium assumption population projection as basis.

2. Once the final person level weights were determined, the weight assigned to the household head was used as the principal person weight (PPW).

3. Using the same LFS files with the final person weights, two household weights were computed. These are the mean (MEAN) and median (MEDIAN) weights of the person-level weights by household. The mean weight was computed because at the household level, it is the value (w_h^*) that minimizes $\sum_{k=1}^{n_h}(w_{hk} - w_h^*)^2$. Similarly, the median weight was computed because at the household level, it is the value (w_h^*) that minimizes $\sum_{k=1}^{n_h}| w_{hk} - w_h^* |$. In here, *h* refers to a household; *k* refers to a member of the household; n_h is the household size; and, w_h^* is the determined household weight.

Thus, five different household weights are proposed. Table 2 presents the labels denoting the household weight and their brief description.

Table 2.
Household weights considered and their labels.

HOUSEHOLD WEIGHT LABEL	DESCRIPTION
OFF	Official methodology used in the 2003 FIES for purposes of generating official poverty statistics.
BASE	The weight assigned to a sample household which is the product of the original MS Base weight (inverse of selection probability) and the inverse of weighted response rate computed from nonresponse adjustment cells. The original household weight without post-stratification adjustment.
PPW	Principal person weight which is equal to the final person weight of the household head.
MEAN	Mean of final person weights in a household
MEDIAN	Median of final person weights in a household.

Impact of Household Weights in the Estimation of Population Counts

Once the household weights were determined, they were assigned to the members of the household for the purpose of determining its effects in the estimation of population counts. The sample sum of weights generally is believed to be an estimate of the size of a population. Figure 1 shows the projected estimated population counts of each household weight considered. It can be seen that of the five household weights considered, the estimate of total population using mean household weight appears to be consistent with total population count with median weight very close. Note that when no adjustment for population counts are made, the original household weight adjusted for nonresponse severely underestimates total population. This is basically due to the fact that selection probabilities were based on the 2000 CPH. This result also highlights the need to make the necessary post-stratification adjustment. Consistent with the results in Table 1, the weight adjustment used in the official methodology underestimates the total population. Such underestimation was also observed using the principal person weight. Table 3 shows the effect of such weights in the estimation of population counts by region in terms of differences of the estimate from the projected value and its percentage change.

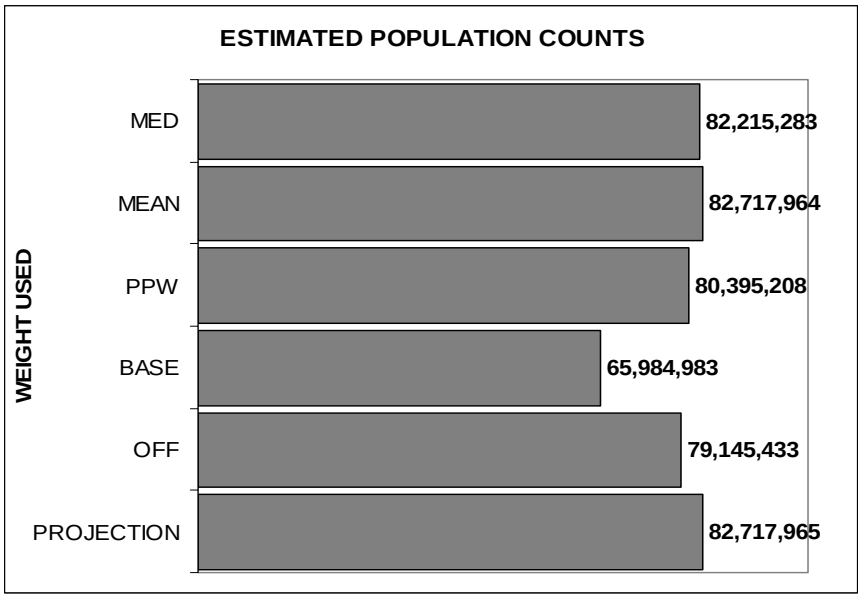

Figure 1.
Projected and Estimated population counts with different weights.

Table 3 shows that among the household weights considered, only the mean household weight yielded estimates of regional population counts that are consistent with projected values. Generally, there is an underestimation of regional population counts with the other weights. Percentage wise, the estimated population counts using the official methodology is about 4% less than the projected count at the national level and a high of 17% less than the projected population count in the ARMM. There was very slight underestimation of regional population counts percentage-wise using median weights and performed better than the principal person weights with regards to establishing consistency of the estimates with projected counts. Estimation of regional population counts using the mean, median and principal person weights performed better than the official methodology. The estimated population counts by different household weights at the region and national levels are shown in Appendix Table 1.

Table 3.
Difference and %difference of estimated population counts using different weights with projected population by region.

REGION	PROJECTED POPULATION	WEIGHT USED									
		OFF		BASE		PPW		MEAN		MEDIAN	
		Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	4,540,906	-177,867	-3.9	-567,197	-12.5	-119,422	-2.6	0	0.0	-25,718	-0.6
2 - Cagayan Valley	3,005,931	-243,600	-8.1	-377,827	-12.6	-54,338	-1.8	0	0.0	-14,015	-0.5
3 - Central Luzon	8,910,542	-36,309	-0.4	-1,277,922	-14.3	-316,645	-3.6	0	0.0	-63,797	-0.7
4A - CALABARZON	10,283,133	-181,873	-1.8	-1,604,051	-15.6	-298,642	-2.9	1	0.0	-68,093	-0.7
4B - MIMAROPA	2,545,344	-98,582	-3.9	-374,142	-14.7	-62,209	-2.4	0	0.0	-21,995	-0.9
5 - Bicol	5,041,583	-113,400	-2.2	-806,175	-16.0	-97,236	-1.9	0	0.0	-27,668	-0.5
6 - Western Visayas	6,678,626	-230,314	-3.4	-989,247	-14.8	-243,216	-3.6	1	0.0	-42,760	-0.6
7 - Central Visayas	6,167,057	-224,339	-3.6	-688,257	-11.2	-102,463	-1.7	-1	0.0	-12,046	-0.2
8 - Eastern Visayas	3,899,648	67,262	1.7	-356,591	-9.1	-124,510	-3.2	0	0.0	-28,508	-0.7
9 - Zamboanga Peninsula	3,060,336	-165,817	-5.4	-760,582	-24.9	-80,247	-2.6	0	0.0	-21,224	-0.7
10 - Northern Mindanao	3,798,710	-209,895	-5.5	-958,036	-25.2	-72,120	-1.9	0	0.0	-20,176	-0.5
11 - Davao	3,921,476	-139,941	-3.6	-1,098,388	-28.0	-109,182	-2.8	0	0.0	-26,478	-0.7
12 - SOCCKSARGEN	3,524,104	-134,812	-3.8	-707,711	-20.1	-82,299	-2.3	0	0.0	-25,100	-0.7
13 - NCR	10,546,706	-991,957	-9.4	-4,774,825	-45.3	-410,581	-3.9	-1	0.0	-74,054	-0.7
14 - CAR	1,479,124	-36,938	-2.5	-235,935	-16.0	-26,298	-1.8	0	0.0	-5,396	-0.4
15 - ARMM	3,062,117	-537,617	-17.6	-765,291	-25.0	-94,770	-3.1	0	0.0	-20,680	-0.7
16 - CARAGA	2,252,621	-116,536	-5.2	-390,806	-17.3	-28,581	-1.3	0	0.0	-4,973	-0.2
PHILIPPINES	82,717,965	-3,572,532	-4.3	-16,732,982	-20.2	-2,322,757	-2.8	-1	0.0	-502,682	-0.6

*Diff = Estimate – Projected Population; %Diff= (Diff/Projected Population)*100*

Comparison of Estimated Number of Households

Using the household weights defined, the total number of households was likewise estimated at the national and regional levels. Figure 2 shows the estimated total number of households using the different household weights at the national level. As expected, the estimated total number of households was smallest when no weight adjustment was applied. Moreover, it was observed that the estimated number of households using PPW, MEAN and MEDIAN weights were higher as compared to same estimate using official weights. This result is consistent with the estimated population counts thereby suggesting underestimation when the official weights are used. Table 4 shows the magnitude and percentage of the differences in the estimates using BASE, PPW, MEAN and MEDIAN weights with the weight corresponding to the official methodology. Underestimation of the total number of households using the official methodology is evident in most regions with the highest percentage difference recorded in the ARMM. Using the MEAN weight, the estimated total number of household is 20% higher as compared to the official methodology. The estimated values using the different weights are shown in Appendix Table 2.

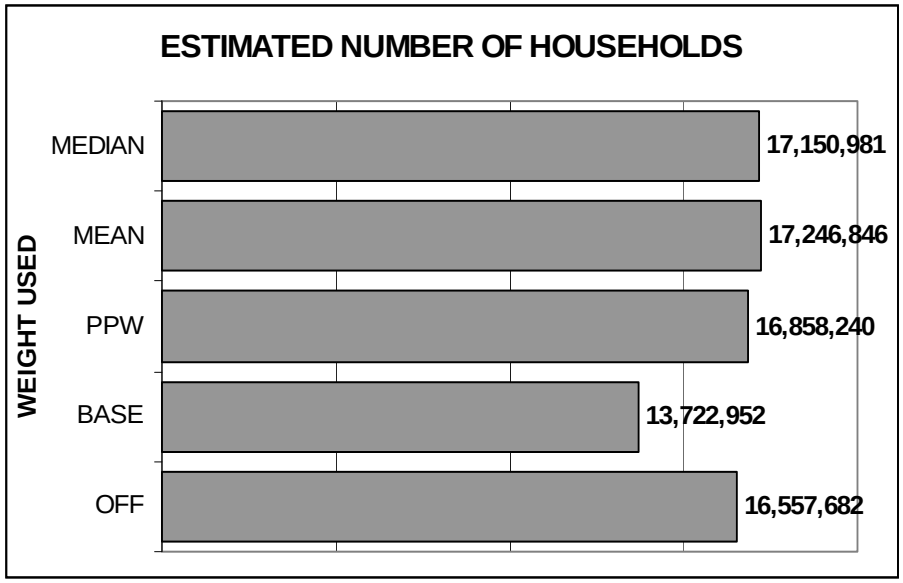

Figure 2.
Estimated number of households by weight used.

Table 4.
Difference and percentage difference of the estimated number of households between official methodology and other household weights by region.

REGION	WEIGHT USED								
	OFF	BASE		PPW		MEAN		MEDIAN	
		Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	899,719	-80,150	-8.9	12,652	1.4	31,800	3.5	27,030	3.0
2 - Cagayan Valley	593,122	-28,659	-4.8	40,542	6.8	49,553	8.4	47,002	7.9
3 - Central Luzon	1,812,688	-255,592	-14.1	-54,762	-3.0	-2,136	-0.1	-14,361	-0.8
4A - CALABARZON	2,122,084	-302,100	-14.2	-21,773	-1.0	27,459	1.3	13,785	0.6
4B - MIMAROPA	510,414	-56,067	-11.0	8,723	1.7	19,170	3.8	15,041	2.9
5 - Bicol	962,437	-135,031	-14.0	2,221	0.2	17,739	1.8	12,779	1.3
6 - Western Visayas	1,304,874	-154,338	-11.8	-2,405	-0.2	38,763	3.0	30,100	2.3
7 - Central Visayas	1,229,346	-95,898	-7.8	25,285	2.1	41,101	3.3	39,060	3.2
8 - Eastern Visayas	773,864	-81,774	-10.6	-36,697	-4.7	-15,976	-2.1	-21,407	-2.8
9 - Zamboanga Peninsula	593,520	-121,736	-20.5	18,232	3.1	30,788	5.2	26,582	4.5
10 - Northern Mindanao	748,289	-155,851	-20.8	29,834	4.0	40,762	5.4	37,080	5.0
11 - Davao	807,138	-204,477	-25.3	7,153	0.9	26,111	3.2	21,114	2.6
12 - SOCCKSARGEN	706,854	-117,434	-16.6	15,176	2.1	28,733	4.1	24,139	3.4
13 - NCR	2,277,907	-901,858	-39.6	151,270	6.6	226,650	9.9	212,248	9.3
14 - CAR	286,971	-40,070	-14.0	2,035	0.7	5,971	2.1	5,113	1.8
15 - ARMM	504,897	-48,815	-9.7	86,266	17.1	101,585	20.1	97,697	19.3
16 - CARAGA	423,559	-54,881	-13.0	16,806	4.0	21,093	5.0	20,297	4.8
PHILIPPINES	16,557,682	-2,834,730	-17.1	300,558	1.8	689,164	4.2	593,299	3.6

*Diff = Estimate(other)-Estimate(OFF); %Diff=(Diff/Estimate(OFF))*100*

Comparison of the Estimated Number of Poor Families

Figure 3 shows the estimated number of poor families using the five household weights. Similar to earlier results, the estimated number of poor families is larger by about 200,000 families using MEAN weight as compared to weight associated with the official methodology. This implies that if the characteristics and trends of the estimates from previous results apply in the estimation of the number of poor households then there is reason to believe that there is an underestimation using the official methodology and that about 200,000 poor families will be left out for targeting purposes. As shown in Table 5, the estimate using MEAN weight is higher by about 5% at the national level compared to the estimate using the official method. At the region level, the highest underestimation of the official methodology is in the ARMM. This would translate to the possibility of missing out close to 50,000 families in the region. The estimated values are shown in Appendix Table 3.

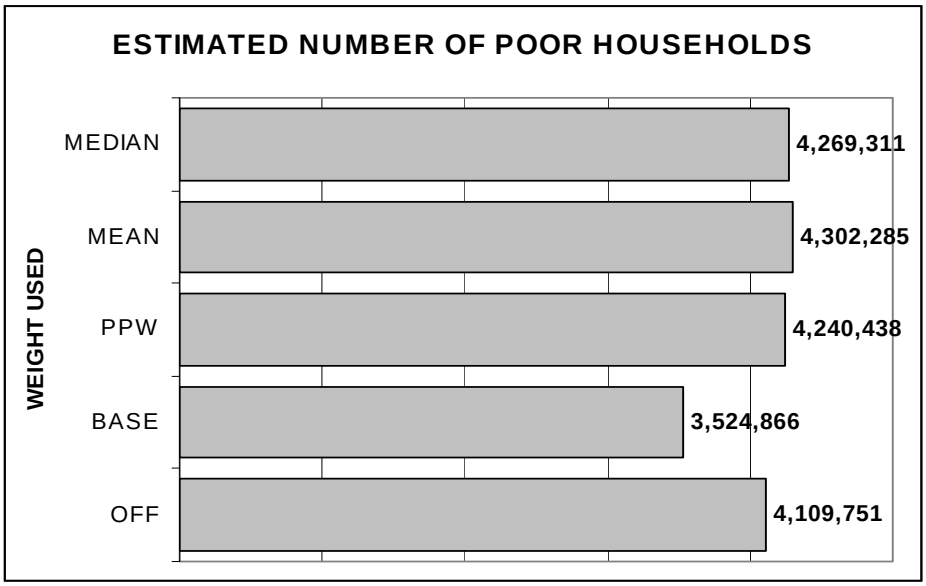

Figure 3.
Estimated number of poor households by weight used.

Table 5.
Difference and percentage difference of the estimated number of poor households between official methodology and other household weights by region.

REGION	WEIGHT USED								
	OFF	BASE		PPW		MEAN		MEDIAN	
		Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	217,252	-19,623	-9.0	6,233	2.9	8,326	3.8	6,239	2.9
2 - Cagayan Valley	110,639	-5,489	-5.0	9,570	8.6	10,219	9.2	9,253	8.4
3 - Central Luzon	240,659	-34,838	-14.5	-4,577	-1.9	-279	-0.1	-2,803	-1.2
4A - CALABARZON	337,152	-33,375	-9.9	16,423	4.9	21,136	6.3	17,524	5.2
4B - MIMAROPA	193,230	-21,074	-10.9	5,230	2.7	8,344	4.3	6,428	3.3
5 - Bicol	393,450	-55,088	-14.0	7,869	2.0	10,022	2.5	7,484	1.9
6 - Western Visayas	412,508	-50,638	-12.3	-528	-0.1	11,008	2.7	7,766	1.9
7 - Central Visayas	281,924	-24,665	-8.7	3,704	1.3	5,312	1.9	4,165	1.5
8 - Eastern Visayas	269,352	-27,483	-10.2	-9,995	-3.7	-3,723	-1.4	-5,725	-2.1
9 - Zamboanga Peninsula	281,646	-53,454	-19.0	16,085	5.7	20,589	7.3	18,180	6.5
10 - Northern Mindanao	291,910	-59,256	-20.3	16,631	5.7	18,931	6.5	16,889	5.8
11 - Davao	245,133	-61,862	-25.2	3,370	1.4	8,184	3.3	6,084	2.5
12 - SOCCKSARGEN	230,988	-39,935	-17.3	4,398	1.9	7,671	3.3	5,725	2.5
13 - NCR	97,014	-38,409	-39.6	7,459	7.7	9,458	9.7	8,390	8.6
14 - CAR	76,113	-9,556	-12.6	1,875	2.5	2,667	3.5	2,207	2.9
15 - ARMM	226,334	-20,592	-9.1	41,378	18.3	48,104	21.3	45,818	20.2
16 - CARAGA	204,447	-29,549	-14.5	5,566	2.7	6,566	3.2	5,935	2.9
PHILIPPINES	4,109,751	-584,886	-14.2	130,689	3.2	192,534	4.7	159,560	3.9

*Diff = Estimate(other)-Estimate(OFF); %Diff=(Diff/Estimate(OFF))*100*

Comparison of the Estimated Number of Poor Persons

As previously discussed, the difference on the number of poor families between the estimate using mean household weight and the estimate using official methodology is about 200,000 families. In terms of persons, this translates to a difference between the two methods of estimation of about one million persons as shown by Figure 4. Consistent with other results, no post-stratification adjustment would yield severe underestimation of the total number of poor families. In addition, the estimate based on official methodology is consistently lower as compared to the estimates using the PPW, MEAN and MEDIAN weights. Table 6 shows the extent of differences with the official methodology by region. Using the MEAN weight as benchmark figure and comparing it with the estimate based on the official methodology, there is consistent underestimation at the regional levels except in the Eastern Visayas region with the largest underestimation observed in the ARMM which translates to an underestimation of about 300,000 persons. The computed estimates by region and weights used are given in Appendix Table 4.

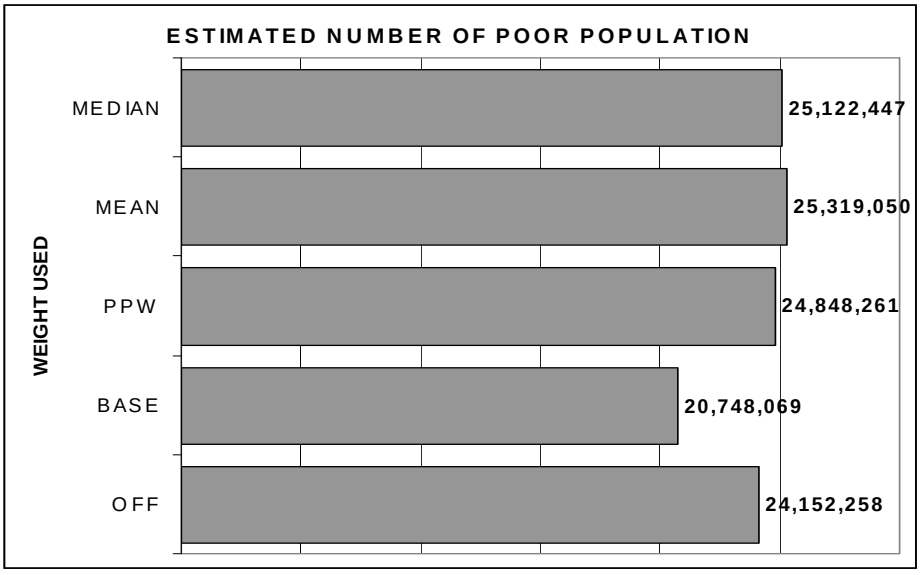

Figure 4.
Estimated number of poor population by weights used.

Table 6.
Difference and percentage difference on the estimated number of poor population between official methodology and other household weights.

REGION	WEIGHT USED								
	OFF	BASE		PPW		MEAN		MEDIAN	
		Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	1,297,212	-117,272	-9.0	33,655	2.6	51,475	4.0	38,938	3.0
2 - Cagayan Valley	661,811	-32,705	-4.9	54,488	8.2	60,605	9.2	54,553	8.2
3 - Central Luzon	1,530,550	-218,695	-14.3	-34,879	-2.3	954	0.1	-15,165	-1.0
4A - CALABARZON	1,951,777	-198,752	-10.2	84,708	4.3	122,289	6.3	101,696	5.2
4B - MIMAROPA	1,136,258	-125,726	-11.1	27,622	2.4	49,344	4.3	37,960	3.3
5 - Bicol	2,381,258	-334,597	-14.1	38,108	1.6	58,669	2.5	42,112	1.8
6 - Western Visayas	2,498,420	-305,198	-12.2	-5,480	-0.2	76,141	3.0	57,742	2.3
7 - Central Visayas	1,626,671	-140,043	-8.6	26,577	1.6	40,760	2.5	33,735	2.1
8 - Eastern Visayas	1,703,492	-174,868	-10.3	-65,592	-3.9	-19,829	-1.2	-31,988	-1.9
9 - Zamboanga Peninsula	1,530,205	-296,155	-19.4	78,533	5.1	110,814	7.2	97,716	6.4
10 - Northern Mindanao	1,624,627	-332,291	-20.5	83,988	5.2	105,374	6.5	93,111	5.7
11 - Davao	1,370,833	-344,583	-25.1	17,871	1.3	53,058	3.9	41,188	3.0
12 - SOCCKSARGEN	1,320,082	-229,413	-17.4	18,532	1.4	43,281	3.3	31,631	2.4
13 - NCR	552,068	-218,572	-39.6	41,102	7.4	55,758	10.1	49,176	8.9
14 - CAR	468,653	-58,254	-12.4	13,363	2.9	18,770	4.0	15,937	3.4
15 - ARMM	1,339,761	-112,733	-8.4	248,263	18.5	295,617	22.1	282,436	21.1
16 - CARAGA	1,158,581	-164,335	-14.2	35,144	3.0	43,709	3.8	39,411	3.4
PHILIPPINES	24,152,258	-3,404,189	-14.1	696,002	2.9	1,166,791	4.8	970,189	4.0

*Diff = Estimate (other)-Estimate(OFF); %Diff=(Diff/Estimate(OFF))*100*

Effect of household weights in estimating poverty incidence of families and population.

Figures 5 and 6 show that in terms of estimating poverty incidence of families and population, the differences in the estimates are not as large among the weights used. In particular, the difference between the estimates using the official methodology and the MEAN weight is only about 0.1 percent. The small differences in the proportions are not totally surprising considering that the weights considered are functions of the selection probabilities hence to some extent; such weights are proportional to the selection probabilities. When this happens, the difference in estimates of proportions or means is not expected to be large. This implies that if when the current estimates based on the

official methodology are revised using say the MEAN weight, the revised estimates for proportions or means is expected to be consistent with published results. Tables 7 and 8 shows the difference in the estimates of poverty incidences of families and populations of the different weights considered with such estimates using the official methodology by region. Percentage wise, the differences of the estimates compared to the official methodology is not as large as compared to estimates of totals across regions. The actual estimates are shown in Appendix Tables 5 and 6.

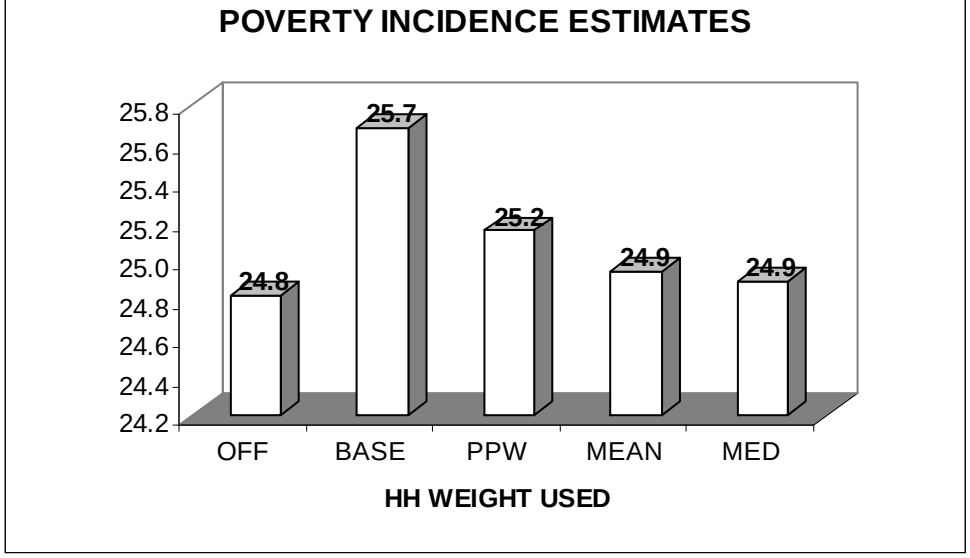

Figure 5.
Estimated incidence of poor households by weight used.

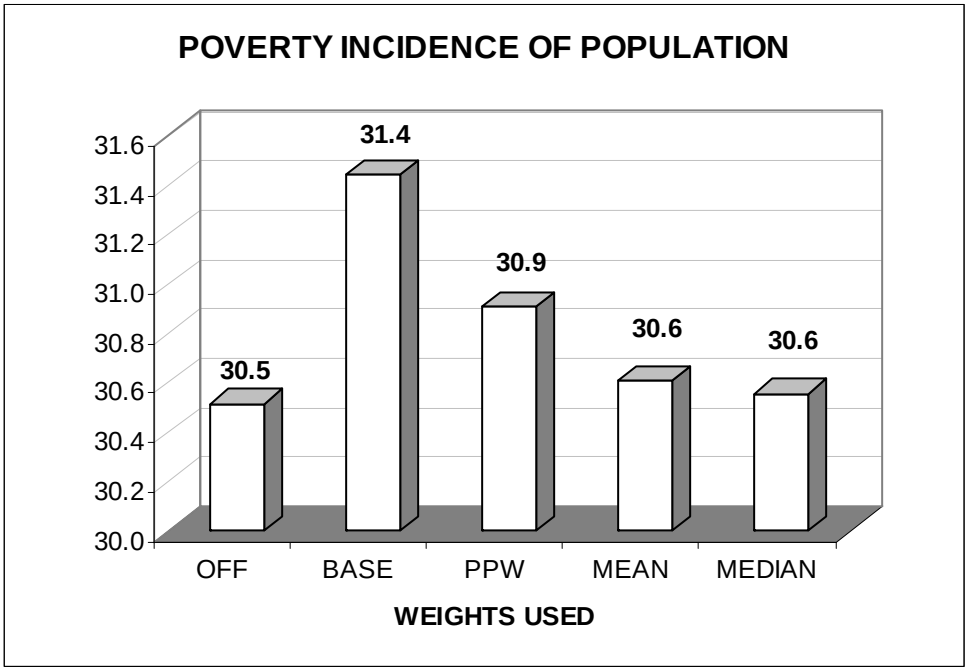

Figure 6.
Estimated incidence of poor population by weight used.

Table 7.
Difference and percentage difference on the estimated incidence of poor families between official methodology and other household weights by region.

REGION	WEIGHT USED								
		BASE		PPW		MEAN		MEDIAN	
	OFF	Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	24.1	0	-0.1	0	1.4	0	0.3	0	-0.1
2 - Cagayan Valley	18.7	0	-0.1	0	1.7	0	0.8	0	0.4
3 - Central Luzon	13.3	0	-0.4	0	1.2	0	0.0	0	-0.4
4A - CALABARZON	15.9	1	5.1	1	6.0	1	4.9	1	4.5
4B - MIMAROPA	37.9	0	0.1	0	1.0	0	0.5	0	0.4
5 - Bicol	40.9	0	0.0	1	1.8	0	0.7	0	0.6
6 - Western Visayas	31.6	0	-0.5	0	0.1	0	-0.3	0	-0.4
7 - Central Visayas	22.9	0	-1.0	0	-0.7	0	-1.4	0	-1.6
8 - Eastern Visayas	34.8	0	0.4	0	1.1	0	0.7	0	0.7
9 - Zamboanga Peninsula	47.5	1	1.9	1	2.6	1	2.0	1	1.9
10 - Northern Mindanao	39.0	0	0.7	1	1.6	0	1.0	0	0.8
11 - Davao	30.4	0	0.1	0	0.5	0	0.1	0	-0.1
12 - SOCCKSARGEN	32.7	0	-0.8	0	-0.2	0	-0.7	0	-0.9
13 - NCR	4.3	0	0.0	0	1.0	0	-0.2	0	-0.6
14 - CAR	26.5	0	1.6	0	1.7	0	1.4	0	1.1
15 - ARMM	44.8	0	0.6	0	1.0	0	0.9	0	0.7
16 - CARAGA	48.3	-1	-1.7	-1	-1.2	-1	-1.7	-1	-1.8
PHILIPPINES	24.8	1	3.5	0	1.3	0	0.5	0	0.3

*Diff=Estimate(other)-Estimate(OFF); %Diff=(Diff/Estimate(OFF))*100*

Table 8.
Difference and percentage difference on the estimated incidence of poor population between official methodology and other household weights by region.

REGION	WEIGHT USED								
		BASE		PPW		MEAN		MEDIAN	
	OFF	Diff	%Diff	Diff	%Diff	Diff	%Diff	Diff	%Diff
1 - Ilocos	29.7	0.0	-0.1	0.4	1.2	0.0	-0.1	-0.1	-0.5
2 - Cagayan Valley	24.0	0.0	-0.1	0.3	1.3	0.1	0.3	0.0	-0.1
3 - Central Luzon	17.2	-0.1	-0.3	0.2	0.9	-0.1	-0.3	-0.1	-0.7
4A - CALABARZON	48.3	0.0	0.0	0.6	1.3	0.1	0.2	0.0	0.0
4B - MIMAROPA	38.7	-0.2	-0.5	0.0	0.0	-0.2	-0.5	-0.2	-0.6
5 - Bicol	27.4	-0.2	-0.9	-0.1	-0.4	-0.3	-1.2	-0.4	-1.4
6 - Western Visayas	42.9	0.2	0.5	0.4	1.0	0.2	0.5	0.2	0.5
7 - Central Visayas	52.9	0.8	1.5	1.1	2.1	0.8	1.4	0.7	1.3
8 - Eastern Visayas	45.3	0.2	0.5	0.6	1.3	0.3	0.6	0.2	0.4
9 - Zamboanga Peninsula	36.3	0.1	0.3	0.2	0.5	0.1	0.2	0.0	0.0
10 - Northern Mindanao	38.9	-0.2	-0.6	-0.1	-0.1	-0.3	-0.7	-0.3	-0.8
11 - Davao	5.8	0.0	0.0	0.1	1.3	0.0	-0.3	0.0	-0.6
12 - SOCCKSARGEN	32.5	0.5	1.6	0.7	2.1	0.5	1.4	0.4	1.2
13 - NCR	53.1	0.4	0.7	0.4	0.8	0.3	0.6	0.3	0.5
14 - CAR	54.2	-0.8	-1.5	-0.6	-1.0	-0.9	-1.6	-0.9	-1.7
15 - ARMM	19.3	0.9	4.5	1.1	5.6	0.8	4.4	0.8	4.0
16 - CARAGA	46.4	0.1	0.2	0.4	0.9	0.1	0.3	0.1	0.2
PHILIPPINES	30.5	0.9	3.0	0.4	1.3	0.1	0.3	0.0	0.1

*Diff=Estimate(other)-Estimate(OFF); %Diff=(Diff/Estimate(OFF))*100*

Variance increase

Kalton and Flores-Cervantes (2003) points out that the main purpose of weighting adjustments is to reduce the bias in survey estimates that nonresponse and noncoverage can cause. This is highlighted by the results presented in which it appears that the noncoverage adjustment implemented using the official methodology results to underestimation of estimated totals. However, such adjustments are expected to result in increased variability in the weights leading to a loss in precision. Kish (1992) presented a useful measure of the loss of precision in the estimates as a result of variation in weights. He measures such loss in precision as

$$1+L=1+[cv(w_k)^2] \qquad (4)$$

where $cv(w_k)$ is the coefficient of variation of the survey weights w_k. For instance, a computed value of 1+L = 1.16 means that the variance of the estimate is inflated which would translate to reduction in the effective sample size of about 16%. The larger 1+L, the less precise the estimates are and thereby adding more pressure to increase the sample size to achieved desired levels of precision. The variance inflation factors due to the variation in weights introduced by post-stratification adjustments were computed and shown in Table 9. The results show no appreciable differences in the amount of variance inflation using OFF, PPW, MEAN and MEDIAN weights. This result provides additional justification to revise the official methodology with either the PPW, MEAN or MEDIAN weights. However, it appears that the bias introduced by the MEAN weight is smaller and thereby indicating the better weight adjustment strategy for noncoverage of households.

Table 8.
Variance Inflation Factors of the Different Household Weights.

HOUSEHOLD WEIGHT	Increase in Variance
OFF	1.14
BASE	1.08
PPW	1.15
MEAN	1.15
MEDIAN	1.15

Implications on Variance Estimation

Nonresponse and noncoverage clearly provides added degree of complexity in the generation of survey estimates of poverty parameters. As it is, the official methodology in the generation of poverty threshold values can be regarded as complex. Because of these added complexities, the method of estimating the variances becomes complex. One particular solution to the estimation of the variance for such situations is the use of the jackknife procedure of variance estimation. In this procedure, jackknife replicates are formed from which estimates are computed and pseudo-values are generated. The variance estimate is then computed as the variance of these pseudo-values. A common procedure in forming the jackknife replicates is to delete one psu at a time (delete one psu jackknife). When these replicates are formed the following steps are conducted for each replicate:

1. The survey proper survey weights are generated beginning with the generation of proper person level weights, i.e. raking ratio adjustment is performed for each replicate. Once this is done, the appropriate household level weights are determined, e.g. MEAN weight. By doing this, the procedure accounts for the complexity of the weights used.

2. In each replicate, poverty thresholds are computed using the prescribed methodology particularly in the determination of the FE/TBE ratio. Note that under existing procedure, food threshold values are computed using information outside of the FIES and thus it is expected that the food threshold values are constant for all replicates. However, because one (or a group of PSUs) are deleted one-at-a time in the generation of replicates, it is expected that the resulting FE/TBE ratio changes from one replicate to another. This would in turn result to different poverty threshold values in the replicates.

3. The procedure requires the creation of custom-made computer program to implement.

Summary and Conclusions

The results presented in this paper shows that the current methodology used in the generation of household weights results into underestimation particularly of totals. The paper also showed that other simple methods in the generation of household weights, in particular the mean of final person weights, yielded better estimates of totals in the sense that they are consistent with known population totals. In addition, the alternative procedures do not result to added increase in the variability in weights as compared to the official methodology. Thus the effect in precision is comparable but the alternative procedures result into substantial decrease in bias.

Therefore, there is a need to seriously consider revising the official methodology in the generation of household weights. Based on the results, the MEAN weight is a better alternative. However, for this recommendation to be realized there is a need to seriously look into the integration of the Labor Force Survey and the Family Income and

Expenditure Survey. Integrating these two major surveys will provide substantial benefits in the estimation and analysis of poverty statistics.

Recommendations

Other household weighting procedures may still be considered as this is obviously a continuing effort towards the improvement of the quality of estimates derived. There is also a need to develop a more organized system towards the integration of the Labor Force Survey and the Family Income and Expenditure Survey.

Appropriate variance estimation procedures that accounts for the complexity of both weight adjustment and method of determining poor families must also be developed.

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Appendix Table 1.
Projected population and Estimated Population by Household Weight and Region.

REGION	PROJECTED POPULATION	HOUSEHOLD WEIGHT				
		OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	4,540,906	4,363,039	3,973,709	4,421,485	4,540,906	4,515,188
2 - Cagayan Valley	3,005,931	2,762,332	2,628,104	2,951,593	3,005,931	2,991,916
3 - Central Luzon	8,910,542	8,874,234	7,632,621	8,593,897	8,910,543	8,846,745
4A - CALABARZON	5,041,583	4,928,183	4,235,408	4,944,347	5,041,583	5,013,915
4B - MIMAROPA	6,678,626	6,448,312	5,689,379	6,435,410	6,678,627	6,635,866
5 - Bicol	6,167,057	5,942,719	5,478,800	6,064,594	6,167,057	6,155,012
6 - Western Visayas	3,899,648	3,966,910	3,543,057	3,775,138	3,899,648	3,871,140
7 - Central Visayas	3,060,336	2,894,519	2,299,754	2,980,089	3,060,336	3,039,112
8 - Eastern Visayas	3,798,710	3,588,815	2,840,674	3,726,590	3,798,710	3,778,534
9 - Zamboanga Peninsula	3,921,476	3,781,535	2,823,088	3,812,294	3,921,476	3,894,998
10 - Northern Mindanao	3,524,104	3,389,293	2,816,393	3,441,805	3,524,104	3,499,004
11 - Davao	10,546,706	9,554,750	5,771,881	10,136,125	10,546,705	10,472,652
12 - SOCCKSARGEN	1,479,124	1,442,186	1,243,189	1,452,826	1,479,124	1,473,728
13 - NCR	3,062,117	2,524,500	2,296,826	2,967,347	3,062,117	3,041,437
14 - CAR	2,252,621	2,136,085	1,861,816	2,224,040	2,252,621	2,247,648
15 - ARMM	10,283,133	10,101,260	8,679,083	9,984,491	10,283,134	10,215,040
16 - CARAGA	2,545,344	2,446,762	2,171,202	2,483,135	2,545,344	2,523,349
PHILIPPINES	82,717,965	79,145,433	65,984,983	80,395,208	82,717,964	82,215,283

Appendix Table 2.
Estimated Number of Households by Household weight and Region.

REGION	HOUSEHOLD WEIGHT				
	OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	899,719	819,569	912,372	931,520	926,750
2 - Cagayan Valley	593,122	564,463	633,665	642,675	640,124
3 - Central Luzon	1,812,688	1,557,097	1,757,927	1,810,552	1,798,327
4A - CALABARZON	2,122,084	1,819,983	2,100,310	2,149,543	2,135,869
4B - MIMAROPA	510,414	454,348	519,137	529,584	525,455
5 - Bicol	962,437	827,406	964,657	980,176	975,216
6 - Western Visayas	1,304,874	1,150,536	1,302,469	1,343,636	1,334,973
7 - Central Visayas	1,229,346	1,133,448	1,254,631	1,270,447	1,268,406
8 - Eastern Visayas	773,864	692,089	737,167	757,888	752,457
9 - Zamboanga Peninsula	593,520	471,784	611,752	624,308	620,102
10 - Northern Mindanao	748,289	592,438	778,123	789,051	785,369
11 - Davao	807,138	602,661	814,291	833,249	828,252
12 - SOCCKSARGEN	706,854	589,420	722,029	735,587	730,993
13 - NCR	2,277,907	1,376,049	2,429,176	2,504,556	2,490,155
14 - CAR	286,971	246,901	289,006	292,941	292,084
15 - ARMM	504,897	456,082	591,163	606,482	602,594
16 - CARAGA	423,559	368,678	440,365	444,651	443,856
PHILIPPINES	16,557,682	13,722,952	16,858,240	17,246,846	17,150,981

Appendix Table 3.
Estimated Number of Poor Families by Household weight and Region.

REGION	HOUSEHOLD WEIGHT				
	OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	217,252	197,629	223,485	225,578	223,492
2 - Cagayan Valley	110,639	105,151	120,209	120,859	119,893
3 - Central Luzon	240,659	205,822	236,083	240,380	237,856
4A - CALABARZON	337,152	303,776	353,574	358,288	354,676
4B - MIMAROPA	193,230	172,155	198,460	201,573	199,658
5 - Bicol	393,450	338,362	401,319	403,472	400,934
6 - Western Visayas	412,508	361,871	411,980	423,516	420,274
7 - Central Visayas	281,924	257,259	285,628	287,236	286,089
8 - Eastern Visayas	269,352	241,869	259,357	265,629	263,627
9 - Zamboanga Peninsula	281,646	228,192	297,731	302,236	299,827
10 - Northern Mindanao	291,910	232,655	308,541	310,841	308,799
11 - Davao	245,133	183,271	248,502	253,317	251,217
12 - SOCCKSARGEN	230,988	191,052	235,385	238,658	236,713
13 - NCR	97,014	58,605	104,472	106,471	105,404
14 - CAR	76,113	66,557	77,988	78,781	78,320
15 - ARMM	226,334	205,741	267,711	274,438	272,151
16 - CARAGA	204,447	174,898	210,013	211,013	210,382
PHILIPPINES	4,109,751	3,524,865	4,240,440	4,302,285	4,269,311

Appendix Table 4.
Estimated Number of Poor Persons by Household weight and Region.

REGION	HOUSEHOLD WEIGHT				
	OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	1,297,212	1,179,940	1,330,867	1,348,687	1,336,151
2 - Cagayan Valley	661,811	629,106	716,299	722,415	716,364
3 - Central Luzon	1,530,550	1,311,856	1,495,671	1,531,504	1,515,385
4A - CALABARZON	1,951,777	1,753,025	2,036,485	2,074,067	2,053,473
4B - MIMAROPA	1,136,258	1,010,532	1,163,880	1,185,602	1,174,218
5 - Bicol	2,381,258	2,046,661	2,419,366	2,439,926	2,423,370
6 - Western Visayas	2,498,420	2,193,221	2,492,939	2,574,561	2,556,161
7 - Central Visayas	1,626,671	1,486,629	1,653,249	1,667,431	1,660,407
8 - Eastern Visayas	1,703,492	1,528,624	1,637,900	1,683,663	1,671,504
9 - Zamboanga Peninsula	1,530,205	1,234,050	1,608,738	1,641,019	1,627,920
10 - Northern Mindanao	1,624,627	1,292,336	1,708,615	1,730,001	1,717,738
11 - Davao	1,370,833	1,026,250	1,388,704	1,423,891	1,412,021
12 - SOCCKSARGEN	1,320,082	1,090,669	1,338,614	1,363,363	1,351,712
13 - NCR	552,068	333,496	593,170	607,826	601,244
14 - CAR	468,653	410,400	482,016	487,424	484,590
15 - ARMM	1,339,761	1,227,028	1,588,024	1,635,378	1,622,197
16 - CARAGA	1,158,581	994,246	1,193,725	1,202,291	1,197,993
PHILIPPINES	24,152,258	20,748,069	24,848,261	25,319,050	25,122,447

Appendix Table 5.
Estimated Poverty Incidence of Families by Household weight and Region.

REGION	HOUSEHOLD WEIGHT				
	OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	24.1	24.1	24.5	24.2	24.1
2 - Cagayan Valley	18.7	18.6	19.0	18.8	18.7
3 - Central Luzon	13.3	13.2	13.4	13.3	13.2
4A - CALABARZON	15.9	16.7	16.8	16.7	16.6
4B - MIMAROPA	37.9	37.9	38.2	38.1	38.0
5 - Bicol	40.9	40.9	41.6	41.2	41.1
6 - Western Visayas	31.6	31.5	31.6	31.5	31.5
7 - Central Visayas	22.9	22.7	22.8	22.6	22.6
8 - Eastern Visayas	34.8	34.9	35.2	35.0	35.0
9 - Zamboanga Peninsula	47.5	48.4	48.7	48.4	48.4
10 - Northern Mindanao	39.0	39.3	39.7	39.4	39.3
11 - Davao	30.4	30.4	30.5	30.4	30.3
12 - SOCCKSARGEN	32.7	32.4	32.6	32.4	32.4
13 - NCR	4.3	4.3	4.3	4.3	4.2
14 - CAR	26.5	27.0	27.0	26.9	26.8
15 - ARMM	44.8	45.1	45.3	45.3	45.2
16 - CARAGA	48.3	47.4	47.7	47.5	47.4
PHILIPPINES	24.8	25.7	25.2	24.9	24.9

Appendix Table 6.
Estimated Poverty Incidence of Persons by Household weight and Region.

REGION	HOUSEHOLD WEIGHT				
	OFF	BASE	PPW	MEAN	MEDIAN
1 - Ilocos	29.7	29.7	30.1	29.7	29.6
2 - Cagayan Valley	24.0	23.9	24.3	24.0	23.9
3 - Central Luzon	17.2	17.2	17.4	17.2	17.1
4A - CALABARZON	48.3	48.3	48.9	48.4	48.3
4B - MIMAROPA	38.7	38.5	38.7	38.5	38.5
5 - Bicol	27.4	27.1	27.3	27.0	27.0
6 - Western Visayas	42.9	43.1	43.4	43.2	43.2
7 - Central Visayas	52.9	53.7	54.0	53.6	53.6
8 - Eastern Visayas	45.3	45.5	45.8	45.5	45.5
9 - Zamboanga Peninsula	36.3	36.4	36.4	36.3	36.3
10 - Northern Mindanao	38.9	38.7	38.9	38.7	38.6
11 - Davao	5.8	5.8	5.9	5.8	5.7
12 - SOCCKSARGEN	32.5	33.0	33.2	33.0	32.9
13 - NCR	53.1	53.4	53.5	53.4	53.3
14 - CAR	54.2	53.4	53.7	53.4	53.3
15 - ARMM	19.3	20.2	20.4	20.2	20.1
16 - CARAGA	46.4	46.5	46.9	46.6	46.5
PHILIPPINES	30.5	31.4	30.9	30.6	30.6